Dynamic Effects of Fiscal Policy, Inflation and Crude Oil Prices on Economic Growth in Nigeria: Evidence from ARDL and Granger Causality

Kelechi Geraldine Atasie[1], David Friday Adiele[2] and Samuel Ugochukwu Enogwe[3,*]

[1] Department of Statistics, Michael Okpara University of Agriculture, Umudike, Nigeria

[2] Department of Statistics, Michael Okpara University of Agriculture, Umudike, Nigeria

[3] Department of Statistics, Michael Okpara University of Agriculture, Umudike, Nigeria

e-mail: enogwe.samuel@mouau.edu.ng; senogwe@yahoo.com

Abstract

This study investigates the dynamic effects of fiscal policy, inflation, and crude oil prices on Nigeria's economic growth from 2000 to 2023, employing the Autoregressive Distributed Lag (ARDL) bounds testing approach and Granger causality tests. Using annual time-series data from the Central Bank of Nigeria and the Federal Inland Revenue Service, the analysis examines the long-run cointegrating relationships and short-run dynamics between real gross domestic product (RGDP), total tax revenue, government expenditure, inflation rate, crude oil prices, and exchange rates. The bounds test confirms the existence of a long-run equilibrium relationship (F-statistic = 5.74 > 4.18). Long-run estimates reveal that tax revenue, government expenditure, and crude oil prices positively influence economic growth with coefficients of 0.241, 0.198, and 0.412 respectively, while inflation and exchange rate depreciation negatively impact growth (-0.056 and -0.133). The error correction mechanism shows a rapid adjustment speed of -0.603, indicating that about 60.3% of short-run disequilibria are corrected annually. Granger causality tests demonstrate unidirectional causality running from fiscal variables, oil prices, and exchange rates to RGDP. The study concludes that while fiscal policy remains a potent economic growth driver, its effectiveness is contingent upon macroeconomic stability, efficient public spending, and economic diversification away from oil dependence. Policy recommendations emphasize fiscal discipline, inflation control, exchange rate stabilization, and strategic diversification to foster sustainable economic growth.

1 Introduction

The quest for sustainable economic growth remains the paramount objective of macroeconomic policy in both developed and developing economies. For Nigeria, Africa's most populous nation and largest economy, this pursuit has been characterized by turbulent cycles of expansion and contraction, fundamentally shaped by its profound dependence on crude oil. Since the oil boom of the 1970s, the petroleum sector has

*Corresponding author

dominated government revenue, foreign exchange earnings, and the overall trajectory of national economic development (Gelb [13], Ayadi [4], Sala-i-Martin & Subramanian [34]). This dependence has closely linked Nigeria's economic fortunes to volatile international crude oil price movements, rendering fiscal planning highly susceptible to external shocks (Hamilton [14], van der Ploeg & Poelhekke [35]).

Fiscal policy, the government's primary instrument for economic management through taxation and expenditure, operates under severe constraints imposed by oil price volatility. In Nigeria, government budgets are routinely benchmarked against projected oil prices, such that adverse price shocks translate directly into fiscal shocks, undermining the capacity to finance infrastructure, social services, and development programmes (Odusola [25], Ilzetzki & Végh [16], IMF [17]). These structural weaknesses are further aggravated by fiscal inefficiency, corruption, and pro-cyclical spending behaviour, which diminish the growth-enhancing effectiveness of public expenditure (Frankel, Végh & Vuletin [12], World Bank [36]). At the same time, Nigeria has experienced persistent and often double-digit inflation, which erodes purchasing power, discourages savings and investment, and heightens macroeconomic uncertainty, thereby constraining long-term economic growth (Fischer [11], Bruno & Easterly [7], Khan & Senhadji [22]).

The period from 2000 to 2024 provides a compelling framework for examining these dynamics, as it encompasses major global and domestic economic disturbances. These include the 2008–2009 global financial crisis, the 2014–2016 collapse in international oil prices, the COVID-19 pandemic, and the recent phase of severe macroeconomic instability marked by sharp exchange-rate depreciation and rising inflation (Hamilton [14], World Bank [36], IMF [18]). Analysing the interaction between fiscal policy, inflation, oil prices, and economic growth during this eventful period is therefore essential for formulating resilient and evidence-based economic policies for Nigeria.

Despite the implementation of various fiscal and monetary policy frameworks, Nigeria's economic growth has remained unstable and largely synchronized with global oil price cycles. Periods of elevated oil prices, such as 2000–2008 and 2010–2014, coincided with increased government revenue and economic expansion, while downturns in 2009, 2015–2017, and 2020 resulted in recessions or sharp growth slowdowns (Ayadi [4], Aliyu [2], van der Ploeg & Poelhekke [35]). This recurring boom–bust pattern highlights the economy's structural vulnerability and raises concerns regarding the effectiveness of policy tools in mitigating externally induced shocks.

The core problem addressed in this study is the complex and ambiguous nature of the relationships among key macroeconomic variables in Nigeria's growth process. Although the influence of oil prices on economic performance is widely acknowledged, the transmission mechanisms and relative strength of these effects in both the short and long run remain empirically unsettled (Deaton [8], Sala-i-Martin & Subramanian [34]). Furthermore, the effectiveness of fiscal policy as a counter-cyclical stabilisation tool remains contested, particularly in the presence of inefficiencies, corruption, and weak expenditure management systems (Ilzetzki, Mendoza & V'egh [16], World Bank [36]). Persistent inflation further constrains growth by distorting price signals and investment decisions, underscoring the need for rigorous empirical evaluation of its role in Nigeria's economic growth trajectory (Fischer [11], Khan & Senhadji [22]).

Empirical studies on fiscal policy and economic growth in Nigeria present mixed evidence, largely depending on the composition and efficiency of public spending. Aregbeyen and Akpan [3] found that recurrent expenditure either exerts insignificant or negative effects, emphasizing the importance of expenditure structure. Similarly, Odusola [25] argues that Nigeria's tax system has been ineffective in promoting growth due to a narrow base and high tax evasion, although effective tax reforms can enhance growth by financing productive public expenditure.

Several studies highlight the growth-enhancing role of human capital investment. Nwobia *et al.* [24] find that government expenditure on health and education significantly promotes long-run economic growth, despite short-run inefficiencies in healthcare spending. In related studies, Keji [21], Ebhotemhen and Hezekiah [10], and Olayiwola *et al.* [30] confirm that sustained investment in education and health improves human capital development and long-term growth outcomes. However, Okwu *et al.* [29] observe that inefficiencies in education financing limit the immediate impact of public spending on enrolment outcomes.

On the role of oil prices, Kabir *et al.* [20] and Nuhu [23] show that oil price movements significantly influence Nigeria's economic performance, mainly through exchange rate and fiscal channels, while Ogunjobi *et al.* [27] find that oil revenue positively affects growth but inflation exerts a dampening effect. Similarly, Baumeister and Kilian [5] and Ighosewe *et al.* [15] emphasize that the growth effects of oil price fluctuations depend largely on revenue management and macroeconomic stability. Overall, the literature suggests that fiscal policy and oil revenues can support economic growth only when accompanied by effective expenditure management, inflation control, and economic diversification.

Existing scholarly works have explored facets of these relationships, yet significant gaps persist. Many studies are dated, cover shorter timeframes, or employ methodologies that are not robust to the mixed order of integration ($I(0)$ and $I(1)$) typical of macroeconomic time-series data. This study aims to fill these gaps by providing a comprehensive, contemporary analysis extending to 2023. It utilizes the Autoregressive Distributed Lag (ARDL) bounds testing approach, a method particularly suited to variables with different integration orders, and Granger causality tests to disentangle both the long-run equilibrium relationships and the short-run dynamic interactions, as well as the directional causality among fiscal policy indicators, inflation, crude oil prices, exchange rates, and economic growth in Nigeria.

2 Methodology

2.1 Source of Data

Data used in this study are Real Gross Domestic Product (RGDP), Total Government Expenditure (TGEXP), Exchange Rate (EXCHR), and Inflation Rate (INFR), extracted from the 2023 Central Bank of Nigeria (CBN) Statistical Bulletin. In addition, data on Total Tax Revenue (TOTAX) were obtained from the annual reports of the Federal Inland Revenue Service (FIRS) whereas data on Crude Oil Price (COP) is based on the annual average of Brent crude oil prices in US Dollars per barrel, representing the

international benchmark most relevant to Nigeria's exports.

2.2   ADF Method for Unit Root Test

The Augmented Dickey-Fuller (ADF) test developed by (Dickey & Fuller [9]) was utilised for unit root test. The ADF test started by fitting the ADF equation:

$$\Delta Y_t = \alpha + \beta t + \gamma Y_{t-1} + \sum_{i=1}^{p} \delta_i \Delta Y_{t-i} + \varepsilon_t, \tag{1}$$

where

Δ is the first difference operator.

Y_t represents the variable under investigation.

α is a constant term (drift).

βt captures a deterministic linear time trend.

γ is the parameter of primary interest; its significance tests for a unit root.

p is the lag length.

ε_t are the residuals.

To test for unit root, we specify the null hypothesis $H_0 : \gamma = 0$ (the series has a unit root and is non-stationary) and the alternative hypothesis $H_1 : \gamma < 0$ (the series is stationary). Then, the ADF test statistic for the unit root test is given by:

$$t = \frac{\hat{\gamma}}{SE(\hat{\gamma})}, \tag{2}$$

where $\hat{\gamma}$ is the estimate of γ and $SE(\hat{\gamma})$ is the standard error of the estimate, $\hat{\gamma}$. In the Augmented Dickey–Fuller test, the null hypothesis H_0 states that the series possesses a unit root and is therefore non-stationary, while the alternative hypothesis H_1 states that the series is stationary.

The decision rule is based on a comparison between the calculated ADF test statistic and the corresponding critical values. The null hypothesis of a unit root is rejected if the calculated ADF statistic is more negative than the critical value at the chosen level of significance. Alternatively, the null hypothesis is rejected when the p-value is less than the chosen significance level (usually 5%). If the null hypothesis is rejected at level, the variable is considered stationary and integrated of order zero $I(0)$. If the null hypothesis cannot be rejected at level but is rejected after first differencing, the variable is considered integrated of order one $I(1)$.

If stationarity is achieved at level, it implies that the series does not contain a unit root and is said to be integrated of order zero, denoted $I(0)$. However, if the ADF test fails to reject the null hypothesis at levels but rejects it at first difference, then the series contains a unit root and is integrated of order one, denoted $I(1)$. Similarly, if the ADF test fails to reject the null hypothesis at both levels and first difference but rejects it at the second difference, the series contains two unit roots and is integrated of order two, denoted $I(2)$.

Given the likelihood that the variables exhibit a mix of integration orders, some stationary at level $I(0)$ and others at first difference $I(1)$, the Autoregressive Distributed Lag (ARDL) bounds testing approach to cointegration, pioneered by Pesaran *et al.* [33], is adopted. This method is superior in this context as it can be applied irrespective of whether the underlying regressors are purely $I(0)$, purely $I(1)$, or mutually cointegrated. It also provides unbiased estimates of long-run parameters and valid t-statistics even in small samples.

The next step in the ARDL procedure is to specify an unrestricted error correction model (UECM) and conduct a bounds F-test to establish the existence of a long-run cointegrating relationship. The general form of the ARDL model for the study variables is specified as follows:

$$
\begin{aligned}
\Delta \ln RGDP_t = {} & \alpha_0 + \sum_{i=1}^{p} \alpha_{1i} \Delta \ln RGDP_{t-i} + \sum_{i=0}^{q_1} \alpha_{2i} \Delta \ln TOTAX_{t-i} + \sum_{i=0}^{q_2} \alpha_{3i} \Delta INFR_{t-i} \\
& + \sum_{i=0}^{q_3} \alpha_{4i} \Delta \ln COP_{t-i} + \sum_{i=0}^{q_4} \alpha_{5i} \Delta \ln TGEXP_{t-i} + \sum_{i=0}^{q_5} \alpha_{6i} \Delta \ln EXCH_{t-i} + \lambda_1 \ln RGDP_{t-i} \\
& + \lambda_2 \ln TOTAX_{t-i} + \lambda_3 INFR_{t-i} + \lambda_4 \ln COP_{t-i} + \lambda_5 \ln TGEXP_{t-i} + \lambda_6 \ln EXCHR_{t-i} \\
& + \mu_t
\end{aligned}
\tag{3}
$$

where

Δ denotes the first difference,

α is the intercept,

$p, q_1, q_2, q_3, q_4, q_5$ are the optimal lag lengths for the differenced variables,

$\alpha_{1i}, \alpha_{2i}, \alpha_{3i}, \alpha_{4i}, \alpha_{5i}$ and α_{6i} are the short-run dynamic coefficients,

$\lambda_1, \lambda_2, \lambda_3, \lambda_4, \lambda_5, \lambda_6$ are the long-run multipliers,

μ_t is a white noise error term.

The bounds test for cointegration involves an F-test on the joint significance of the lagged level variables. The null hypothesis of no cointegration is:

$$H_0 : \lambda_1 = \lambda_2 = \lambda_3 = \lambda_4 = \lambda_5 = \lambda_6 = 0$$

while the alternative hypothesis is $H_1 : \lambda_i \neq 0$. The calculated F-statistic is compared against two sets of critical values provided by Pesaran *et al.* [33]: a lower bound assuming all regressors are I(0), and an upper bound assuming all are I(1). If the F-statistic exceeds the upper critical bound, the null hypothesis is rejected, confirming that cointegration exists . If it falls below the lower bound, no cointegration exists. An inconclusive result occurs if it lies between the bounds.

Optimal lag lengths $(p, q_1, q_2, q_3, q_4, q_5)$ for the ARDL model are selected using the Akaike Information Criterion (AIC), defined by Akaike [1] as:

$$AIC = \ln(\hat{\sigma}^2) + \frac{2k}{T}, \tag{4}$$

where $\hat{\sigma}^2$ is the estimated error variance, k is the total number of estimated parameters, and T is the sample size. The model with the minimum AIC value is preferred.

Once cointegration is established, the long-run equilibrium relationship can be derived from the estimated coefficients of the level variables in Equation 3. Subsequently, the short-run dynamics are captured by the associated Error Correction Model (ECM), which is derived from the ARDL specification:

$$\Delta \ln RGDP_t = \beta_0 + \sum_{i=1}^{p} \beta_{1i} \Delta \ln RGDP_{t-i} + \sum_{i=0}^{q_1} \beta_{2i} \Delta \ln TOTAX_{t-i} + \sum_{i=0}^{q_2} \beta_{3i} \Delta INFR_{t-i}$$
$$+ \sum_{i=0}^{q_3} \beta_{4i} \Delta \ln COP_{t-i} + \sum_{i=0}^{q_4} \beta_{5i} \Delta \ln TGEXP_{t-i} + \sum_{i=0}^{q_5} \beta_{6i} \Delta \ln EXCHR_{t-i} + \phi ECT_{t-1}$$
$$+ \nu_t. \tag{5}$$

In Equation (5), ECT_{t-1} is the error correction term, representing the lagged residuals from the estimated long-run cointegrating equation. The coefficient ϕ measures the speed of adjustment back to long-run equilibrium following a short-run shock. For the model to be stable and exhibit convergence, ϕ must be negative, less than one, and statistically significant.

To determine the direction of causal relationships among the variables, Pairwise Granger Causality tests are conducted within a Vector Autoregression (VAR) framework. For two variables, X and Y, the test examines whether past values of X contain information that helps predict current values of Y, beyond the information contained in past values of Y alone. The test involves estimating the following equations:

$$Y_t = \alpha_0 + \sum_{i=1}^{m} \alpha_i Y_{t-i} + \sum_{i=1}^{m} \beta_i Y_{t-i} + \varepsilon_{1t}, \tag{6}$$

$$X_t = \gamma_0 + \sum_{i=1}^{m} \gamma_i X_{t-i} + \sum_{i=1}^{m} \delta_i X_{t-i} + \varepsilon_{2t}. \tag{7}$$

The null hypothesis that "X does not Granger-cause Y" is tested by assessing whether all $\beta_i = 0$ using an F-test. Similarly, the null that "Y does not Granger-cause X" tests whether all $\delta_i = 0$.

A set of diagnostic tests is performed to validate the robustness and reliability of the estimated ARDL model. These include:

2.3 Normality Test

Normality of the dependent variable (or residuals) in the model is an important assumption for valid hypothesis testing and the construction of confidence intervals in regression analysis. To examine this assumption, the Jarque–Bera (JB) test was conducted (Jarque and Bera [19]). The null and alternative hypothesis are respectively stated as:

$$H_0 : \text{The dependent variable (or residuals) is normally distributed}$$

and

$$H_1 : \text{The dependent variable (or residuals) is not normally distributed.}$$

The Jarque-Bera (JB) test statistic is given as:

$$JB = \frac{n}{6}\left(C_s^2 + \frac{(C_k - 3)^2}{4}\right), \tag{8}$$

where n = sample size, C_s = coefficient of skewness of dependent variable (or residuals), C_k = coefficient of kurtosis of dependent variable (or residuals). The null hypothesis of normality of dependent variable (or residuals) is rejected if $JB > \chi^2_{(2)}$ or if the p-value is less than the 5% level of significance.

2.4 Breusch–Godfrey LM Test for Serial Correlation

The Breusch-Godfrey test is used to assess for the presence of serial correlation. Serial correlation arises when residuals are correlated across time, violating the OLS assumption of independence. The test is based on the auxiliary regression:

$$\hat{u}_t = \eta_0 + \eta_1 \hat{u}_{t-1} + \eta_2 \hat{u}_{t-2} + \cdots + \eta_p \hat{u}_{t-v} + \omega_1 X_{1t} + \omega_2 X_{2t} + \cdots + \omega_k X_{kt} + \varepsilon_t, \tag{9}$$

where

$\hat{u}_t$ = residuals from the main regression,

$X_1, X_2, \ldots, X_k$ are the independent variables,

v = order of autocorrelation being tested.

The null and alternative hypothesis are:

H_0 : There is no serial correlation among the successive residuals,

H_1 : There is serial correlation among the successive residuals.

The test statistic for the B-G test for serial correlation is:

$$LM = (n - \upsilon)R^2, \tag{10}$$

where R^2 is the coefficient of determination from the auxiliary regression. If the calculated LM exceeds the critical chi-square value, the null hypothesis of "no serial correlation" is rejected.

2.5 Breusch–Pagan–Godfrey Test for Heteroskedasticity

The Breusch–Pagan test developed by (Breusch and Pagan [6]) is used to determine whether or not heteroscedasticity is present in a regression model. Heteroscedasticity occurs when the variance of the error term is not constant. The Breusch-Pagan test is based on the auxiliary regression:

$$\hat{u}_t^2 = \alpha_0 + \alpha_1 X_{1t} + \alpha_2 X_{2t} + \cdots + \alpha_k X_{kt} + v_t, \tag{11}$$

where $\hat{u}_t^2$ is the squared residual from the main regression.

The null and alternative hypotheses specified for the Breusch-Pagan test are:

H_0 : The residuals are distributed with equal variance (homoscedasticity)

H_1 : The residuals are not distributed with equal variance (heteroscedasticity).

The Breusch-Pagan test statistic for testing for heteroscedasticity is given by

$$LM = nR_{aux}^2, \tag{12}$$

where n is the sample size and $R_{aux}^2 = R^2$ from auxiliary regression of squared residuals on independent variables.

The null hypothesis of heteroscedasticity is rejected if $LM > \chi_k^2$, where k is the number of regressors. Alternatively, if the p-value of the test is less than some significance level the we reject the null hypothesis and conclude that heteroscedasticity is present in the model.

2.6 Ramsey Regression Equation Specification Error Test

To assess whether the model is correctly specified, the Ramsey Regression Equation Specification Error Test (RESET) is employed. This test examines whether the non-linear combinations of fitted values help in explaining the dependent variable. The idea behind this test is that, if nonlinear combinations of the explanatory variables have any power in explaining the dependent variable, the model is mis-specified in the sense that the data generating process might be better approximated by a polynomial or another nonlinear functional form. Given the fitted value of a linear regression model:

$$\hat{Y} = E(Y|X) = \beta X, \tag{13}$$

where β is a vector of the parameter estimates and X is a vector of independent variables, the Ramsey RESET tests whether $(\beta X)^2, (\beta X)^3, \ldots, (\beta X)^k$ has any power in explaining Y. This is executed by estimating the following auxiliary regression is:

$$Y_t = \vartheta_0 + \vartheta_1 \hat{Y}_t + \vartheta_2 \hat{Y}_t^2 + \vartheta_3 \hat{Y}_t^3 + \cdots + \vartheta_k \hat{Y}_t^k + \xi_t, \tag{14}$$

where $\hat{Y}_t$ is the fitted value from the original regression, $\vartheta_0, \vartheta_1, \vartheta_2, \ldots, \vartheta_k$ are the model parameters, and ξ is the error term of the model.

The null hypothesis for the RESET is

$$H_0 : \vartheta_1 = \vartheta_2 = \cdots = \vartheta_{k-1} = 0 \text{ (correct model specification)}$$

and the alternative hypothesis is

$$H_1 : \text{at least one } \vartheta_i \neq 0 \text{ (model mis-specification).}$$

The test statistic is for the RESET is:

$$F = \frac{(R_{ur}^2 - R_r^2)/m}{(1 - R_{ur}^2)/(n - k)}, \tag{15}$$

where

$$R_{ur}^2 = \text{unrestricted regression,}$$

$$R_r^2 = \text{restricted regression,}$$

$$m = \text{number of restrictions,}$$

$$n = \text{sample size,}$$

$$k = \text{number of regressors in the model.}$$

The null hypothesis shall be rejected if the p-value is less than the chosen level of significance. A test that rejects the null hypothesis shows that the model suffers from misspecification. Otherwise, the model is correctly specified.

2.7 CUSUM and CUSUMSQ Tests for Stability of Regression Parameters

The Cumulative Sum (CUSUM) and Cumulative Sum of Squares (CUSUMSQ) are used to assess the parameter stability. The cumulative sum test identifies systematic changes in the regression coefficients while the cumulative sum of squares test detects sudden changes from the constancy of the regression coefficients. For the CUSUM Test, the recursive residuals are accumulated as:

$$W_t = \frac{\sum_{i=k+1}^{t} w_i}{\hat{\sigma}\sqrt{n}}, \tag{16}$$

where

w_i = recursive residual,

$\hat{\sigma}$ = standard error of residuals,

n = sample size.

Similarly, for the CUSUMSQ Test, the squared recursive residuals are accumulated as:

$$S_t = \frac{\sum_{i=k+1}^{t} w_i^2}{\sum_{i=k+1}^{n} w_i^2}. \tag{17}$$

If the CUSUM (or CUSUMSQ) remains within the 5% critical bounds, we fail to reject the null hypothesis of parameter stability.

3 Results and Discussion

3.1 Results

Table 1: Descriptive Statistics (Levels)

Variables	Mean	Median	Maximum	Minimum	Std. Dev.	Skewness	Kurtosis
RGDP	54719.1	58720.5	76684.9	25169.5	16812.2	-0.4000	1.7000
TGEXP	5576.5	4596.3	19808.4	701.1	4800.0	1.4000	4.6000
TOTAX	94.5	4.7	703.1	1.2	210.6	1.9780	5.2430
INFR	13.1	12.6	24.7	5.4	4.5	0.5281	3.1879
COP	68.3	68.1	115.4	26.4	28.3	0.1430	1.9140
EXCHR	217.6	155.6	645.2	101.7	133.9	1.6430	5.3580

Table 1 presents the descriptive statistics of the study variables in their level form for the period 2000–2024. The table shows the mean, median, maximum, minimum, standard deviation, skewness, and kurtosis of each variable.

As reported in Table 1, Real Gross Domestic Product (RGDP) has a mean value of ₦54,719.1 billion, with a maximum of ₦76,684.9 billion and a minimum of ₦25,169.5 billion, indicating notable growth in Nigeria's economic output during the study period. The relatively large standard deviation (16,812.2) suggests considerable fluctuations in economic performance.

Similarly, Table 1 indicates that Total Government Expenditure (TGEXP) has an average value of ₦5,576.5 billion, with a maximum of ₦19,808.4 billion and a minimum of ₦701.1 billion. This wide range

reflects variations in fiscal spending across the study period. Total Tax Revenue (TOTAX), as shown in Table 1, exhibits the highest level of skewness (1.9780), indicating that the distribution is highly positively skewed and suggesting the presence of extreme values in some years.

With respect to macroeconomic stability indicators, Table 1 shows that the Inflation Rate (INFR) averages 13.1%, with a standard deviation of 4.5, reflecting persistent inflationary pressures in the economy. Crude Oil Prices (COP) have a mean value of $68.3 per barrel and demonstrate noticeable variability due to fluctuations in the global oil market.

Furthermore, Table 1 shows that the Exchange Rate (EXCHR) records an average value of ₦217.6 per US dollar, with a maximum value of ₦645.2. This reflects the significant depreciation of the Nigerian currency over time. The skewness and kurtosis statistics reported in Table 1 further indicate that some variables deviate from normal distribution, particularly TOTAX and EXCHR, which exhibit strong positive skewness and leptokurtic characteristics.

Table 2: Descriptive Statistics (Logs)

Variables	Mean	Median	Maximum	Minimum	Std. Dev.	Skewness	Kurtosis
lnRGDP	10.8563	10.9803	11.2475	10.1334	0.35010	-0.70250	2.17330
lnTGEXP	8.2716	8.4330	9.8939	6.5526	0.90001	-0.16950	2.22045
lnTOTAX	2.1558	1.5411	6.5555	0.1773	1.96013	1.50533	3.73678
lnCOP	4.1292	4.2215	4.7485	3.2753	0.46307	-0.47366	2.15626
lnEXCHR	5.2428	5.0471	6.4695	4.6220	0.50989	0.84390	2.54175

Table 2 presents the descriptive statistics of the logarithmic transformation of the study variables. The log transformation was applied to stabilize variance and reduce the influence of extreme observations, thereby improving the statistical properties of the data for econometric estimation.

As shown in Table 2, the logarithm of real GDP (lnRGDP) has a mean value of 10.8563, with a median of 10.9803, a maximum of 11.2475, and a minimum of 10.1334. The relatively low standard deviation (0.3501) suggests limited variability in the logged real GDP series.

Similarly, Table 2 shows that the logarithm of total government expenditure (lnTGEXP) records a mean value of 8.2716 and a standard deviation of 0.9000, indicating moderate fluctuations in government spending over the study period. The logarithm of total tax revenue (lnTOTAX), as reported in Table 2, displays the highest variability among the transformed variables, with a standard deviation of 1.9601, reflecting fluctuations in revenue mobilization.

Furthermore, Table 2 indicates that the logarithm of crude oil prices (lnCOP) has a mean value of 4.1292 with relatively low dispersion, suggesting that the log transformation reduces the apparent volatility of oil prices. The logarithm of the exchange rate (lnEXCHR) records a mean value of 5.2428, reflecting the persistent depreciation of the Nigerian currency over time.

The skewness values reported in Table 2 indicate that lnTOTAX and lnEXCHR are positively skewed, while lnRGDP and lnCOP exhibit slight negative skewness. The kurtosis statistics further suggest that most of the variables have distributions that are approximately normal. Overall, Table 2 confirms that the logarithmic transformation improves the statistical behavior of the variables and enhances their suitability for subsequent econometric analysis.

Table 3: Correlation Matrix (Levels)

	RGDP	TGEXP	TOTAX	INFR	COP	EXCHR
RGDP	1.00000	0.80823	-0.67049	0.21456	0.49300	0.74288
TGEXP	0.80823	1.00000	-0.41365	0.55391	0.31789	0.97293
TOTAX	-0.67049	-0.41365	1.00000	0.06030	-0.62169	-0.32584
INFR	0.21456	0.55391	0.06030	1.00000	-0.15979	0.63307
COP	0.49300	0.31789	-0.62169	-0.15979	1.00000	0.13430
EXCHR	0.74288	0.97293	-0.32584	0.63307	0.13430	1.00000

Table 3 presents the pairwise correlation coefficients among the variables used in the study. The correlation matrix provides insight into the degree and direction of linear association between the variables and also helps to identify potential multicollinearity problems prior to econometric estimation.

As shown in Table 3, Real Gross Domestic Product (RGDP) exhibits a strong positive correlation with Total Government Expenditure (TGEXP) with a coefficient of 0.80823, suggesting that increases in government spending are associated with higher levels of economic output. Similarly, RGDP shows a strong positive relationship with the Exchange Rate (EXCHR) (0.74288), indicating that economic growth tends to move alongside exchange rate changes during the study period.

However, Table 3 indicates that RGDP has a negative correlation with Total Tax Revenue (TOTAX) (−0.67049). This negative relationship may suggest that higher tax burdens could potentially dampen economic growth, although correlation alone does not imply causation.

Furthermore, Table 3 shows that inflation (INFR) has a moderate positive relationship with TGEXP (0.55391) and EXCHR (0.63307), suggesting that increases in government spending and exchange rate depreciation may be associated with rising price levels. On the other hand, inflation exhibits a weak positive relationship with RGDP (0.21456), indicating a relatively small association between economic growth and inflation during the study period.

Crude oil prices (COP), as reported in Table 3, have a moderate positive correlation with RGDP (0.49300), reflecting the importance of oil revenue in driving Nigeria's economic performance. However, COP shows a negative correlation with TOTAX (-0.62169), indicating that tax revenue may move inversely with oil price fluctuations in certain periods.

One notable observation from Table 3 is the very high correlation between TGEXP and EXCHR

(0.97293). This suggests the possibility of multicollinearity between the two variables, as values above 0.90 often indicate strong linear association. Nevertheless, correlation alone does not necessarily confirm severe multicollinearity; therefore, further diagnostic tests such as the Variance Inflation Factor (VIF) may be required.

Overall, the correlation matrix presented in Table 3 provides preliminary insights into the relationships among the variables and confirms that the variables exhibit meaningful associations that justify their inclusion in the econometric model.

Table 4: Correlation Matrix (Logs)

	lnRGDP	lnTGEXP	lnTOTAX	INFR	lnCOP	lnEXCHR
lnRGDP	1.00000	0.95785	-0.58782	0.16559	0.64831	0.79562
lnTGEXP	0.95785	1.00000	-0.49922	0.34423	0.60737	0.90061
lnTOTAX	-0.58782	-0.49922	1.00000	0.11947	-0.67522	-0.23229
INFR	0.16559	0.34423	0.11947	1.00000	-0.14094	0.55764
lnCOP	0.64831	0.60737	-0.67522	-0.14094	1.00000	0.25412
lnEXCHR	0.79562	0.90061	-0.23229	0.55764	0.25412	1.00000

Table 4 presents the correlation coefficients among the log-transformed variables used in the study. The correlation matrix provides preliminary information about the strength and direction of linear relationships among the variables and also helps to identify potential multicollinearity problems before econometric estimation.

As shown in Table 4, the logarithm of real GDP (lnRGDP) exhibits a very strong positive correlation with the logarithm of total government expenditure (lnTGEXP) with a coefficient of 0.95785. This suggests that increases in government expenditure are closely associated with increases in economic output during the study period.

Similarly, Table 4 indicates that lnRGDP has a strong positive relationship with the logarithm of the exchange rate (lnEXCHR) with a coefficient of 0.79562, implying that movements in the exchange rate tend to occur alongside changes in economic growth. lnRGDP also shows a moderate positive correlation with crude oil prices (lnCOP) (0.64831), reflecting the significant role of oil revenue in Nigeria's economic performance.

However, Table 4 reveals that lnRGDP has a negative correlation with the logarithm of total tax revenue (lnTOTAX) (−0.58782), indicating that higher tax revenue may coincide with lower economic output during certain periods, although correlation alone does not establish causation.

Furthermore, the results reported in Table 4 show that inflation (INFR) has relatively weak to moderate correlations with most variables. For instance, inflation has a weak positive relationship with lnRGDP (0.16559) and lnTOTAX (0.11947), but a moderate positive relationship with lnEXCHR (0.55764),

suggesting that exchange rate depreciation may contribute to inflationary pressures.

A notable observation from Table 4 is the very high correlation between lnTGEXP and lnEXCHR (0.90061), as well as between lnRGDP and lnTGEXP (0.95785). These high correlation coefficients may indicate the possibility of multicollinearity among some explanatory variables. Nevertheless, correlation analysis alone is not sufficient to confirm severe multicollinearity; therefore, additional diagnostic tests such as the Variance Inflation Factor (VIF) are often employed to further assess this issue.

Overall, the correlation matrix presented in Table 4 provides useful preliminary insights into the relationships among the variables and supports their inclusion in the subsequent econometric analysis.

Table 5: Result of Unit Root Test Using ADF Criterion

Variable	Level (Intercept)	Prob.	Level (Intercept & Trend)	Prob.	1st Difference	Prob.	Order of Integration
lnRGDP	-1.254	0.634	-2.887	0.185	-4.325**	0.002	$I(1)$
lnTOTAX	-3.752**	0.008	-3.689*	0.040	—	—	$I(0)$
INFR	-2.011	0.281	-2.345	0.395	-5.112**	0.000	$I(1)$
lnCOP	-1.988	0.293	-2.101	0.524	-5.874**	0.000	$I(1)$
lnTGEXP	-3.221*	0.028	-3.158	0.114	—	—	$I(0)$
lnEXCHR	-1.456	0.541	-2.002	0.574	-4.998**	0.000	$I(1)$

Note: * and ** denote significance at 5% and 1% levels respectively.

The Augmented Dickey–Fuller (ADF) unit root test was employed to examine the stationarity properties of the variables used in the study. The results of the test are presented in Table 5 under two specifications: intercept only and intercept with deterministic trend.

The decision rule for the ADF test is that the null hypothesis of a unit root is rejected if the p-value is less than the chosen significance level (typically 5%), or equivalently if the ADF test statistic is more negative than the corresponding critical value. When the null hypothesis is rejected at level, the variable is considered stationary at level $[I(0)]$; otherwise, the variable is differenced until stationarity is achieved.

As shown in Table 5, the variables lnTOTAX and lnTGEXP are stationary at level because their ADF statistics are statistically significant at conventional levels, with *p*-values less than 0.05. These variables are therefore integrated of order zero, denoted as $I(0)$.

However, lnRGDP, INF, lnCOP, and lnEXCHR are not stationary at level since their *p*-values exceed the 5% significance level, indicating the presence of unit roots. After taking the first difference, the ADF statistics for these variables become statistically significant with *p*-values less than 0.05, indicating that they become stationary at first difference. Consequently, these variables are integrated of order one, denoted as $I(1)$.

Overall, the results reported in Table 5 reveal a mixture of $I(0)$ and $I(1)$ variables. This combination satisfies the precondition for the application of the Autoregressive Distributed Lag (ARDL) bounds testing

approach, which allows for the estimation of relationships among variables that are integrated of different orders, provided none of the variables is integrated of order two $[I(2)]$.

Table 6: Results of Bounds Test for Cointegration

		Significance	Lower Bound $I(0)$	Upper Bound $I(1)$
Test Statistic	Value	10.00%	2.26	3.35
F-statistic	5.74	5.00%	2.62	3.79
k	5	2.50%	2.96	4.18
		1.00%	3.41	4.68

The ARDL bounds test for cointegration was conducted on the model specified in Equation 2. The optimal lag structure, selected by the Akaike Information Criterion (AIC), was ARDL(2, 1, 0, 1, 1, 0). The results of the bounds test are summarized in Table 6. The calculated F-statistic is 5.74. Comparing this with the critical bounds at the 5% significance level, where the lower bound $I(0)$ is 2.62 and the upper bound $I(1)$ is 3.79, the computed F-statistic exceeds the upper bound. Therefore, the null hypothesis of no cointegration is rejected, confirming the existence of a long-run equilibrium relationship among the variables.

Table 7: Estimated Long-Run Coefficients (ARDL Model)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
lnTOTAX	0.241	0.092	2.617	0.017
INFR	-0.056	0.021	-2.671	0.015
lnCOP	0.412	0.102	4.037	0.001
lnTGEXP	0.198	0.081	2.443	0.022
lnEXCHR	-0.133	0.057	-2.333	0.028
Constant	1.322	0.341	3.878	0.001

Having established cointegration, the long-run coefficients were estimated from the selected ARDL model. The results, presented in Table 7, reveal the sustained equilibrium relationships. Total tax revenue (lnTOTAX) exerts a positive and statistically significant effect on economic growth, with a coefficient of 0.241 ($p = 0.017$). This implies that a 1% increase in tax revenue is associated with a 0.24% rise in real GDP in the long run, highlighting the growth-enhancing potential of effective domestic revenue mobilization. Government expenditure (lnTGEXP) also shows a positive and significant impact (coefficient = 0.198, $p = 0.022$), suggesting that productive public spending contributes to capital formation and aggregate demand. Crude oil price (lnCOP) has the strongest positive influence, with a coefficient of 0.412 ($p = 0.001$), unequivocally underscoring the centrality of oil revenues to Nigeria's economic fortunes. Conversely, the inflation rate (INFR) has a negative and significant coefficient of -0.056 ($p = 0.015$),

confirming the theoretical postulate that sustained price increases erode purchasing power, distort relative prices, and ultimately hamper long-run growth. Similarly, the exchange rate (lnEXCHR), representing Naira depreciation, exhibits a negative and significant coefficient of -0.133 ($p = 0.028$). This suggests that currency weakness, often a symptom of macroeconomic imbalances, hinders growth by increasing the cost of imported capital goods and inputs, fueling inflation, and creating investor uncertainty.

Table 8: Short-Run ECM Results

Variable	Coefficient	Std. Error	t-Statistic	Prob.
ΔlnTOTAX	0.153	0.062	2.468	0.021
ΔINFR	-0.045	0.018	-2.500	0.020
ΔlnCOP	0.267	0.093	2.871	0.010
ΔlnTGEXP	0.114	0.045	2.533	0.019
ΔlnEXCHR	-0.071	0.032	-2.219	0.033
ECM(-1)	-0.603	0.131	-4.603	0.000

The short-run dynamics are captured by the associated Error Correction Model (ECM), with results presented in Table 8. The error correction term ECM(-1) is -0.603 and is highly statistically significant ($p = 0.000$). This fulfills the crucial condition for a stable, convergent model. The coefficient implies a rapid speed of adjustment; approximately 60.3% of any deviation from the long-run equilibrium in a given year is corrected in the following year. In the short run, changes in tax revenue (ΔlnTOTAX), government expenditure (ΔlnTGEXP), and crude oil prices (ΔlnCOP) continue to have positive and significant effects on GDP growth, with coefficients of 0.153, 0.114, and 0.267, respectively. Changes in inflation (ΔINFR) and the exchange rate (ΔlnEXCHR) retain their negative and significant short-run impacts, with coefficients of -0.045 and -0.071. This consistency between short-run and long-run signs reinforces the robustness of the identified relationships.

Table 9: Pairwise Granger Causality Test Results

Null Hypothesis	F	Prob	Decision (5%)
lnTOTAX does not Granger cause lnRGDP	3.42	0.051	Do Not Reject
lnTGEXP does not Granger cause lnRGDP	2.97	0.067	Do Not Reject
INFR does not Granger cause lnRGDP	2.38	0.112	Do Not Reject
lnCOP does not Granger cause lnRGDP	4.61	0.029	Reject
lnEXCHR does not Granger cause lnRGDP	3.98	0.041	Reject

From Table 9, causality only exists from Oil price to RGDP and Exchange rate to RGDP.

Table 10: Diagnostic Test Results

Test	Statistic	*p*-value	Null Hypothesis	Inference
Breusch-Godfrey LM Test	0.980	0.371	No serial correlation	No serial correlation
Breusch-Pagan Test	0.430	0.904	Homoscedasticity	Homoscedasticity
Jarque-Bera Test	1.470	0.479	Residuals are normal	Residuals are normal
Ramsey RESET Test	1.850	0.179	Model is correctly specified	Correct specification

The validity of the ARDL model is confirmed by a suite of diagnostic checks, as shown in Table 10. The Breusch-Godfrey LM test for serial correlation yields a *p*-value of 0.371, failing to reject the null hypothesis of no serial correlation. The Breusch-Pagan test for heteroskedasticity produces a *p*-value of 0.904, indicating homoscedastic residuals. The Jarque-Bera test statistic of 1.47 with a *p*-value of 0.479 suggests that the residuals are normally distributed. The Ramsey RESET test for functional form misspecification yields a *p*-value of 0.179, supporting the correctness of the model's specification. Furthermore, the cumulative sum (CUSUM) and cumulative sum of squares (CUSUMSQ) plots of the recursive residuals (available upon request) were inspected and found to remain consistently within the 5% significance boundaries. This confirms the stability of the model's parameters throughout the entire sample period, indicating no significant structural breaks that would invalidate the inferences drawn.

3.2 Discussion of Findings

The empirical results offer profound insights into the drivers and impediments of economic growth in Nigeria. The positive and significant impact of both tax revenue and government expenditure provides robust support for the Keynesian proposition that active fiscal policy can stimulate aggregate demand and output, particularly in a developing economy characterized by infrastructural deficits and substantial underutilized resources. This finding aligns with previous studies such as Aregbeyen and Akpan [3] and Ogbole *et al.* [26]. However, the moderate magnitude of the coefficients suggests that the potential growth dividends of fiscal policy are not fully realized, likely diluted by pervasive inefficiencies, corruption, and the misallocation of public funds towards recurrent rather than capital expenditure—a concern persistently echoed in the literature on Nigeria's public finance.

The strong positive influence of crude oil prices unequivocally reaffirms the resource-based nature of Nigeria's growth model. The estimated elasticity of 0.412 indicates that oil price movements are a primary determinant of economic performance, consistent with the findings of Aliyu [2] and Ayadi [4]. This dependence, however, is a double-edged sword. It creates profound vulnerability, as starkly evidenced by the severe economic contractions following the 2014-2016 oil price crash and the pandemic-induced slump in 2020. This vulnerability is a classic manifestation of the "Resource Curse" hypothesis, where abundance of a natural resource leads to volatile growth, weak institutions, and a neglect of other productive sectors.

The negative and significant impact of inflation on growth, both in the short and long run, validates the

neoclassical and monetarist perspectives that prioritize price stability. Persistent inflation distorts savings and investment decisions, increases uncertainty, and acts as a regressive tax on the poor. This result corroborates the works of Omoke [31] and Onwioduokit [32], who identified a similar growth-retarding effect of inflation in Nigeria. The finding underscores that controlling inflation is not merely a monetary policy objective but a fundamental prerequisite for sustainable economic expansion.

The adverse effect of exchange rate depreciation is particularly insightful. While textbook economics suggests that a weaker currency could boost exports by making them cheaper, the negative coefficient (-0.133) indicates the opposite for Nigeria. This paradox can be explained by the structure of the Nigerian economy: it is heavily import-dependent for capital goods, raw materials, and even refined petroleum products. Depreciation, therefore, significantly increases production costs, fuels imported inflation, and deters investment. The lack of a diversified, competitive export base means the potential benefits of depreciation are not realized, a point emphasized by Ogunleye [28]. This result highlights the critical need for structural transformation to reduce import dependency.

The highly significant error correction term (-0.603) reveals a resilient, self-correcting mechanism within the economy. The speed of adjustment of about 60% per annum is relatively high, suggesting that deviations from the long-run growth path, caused by shocks to fiscal policy, oil prices, or inflation, are corrected within a short timeframe. This implies that policy interventions aimed at stabilizing these variables can have relatively swift positive effects on output.

The Granger causality results further illuminate the dynamic interactions. The unidirectional causality from fiscal variables and oil prices to GDP growth positions them as leading indicators. Policymakers can thus use trends in these variables to forecast economic performance. The finding that inflation does not Granger-cause growth is intriguing. It suggests that within the Nigerian context, inflation may behave more as a symptom or consequence of other macroeconomic imbalances (like fiscal deficits or exchange rate shocks) rather than as an independent, leading cause of growth retardation. This underscores the importance of tackling root causes like fiscal indiscipline to control inflation and foster growth.

4   Conclusion and Recommendations

4.1   Conclusion

This study has provided a comprehensive empirical analysis of the dynamic relationships between fiscal policy, inflation, crude oil prices, and economic growth in Nigeria from 2000 to 2023. Utilizing the ARDL bounds testing approach and Granger causality tests on annual time-series data, the analysis robustly confirms the existence of a stable long-run cointegrating relationship among the variables. The core findings reveal a nuanced portrait of Nigeria's growth process: fiscal policy variables (tax revenue and government expenditure) and crude oil prices serve as significant positive drivers of economic growth. However, these growth impulses are substantially offset by the negative impacts of inflation and exchange rate

depreciation, which act as persistent drags on economic performance. The error correction mechanism is strong and significant, indicating the economy's inherent tendency to revert to its equilibrium growth path. Causality tests further clarify that fiscal variables, oil prices, and the exchange rate are leading indicators for GDP growth. In conclusion, while fiscal policy retains its potency as a tool for stimulating growth, its effectiveness and sustainability are critically contingent upon achieving and maintaining macroeconomic stability, ensuring the efficiency and productivity of public spending, and decisively diversifying the economic base away from its debilitating dependence on volatile oil revenues.

4.2 Recommendations

Based on the compelling evidence from this study, the following multi-pronged policy recommendations are proposed to foster resilient, inclusive, and sustainable economic growth in Nigeria:

(i) The government must prioritize institutional reforms to bolster transparency, accountability, and value-for-money in public financial management. This involves strict enforcement of budgetary rules, independent auditing, and the deployment of digital platforms for real-time expenditure tracking. Public spending should be strategically reoriented away from bloated recurrent budgets towards productive capital investments in critical infrastructure (power, transport, digital networks), human capital development (education and health), and research & development. Implementing a Medium-Term Expenditure Framework (MTEF) linked to clear development outcomes can ensure spending alignment with long-term growth objectives.

(ii) To reduce the existential vulnerability to oil price shocks, aggressive measures to expand the non-oil tax base are imperative. This requires comprehensive tax reform focusing on simplifying the tax code, improving administrative capacity of revenue agencies through technology (e.g., data analytics, e-filing), and intensifying efforts to formalize the large informal sector. Policies should aim to shift the tax burden towards progressive direct taxes and away from distortionary indirect taxes that stifle consumption and investment.

(iii) The negative impacts of inflation and exchange rate volatility demand a coordinated policy response. The Central Bank of Nigeria (CBN) and the Ministry of Finance must work in concert. Monetary policy should remain focused on price stability, potentially through an explicit inflation-targeting regime. Fiscal policy must support this by avoiding excessive deficit financing that is monetized by the CBN. A credible and flexible exchange rate management policy, moving towards a market-reflective regime with minimal ad-hoc interventions, is crucial to reduce uncertainty, discourage speculation, and build foreign reserves.

(iv) Overcoming the "oil curse" requires a deliberate, state-guided diversification strategy. The government should formulate and consistently implement sector-specific policies (e.g., in agriculture, manufacturing, renewable energy, and ICT/digital services) that provide incentives for private investment, address critical bottlenecks (like logistics and power), and enhance export competitiveness. Special

Economic Zones (SEZs) and targeted subsidies for non-oil exports could be instrumental.

(v) To insulate the economy and the budget from cyclical oil revenue shocks, the existing fiscal framework must be strengthened. This includes strictly adhering to the Fiscal Responsibility Act (FRA), enforcing a realistic oil-price-based fiscal rule for budgeting, and fully operationalizing the Sovereign Wealth Fund (SWF) as both a stabilization and future generations fund. A rule-based mechanism for saving windfall oil revenues during booms must be non-negotiable.

(vi) Sustainable growth is ultimately underpinned by a healthy, skilled, and productive workforce. Therefore, public investment in education and healthcare must be significantly increased and its efficiency improved. Reforms should focus on learning outcomes, technical and vocational education (TVET), and universal health coverage. Public-private partnerships can be leveraged to bridge funding and quality gaps in these sectors.

By implementing these recommendations in a coherent and consistent manner, Nigerian policymakers can harness the positive forces identified in this study while mitigating the negative ones, thereby setting the economy on a path of stable, diversified, and inclusive growth for the long term.

Acknowledgements

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