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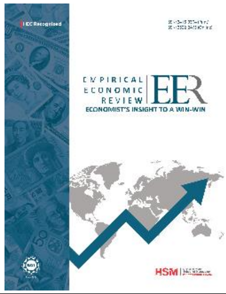

Title: **Modeling Oil Price Shocks on Macroeconomic Performance in Nigeria**

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Modeling Oil Price Shocks on Macroeconomic Performance in Nigeria

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Abstract

The study examines the relationship between economic performance and oil price volatility in Nigeria, with a particular emphasis on fiscal imbalance, corruption, exchange rate, and real GDP. It utilizes the Autoregressive Distributed Lag (ARDL) model with structural breaks, Augmented Dickey fuller test and Philips (ADF) and Philips Perron (PP) were employed to test the stationarity properties of the variables. For structural break, the Perron and Vogelsang unit root test is employed. After ascertaining the stationarity properties using Gregory-Hansen test, the study determines that there is a co-movement between oil price volatility and macroeconomic performance, while the results of the short-run test indicate moderate adjustment back to the equilibrium. The results suggest that oil price changes, fiscal imbalance, corruption, and exchange rate significantly influence real GDP, while the outcomes of Granger causality test based on the Toda-Yamamoto framework show a unidirectional causality from exchange rate and corruption to economic performance. Similarly, the results of diagnostic and stability tests confirm the robustness and proper specification of the model. The study concludes that macroeconomic performance in Nigeria is highly sensitive to oil price fluctuations and institutional dynamics. Policy implications highlight the need for effective fiscal management, as well as diversification strategies to mitigate external shocks and promote sustainable economic growth.

Keywords**:** exchange rate, fiscal imbalance, macroeconomic performance, Nigeria, oil price volatility

JEL Codes: Q 43, E 60, F 31, O 55

Introduction

Nigeria has become a mono product economy with significant structural

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challenges. Before crude oil was discovered in large quantities in 1956, agricultural products like palm oil, rubber, cotton, groundnuts and cocoa were the foundation of the Nigerian economy. Since the discovery of oil, crude oil prices have increased on a continuous basis, hitting an average of $147 per barrel in 2008 before averaging $90 per barrel in 2010 (Oriakhi & Osaze, 2013). This has further increased Nigeria's reliance on the revenue from oil and gas. Yakubu Gowon (1966), the nation's political leader at the time, was responsible for the 'oil boom' in Nigeria, where it was claimed that the issue was not how to make money because the nation had an abundance of it, but rather how to spend it. From 1970 to 1999, oil generated about $231 billion in rent, constituting between 21-48% of the country's GDP since 1974. This indicates that oil contributes to economic growth in Nigeria by yielding returns that are greater than its production costs (Darby et al., 1998). Tensions between foreign oil corporations and several minority ethnic groups in the Niger Delta, particularly the Ogoni and ljaw, who felt that they were being exploited, gave rise to the crisis that lasted until 2007. Over 30 million people were estimated to live in the Delta region in 2005, making up more than 23% of Nigeria's total population. The Structural Adjustment Program (SAP), which is related to both the welfare of the populace and the development of the economy, is one of the policies developed as a result of the significant influence that variations in oil prices have had on macroeconomic performance and economic growth of the country Polterovich and Popov (2006).

Nigerian government policymakers face significant challenges due to irregular fluctuations in the price of oil. Over the past few decades, there have been a number of macroeconomic and fiscal effects of these irregular fluctuations on oil prices, both in Nigeria and in the importing nations (Cashin & McDermott, 2000). The decline in crude oil prices which started in July 2014 created adverse economic effects for Nigeria through its impact on foreign reserves and currency crisis and declining government revenue, all of which resulted in a risk to the nation's capacity to meet its financial commitments. The price of Brent crude oil fell 24% to USD 81 on November 11, 2014, which represented a four-year low. The price of Brent crude oil started at USD 114.91 on January 31 and decreased to USD 102.12 on May 31, while the price on March 31, 2015 ranged from USD 57.8 to USD 67.6. Its value fluctuated between USD 53.29 on December 31, 2016 and USD 57.87 on October 23, 2017. This led to a significant outflow of policies from academia and policymakers. According to LeBlanc and Chinn

(2004), there is disagreement in the economic literature over a theoretical framework that explains how fluctuations in oil prices impact economic activity and growth. Literature identifies a broad spectrum of alternative channels through which oil price changes could affect the economy, mainly by increasing input costs and raising investment uncertainty, thus affecting the aggregate price level and reducing real balances, or by affecting relative prices, hence provoking costly reallocation of resources between sectors. It is for this reason that this study investigates how Nigeria's macroeconomic performance is affected by fluctuations in oil prices. This paper contributes to the literature by using a battery of modern cointegration tests that count for structural break. This is an area that has remained underexplored. After introduction, Section 2 provides the literature review. The methodology is provided in Section 3, Section 4 presents the data and interpretation, while Section 5 presents the conclusion.

Literature Review

Ogiri et al. (2013) defined volatility as the unpredictable behavior of oil prices which can experience sudden price movements during any selected period between one day and one year. Oriakhi and Osazee (2013) defined volatility as the standard deviation which occurs during a designated time frame. They demonstrated that oil price movements take one year to reach their peak agreement, while economic growth suffers from immediate and significant negative effects of volatility. The decline in the global reserve base was suggested by Pirog (2004) to be the long-term explanatory factor driving up oil prices. Merino and Ortiz (2005) argued for a conventional approach, suggesting that variations in oil prices should be explained by the interplay between supply and demand pressures. Nigerian economy suffered a significant decline in the amount of foreign exchange inflow during the periods of low crude oil prices, which is typically caused by factors such as low demand, seasonality, excess supply, and exchange rate appreciation. Conversely, as a share of overall export, non-oil export declined from 7.0% during the period 1970-1985 to 4.0% in the subsequent period ending in 1986 (Central Bank of Nigeria, 2006). Again, the "Dutch disease" was brought about by the discovery of crude oil in Nigeria. As a result, the manufacturing sector's performance continued to be less outstanding, while the agriculture sector's performance decreased.

Igberaes (2013) viewed economic growth as a long-term, steady, and gradual development brought about by a general increase in population and saving rate. Nigeria's economy is among the fastest growing in the world, despite a lack of economic development and infrastructure. The country's rapid growth has currently slowed down to about 7%, while oil prices still remain unstable due to global shocks, such as financial crises, wars, strikes, and lower oil production. Englama (2010) claimed that Nigeria's economy is now more vulnerable to abrupt changes in oil prices due to its reliance on oil export earnings. In actuality, the country's oil output (exports) practically stagnated in 2011-2012. In the medium-term, oil growth is anticipated to be modest until possible investments that might greatly increase production (World Bank, 2013).

There is a large body of research available on the volatility of oil prices and how it affects economic growth. According to David et al. (2024), Nigeria's exposure to fluctuations in oil prices increased when it began importing refined petroleum products as a result of the closure of its domestic refineries in late 1980s. For this reason, the nation was unable to sustain the substantial subsidy it had agreed to. Hence, between 1999 and 2010, the Federal Government changed its petroleum product subsidy eight times. Oriakhi and Osazee (2013) showed that oil price fluctuations produce a stronger effect on the Naira exchange rate than any other economic factor. The reason is that Nigeria depends on crude oil export earnings to generate 90% of its foreign exchange revenue which establishes its foreign reserves. These currently stand at an alarming $30 billion after decreasing from over $60 billion in 2008.

Several theories lend credence to the relationship between oil price fluctuation and economic outcomes. These include the Dutch disease theory, the Pareto-optimality model, the Solow growth model, the structural theory, and the mainstream theory. On the amplitude effect of structural shocks, structuralist theories disagree sharply. Contrary to this, supply shocks only temporarily affect the entire economy in the short-term (Ball & Mankiw, 1995). Policymakers should instead concentrate on reducing 'the second-round effect,' which is anticipated to be more persistent and may cause economic downturn (Central Bank of Nigeria, 2006). Fischer (1985) contended that supply shocks by themselves do not necessitate a policy response, so long as there is no genuine wage opposition by workers. Empirical evidence from emerging nations and Latin America also demonstrated that structural shocks may persist and have their origins in inelastic supply bottlenecks in the oil and agriculture sectors (Blecker, 2007). Robert Solow, a Nobel laureate, devised the Solow growth model in 1980, which serves as the primary theoretical framework for economic growth. This model remains severely constrained and mostly unsuitable to explain the dynamics of growth in contemporary economies, in particular the differences in economic growth over time and geography. The Solow model serves as a standard by which all other growth models are measured, making it an essential instrument for the economics of growth. Solow starts with the Cobb-Douglas type $Q=A\ K^{a}\ L^{1-b}$ production function.

The Solow growth model illustrates the relationship between labor force expansion and technological advancements and how it impacts the output. The relationship between an increasing labor force and technical improvements and how it affects the output is demonstrated by the Solow growth model. The model can be used to describe the allocation, distribution, and production of economic output at a specific point in time. Unlike the Solow-Swan model, the new growth model predicts divergence, as suggested by Romer (2008). As a result, countries with plentiful physical and human capital expand faster than those with modest capital.

The Pareto criteria, named after the renowned Italian economist Vilfredo Pareto (1848-1923), relates to economic efficiency that can be measured objectively. On the other hand, a decline in social welfare results in a situation where nobody gains and at least one person loses. Pareto optimality places a great deal of restrictions on the facilities that economists can use to make significant or even practical statements regarding public concerns Jack and Akidi (2024). The ‘Dutch disease’ presents an economic phenomenon which leads to a decrease in the non-resource tradable sector as the natural resource sector and economic growth expands. The economy develops two specialized sectors which include resource extraction and non-tradable activities, thus increasing its vulnerability to specific sectoral shocks. The Dutch disease model was developed by Max Corden and Peter in 1982. Odularo (2010) provides strong proof connecting oil price disruptions with the presence of the Dutch disease. The analysis implicates that oil price fluctuations deliver steady impacts on both factor price ratios and production methods which the manufacturers use to create their goods in the non-tradable labor-intensive sector.

Empirically, studies such as Alenoghena (2020), investigated how oil price shocks affected macroeconomic performance from 1980 to 2018. The study used structural vector autoregression (SVAR) variables including inflation, interest rates, industrial production index, and output growth. The study revealed that oil price shocks exerted a significant negative impact on economic growth and the industrial production index, which showed that adverse oil price fluctuations negatively affected the total economic output.

Jibril and Halac (2019) used the Global Vector Autoregressive (GVAR) model to study how oil price changes affected various economic indicators in Nigeria, while analyzing the country's main trading partner countries. The study covered the years 1979-2018. The findings showed that positive oil price shocks resulted in increased real output and money supply and caused a slight rise in the real effective exchange rate of Nigeria. Magaji and Singla (2020) used annual time series data from 1981 to 2019 to examine how oil price shocks affected Nigeria's currency rate and economic growth. The ARDL model results for the GDP equation showed that oil prices and GDP have a strong positive relationship in both short-term and long-term.

Omolade and Ngalawa (2019) studied the effects of crude oil price shocks on the economic performance of African oil-producing countries. The study examined 8 major net oil-producing countries including Algeria, Nigeria, Egypt, Angola, Gabon, Equatorial Guinea, and Republic of Congo from 1980 to 2016. The research used panel structural vector auto-regression as its primary analysis method. The results showed that different output responses occurred because economies reacted differently to positive and negative oil price shocks, which led to sharp increases and declines in crude oil prices.

Wasurum (2025) investigated the connection between Nigeria's economic development and changes in oil prices. The research used Granger causality and VAR methods for its analytical procedures. The study showed that GDP growth and oil price fluctuations in Nigeria create a relationship that affects both economic factors. Darma et al. (2022) investigated how fluctuations in oil prices and changes in government spending affected the country's economic development during the period 1986-2018. The findings demonstrated that oil prices have a significant connection to both government expenditure and economic development based on research conducted through Generalized Methods of Moments (GMM) and Vector Error Correction (VECM) models.

Despite the rich and growing body of literature, several critical gaps remain in most existing studies. Some of the studies used linear econometric models, such as VAR, SVAR, ARDL, and GMM, which assume symmetric responses of macroeconomic indicators to oil price fluctuation. Other studies reported using a cross country specific analysis, finding minimal or no effect on this relationship. This contradiction stems from different data periods, model specifications, variable selection, and absence of institutional factors. While, a few studies focused only on direct effects of oil price shocks on GDP, ignoring indirect or transmission mechanisms (e.g., fiscal policy, current account, monetary response). For the current study, the scope was extended and a major contribution of this study is the use of the Gregory-Hansen (1996) cointegration test. This test offers several advantages over conventional cointegration techniques by explicitly allowing for a single structural break in the long-run relationship among the variables. Unlike traditional methods such as the Engle-Granger and Johansen tests, which assume parameter stability over time, the Gregory-Hansen (1996) approach endogenously determines the timing of the structural break, thereby reducing researcher bias and improving model reliability. This feature makes the test particularly suitable for empirical studies involving policy changes, institutional reforms, or economic shocks, such as accounting standard transitions and financial sector reforms. Its ability to perform relatively well in small samples further enhances its applicability in studies with limited time-series observations. Overall, by accounting for structural breaks, the Gregory-Hansen test (1996) reduces the likelihood of falsely rejecting cointegration and provides more robust and realistic evidence of long-run relationships.

Materials and Method

Data for this study were sourced from secondary sources, utilizing annual data on real GDP (which proxy macroeconomic performance), oil price, from which the measure of volatility will be derived. Real GDP data was sourced from (Central Bank of Nigeria, n.d.). Data on oil prices were sourced from the World Bank commodity prices (World Bank, n.d.-a) and various factors, including exchange rate (official parallel market) and fiscal imbalance, were sourced from (National Bureau of Statistics, 2024). While, corruption (which is the last control variable) was sourced from the World Bank (n.d.-b).

Model Specification

Based on the foregoing and in line with theoretical linkage, the general form of a linear model was constructed for this study as follows:

RGDP= f (OP, EXCH, FI, COR,) (1)

where RGDP= Real gross domestic product, OP= oil Price, COR= Corruption, FI = Fiscal imbalance, EXCH= Exchange rate

The econometric model, therefore, becomes

$$RGDP\ t = \alpha_0 + \alpha_1 OP_t + \alpha_2 (EXCH)_t^2 + \alpha_3 FI_t + \alpha_4 COR_t \quad (2)$$

Estimation Strategies

Pre-Model Estimation Stage

The measure of oil price shocks is the residual obtained from the GARCH (1, 1) estimation of a univariate autoregressive model of the nominal exchange rate. A GARCH (1 1) model requires its basic structure to be specified through its general definition,

$$y_t = \mu_t + u_t \quad (3)$$

where

$$\mu_t = 0(cons\tan t);\ u_t = \sigma_t \varepsilon_t$$

$$y_t = u_t = \sigma_t \varepsilon_t \quad (4)$$

$$\begin{aligned} &Var(y_t \mid y_{t-1}) = \sigma_t^2 = \alpha_1 + \alpha_2 y_{t-1}^2 + \beta_1 \sigma_{t-1}^2; \alpha_1 >= 0; \alpha_2 >= 0 \\ &\varepsilon_t \sim i.i.d(\mu = 0, \sigma^2 = 1) \end{aligned} \quad (5)$$

$$y_t = u_t = (\alpha_1 + \alpha_2 y_{t-1}^2)\varepsilon_t \quad (6)$$

The lagged values of the variable determine the predicted variance of the series at time t. The exchange rate volatility assessment requires the calculation of series variance which is assumed to have a mean value of zero.

$$exr_t = u_t = (\alpha_1 + \alpha_2 exr_{t-1}^2)\varepsilon_t \quad (7)$$

The estimation procedure is a two-step procedure. It began with the extraction of oil price volatility, which originated from a univariate

Generalized Autoregressive Conditional Heteroscedasticity (GARCH) framework. The residual of the estimation outcome was taken as the explained variable, while the explanatory variables were regressed against it. Following the trend, descriptive statistics were computed and the mean and the level of skewness of the coefficient were ascertained. In addition, the unit root tests were carried out to identify the stationarity properties of the variables. The Augmented Dickey-Full (ADF) test and the Philips and Perron unit (1988) root test served this purpose (Dickey & Fuller, 1979). The Perron and Vogelsang (1992) test was used because it effectively handles the particular difficulties that arise in analyzing time series data. Employing the three unit root tests created a robust testing framework, enabling comparative analysis while preventing false regression results.

To further examine the existence of a long-run cointegration relationship between oil price shocks and macroeconomic performance, this study employed the Gregory-Hansen cointegration test (1996). The key advantage of this approach lies in its ability to endogenously identify potential structural break dates in the relationship, rather than imposing break points a priori based on unit root test results before conducting the cointegration analysis. After the cointegration test, the short-run relationship between real economic growth and oil price volatility was investigated through Autoregressive Distributive Lags (ARDL) bound test approach incorporating structural breaks and specified as follows:

$$\Delta RDP_t = \delta_x + \sum_{i=1}^{k+d} \beta_x \Delta RGDP_{t-i} + \sum_{j=0}^{k+d} \beta_x \Delta OILP_{t-i} + \sum_{j=0}^{k+d} \beta_x \Delta CORRPT_{t-i} + \mu_t \quad (8)$$

$$\Delta RGDP_t = \delta_y + \sum_{i=1}^{k+d} \beta_y \Delta EXCHR_{t-i} + \sum_{j=0}^{k+d} \beta_y \Delta FISIMB_{t-i} + \sum_{j=0}^{k+d} \beta_x \Delta CORRPT_{t-i} + \mu_t \quad (9)$$

In equation 8, RGDP represents real gross domestic product, OILPV is the oil price volatility, while exchange rate, fiscal imbalance, and corruption represent the control variables in the model. Similarly, Δ is the first-deference operator; δ_x and δ_y are the intercepts; k is the optimal lag length; d is the maximum order of integration; βx and βy are the coefficients of $RGDP_t$ and $OILP_t$, respectively.

The test of Toda and Yamamoto (1995) was used to determine the generalized pairwise Granger causality. The TY framework was used to develop an advanced VAR model which uses the modified Wald test statistic for its operations. This test is a modified VAR model employed for a multivariate framework that allows for series with different orders of integration. The TY framework demonstrates superior power for testing causality because it handles time series data with multiple integration levels better than the traditional Granger causality test. The system achieves better accuracy through its improved ability to establish correct model specifications and reduced chances of false causal relationships. The bivariate Toda-Yamamoto (TY) model is specified as follows:

$$y_{1t} = \alpha_0 + \sum_{i=1}^{k} \alpha_{1i} y_{1t-i} + \sum_{j=k+1}^{k+d_{\max}} \alpha_{2j} y_{1t-j} + \sum_{i=1}^{k} \delta_{1i} y_{2t-i} + \sum_{j=k+1}^{k+d_{\max}} \delta_{2j} y_{2t-j} + \upsilon_{1t}$$

$$y_{2t} = \beta_0 + \sum_{i=1}^{k} \beta_{1i} y_{1t-i} + \sum_{j=k+1}^{k+d_{\max}} \beta_{2j} y_{1t-j} + \sum_{i=1}^{k} \phi_{1i} y_{2t-i} + \sum_{j=k+1}^{k+d_{\max}} \phi_{2j} y_{2t-j} + \upsilon_{2t} \quad (10)$$

The optimal lag length of the model is represented by the variable k. The maximum order of integration for the system is determined by the standard information criteria which includes AIC andIC; $d_{\max}$ is the maximum order of integration. It is determined after obtaining the orders of integration of all the variables. For example, if y1 is I (1) and y2 is I (2), then the maximum order of integration is 2, that is, $d_{\max} = 2$.

After the estimation of short-run parameters and the outcomes of the causality test, various post estimation diagnostic tests were conducted.

Results

Table 1
Descriptive Statistics

	Oil Price	Fiscal Imbalance	Corruption	RGDP	EXCHR
Mean	0.51221	2.16521	0.47122	41332.7	2.1452
Median	0.31711	2.09171	0.81991	311232.3	3.17662
Maximum	0.56112	5.87221	0.38162	341811.4	3.1928.
Minimum	0.56122	0.61522	0.65112	57112.10	0.7822
Std. Dev.	0.067152	1.67522	0.45128	321556.3	1.81722
Skewness	-0.056122	0.56133	0.22123	1.76223	5.12816
Kurtosis	2.41551	2.61722	0.71811	13.67133	2.10921
Jarque-Bera	0.614222	4.89133	0.67141	312.451	4.37262
Probability	0.71229	0.041722	0.38912	0.000001	0.000000
Sum	37.7222	105.3381	0.44391	312233	11.2312
Sum Sq. Dev.	0.28162	398.4113	0.41512	5.14E+11	0.34126
Observations	40	40	40	40	40

The descriptive analysis presented in Table 1 provides insight into the underlying distributional properties and variability of the variables, namely oil price, fiscal imbalance, corruption, and real GDP (RGDP). According to the table, the oil price volatility variable demonstrates statistical normality, as indicated by its near-zero skewness -0.056, moderate kurtosis value of 2.42, and a non-significant Jarque-Bera test with *p*-value of 0.712. These characteristics, coupled with a low standard deviation value of 0.067, suggest that oil prices remained relatively stable over the observed period, with no evidence of extreme fluctuations. This stability is important, particularly for economies where oil is a key export commodity or a determinant of fiscal health, as it implies a consistent revenue base from oil-related activities. In contrast, the fiscal imbalance variable has a moderate positive skewness value of 0.561, indicating the presence of a few years or observations with unusually high deficits. The mean value of 2.165 exceeds the median value of 2.092, further confirming this skew. The Jarque-Bera statistic with *p*-value of 0.0417 reveals that the distribution deviates significantly from normality, suggesting that fiscal outcomes were not evenly distributed across the sample. This may reflect periods of fiscal shocks or crisis episodes where successive governments experienced unusually high imbalances, possibly due to commodity price volatility or increased expenditure pressures. The corruption index, with a mean value of 0.471 and a median of 0.820, initially suggests a negatively skewed distribution; however, the skewness statistic is slightly positive with 0.221, pointing to some inconsistency, likely due to the flatness of the distribution represented by the kurtosis value of 0.718. The standard deviation has the moderate value of 0.451, whereas the Jarque-Bera test is not significant with *p*-value 0.389, indicating that while the data may lack a pronounced central tendency or extreme values, it still approximates a normal distribution. This suggests that corruption levels, although not highly variable, were distributed relatively evenly across the sample, without dominant extremes possibly due to data smoothing or composite index averaging. RGDP exhibits the most extreme distributional characteristics. The significant disparity between the mean value of 41332.7 and the median value of 311232.3, coupled with a high positive skewness value of 1.762 and extremely high kurtosis value of 13.67, reflects a distribution heavily influenced by a few very large values, most likely from economically dominant country or high-growth years. The Jarque-Bera test confirms severe non-normality with *p*-value of 0.001, while the high standard deviation of 321.556 indicates considerable variability. This heavy-tailed distribution suggests that the RGDP values are not only unequal but also contain outliers that could distort regression analysis, if not transformed appropriately.

Table 2

Unit Root Test Result

Variables	ADF	PP	Order of order
OILP	-3.0760	4.1966	I(1)
FISIMB	-1.8014	-3.9794	I(0)
RGDP	-3.8605*	-6.0972*	I(1)
CORRPT	-0.5532	-0.4063	I(1)
EXCHR	-1.8496	-2.2032	I(1)
ΔOILP	-4.7553	-16.6047*	I(1)
ΔFISIMB	-4.3666	-5.8062*	I(1)
ΔRGDP	-7.8241	-11.4843*	I(1)
ΔCORRPT	-6.7965	-32.0798*	I(1)
$\Delta EXCHR$	-5.6823	-21.1639*	I(1)

Note. * indicates statistical level of significance at 1% significance

The results presented in Table 2 indicate that most variables are non-stationary at level but become stationary after first differencing, which confirms them as integrated of order one I(1) variables. These include oil price (OILP), real GDP (RGDP), corruption (CORRPT), and exchange rate (EXCHR). For these variables, both ADF and PP test statistics fail to reject the null hypothesis of a unit root test, but at first difference show highly significant statistical results, confirming stationarity at first difference. For instance, oil price with a critical value of -3.0760 and PP with a critical value of 4.1966 at level suggest non-stationarity, but become stationary after differencing. Similar patterns are observed for RGDP and the other I (1) variables. Notably, fiscal imbalance (FISIMB) is found to be stationary at level, as indicated in the PP test statistic of -.9794, which is statistically significant, even though the critical value in the ADF statistics of -1.8014 is not. Since the PP test is robust to serial correlation and heteroskedasticity and the test result is significant, it supports the classification of FISIMB as integrated of order zero, I (0). This finding implies that fiscal imbalance exhibits mean-reverting behavior and can be used at level in regression modeling without the risk of spurious results. The unit root test results presented in Table 3, which include an endogenous structural break, demonstrate that the null hypothesis of a unit root with a break is accepted for three variables: FISIMB, CORRUPT, and RGDP. The break dates show general consistency except for two exceptions, which are EXCHR and OILPRICE. The break year for OILPRICE was 2015 with intercept, while EXCHR had break years of 2009 with intercept and 2011 with trend and intercept.

Table 3

Unit Root Test Results with Structural Break (Innovative Outlier Model)

Variable	Intercept		Intercept and trend	
	t-Statistics	Break Date	*t*-Statistics	Break Date
OILPRICE	-4.3918*	2009	-4.19273*	2011
FISIMB	-5.4263**	2009	-4.62733**	2009
RGDP	-4.1723*	2017	-4.27189*	2017
CORRUPT	-5.8927**	2022	-5.3319*	2009
EXCHR	--3.0137	2015	-4.27833*	2003

Note. *, ** indicates statistical level of significance at 1% and 5% significance

To further examine the long-run cointegration between oil price shocks and RGDP, this study employed the Gregory-Hansen (1996) cointegration test. The key advantage of this approach lies in its ability to endogenously identify potential structural break dates in the relationship, rather than imposing break points a priori based on unit root test results before conducting cointegration analysis.

Table 4

Gregory–Hansen Cointegration Test

Test Statistic	Value	Break Point	Critical Value (1%)	Critical Value (5%)	Critical Value (10%)
Panel A: Regime Change in Oil Price					
ADF	-10.23	2011	-5.26	-5.47	-4.72
Zt	-10.27	2017	-5.52	-5.28	-4.19
Za	-10.23	2022	-65.11	45.37	-33.19
Panel B: Regime Change in Oil Price and Trend					
ADF	9.11	2019	4.71	-4.24	-5.28
Zt	10.05	2020	-4.81	-4.19	-5.22
Za	72.16	2008	-63.42	-5.21	-47.22
Panel C: Change in Level					
ADF	-6.21	2019	-4.11	-4.38	-4.78
Zt	-3.56	2002	-4.49	-4.81	-5.33
Za	-54.31	2016	-31.2	-29.17	-31.22
Panel D: Change in Level and Trend					
ADF	-7.45	2016	-4.29	-5.33	-4.17
Zt	-9.23	2012	-4.21	-3.42	-5.21
Za	-51.25	2007	-33.32	-21.04	-21.38

The results of Gregory-Hansen cointegration test are reported in Table 4. The results provide a strong evidence of a co-movement between oil price shocks and macroeconomic performance, once structural breaks are taken into account. Under the regime shift specification in panel A, the statistical values are all negative than their respective critical values, suggesting cointegration and indicating that changes in oil price regimes significantly influence the long-run relationship. The endogenously identified break dates around 2011, 2017, and 2022 suggest a major disruption in the oil market that altered the underlying dynamics between oil price and macroeconomic performance. In contrast, when both regime shift and deterministic trends are jointly incorporated (Panel B), the statistical test fails to reject the null hypothesis of no cointegration. This implies that the inclusion of the trend weakens the evidence of a stable co-movement. However, cointegration is reestablished under the level shift model (Panel C), where the test statistics indicate a significant long-run relationship with structural break occurring around 2002, 2016, and 2019, reflecting important structural adjustment in the economy. Similarly, the results in Panel D also confirm the presence of cointegration as all test statistics exceed the critical values. The identified break data suggests that both level and trend changes play a significant role in shaping the long-run interaction between oil price shocks and macroeconomic performance. The results underscore the significance of accounting for breaks in cointegration, as neglect might lead to misleading conclusions about the long-run effects of oil price shocks.

To estimate the coefficients, a maximum lag of 3 was initially set based on the lag order criteria, as mentioned earlier. Importantly, the dummies that appear as explanatory variables relate to those of macroeconomic performance (the dependent variable). In other words, the structural breaks in the dependent variable are used as fixed regressors, in line with model specification.

Table 5

Short-run Dynamics

Variables	Coefficient	Standard Error	*t*	*p*
ECT (-1)	-0.3812	0.0642	-4.0044	0.000
D(OILP-1)	0.3715	0.2417	2.6143	0.0027
D(FISIMB-1)	0.0148	0.0053	-1.2715	0.0281
D(CORRPT_2)	2.2318	3.2710	4.0617	0.0000
D(EXCHR)	0.0040	0.0064	2.3001	0.0037
D(RGDP)	2.5182	3.6002	3.3192	0.0004
DUMMY_RGDP	2.7031	2.5102	2.0028	0.0033
R^2			0.71	
Adjusted R^2			0.65	
Durbin-Watson			2.0151	

The short-run results in Table 5 show that the lagged error correction term coefficient ECT (-1) has an estimated value of -0.3812, which is significant at 1% level. The negative and significant sign confirms the existence of a stable co-movement p among the variables. The result is consistent with cointegration results. Intuitively, the coefficient shows that about 38.1% of any disequilibrium reaches correction within a single period, which proves that the system moves to its long-term balance at a moderate speed after experiencing short-term disturbances. The lagged first difference of oil price (D (OILPRICE-1) exhibits a positive and statistically significant effect with the coefficient value of 0.3715 and the corresponding *p*-value of 0.0027. This result suggests that any increase in oil prices leads to immediate positive changes in the dependent variable, reflecting the importance of oil price fluctuations in shaping short-term economic dynamics. Fiscal imbalance (D (FISIMB-1) also shows a positive and statistically significant impact with the coefficient value of 0.0148 and the corresponding *p*-value of 0.0281. This finding indicates that fiscal pressures, such as budget deficits or imbalances, exert short-run effects on the outcome variable, potentially through government spending or borrowing channels. Also, the two-period lagged change in corruption (D(CORRUP-2) has a large, positive, and highly significant coefficient value of 2.2318 and a corresponding *p*-value of 0.001, highlighting the substantial influence of institutional factors on the dependent variable. The lag structure suggests that the effects of corruption manifest with some delay, underscoring its complex and pervasive impact on economic performance. The contemporaneous change in the exchange rate (D(EXCHR) is positive and statistically significant with the coefficient value of 0.0040 and *p*-value of 0.0037, indicating that currency depreciation or appreciation materially affects the dependent variable in the short-term, possibly through trade competitiveness or inflationary channels. The real GDP growth (D(RGDP) similarly exerts a strong positive short-run influence with the coefficient value of 2.5182 and the corresponding *p*-value of 0.0004, confirming the critical role of economic activity in driving the dependent variable within the said period.

Table 6

Granger Causality Results from Other Variables to RGDP

Variables	Chi-Square	Prob. Values
OILP	3.24182	0.5110
FISIM	5.31762	0.14716
CORRP	17.6152	0.0000
EXCHR	6.02817	0.0337
ALL	40.01982	0.0000

In line with the results presented in Table 6, the null hypothesis of no joint Granger causality between oil price volatility and macroeconomic performance variables in Nigeria cannot be rejected at 10% significance level. Despite the Chi-square probability value being reported as 0.0000, which typically indicates strong statistical significance, the joint test results suggest that oil price volatility does not collectively Granger-cause macroeconomic performance in the Nigerian context at conventional levels of significance. However, a closer examination of individual variables reveals that exchange rate (EXCHR) and corruption (CORRP) exert statistically significant causal effects on macroeconomic performance, proxied by real GDP (RGDP). Specifically, the null hypothesis of no Granger causality from exchange rate and corruption to macroeconomic performance is rejected at both 5% and 10% significance levels, with corresponding Chi-square probabilities of 0.0000 and 0.0337, respectively. These findings suggest that among the variables considered, fluctuations in exchange rate and level of corruption play a more immediate and significant role in influencing Nigeria's macroeconomic performance in the short-run.

Table 7

Granger Causality Results from RGDP to Other Variables

Variables	Chi-Square	Prob. Values
OILP	12.8172	0.2716
FISIM	4.27162	0.5361
CORRP	11.6152	0.2817
EXCHR	2.71622	0.0003

In addition, the analysis of the causal relationship which starts from real gross domestic product (RGDP) and affects all explanatory variables in the study is presented. The results show that the null hypothesis, which states no Granger causality exists from RGDP to these variables, can only be rejected at 10% significance level for the exchange rate relationship. This suggests that RGDP does not significantly influence other explanatory variables in the short-run in general, except for the exchange rate. These findings imply a unidirectional causality from exchange rate and corruption (CORRP) to RGDP, while reverse causality is observed only in the case of exchange rate, since RGDP also Granger-causes exchange rate fluctuations. This pattern highlights the dominant influence of institutional and external sector dynamics, particularly exchange rate movements and corruption, on Nigeria's macroeconomic performance, while RGDP has limited feedback effects on these variables.

Table 8

Diagnostic Tests

Variables	*t*-values	*p*-values
Breusch-Godfey Test(ch^2,1)	0.419271	0.5172
Breusch-Godfey Test(ch^2,2)	0.43817	0.7142
Heteroskedasticity test (ch^2,1)	1.74166	0.1415
Heteroskedasticity test (ch^2,2)	0.74211	0.39102
RAMSEY RESET	0.67122	0.51622
Jaque-Bera	1.61527	0.38992
Standard error of regression	0.0003517	

Table 8 presents the results of the Breusch-Godfrey (BG) Serial Correlation LM test. The results show that the study cannot reject the null hypothesis of no serial correlation, which proves that the model's residuals display no autocorrelation patterns. The ARCH test results show that homoskedasticity exists because the null hypothesis of constant variance was accepted, which proves that the error terms maintain stable variance throughout the test period. The Regression Specification Error Test (RESET) further supports the correctness of the model's functional form. The test's F-statistic is not statistically significant and the *p*-value exceeds the 5% threshold, suggesting that the model is correctly specified and free from functional form misspecification.

Conclusion

The study empirically examines the impact of oil price shocks on macroeconomic performance in Nigeria using data for the period 1985-2024. For this purpose, both linear and non-linear unit root test results were employed. The Gregory-Hansen cointegration test incorporating structural break was also employed to capture the co-movement of the variables employed in the model. The Autoregressive Distributive Lag (ARDL) model was employed to capture shorten movement and the Toda-Yamamoto test was employed to examine the direction of causality. The findings underscore the deep structural linkages between oil price shocks and Nigeria's macroeconomic performance. While oil price fluctuations continue to influence growth dynamics, the study reveals that its direct effect is less pronounced than those of institutional and external sector variables. The existence of a co-movement emanating from the results implies that oil price movements, fiscal behavior, and corruption collectively determine the country's macroeconomic equilibrium. The significance of corruption and exchange rate in the short-run causality framework points to the centrality of governance quality and external competitiveness in explaining Nigeria's growth performance. Persistent fiscal imbalances further reflect the economy's vulnerability to oil revenue volatility, underscoring the need for prudent fiscal management. In essence, the country's macroeconomic performance remains highly sensitive to global oil market developments, yet the transmission mechanisms are heavily mediated by institutional quality, fiscal discipline, and exchange rate management. Thus, sustainable growth in Nigeria depends not only on favorable oil prices but also on strengthening governance frameworks and implementing diversification strategies that insulate the economy from external shocks. Although, strengthening macroeconomic resilience requires a comprehensive policy approach that reduces vulnerability to oil price volatility and promotes sustainability growth. In this regard, an effective fiscal stabilization mechanism and enforceable fiscal responsibility rules to smooth public expenditure during the period of oil downturns comprise the suggested remediation.

Author Contribution

Lawal Wasiu Omotayo: conceptualization, formal analysis, investigation, methodology, supervision, writing – original draft. **Saheed Oluwaseun Lawal:** data curation, resources, software, validation, visualization, writing – review & editing. **Odetokun Blessing Odelekke**, writing – review & editing, project administration.

Conflict of Interest

The authors of the manuscript have no financial or non-financial conflict of interest in the subject matter or materials discussed in this manuscript.

Data Availability Statement

Data supporting the findings of this study will be made available by the corresponding author upon request.

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