Journal of Statistical Modelling: Theory and Applications
Vol. 5, No. 2, 2024, pp. 175-196
Yazd University Press 2024

JSMTA

Research Paper

Crude oil price, consumer price index and exchange rate nexus: Evidence from dynamic vector autoregressive model

Samuel Olorunfemi Adams*, Kolawole T. Babalola, Wumi Y. Oyetunji
Department of Statistics, University of Abuja, Abuja, Nigeria

Received: February 18, 2025/ Revised: May 30, 2025/ Accepted: July 28, 2025

Abstract: This study offers an assessment of the dynamic relationship between crude oil price, the consumer price index, and the exchange rate in Nigeria. The data used for this study were secondary data sourced from the Central Bank of Nigeria's statistical bulletin and the National Bureau of Statistics annual report. Optimum selection criteria, such as the Akaike information criterion, optimal lag length, and the vector autoregressive model approach, were utilized to capture the dynamic behavior of the endogenous variables. The results indicated that the coefficients of determination for crude oil prices, the consumer price index, and the exchange rate were 73.3%, 72.2%, and 81.3%, respectively, indicating the proportion of total variation explained by the variables of interest. The pairwise Granger causality tests revealed that the price of crude oil Granger-causes both the consumer price index and the exchange rate. The vector autoregressive estimation model found that crude oil prices had an insignificant positive relationship with the first lag of the consumer price index, and an insignificant negative relationship with the second lag. The results also indicated a significantly positive relationship between crude oil prices and both the first and second lags of the exchange rate. Additionally, the consumer price index exhibited a positive and significant relationship with both the first and second lags of the exchange rate. The study recommends the use of the vector autoregressive model to assess the dynamic relationship between crude oil prices, consumer price index, and exchange rate in Nigeria.

Keywords: Akaike information criterion; Exchange rate; Grander causality; Consumer price index; Crude oil; Vector autoregressive.
Mathematics Subject Classification (2010): 62P20.

*Corresponding author: samuel.adams@uniabuja.edu.ng

1 Introduction

Crude oil is one of the key factors driving the global economy, and changes in its price have a significant impact on population welfare and economic growth worldwide (Fasanya and Onakoya, 2015). The price of crude oil is extremely volatile, significantly influencing economic growth and sparking numerous debates among policymakers, scholars, and researchers (Musa et al., 2019).

Nigeria is often referred to as the "Giant of Africa" and stands as one of the continent's most influential economies due to its large population, abundant natural resources, and strategic location in West Africa (Nnaemeka et al., 2015). At Nigeria's independence in 1960 and throughout that decade, agriculture served as the economic bedrock (Chete et al., 2020). Agriculture provided food and employment for the majority of the population, supplied raw materials for emerging industries, and contributed significantly to tax revenue and foreign exchange earnings.

However, the fortunes of agriculture rapidly declined as crude oil exploration and commercial exportation began, eventually making oil the primary source of income and export revenue (Adams and Bello, 2022). Prior to the discovery of crude oil, agricultural products were already central to the economy. Following the oil boom, crude oil became the country's major income source, contributing over 80% of federal government revenue (Obioma and Eke, 2015).

Nigeria's crude oil production has fluctuated over the years due to OPEC quotas and socio-political instability (Abayomi et al., 2015). As one of Africa's largest oil producers, Nigeria's economy is deeply tied to oil exports. The global market price of crude oil substantially affects national revenue. Oil price increases impact both developed and developing countries, placing crude oil at the center of global commerce and economic development (Iwayemi and Fowowe, 2011; Adeyemi et al., 2018). In recent years, crude oil prices have plummeted globally, triggering consumer price shocks and impacting Nigeria's foreign exchange rate (Adams et al., 2019). The oil sector remains central to Nigeria's economic structure, shaping fiscal policies, trade dynamics, and broader economic performance.

Nigeria relies heavily on oil exportation, making it extremely susceptible to changes in the price of crude oil throughout the world (Gylych et al., 2020). As of 2000, oil and gas exports generated more than 14% of the country's GDP, more than 98% of export earnings, and approximately 83% of federal government revenue. Additionally, it produces roughly 65% of government budgetary income and 95% of foreign exchange gains (World Bank, 2004). As one of the African countries leading oil producers, the country's economy is intricately linked to the international oil market. Variations in crude oil prices can have profound and far-reaching effects on Nigeria's revenue, foreign exchange reserves, and economic stability. The Nigerian government often uses oil revenues to finance a significant portion of its annual budget, making the country vulnerable to oil price shocks. Meanwhile, crude oil is one of the basic sources of energy in the world and it plays a significant role in the economic growth as well as the development of so many economies mainly depend on it because of the frequent need for crude oil, the oil market is susceptible to the dynamics of supply and demand, which do cause price fluctuations (Hamilton, 2009). Crude oil, which pours through the veins of the world's economy and powers our everyday lives in many ways, is the lifeblood of the modern world. The effects of crude oil are felt everywhere, from the

gasoline that powers our cars to the plastics that compose our society. Crude oil is a naturally occurring subterranean liquid that contains hydrocarbons and other organic components which is the source of gasoline, diesel fuel, heating oil, kerosene, liquefied petroleum gas, jet fuel, asphalt base, heating oil, as well as fuel oils is a substance all nations require for their economic growth even though it is a limited natural resource.

Over the past few decades, the interaction of the crude oil price, consumer price level, and exchange rate variables has been an interesting topic among crude oil analysts and numerous researchers. Some economic researchers argued that crude oil will promote economic growth since it was observed that in oil-exporting countries that increase in oil prices will increase the national income of the countries exporting crude oil (Musa et al., 2019). A study by Obioma and Eke (2015) revealed that any shock in Nigeria's crude oil price will have a negative impact on the country's exchange rate also any variation in the country's exchange rate is mostly always substantially caused by the crude oil price. Nevertheless, any slight shock on the exchange rate will have a negative effect on the consumer price level (Adams et al., 2014). Different models have been used and compared to explain the benefits and impacts of crude oil on the Nigerian economy by many researchers. Furthermore, even with the theoretical and empirical appeals on the link between the oil price fluctuations and the exchange rates, how crude oil price fluctuates impact the exchange rates and its volatility is still much exposed for debate, especially in emerging economies in sub-Saharan Africa region (Ehikioya et al., 2020).

Therefore, for an import-dependent nation like Nigeria, there is a need to comprehend the interaction that exists between the crude oil price, the consumer price level, and the exchange rate of the nation. Additionally, the study seeks to investigate the long and short-term relationship between the Nigerian crude oil price, the consumer price level, and the exchange rate. The study employs vector autoregressive (VAR) modeling techniques to analyze the interactions and interdependencies among these variables over time. This study also endeavors to add to the existing body of knowledge by examining the impact of crude oil prices on the consumer price index and exchange rate in Nigeria, in the fullness of time providing reasonable and valuable insights for policymakers, financial analysts, and other related sectors.

2 Literature review

Crude oil price

Crude oil is an increasingly valuable natural resource with large-scale influence in both advanced and emerging economies (Ehikioya et al., 2020). The product has been at the center stage in global economic growth and trade (Iwayemi and Fowowe, 2011). It was observed in oil-exporting countries that an increase in oil prices will increase the national income of exporting countries (Musa et al., 2019) because several economies depend solely on crude oil for productivity (Adams and Bello, 2022). For oil-exporting nations in the sub-Saharan African region, crude oil provides foreign revenue to support economic activities leading to economic performance (Ajayi et al., 2019).

Captivatingly, before oil was detected in large quantities in the sub-Saharan Africa region, agriculture was relied on as the leading source of foreign revenue for the gov-

ernment. However, since the early 1970s, when the world experienced an oil boom, oil-exporting countries in the region relegated the importance of agriculture and other parts of the economy to become a mono-cultured economy (Zubair et al., 2022). Since that time till now, these countries have been generating a higher percentage of their foreign exchange and earnings from crude oil transactions at the international oil markets (Ehikioya, 2019).

At the global oil markets, the American dollar is said to be the most tradable and most acceptable legal tender (money) for the invoice and the settlement, which connotes that any fluctuations in oil prices in addition to the American dollar, could manipulate the exchange rates of trading countries differently (Salisu and Mobolaji, 2013). Like other emerging economies, Nigeria as a nation had suffered and also benefitted from the effect of oil price fluctuations. The country has also suffered from the influencing power of exchange rate volatility, high inflation, and the instability of other macroeconomic variables, which continued to challenge policymakers entrusted with the responsibility of stabilizing and growing the country's economy.

However, for some years now, there has been an increasing concern that the effect of oil price fluctuations would have an impact on the country's exchange rate and economy (Mensah et al., 2017). Even though crude oil prices are highly unstable and have a great impact on economic growth it arouses many controversies among the numerous policymakers and researchers. (Musa et al., 2019) investigated the impact of crude oil price and exchange rate on economic growth in Nigeria using an autoregressive distributed lag model. The data used covers the period from 1982–2018. The results indicated that crude oil price and exchange rate have a significant positive influence on economic growth in both the long-run and the short-run periods. The findings in the study suggested that crude oil price and exchange rate which are the focal points of the study, could affect the economic growth in both the long-run and the short-run. Therefore, the government should diversify its earnings in agriculture, industrialization, and investment to reduce the heavy reliance on crude oil and income fluctuation resulting from the fluctuation in crude oil prices.

Al-zanganee (2017) investigates the impact of crude oil price volatility on the levels of economic activity in Iraq over the periods of 2003 to 2015 using multivariate VAR model approach, the results in the study revealed a highly significant impact of volatility of crude oil price on the level of gross domestic product in Iraq.

Abraham (2016) examines the effects of the crude oil price movement and the exchange rate policy on the Nigerian stock market for 13 years with the period spanning 2012 to 2015. After applying the autoregressive distributed lags (ARDL) approach, the results in the study revealed that oil prices are positively and significantly related to the performance of the Nigerian stock market, and the exchange rate is found to be effective in cushioning the effect of crude oil price decline on the stock market. The result from the Granger causality test in the study suggested that the policy measure may not be as potent as expected.

Wilson et al. (2014) investigated the causal relationship between oil prices and key macroeconomic variables in Nigeria using the simple ordinary least square (OLS) method and Granger causality test. The data used in the study covers the 1980 to 2010 periods while the findings in the study revealed that there was a positive and insignificant relationship between oil price and the gross domestic product and exchange

rate in Nigeria. There was no evidence for a causal relationship running from gross domestic product to oil price and from oil price to gross domestic product.

Ukemenam et al. (2018) examined the macroeconomic effects of exogenous oil price shock in Nigeria using the generalized autoregressive conditional heteroscedasticity (GARCH), component generalized autoregressive conditional heteroscedasticity (CGARCH), and exponential generalized autoregressive conditional heteroscedasticity (EGARCH). The result of the study showed that oil price volatility has a significant positive impact on the exchange rate, foreign external reserves, government revenue, and capital importation and, symmetric and persistent oil price shock in Nigeria.

Exchange rate

The exchange rate has an insignificant relationship with the stock market performance both in the short- and the long-run asymmetric test. The adjustment asymmetry from the dynamic multiplier graphs in the study revealed that the response of stock market performance to a negative change in the oil price is stronger than that of the response to a positive change. The overall result of the study shows the need to diversify investment portfolios through the international equity market, keeping a close watch on the oil price fluctuation which is of importance in formulating risk-return portfolios of stock market performance.

Apere and Eniekezimene (2016) in their study examines the relationship between crude oil price and the economic growth of Nigeria over the periods of 1981 to 2013 using VAR model and OLS. The results from the VAR model revealed that the changes in oil prices have a significant impact on the economic growth of Nigeria while the result from the OLS method revealed that oil prices have a positive relationship with the gross domestic product (GDP) of the nation. The decrease in oil prices has a negative impact on the GDP of the nation and also fluctuation in exchange rate has both negative and positive impacts on crude oil price as well as the GDP. The study recommended the need for diversification in the economy to strengthen the economy even without oil.

Okeke et al. (2021) explore the linear and non-linear aspects of Nigeria's oil price and exchange rate on stock market performance from January 1995 to December 2019 utilizing the non-linear autoregressive distributed lag (NARDL) method. The results from the linear ARDL in the study revealed a long and short-run positive relationship between the Nigerian stock market and crude oil prices. The exchange rate revealed an insignificant in the long-run effect but a significant positive relationship in the short run. The non-linear ARDL front test revealed that the impact of positive shocks in crude oil prices in Nigeria has a significantly increasing effect on stock market performance, while negative shocks in crude oil prices have a significantly increasing effect on stock market performance.

Adegbemi et al. (2019) in their study evaluated the effect of crude oil price volatility on Nigeria's economy and the national income over a period spanning 1995 to 2017. Using descriptive and inferential (regression) statistics showed that oil price volatility has a negative and insignificant combined effect on the gross domestic product, gross national product, and per capita income. The study recommended that Nigeria should adopt policies that will address negative oil price shocks so that the budgetary system and the national income will not be affected.

Chikwe et al. (2016) in their study analyzed the effect of oil prices on the macroeconomic variables from 1990–2015 in Nigeria using multiple regression techniques. The results of the study showed that the unemployment rate contributes positively and significantly to crude oil prices while the interest rate impacts negatively and significantly on crude oil prices. Furthermore, the result of the study revealed that the inflation rate, exchange rate, and real gross domestic product do not have any effect on crude oil prices in the nation.

Akpanta and Okorie (2014) applied Box-Jenkins techniques in modeling and forecasting monthly Nigerian crude oil prices in Nigeria. The study compared the two models based on the Akaike information criterion (AIC), it was found that ARIMA (2, 1, 2) was better than the other competing models and was used to make forecasts. The study concluded that at a 5% level of significance, the difference between the observed crude oil price values and the forecast price values is statistically not significant from zero.

Ismail and Onakoya (2013) explored the impact of oil price movements on real output growth in Nigeria during the period 1970–2011 with the dynamic VAR analytical approach, the findings in the study indicated that the oil price shocks are not found to directly contribute to the output, exchange rate or inflation in the short run. However, the relationship manifests significantly and positively with output growth in the long run. The generalized impulse responses reaffirm the direct link between the oil price shock and growth, as well as the indirect linkages.

Orlu (2017) studied the impact of domestic pricing of petroleum on economic growth in Nigeria from 1970 to 2013 using an error correction model. The result showed that premium motor spirit and the lags of interest rate denoted a negative and significant impact on economic growth, while gross domestic investment and the lags of labor employment indicated a positive and significant impact on economic growth. The study recommends that the Nigerian government reduce the premium motor spirit pump price by deregulation and allowing private sector participation.

Zied et al. (2016) examined the relationship between crude oil prices and economic growth in the United Arab Emirate, Kuwait, Saudi Arabia, and Venezuela in the organization of petroleum exporting countries (OPEC) over the periods of 2000 to 2010 using the frequency approach of Priestley and Ton and Engle-Granger test for co-integration. The results of the study showed that oil price shocks in periods during the period of fluctuations in the global financial turmoil affect the relationship between oil and economic growth in the OPEC countries.

Consumer price index

Mahmoud (2015) attempted to examine the association between consumer price index (CPI) and GDP in Mauritania. The data set contains annual time series observations during the period of 1990–2013. It was considered that GDP as the dependent variable and CPI as the independent variable. OLS and Granger Causality Test Model were employed to obtain the empirical evidences. The stationarity of variables was examined using Augmented Dickey-Fuller Test (ADF) and the variables were found to be stationary at first difference at 5% significance level. A positive and significant relationship between the GDP and CPI was revealed by OLS Test.

Hossain et al. (2024) examines the impact of the CPI and Inflation on the GDP of Bangladesh during 2006–2007 to 2021–2022. The research investigates the connection between GDP and these economic indicators using multiple linear regression analysis. The results reveals that the CPI significantly boosts GDP, suggesting that shifts in consumer prices over time have a big impact on the nation's overall economic development.

Omojuyigbe et al. (2021) analyzed the impact of Consumer Price Index on Nigeria economic growth. Vector error correction model (VECM) model was employed to allow each variable in the model as endogenous variable. The scope of the study was from 2010 to 2018 and the results revealed from VECM probability value, there is short run relationship between GDP as dependent variable with CPI. However, C(2) with p/value of (0.3391) shows that CPI does not have a long run causal effect on GDP at 5% of significant. Also, the second equation of VECM probability value, the result shows that, there is short run relationship between CPI as dependent variable with GDP. However, C(8) with p/value of (0.7303) shows that GDP does not have a long run causal effect on GDP at 5% of significant.

Izuchukwu and Patricia (2015) ascertain the existence of a relationship between CPI and economic growth in Nigeria. The scope of the study spanned from 2000 to 2009. Ordinary least square method and t-test was used to test the variables most likely to impact on economic growth in Nigeria due to inflation. The findings also shows that there is strong relationship between CPI and economic growth in Nigeria, that exchange rate has positive impact on economic growth and that high interest rate discourages investment and hence forestalls economic growth.

Adaramola and Dada (2020) examined the influence of inflation on the growth on Nigerian economy, the study employs the autoregressive distributed lag on the selected variables, that is, real GDP, inflation rate, interest rate, exchange rate, degree of economy's openness, money supply, and government consumption expenditures for the period 1980–2018. The study findings indicate that inflation and real exchange rate exert a significant negative impact on economic growth, while interest rate and money supply indicate a positive and significant impact on economic growth. Other variables in the model depict no influence on the economic growth of Nigeria.

3 Materials and methods

3.1 Data

This study utilizes the monthly data, starting from 2009:M1 to 2023:M8 to examine the impact of crude oil price (COP), CPI, and exchange rate (EXR) in Nigeria. The CPI dataset are sourced from the Nigeria national bureau of statistics (NBS) while Crude oil price and Exchange Rate was extracted from the central bank of Nigeria (CBN).

3.2 VAR model

The VAR model is a statistical technique used in capturing the relationship between multiple variables as they change concerning time. Vector autoregressive is another particular stochastic process model. Vector autoregressive models generalize a variable

(univariate) autoregressive model which is permitted in multivariate time series. In VAR, every variable included in the model has an equation that models how it changes over time, just like the autoregressive model as well as being flexible in modeling a multiple and multidimensional system (Victor-Edema and Wariboko, 2023).

In this study, the dynamic VAR models employed to analyze the relationship between COP, CPI, and EXR in Nigeria. It also captured their dynamic interactions and predicting future values. The statistical method was also employed to described the dynamic behavior of the three economic and financial time series variables, It will also provide superior forecasts CPI, EXR and COP.

The following expression contains the lagged (past) values of the variable, the error term, and the lagged values of the other variables in the model which is compared to structural models with simultaneous equations. VAR models do not require as much information about the forces influencing a variable. The VAR model portrays the change in the values of a set of p variables, which are called endogenous variables concerning time (Asteriou and Hall, 2007). Each period of the time is numbered, $t = 1, ..., T$. The variables that are used in the model are collected in a vector, y_t, which is of length p (which might be described as a $(p \times 1)$ matrix.). The vector is simulated as a linear function of its prior value. The components of the vector are referred to as $y_{i,t}$, i.e., the observation at time t of the p-th variable.

VAR models are featured by their order, which is the number of the earlier periods (lagged) the model will use. A lag is the value of a variable in a previous period. In general, a path-order VAR is a VAR model that includes lags for the past lags. A path-order VAR is denoted as `VAR(p)` which is called "a VAR with p lags". A pth-order VAR model is written as

$$y_t = c + A_1 y_{t-1} + A_2 y_{t-2} + A_3 y_{t-3} + \ldots + A_p y_{t-p} + e_t.$$

Mathematically, the vector autoregressive model of order p written as VAR(p) is depicted as follows

$$\begin{bmatrix} Y_{1t} \\ Y_{2t} \\ \vdots \\ Y_{mt} \end{bmatrix} = \begin{bmatrix} c_1 \\ c_2 \\ \vdots \\ c_m \end{bmatrix} + A_1 \begin{bmatrix} Y_{1,t-1} \\ Y_{2,t-1} \\ \vdots \\ Y_{m,t-1} \end{bmatrix} + \cdots + A_p \begin{bmatrix} Y_{1,t-p} \\ Y_{2,t-p} \\ \vdots \\ Y_{m,t-p} \end{bmatrix} + \begin{bmatrix} \varepsilon_{1t} \\ \varepsilon_{2t} \\ \vdots \\ \varepsilon_{mt} \end{bmatrix},$$

$$\theta(z) = 1 - \theta_1 z - \theta_2 z^2 - \ldots - \theta_p z^p,$$

$$\varepsilon(\varepsilon_i) = 0, \quad \varepsilon(\varepsilon_i^2) = \mathrm{var}(\varepsilon_i), \quad \varepsilon(\varepsilon_i \varepsilon_j) = \mathrm{cov}(\varepsilon_i, \varepsilon_j) \neq 0.$$

The parameter in the model should contain certain restrictions for the vector autoregressive model to be stationary (Asteriou and Hall, 2007). The process is similar to the AR model case. The variables of the form y_{t-i} indicate the variable's value i-time prior periods and are called the "ith lag" of y_t. c is a k-vector of constants that serves as the intercept of the model. A_p is the time-invariant $(m \times m)$ matrix and e_t is a k-vector of error terms.

The VAR model provides the accommodation of several variables where changes in a particular variable can affect changes in its lag and changes in other variables and the lags of those variables (Akpan, 2009). Since the VAR expresses the dependent variables in terms of predetermined lagged variables, it is a reduced-form model.

Note that the VAR model provides the accommodation of several variables where changes in a particular variable can affect changes in its lag and changes in other variables and the lags of those variables. It is a model in which K variables are specified as linear functions of p of their own lags, p lags of the other $K-1$ variables, and possibly exogenous variables. A VAR model with p lags is usually denoted a VAR(p). Since the VAR expresses the dependent variables in terms of predetermined lagged variables, it is a reduced-form model.

$$\begin{bmatrix} COR_t \\ CPR_t \\ EXR_t \end{bmatrix} = \begin{bmatrix} c_1 \\ c_2 \\ c_3 \end{bmatrix} + A_1 \begin{bmatrix} COR_{t-1} \\ CPR_{t-1} \\ EXR_{t-1} \end{bmatrix} + \cdots + A_p \begin{bmatrix} EXC_{t-p} \\ INF_{t-p} \\ IMP_{t-p} \\ EXP_{t-p} \end{bmatrix} + \begin{bmatrix} \varepsilon_1 \\ \varepsilon_2 \\ \varepsilon_3 \\ \varepsilon_4 \end{bmatrix}. \tag{1}$$

The equation (1) is reduced to an autoregressive model of order 3 (i.e., AR(3)):

$$Y_t = \beta_i + \sum_{i=1}^{3} \beta_{ii} Y_{t-i} + \varepsilon_i,$$

where Y_t is a (3×1) matrix of the endogenous variable, considered as the COP, CPI and EXR, β_i is a fixed coefficient matrix of (3×1) of intercept, β_{ii} is (3×3) matrix containing the estimating parameter, y_{t-i} is (3×1) matrix of the variable and ε_i is the (3×1) matrix of dimensional white noise terms (Asteriou and Hall, 2007).

3.3 Model specification

The model utilized in this study is specified as

$$\begin{aligned}
\Delta COP_t &= \sum_{i=1}^{L} \alpha_{11i} \Delta COP_{t-i} + \alpha_{120} \Delta CPI_t + \sum_{i=1}^{L} \alpha_{12i} \Delta CPI_{t-i} \\
&\quad + \alpha_{130} \Delta EXR_t + \sum_{i=1}^{L} \alpha_{13i} \Delta EXR_{t-i} + S_{1t}, \\
\Delta CPI_t &= \sum_{i=1}^{L} \alpha_{21i} \Delta CPI_{t-i} + \alpha_{220} \Delta COP_t + \sum_{i=1}^{L} \alpha_{22i} \Delta COP_{t-i} \\
&\quad + \alpha_{230} \Delta EXR_t + \sum_{i=1}^{L} \alpha_{23i} \Delta EXR_{t-i} + S_{2t}, \\
\Delta EXR_t &= \sum_{i=1}^{L} \alpha_{31i} \Delta EXR_{t-i} + \alpha_{320} \Delta COP_t + \sum_{i=1}^{L} \alpha_{32i} \Delta COP_{t-i} \\
&\quad + \alpha_{330} \Delta CPI_t + \sum_{i=1}^{L} \alpha_{33i} \Delta CPI_{t-i} + S_{3t},
\end{aligned}$$

where

- COP = Crude Oil Price,
- CPI = Consumer Price Index,

- EXR = Exchange Rate,
- L = Lag length,
- t = Time,
- S_{1t}, S_{2t}, S_{3t} = Error terms (innovations).

The VAR model is employed for this study because of its prowess in describing the dynamic behavior of economic and financial time series variables.

4 Results

4.1 Descriptive statistics

Table 1 presents the descriptive statistics of the consumer price index, crude oil price data, and exchange rate data in Nigeria. The data comprises 176 observations each. The mean (average) consumer price index, crude oil price data, and exchange rate are 13.29044, 78.22398, and 262.6174 respectively, which represents the central tendency of the data. The minimum values of the variables are 7.707051, 14.28000, and 144.0100 respectively while the maximum values are 25.79784, 130.1000, and 770.3800 respectively. The standard deviation of the variables is 3.945216, 26.50249, and 122.9469 respectively, which measures the amount of variation or dispersion in the data. A higher standard deviation indicates greater variability in the variables. The sample variance, which is a measure of how much the data values deviate from the mean, is 15.56472, 702.3819, and 15115.94 respectively. The kurtosis values are 3.033332, 1.948273, and 5.576398 respectively which indicates the shape of the distribution. A negative kurtosis suggests that the distribution has heavier tails and a flat peaked shape. The skewness values are 3.03333, 1.948273, and 5.576398 which indicates the asymmetry of the distribution of the variables. A positive skewness suggests that the distribution is skewed to the right, meaning that the tail on the right side of the distribution is longer or stretched compared to the left side.

Table 1: Descriptive statistics of the consumer price index, crude oil price, and exchange rate in Nigeria at level.

Statistics	CPI	COP	EXR
Mean	13.29044	78.22398	262.6174
Maximum	25.79784	130.1000	770.3800
Minimum	7.707051	14.28000	144.0100
Variance	15.56472	702.3819	15115.94
Std. Dev.	3.945216	26.50249	122.9469
Skewness	0.721249	0.114761	1.274197
Kurtosis	3.033332	1.948273	5.576398
Sum	2339.118	13767.42	46220.66
Observations	176	176	176

Figure 1 displays the time series plot of consumer price index, crude oil price, and exchange rate data in Nigeria spanning from 2009 to 2023. The plot reveals several

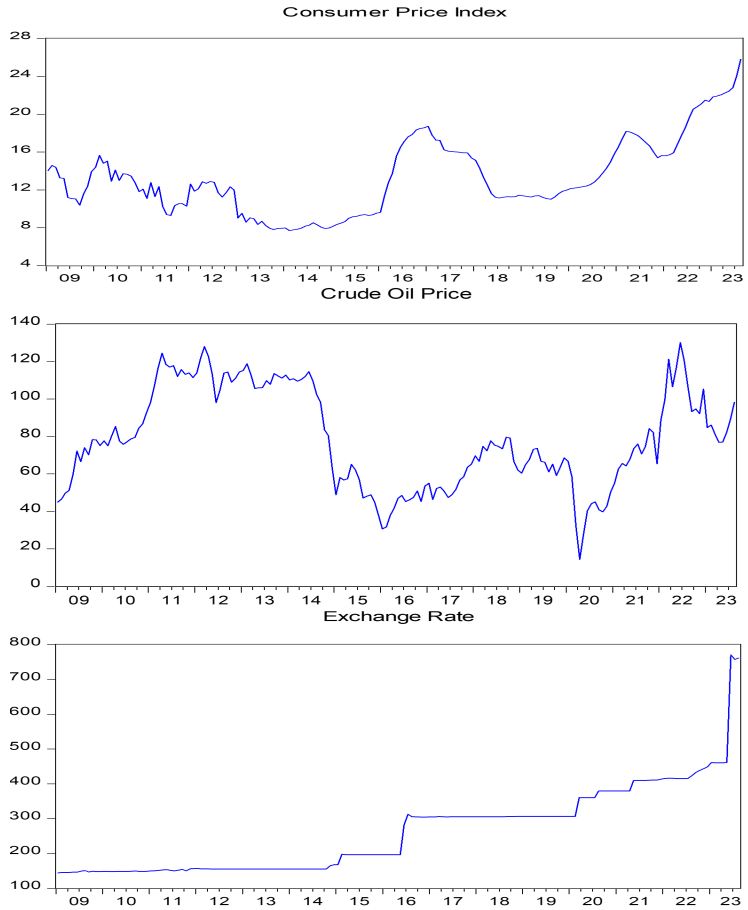

Figure 1: Time series plot of CPI, COP, and EXR (2009–2023).

increases and decreases in the consumer price index and crude oil prices from 2009 to 2023 while the exchange rate reveals several increases from 2009 to 2023.

Figure 2 depicts the plot of the differenced consumer price index, crude oil price, and exchange rate data, which are stationary (i.e., the mean, variance, and covariance of the series are constant over time) in Nigeria from 2009 to 2023. The data exhibits stationary characteristics at the first difference, as evidenced by the trends fluctuating around the mean.

Unit root test is an important step to check the stationarity of the data included in any time series analysis (Zivot and Wang, 2006). It is also used in most applications of modeling studies. It was developed by Dickey-Fuller (DF) in 1979 (Zivot and Wang, 2006). Furthermore, Augmented Dickey-Fuller (ADF) tests the presence of difference stationarity (unit root in the series).

For processing this study, the researchers have first examined the integration order of each of three panel-level series; CPI, COP, and EXR included in the model. As a necessity, but not sufficient condition for cointegration, each of the variables integrated

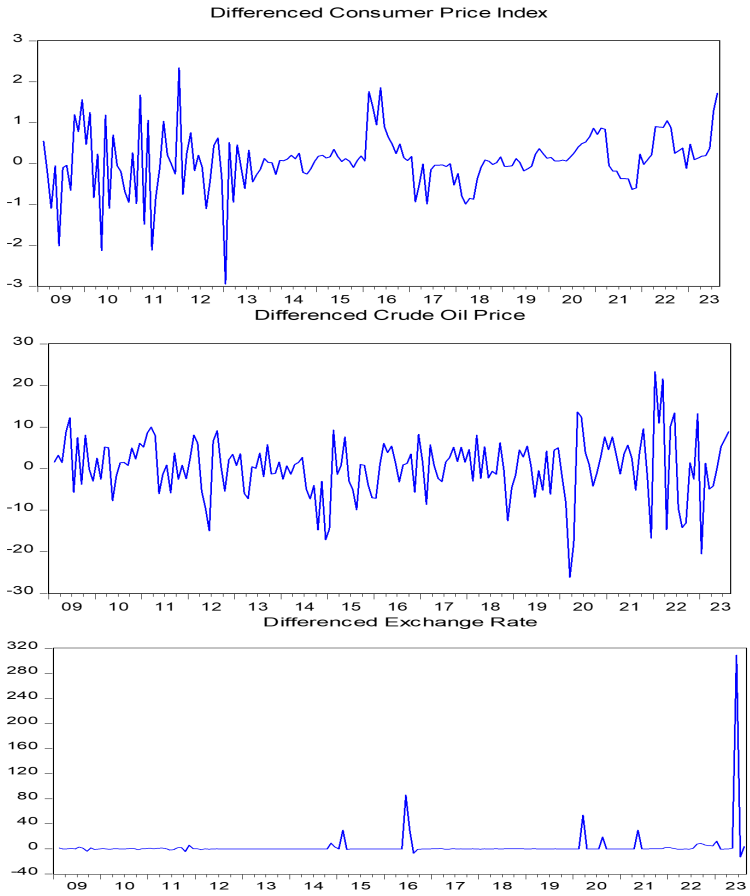

Figure 2: First difference plot of CPI, COP, and EXR (2009–2023).

must be of the same order, where the order of integration must be greater than zero. To achieve this, the unit root tests for stationarity called Augmented Dickey-Fuller (ADF) were utilized under the null hypothesis: H_0: unit root is present (data is stationary) versus H_1: there is no unit root (data is not stationary).

The results of the ADF unit root test for stationarity test as shown in Table 2 revealed that all variables are integrated of order one. The test statistic is less negative than the critical value, the null hypothesis cannot be rejected, and this indicates that there is the presence of a unit root in the three variables, which also implies that each data series is stationary after the first difference stationary at 5% level using the ADF test.

Table 2: ADF unit root test for stationarity of data.

ADF	Test Level	First Difference
CPI	-2.88	-3.22*
COP	-2.76	-4.14*
EXR	-2.79	-5.32**

Note: * Indicates significance at $p = 0.01$; ** Indicates significance at $p = 0.05$.

Table 3 shows the VAR Lag order selection criteria for the variables. Based on the Akaike Information Criterion (AIC), the optimal lag selected is lag 2 for all the variables. Therefore, this lag length will be used in the model estimation to obtain the values of the information criterion.

Table 3: VAR lag order selection criteria.

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-1574.8140	NA	16764.1000	18.2406	**18.2953**	**18.2628**
1	-1569.4600	10.4615	17486.1300	18.2828	18.5015	18.3715
2	**-1549.7460**	**37.8319**	**15450.7800**	**18.1589**	18.5417	18.3142

Note: * Indicates lag order selected by the criterion.

Table 4 presents the estimated coefficient, standard error, and the t-statistic. The result of the COP equation showed an insignificant positive relationship between COP and the first lag of CPI and an insignificant negative relationship with the second lag of CPI. The result also indicated the presence of a significantly positive relationship between COP and the first and second lag of EXR.

The R^2 value of 0.733049 shows the model of this equation explains about 73% variations in COP. Looking at the findings of the CPI equation, it was observed that CPI showed a significant negative relationship between CPI and the first lag of COP and a significantly positive relationship between CPI and the second lag of COP. The result of CPI and EXR indicated that there exists a positive and significant relationship between CPI and the first and second lag of EXR. The R^2 values of 0.721665 show the model of this equation explains 72.2% variations in CPI.

In the EXR equation, the coefficients of the first and second lag of CPI are insignificant and negative, while EXR has shown a positive and insignificant relationship between the first and second lag of COP. The R^2 value of 0.813801 shows the model of this equation explains 81.4% variations in EXR.

Table 4: VAR(2) model estimation results.

	COP			CPI			EXR		
Variables	est.	S.E.	t-stat.	est.	S.E.	t-stat.	est.	S.E.	t-stat.
COP(-1)	0.1388	0.0774	1.7942	-0.0049	0.0069	-0.7155	-0.0775	0.2709	-0.2861
COP(-2)	-0.0299	0.0776	-0.3854	0.0069	0.0069	1.0046	-0.1227	0.2715	-0.4521
CPI(-1)	0.4511	0.7992	0.5645	0.0573	0.0711	0.8066	2.5060	2.7976	0.8958
CPI(-2)	-0.3422	0.7992	-0.4282	0.4016	0.0711	5.6497	2.4959	2.7976	0.8922
EXR(-1)	0.0050	0.0221	0.2257	0.0032	0.0020	1.6291	-0.0423	0.0775	-0.5463
EXR(-2)	0.0295	0.0224	1.3181	0.0043	0.0020	2.1720	-0.0298	0.0783	-0.3809
C	0.1204	0.5624	0.2141	0.0153	0.0500	0.3067	3.6008	1.9686	1.8291
R-squared		0.7331			0.7217			0.8138	
Adj. R-squared		0.7019			0.6983			0.7919	
S.E.		7.2217			0.6423			25.2799	
Sum Sq. Residuals		657.4020			68.4783			6086.5100	
F-statistic		0.9456			7.6521			0.3872	
Log-likelihood		-583.9403			-165.3104			-800.6955	
AIC		6.8317			1.9920			9.3375	
Schwarz SC		6.9593			2.1196			9.4651	
Mean dependent		0.2801			0.0661			3.5612	
S.D. dependent		7.2149			0.7129			25.0083	

Therefore, the equation for the model is given below

$$\begin{aligned}
\mathrm{COP}_t &= C(1)\cdot \mathrm{COP}_{t-1} + C(2)\cdot \mathrm{COP}_{t-2} + C(3)\cdot \mathrm{CPI}_{t-1} + C(4)\cdot \mathrm{CPI}_{t-2} \\
&\quad + C(5)\cdot \mathrm{EXR}_{t-1} + C(6)\cdot \mathrm{EXR}_{t-2} + C(7), \\
\mathrm{CPI}_t &= C(8)\cdot \mathrm{COP}_{t-1} + C(9)\cdot \mathrm{COP}_{t-2} + C(10)\cdot \mathrm{CPI}_{t-1} + C(11)\cdot \mathrm{CPI}_{t-2}, \\
&\quad + C(12)\cdot \mathrm{EXR}_{t-1} + C(13)\cdot \mathrm{EXR}_{t-2} + C(14), \\
\mathrm{EXR}_t &= C(15)\cdot \mathrm{COP}_{t-1} + C(16)\cdot \mathrm{COP}_{t-2} + C(17)\cdot \mathrm{CPI}_{t-1} + C(18)\cdot \mathrm{CPI}_{t-2} \\
&\quad + C(19)\cdot \mathrm{EXR}_{t-1} + C(20)\cdot \mathrm{EXR}_{t-2} + C(21),
\end{aligned}$$

Table 5 and Figure 3 present the AR roots using a complex coordinate system that reports the inverse root of the characteristic AR polynomial. The VAR is said to be stationary at 0.257821 to 0.928229 and falls inside the unit circle while the one with the modulus value of 1.044380 is not stationary and also falls outside the unit circle.

Table 5: Inverse roots of AR characteristic polynomial.

Root	Modulus
0.7022	0.7022
-0.6024	0.6024
0.1653 − 0.2379i	0.2897
0.1653 + 0.2379i	0.2897
-0.1383 − 0.2417i	0.2785
-0.1383 + 0.2417i	0.2785

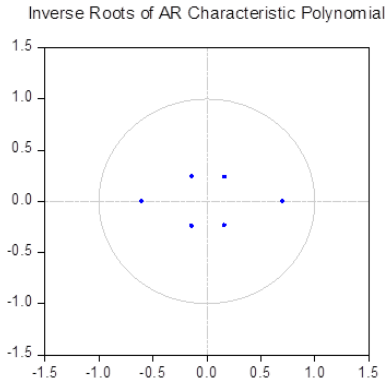

Figure 3: AR root inverse characteristic polynomial plot.

The Granger causality block exogeneity Wald test shown in Table 6 indicated that the consumer price index on crude oil price with (p-value = 0.7933) is insignificant at 5% and the exchange rate with (p-value = 0.4137) is also not significant. The result for consumer price also shows that crude oil price is insignificant with (p-value = 0.5072) while the exchange rate is significant with (p-value = 0.0292).

For the exchange rate, the result moved in a one-way direction for both crude oil prices and the consumer price index. Crude oil price and consumer price index were both insignificant. The result presented in Table 7 shows that there is evidence that the consumer price index Granger-causes crude oil price, crude oil price Granger-causes

consumer price index, exchange rate Granger-causes crude oil price, and crude oil price Granger-causes exchange rate. Finally, exchange rate Granger-causes consumer price index and consumer price index also Granger-causes exchange rate. This result implies that each of the time series is useful in forecasting the other time series variables.

Table 6: Granger causality block exogeneity Wald tests.

Dependent	COP			CPI			EXR			All		
variable	Chi-sq.	df	Prob.	Chi-sq.	df	Prob.	Chi-sq.	df	Prob.	Chi-sq.	df	Prob.
COP	-	-	-	0.4631	2	0.7933	1.7651	2	0.4137	2.4365	4	0.6560
CPI	1.3578	2	0.5072	-	-	-	7.0676	2	0.0292	8.3384	4	0.0799
EXR	0.3251	2	0.8500	1.7526	2	0.4163	-	-	-	2.1277	4	0.7123

Table 7: Pairwise granger causality tests.

Null hypothesis	Obs	F-statistic	Prob.
CPI does not Granger Cause COP	173	7.3362	0.0175
COP does not Granger Cause CPI		6.6168	0.0409
EXR does not Granger Cause COP	173	9.9958	0.0316
COP does not Granger Cause EXR		8.1878	0.0289
EXR does not Granger Cause CPI	173	7.5037	0.0323
CPI does not Granger Cause EXR		9.9104	0.0044

Figure 4 shows the correlation plots for the variables under consideration. It was observed that the second, third, sixth, eighth, and ninth plots did not cross the stationary line at any lag, while the plots of the first, fourth, fifth, and seventh cut the stationary line at different lags.

Figure 5 gives the response of the consumer price index to the standard deviation shock of the crude oil price. The consumer price index decreases from 1 to 2, increases from 2 to 3, and keeps a slight increase and decrease from 3 to 5, and remains in the negative region below the steady state. Given that any shocks to crude oil prices will have asymmetric impacts on the consumer price index both in the short run and long run.

The response of EXR to one standard deviation shock in the crude oil price is shown in Figure 5. The EXR decreases from 1 to 3 and keeps a steady state region from 3 to 5 while it remains in the negative region and below the steady state region. This indicates that shocks to crude oil prices will also have asymmetric impacts on EXR in both the short-run and long-run.

The coefficient of determination (R^2) of 0.7331, 0.7217, and 0.8138 for COP, CPI, and EXR respectively suggests that the model has provided a good fit and that the proportion of variance in the Nigerian economy that is explained by the COP, CPI, and EXR in a statistical model is about 73.3% of the crude oil price, 72.1% of consumer price index and 81.3% of the exchange rate. This further suggests an existence of a strong positive relation between the three variables of interest and the Nigerian economy.

5 Discussion

The findings from this study show that COP increases as CPI at the first lag, while COP reduces as CPI increases at the second lag. The implication is that the price of crude oil is driven by external forces since it is determined by exogenous factors. This

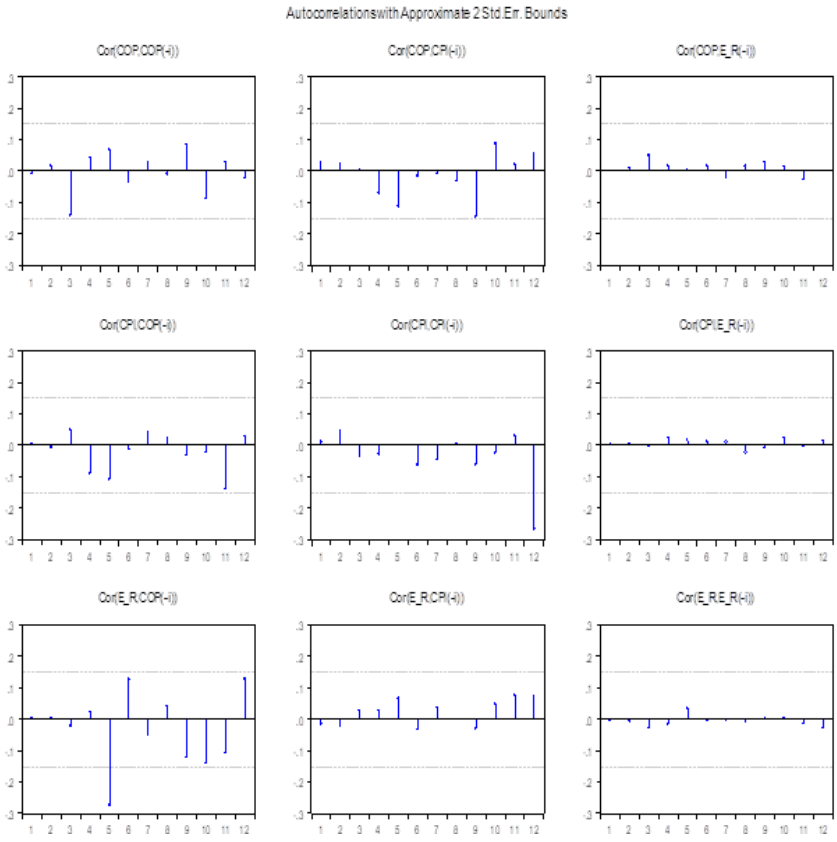

Figure 4: Correlation plots of residuals.

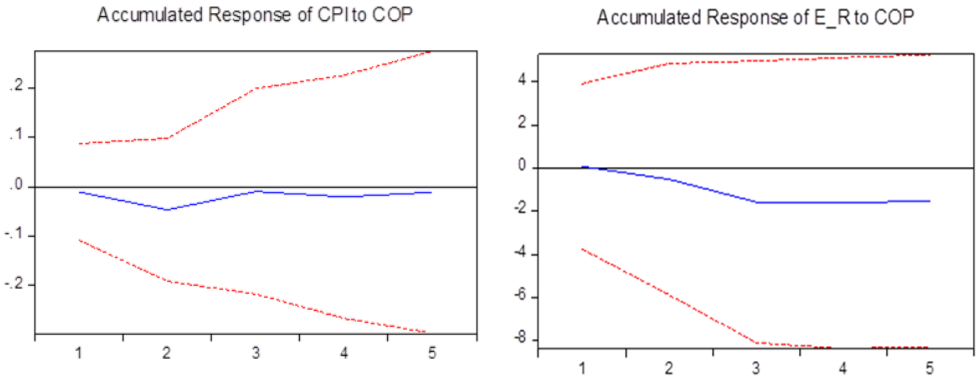

Figure 5: Impulse response of CPI (left) and EXR (right) to one standard deviation shock in COP.

means that, considering the last year ago (lag 1) if crude oil prices decline the CPI of the country will equally fall. If the COP improves then CPI will also increase.

The result also indicated that CPI is directly related to EXR, this relationship was

found to be significant. As the consumer price index increases, the exchange rate also increases, this finding is in agreement with Mordi (2014) who attempted to examine the relationship between exchange rate and inflation rate in Nigeria. Employing the VAR technique, the study used monthly series of inter-bank rate, world export prices, real gross domestic product, oil prices and consumer price index from 2000M1 to 2015M1. The results from the study show that there exist a significant relationship between exchange rate and inflation, a shock to exchange rate (depreciation) would increase domestic price by 0.72 per cent in the first month. The effect rose to 0.82, 0.85 and 0.86 per cent in month 2, 4 and 6, respectively, before it began to fall. By the sixth month, it stood at around 0.84 per cent, on the average. Also the results of the VAR model and exchange rate pass-through coefficients indicate that pass-through to price level in Nigeria is partial or incomplete.

The impulse functions show that CPI and EXR exhibited a volatile response to innovations. Another result is the inverse negative and insignificant relationship between the exchange rate and crude oil prices at the first and second lag. As the exchange rate increases, crude oil price reduces, in the country. The insignificant relation between crude oil prices and the exchange rate implies that the exchange rate has no significant influence on crude oil in Nigeria. This is not surprising because the computation of CPI in Nigeria does not include crude oil prices. This finding is corroborated by the studies from Abraham (2016), Ukemenam et al. (2018), Wilson et al. (2014), and Apere and Eniekezimene (2016) whose studies show that oil prices are positively and significantly related to the performance of the Nigerian stock market and exchange rate is found to be effective in cushioning the effect of crude oil price decline on the stock market. The result from the Granger causality test suggested that the policy measure may not be as potent as expected.

Subsequently, the Granger Causality test was employed to test the causal relationship between the variables and the direction of causality among the variables in the model. The result indicated that; there is evidence that the consumer price index Granger-cause crude oil price, crude oil price Granger-cause consumer price index. Exchange rate Granger-cause crude oil price and crude oil price Granger-cause exchange rate, and finally, Exchange rate Granger-cause consumer price index and consumer price index also Granger-cause exchange rate. This result implies that each of the time series is useful in forecasting the other time series variables. This result is in agreement with Musa et al. (2019), whose finding indicated that an increase in the price of crude oil in the oil market will increase economic growth and the same thing applies to the exchange rate in Nigeria. Our findings are also substantiated by Ekong and Ebong (2016) whose results showed that crude oil price Granger-causes market capitalization and exchange rate, Market capitalization does not Granger-cause crude oil price and exchange rate; and exchange rate does not Granger-cause crude oil and market capitalization.

6 Concluding remark

This study was designed to assess and analyze the crude oil price on the consumer price index and exchange rate in Nigeria. The data used for this study is secondary data sourced from central bank of Nigeria annual and NBS, websites. To achieve the study

objectives, the VAR model was employed. The essence was to fit the appropriate VAR model to the data.

The descriptive statistics of the consumer price index, crude oil price data, and exchange rate data in Nigeria were presented. The data comprises 176 observations each. The mean (average) consumer price index, crude oil price data, and exchange rate are 13.29044, 78.22398, and 262.6174 respectively, which represents the central tendency of the data. The standard deviation of the variables is 3.945216, 26.50249, and 122.9469 respectively. The sample variance, which is a measure of how much the data values deviate from the mean, is 15.56472, 702.3819, and 15115.94 respectively. The kurtosis values are 3.033332, 1.948273, and 5.576398 respectively. The skewness value is 3.03333, 1.948273, and 5.576398 respectively.

The data were not stationary at level but after differencing, the stationary of the series was achieved. The VAR lag order selection criteria for the variables were tested with the Akaike Information Criterion (AIC) and the optimal lag was two for all the variables in which lag length was used in the model estimation.

The R^2 for the variables are 0.733049 (73.3%), 0.721665 (72%), and 0.813801 (81%) respectively which indicated the coefficient of determination (R^2) of 0.733049, 0.721665 and 0.813801 for COP, CPI and EXR respectively suggests that the model has provided a good fit and that the proportion of variance in the Nigerian economy that is explained by the COP, CPI and EXR in a statistical model is about 73.3% of the crude oil price, 72.1% of consumer price index and 81.3% of the exchange rate. This further suggests an existence of a strong positive relation between the three variables of interest and the Nigerian economy. The adjusted R^2 of 0.701901 (70.2%), 0.721665 (72.2%) and 0.813801 (81.4%) respectively.

The causality test estimation method for the coefficients in the model was achieved using the least squares with the model equations and it was seen that most of the coefficients were significant at the 0.01 and 0.05 significant levels. The Pairwise Granger Causality tests revealed the consumer price index Granger-cause crude oil price, crude oil price Granger-cause consumer price index. Exchange rate Granger-cause crude oil price and crude oil price Granger-cause exchange rate, and finally, Exchange rate Granger-cause consumer price index and consumer price index also Granger-cause exchange rate.

Based on the findings of this study, it is concluded that VAR statistical methodology should be employed for modeling crude oil prices, consumer price index, and exchange rate in Nigeria. The study will be helpful for the government in its role as a policy maker in regularizing policy in light of oil price fluctuation and the Nigeria government should encourage the following:

1. A policy that promotes an enabling environment that encourages local investors to produce goods for local consumption and export since this will help to conserve foreign exchange should be implemented.
2. The Nigerian government should ensure that individuals do not interfere with the apex bank surveillance over the excess crude account.
3. Policy maker should develop a framework for stable and enable oil and gas landscape in which there will be improved transparency, efficiency, cost effectiveness, attractive investment climate, and a well-protected and sustainable environment.

7 Limitation of the study

While VAR models are useful for analyzing the relationships between variables like consumer price index, exchange rate and crude oil prices, it has limitations, including the assumption of linearity and the potential for misspecification if important exogenous variables are not included. Additionally, the model's ability to capture complex, non-linear relationships and external shocks can be limited.

Limitations of the CBN and NBS's CPI, COP, and EXR data include possible data collecting errors and the fact that, although CPI rebasing increases statistical accuracy, it ignores the underlying drivers of inflation. Additionally, the CPI might not properly account for the influence of informal markets on price fluctuations and might not fairly represent the costs of products and services across Nigeria, especially in rural areas. Inconsistency and the use of monthly data rather than daily data are limitations of crude oil price data, while possible reporting delays, the necessity of a market-driven exchange rate, and the potential for manipulated data are limitations of exchange rate data.

Acknowledgements

The author is grateful to the anonymous reviewers for their constructive comments and suggestions that helped to improve this article.

References

Abayomi, A., Adams, S.O. and Alumbugu, A.I. (2015). Oil exportation and economic growth in Nigeria. *Developing Country Studies*, **5**(15):83–92.

Abraham, T.W. (2016). Exchange rate policy and crude oil prices: effect on the Nigerian stock market. *CBN Journal of Applied Statistics*, **7**:111–123.

Adams, S.O. and Bello, J.O. (2022). Modeling the effect of crude oil production and other factors on Nigeria economy: An autoregressive distributed lag approach. *Science Archives*, **3**(1):72–79.

Adams, S.O., Awujola, A. and Alumbugu, A.I. (2014). Modeling Nigeria's consumer price index using ARIMA modeling. *International Journal of Development and Economic Sustainability*, **2**(2):37–47.

Adams, S.O., Bamanga, M.A. and Mbusube, A. (2019). Principal component analysis of Nigerian economy from 2006-2017. *Asian Journal of Advanced Research and Reports*, **5**(4):1–9.

Adaramola, O.A. and Dada, O. (2020). Impact of inflation on the growth prospects of the Nigerian economy. *Investment Management and Financial Innovations*, **17**(2):1–10.

Adegbemi, F.F., Akintoye, I.R. and Olayinka, O.G. (2019). Evaluation of petroleum crude oil price volatility on Nigeria national income and Nigeria economy. *European Journal of Accounting and Finance Research*, **7**(6):65–83.

Adeyemi, R.A., Joel, A., Ebenezer, J.T. and Attah, E.Y. (2018). The effect of brain drain on the economic development of developing countries: Evidence from selected African countries. *Journal of Health and Social Science Issues*, **7**(2):66–76.

Ajayi, A., Adams, S.O. and Akano, R.O. (2019). Modeling Nigeria Naira exchange rate against some selected country's currencies volatility: Application of GARCH model. *Asian Journal of Probability and Statistics*, **5**(1):1–13.

Akpan, E.O. (2009). Oil price shocks and Nigeria's Macro economy. *Journal of Economics*, **4**:12–19.

Akpanta, A.C. and Okorie, I.E. (2014). Application of Box-Jenkins techniques in modelling and forecasting Nigeria crude oil prices. *International Journal of Statistics and Applications*, **4**(6):283–291.

Al-zanganee, S.A.M. (2017). Impact of crude price volatility on levels of economic activity: Evidence from Iraq. *European Scientific Journal*, Special Edition:530–545.

Apere, T.O. and Eniekezimene, A.F. (2016). Crude oil price fluctuation and the Nigerian economy. *International Journal of Social Science and Economic Research*, **1**(6):760–770.

Asteriou, D. and Hall, S. (2007). *Applied Econometrics: A Modern Approach*. New York: Palgrave Macmillan.

Chete, L.N., Adeoti, J.O., Adeyinka, F.M. and Ogundele, O. (2020). Industrial development and growth in Nigeria: Lessons and challenges. *Financial Times*, April 2017. Archived from the original on 10 December 2022.

Chikwe, G.C., Ujah, C. and Uzoma, C.H. (2016). The effect of oil price on Nigerian macroeconomic variables from 1990-2015. *International Journal of Managerial Studies and Research*, **4**(11):13–20.

Ehikioya, B.I. (2019). The impact of exchange rate volatility on the Nigerian economic growth: An empirical investigation. *Journal of Economics and Management*, **37**(3):45–68.

Ehikioya, B., Omankhanlen, A., Babajide, A., Osuma, G. and Omodero, C.O. (2020). Oil price fluctuations and exchange rate in selected Sub-Saharan Africa countries: A vector error correction model approach. *International Journal of Energy Economics and Policy*, **10**(6):242–249.

Ekong, N.P. and Ebong, D.W. (2016). On the crude oil price, stock market movement and economic growth Nexus in Nigeria evidence from cointegration and VAR analysis. *Asian Journal of Economic Modelling*, **4**(3):112–123.

Fasanya, I.O. and Onakoya, A.B. (2015). Oil price fluctuations and output performance in Nigeria: A VAR approach. *Romanian Economic Journal*, **16**(49):47–72.

Ftiti, Z., Guesmi, K., Teulon, F. and Chouachi, S. (2016). Relationship between crude oil prices and economic growth in selected OPEC countries. *Journal of Applied Business Research*, **32**(1):11–22.

Gylych, J., Jibrin, A.A., Celik, B. and Isik, A. (2020). Impact of oil price fluctuation on the economy of nigeria, the core analysis for energy producing countries. In *Global Trade in the Emerging Business Environment*, IntechOpen.

Hamilton, J.D. (2009). *Causes and Consequences of the Oil Shock of 2007-08*. San Diego: The Organization of the Petroleum Exporting Countries (OPEC), Department of Economics, UC San Diego.

Hossain, M.S., Hossain, M.M. and Moshiuddullah, A. (2024). Impact of consumer price index (CPI) and inflation on GDP: Evidence from Bangladesh. *Asian Journal For Convergence in Technology*, **10**(2):1–11.

Ismail, O.F. and Onakoya, A.B. (2013). Oil Price Fluctuations and Output Performance in Nigeria: A VAR Approach. *Romanian Economic Journal*, **16**(49):4–72.

Iwayemi, A. and Fowowe, B. (2011). Impact of oil price shocks on selected macroeconomic variables in Nigeria. *Energy Policy*, **39**(2):603–612.

Izuchukwu, C.D. and Patricia, C.N. (2015). Impact of inflation on economic growth in Nigeria (2000-2009). *International Journal of Business and Management Review*, **3**(5):26–34.

Mahmoud, L.O. (2015). Consumer price index and economic growth: a case study of Mauritania 1990–2013. *Asian Journal of Empirical Research*, **5**(2):16–23.

Mensah, L., Obi, P. and Bokpin, G. (2017). Cointegration test of oil price and us dollar exchange rates for some oil dependent economies. *Research in International Business and Finance*, **42**:304–311.

Mordi, C.N.O. (2014). Exchange rate and inflation: is there a relationship in Nigeria. *CBN Economic and Financial Review*, **52**(4):105–123.

Musa, K.S., Muhammad, A., Mohammed, N. and Adamu, S. (2019). Foreign exchange rate and economic growth nexus: New evidence from Nigeria (1981-2017). *Journal of Economics and Sustainable Development*, **10**(18):145–156.

Musa, K., Maijama'a, R., Shaibu, H. and Muhammad, A. (2019). Crude oil price and exchange rate on economic growth: ARDL approach. *Open Access Library Journal*, **6**:e5930.

Nnaemeka, C.A., Chukwuemeka, A.F.O., Tochukwu, M.O. and Chiamaka, O.J.A. (2015). Corruption and insecurity in Nigeria: A psychosocial insight. *Journal of Political Sciences and Public Affairs*, **S1**:1–4.

Obioma, B.K. and Eke, C.N. (2015). An empirical analysis of crude oil price, consumer price level and exchange rate interaction in Nigeria: A vector autoregressive (VAR) approach. *American Journal of Economics*, **5**(3):385–393.

Okeke, K.I., Muoneke, O.B. and Onuoha, F.C. (2021). Symmetric and Asymmetric Effects of Crude Oil Price and Exchange Rate on Stock Market Performance in Nigeria: Evidence from Multiple Structural Breaks and NARDL Analysis. *The Journal of International Trade & Economic Development*, **30**(6):930–956.

Omojuyigbe, S.T., Agbonjinmi, S.A. and Bewaji, S.O. (2021). Impact of consumer price index on Nigeria economic growth: via VAR approach (2010-2020). *Quest Journals Journal of Research in Humanities and Social Science*, **9**(10):35–41.

Orlu, R.N. (2017). The impact of domestic pricing of petrol on economic growth of Nigeria (1970-2013). *Global Journal of Social Sciences*, **16**:1–8.

Salisu, A.A. and Mobolaji, H. (2013). Modeling returns and volatility transmission between oil price and US–Nigeria exchange rate. *Energy Economics*, **39**:169–176.

Ukemenam, A.I., Opadeji, B., Garbobiya, T.S. and Ujunwa, A. (2018). Macroeconomic effects of exogenous oil price shock in Nigeria: persistent or transitory. *International Journal of Economics and Finance*, **10**(11):1–28.

Victor-Edema, U.A. and Wariboko, A. (2023). Performance of symmetric and asymmetric GARCH models in Nigeria's crude oil markets. *Faculty of Natural and Applied Sciences Journal of Mathematical and Statistical Computing*, **1**(1):1–9.

Wilson, A., David, U., Inyiama, O. and Beatrice, E. (2014). Oil price volatility and economic development: Stylized evidence in Nigeria. *Journal of Economics and International Finance*, **6**:125–133.

World Bank. (2004). *Taxation and State Participation in Nigeria's Oil and Gas Sector.*

Zied, F., Khaled, G., Frederic, T. and Slim, C. (2016). Relationship between crude oil prices and economic growth in selected OPEC countries. *Journal of Applied Business Research*, **32**:11–22.

Zivot, E. and Wang, J. (2006). *Modeling Financial Time Series with S-Plus®*. New York, NY: Springer.

Zubair, M.A., Adams, S.O. and Aniagolu, K.S. (2022). Economic impact of some determinant factors of Nigerian inflation rate. *Universal Journal of Finance and Economics*, **5**(2):23–41.