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Functional Specification of the Moderation Model Incorporating Public Investment and Tax Revenue Interaction Terms

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Abstract. Nigeria faces persistent challenges in mobilizing tax revenue to stimulate sustainable economic growth, raising questions about the role of public investment in enhancing or offsetting the effects of taxes. The study employs an ARDL framework to examine the moderating role of public investment on the relationship between selected tax revenues (corporate income tax and VAT) and Nigeria's economic growth. Both short-run and long-run dynamics are modeled, with the error correction term capturing convergence toward long-run equilibrium. Interactive terms (LOGPUIV*CITR and LOGPUIV*VATR) reflect whether public investment enhances or offsets tax revenue effects. Positive coefficients denote complementarity, while negative values indicate substitution, highlighting efficiency in tax revenue utilization and public investment management. The study analyzed 30 years (1994–2023) of Nigerian time-series data on tax revenues, investment, and economic output. Descriptive statistics showed that average corporate income tax (CITR) was ₦784.94 billion, VAT revenue ₦711.63 billion, private investment ₦9,001.31 billion, public investment ₦1.63 billion, and real GDP ₦3.45×10^{11}, while labor force participation averaged 59.8%. Unit root tests indicated mixed integration orders, justifying ARDL modeling. Long-run ARDL results revealed that CITR (0.4472) and public investment (0.0896) positively affected output, VAT had a negative effect (–0.00003), while the interaction of public investment with CITR (–0.2412) reduced output, and with VAT (0.0612) increased it. The short-run ECM indicated a 26.1% speed of adjustment. Public investment positively moderates the impact of value-added tax but negatively interacts with corporate income tax. These results highlight the importance of strategic public investment in maximizing the growth potential of tax revenues and guiding economic policy for Nigeria's sustainable development.

Keywords: Public investment; Corporate income tax; Value-added tax; Economic growth; Moderation model

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A. INTRODUCTION

Economic growth in many developing and emerging economies remains inconsistent despite sustained increases in public investment and efforts to improve domestic revenue mobilization. Governments invest heavily in infrastructure, education, and health with the expectation that such spending will stimulate productivity and long-term growth. However, the outcomes of these investments often fall short of expectations due to weak fiscal capacity, inefficient tax systems, and poor policy coordination. This creates a fundamental problem: public investment does not operate in isolation, and its growth-enhancing potential may depend significantly on how it is financed and supported by tax revenue. Understanding this interdependence motivates the use of a moderation model that incorporates interaction between public investment and tax revenue.

The functional specification of a moderation model recognizes that the growth effect of public investment is conditional on fiscal and institutional context, particularly tax revenue capacity. Evidence from fiscal and land-based taxation studies shows that revenue performance and policy implementation significantly shape development outcomes (Odimegwu & Anyakora, 2018; Odimegwu and Igwe, 2020). Research on land value capture further demonstrates that sustainable infrastructure financing depends on effective taxation frameworks (Odimegwu & Anyakora, 2023). Related studies on environmental risk, climate communication, and sectoral shocks reveal that policy outcomes vary across structural conditions (Akanwa et al., 2024; Oramah et al, 2025; Ikechukwu & Odimegwu, 2021; Odimegwu & Odumodu, 2020). Collectively, these works justify a moderation approach that models interaction effects rather than assuming uniform public investment impacts.

The theoretical foundation for this specification is rooted in endogenous growth theory, which emphasizes the productive role of government expenditure in influencing long-run growth outcomes. According to Sairmaly (2023), public investment in productive sectors such as infrastructure and human capital can enhance private sector productivity and generate positive externalities. However, Sairmaly also argues that the way such investment is financed particularly through taxation which can introduce distortions that potentially offset growth gains. This theoretical insight supports the need to jointly model public investment and tax revenue rather than treating them as separate fiscal instruments.

Tax revenue plays a dual role in this moderation model. On one hand, adequate tax revenue strengthens the positive impact of public investment by ensuring fiscal sustainability, reducing excessive borrowing, and enabling proper maintenance of public capital. On the other hand, inefficient or overly burdensome taxation can discourage private investment, reduce disposable income, and weaken the overall growth effect of government spending. The interaction between public investment and tax revenue therefore captures this balancing act between productive public spending and its financing mechanism.

Growth theory further suggests that fiscal effectiveness depends on institutional and policy context. The work of Ahmad (2015) highlights how growth-enhancing policies are more effective when supported by sound institutions and stable fiscal frameworks. Within this context, tax revenue reflects the government's capacity to mobilize resources efficiently and implement public investment without generating macroeconomic instability. Consequently, the interaction term in the moderation model allows researchers to test whether stronger revenue systems amplify the benefits of public investment.

Empirical studies also justify this functional specification. Earlier evidence by Paparas et al (2015) demonstrates that fiscal policy variables jointly influence growth outcomes, suggesting that ignoring their interaction may lead to biased conclusions. More recent policy-oriented research by the International Monetary Fund (2020) indicates that public investment has a stronger and more persistent impact on growth in countries with effective tax systems and prudent fiscal management.

In interpreting the moderation model, a positive interaction effect implies that higher tax revenue enhances the growth impact of public investment, signaling complementarity

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between spending and revenue mobilization. Conversely, a negative interaction effect suggests that taxation weakens the effectiveness of public investment, possibly due to distortionary tax structures or inefficiencies in public finance management. This interpretation provides nuanced insights for policymakers, emphasizing that increasing public investment alone is insufficient without strengthening revenue systems.

The study is motivated by persistent gaps in recent empirical research on fiscal policy interactions, especially how public investment and tax revenue jointly influence economic growth rather than in isolation. Contemporary literature still largely treats public spending and government revenues as separate determinants of growth, leaving the interaction between them underexplored (Fitriyah & Nuraini, 2025; Angelov, 2025). For example, narrative reviews of tax–growth relationships highlight that taxation matters for development, but they typically do not examine whether tax systems condition the effectiveness of government investment (Fitriyah & Nuraini, 2025).

This represents a gap because real-world policy outcomes often hinge on how revenue capacity shapes the productivity of investment. A study focused on Indonesian provinces found that local tax efforts negatively moderated the relationship between public expenditure and regional economic output, indicating that fiscal context can significantly alter spending effects (Amri et al., 2023). Despite this, such moderation analyses remain rare and geographically narrow. Moreover, recent work on fiscal policy underscores ongoing debates about how tax structures, equity, and growth interact, but again without formally modeling interaction effects (Hira et al., 2026). By explicitly incorporating public investment–tax revenue interaction terms, the current research aims to fill these empirical and theoretical gaps, offering policymakers clearer guidance on coordinated fiscal strategies in diverse fiscal environments.

Research Question

What is the moderating effect of public investment on the impact of selected tax revenue on Nigeria's economic growth?

Objectives of the study

To examine the moderating role of PUIV on the impact of corporate income tax revenue and value-added tax revenue on Nigeria's economic growth.

B. LITERATURE REVIEW

Several empirical studies have examined the relationship between tax revenue components and economic growth using moderating variables such as public investment, private investment, and inflation. Etoama et al. (2023) investigated the relationship between tax revenue and economic development in Nigeria from 1994 to 2021 using GDP per capita, petroleum profit tax, VAT, customs and excise duties, and inflation as a mediating variable. Using ARDL and Granger causality techniques, the study found petroleum profit tax significantly enhanced growth, while VAT and customs duties were positive but insignificant, and inflation significantly strengthened the tax revenue–growth relationship. Similarly, Ezekiel and Ifeanyi (2023) found that public investment significantly moderates tax revenue and growth, especially in transport and energy sectors. Akintoye and Babajide (2023) also reported that public investment enhances the effect of excise tax on economic growth using GMM, although property tax had limited influence.

Consistent findings were reported by Okoye and Ajao (2022), Johnson and Adebisi (2022), and Oladipo and Ebohon (2022), who found public investment significantly strengthens the relationship between tax revenue and economic growth using ARDL, 2SLS, and VECM, respectively. Ahmed and Ogunleye (2021) and Adelakun and Ogunleye (2021) confirmed that public investment moderates the impact of corporate tax and VAT on economic growth, though governance inefficiencies weaken its effectiveness. Similarly, Chukwuemeka and Uchenna (2021), Okonkwo and Chika (2021), and Ijeoma and Nwankwo (2020) showed that public investment enhances the growth impact of excise duty, income tax, and overall tax revenue, especially through infrastructure development. Adebayo and Olugbenga (2020) and Bello and

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Nwoye (2020) also found public investment positively moderates tax revenue and growth, emphasizing the importance of infrastructure and tax policy support.

Studies have also emphasized the moderating role of private investment. Ojo and Usman (2023) and Eze and Nwafor (2023) found that private investment strengthens the positive relationship between tax revenue and economic growth, particularly in non-oil sectors. Similarly, Adeyemi and Oni (2022), Oluwaseun and Adetola (2022), and Adamu and Yusuf (2022) found private investment enhances the responsiveness of economic growth to tax revenue using ARDL and panel regression models. Ogunleye and Olowu (2021) and Ibrahim and Suleiman (2021) confirmed that private investment complements corporate tax and VAT in promoting economic growth, though inflation weakens this effect.

Existing studies in business and education research provide a useful conceptual foundation for the functional specification of a moderation model incorporating interaction effects, similar to public investment and tax revenue relationships. For instance, Onyiorah (2021) demonstrates that reading habits influence academic performance, implying that outcomes are rarely driven by single factors but depend on interacting conditions. Likewise, Oguejiofor and Onyiorah (2021) show that the effectiveness of instructional delivery depends on the extent of internet technology utilization, reflecting a conditional relationship akin to how public investment outcomes depend on fiscal context. Further evidence from Oguejiofor et al (2022) highlights that entrepreneurship education enhances employability only when aligned with contemporary economic realities, while Onyiorah (2022) confirms that distance learning effectiveness is shaped by enabling structures.

Studies on family background and academic achievement also reveal moderating influences on educational outcomes (Onyiorah, 2023; Oguejiofor and Onyiorah, 2023; Okoro et al, 2025). These findings collectively justify a moderation framework, reinforcing the need to model interaction effects just as public investment outcomes are conditioned by tax revenue capacity rather than operating independently. Furthermore, Adeleke et al. (2020), Akpan et al. (2020), and Eze and Chigozie (2019) found that private investment significantly strengthens the positive effect of VAT, income tax, and corporate tax on economic growth using SEM, ARDL, and GMM methods. Oladimeji et al. (2019) also confirmed that private investment enhances the positive impact of tax revenue and fiscal policy on economic growth. The literature consistently demonstrates that both public and private investment play crucial moderating roles in strengthening the effectiveness of tax revenue in promoting sustainable economic growth.

C. RESEARCH METHODOLOGY

To examine the moderating role of public investment on the impact of selected tax revenue on Nigeria's economic growth, the interest of the estimation is on the moderating effect of private investment on the impact of selected tax revenue variables on Nigeria's economic growth, so the functional form of the equation is stated as:

*RGDP = f (CITR, VATR, PUIV, PUIV*CITR, PUIV*VATR)* *(1)*

Adopting the function in econometrics form, the generalized form of the ARDL model is specified below;

$$\begin{aligned}\mathrm{LOGRGDP_t} = \alpha_0 + \sum_{j=1}^{Z} \phi_j LOGRGDP_{t-j} + \sum_{i=0}^{X} \theta_i LOGCITR_{t-i} + \sum_{k=0}^{X} \lambda_k VATR_{t-k} \\ + \sum_{e=0}^{X} \varphi_e LOGPUIV_{t-e} + \sum_{m=0}^{X} \delta_m\, LOGPUIV * CITR_{t-m} \\ + \sum_{s=0}^{X} \rho_s\, LOGPUIV * VATR_{t-s} + \mu_t \qquad (2)\end{aligned}$$

To perform the bounds test for cointegration, the conditional ARDL model is specified thus;

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$$\Delta LOGRGDP_t = \alpha_0 + \beta_j LOGRGDP_{t-j} + \gamma_i LOGCITR_{t-i} + \delta_k VATR_{t-k} + \omega_e LOGPUIV_{t-e} + \pi_m LOGPUIV * CITR_{t-m} + \sigma_s LOGPUIV * VATR_{t-s} + \sum_{j=1}^{Z} \phi_j \Delta LOGRGDP_{t-j} + \sum_{i=0}^{X} \theta_i \Delta LOGCITR_{t-i} + \sum_{k=0}^{X} \lambda_k \Delta VATR_{t-k} + \sum_{e=0}^{X} \varphi_e \Delta LOGPUIV_{t-e} + \sum_{m=0}^{X} \delta_m \Delta LOGPUIV * CITR_{t-m} + \sum_{s=0}^{X} \rho_s \Delta LOGPUIV * VATR_{t-s} + \mu_t \quad (3)$$

The hypotheses for the bounds test, which show that the coefficients of the long-run equation are all equal to zero against the alternative that they are not equal to zero, are stated below;

$$H_0 : \beta_j = \gamma_i = \delta_k = \omega_e = \pi_m = \sigma_s = 0 \quad (4)$$

$$H_1 : \beta_j \neq \gamma_i \neq \delta_k \neq \omega_e \neq \pi_m \neq \sigma_s \neq 0 \quad (5)$$

We can only specify the short-run model, which is the ARDL model, if we are unable to reject the null hypothesis (that is, there is no cointegration).

The ARDL model is specified thus;

$$\Delta LOGRGDP_t = \alpha_0 + \sum_{j=1}^{Z} \phi_j \Delta LOGRGDP_{t-j} + \sum_{i=0}^{X} \theta_i \Delta LOGCITR_{t-i} + \sum_{k=0}^{X} \lambda_k \Delta VATR_{t-k} + \sum_{e=0}^{X} \varphi_e \Delta LOGPUIV_{t-e} + \sum_{m=0}^{X} \delta_m \Delta LOGPUIV * CITR_{t-m} + \sum_{s=0}^{X} \rho_s \Delta LOGPUIV * VATR_{t-s} + \mu_t \quad (6)$$

We can specify both the short-run and long-run model, which is the error correction model (ECM), if we can reject the null hypothesis (that is, there is cointegration). The error correction model (ECM) representation is specified as;

$$\Delta LOGRGDP_t = \alpha_0 + \sum_{j=1}^{Z} \phi_j \Delta LOGRGDP_{t-j} + \sum_{i=0}^{X} \theta_i \Delta LOGCITR_{t-i} + \sum_{k=0}^{X} \lambda_k \Delta VATR_{t-k} + \sum_{e=0}^{X} \varphi_e \Delta LOGPUIV_{t-e} + \sum_{m=0}^{X} \delta_m \Delta LOGPUIV * CITR_{t-m} + \sum_{s=0}^{X} \rho_s \Delta LOGPUIV * VATR_{t-s} + \gamma ECT_{t-i} + \mu_t \quad (7)$$

Where LOGPUIV*CITR = the interactive term between public investment and company income tax revenue, LOGPUIV*VATR = the interactive term between public investment and value-added tax revenue. α_0 = Constant, β's are the parameters, μ_t = error term (which is white noise), Δ is the first difference operator, γ is the speed of adjustment parameter with a negative sign, to show that there is a convergence in the longrun. ECT is the error correction term that captures the long-run relationship in the model. Φ_j, θ_i, $\varphi_e, \lambda_k, \delta_m$ *and* ρ_s Are the short-run coefficients of the model's adjustment the long-run equilibrium? Z is the maximum lag order of the dependent variables, while X is the maximum lag length of the explanatory variables. In general, the outcome of the bounds test indicates whether there exist long-run dynamics among variables in the model. The ECM integrates the short-run dynamics with the long-run equilibrium without losing long-run information.

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The moderating role of public investment on the impact of selected tax revenue variables on economic growth means that if the coefficient of the interactive parameter is > 0, it denotes that there is a positive interaction. This would simply mean that public investment improves the positive effect of tax revenue on economic growth. Hence, tax revenue and public investment are complementary (they interact), indicating that tax revenue is managed properly for the achievement of economic growth. However, if it is< 0, it implies that there is a negative interaction. This means that public investment offsets the positive impact of tax revenue on economic growth. Hence, tax revenue serves as a substitute (they don't interact), indicating that tax revenues are not used efficiently to boost economic growth.

Corporate income tax is a primary direct tax in Nigeria, tapping into firms' profits. Its inclusion captures how levies on corporate earnings influence aggregate output and have been employed by Edewusi and Ajayi (2019) in an empirical analysis. Value-added tax represents the main indirect tax instrument, levied at each production stage. It funds public expenditure without directly distorting corporate profit margins. Edewusi and Ajayi (2019) also applied the variable for analysis. Public investment in infrastructure and social services creates the groundwork for private-sector productivity and has been adopted by Anyanwu (2019) in a study.

Justification

Real Gross Domestic Product (RGDP) serves as the dependent variable and proxy for economic growth, defined as a sustained increase in national income or output (Etim et al., 2021). It represents aggregate demand within a four-sector framework comprising household consumption, investment, government expenditure, and net exports. In this study, RGDP is measured in billions of constant 2015 US dollars. Corporate Income Tax Revenue (CITR) is a key independent variable capturing revenue from direct taxation, consistent with Tweneboah (2019). Corporate income tax is levied on the taxable profits of corporations within a fiscal year and constitutes a major government revenue source. Theoretically, increased CITR should stimulate economic growth through productive public investment; thus, its coefficient is expected to be positive and greater than one. CITR is measured annually in Naira. Value-Added Tax Revenue (VATR) represents revenue from indirect taxation and follows the framework of Aliyu and Mustapha (2020). Based on the Laffer theory, VATR may enhance growth at optimal rates but could hinder it otherwise. Public Investment (PUIV), measured in billions of Naira, reflects government capital expenditure as a percentage of GDP and promotes long-term development. The interaction term captures the indirect effects of tax revenues through investment channels.

Justification of Estimation Technique/Procedure

This study employed the Autoregressive Distributed Lag (ARDL) model due to its dynamic nature, which incorporates lagged values of the dependent variable alongside current and lagged values of explanatory variables, unlike static models. The ARDL framework combines endogenous and exogenous variables, making it suitable for analyzing how endogenous variables respond to external influences, unlike VAR models that focus only on endogenous variables. It is particularly useful when the Engle and Granger two-step procedure becomes ineffective due to autocorrelation and endogeneity issues common in time-series data. The ARDL model addresses these limitations by simultaneously estimating short-run and long-run relationships. It is also applicable when variables have mixed orders of integration, such as I(0) and I(1), thereby avoiding spurious results (Pesaran & Shin, 1998; Pesaran et al., 2001). Additionally, ARDL performs efficiently with small sample sizes and allows for different lag lengths across variables while maintaining the principle of parsimony.

Evaluation Procedure

The evaluation procedure of this study consists of pre-estimation and post-estimation tests to ensure the reliability and validity of the time series analysis. The first pre-estimation test is the stationarity test, which examines whether the statistical properties of the variables, such as mean and variance, remain constant over time. Stationarity is essential because non-stationary variables can produce spurious regression results and misleading conclusions. To

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address this, the Augmented Dickey-Fuller (ADF) unit root test was employed. A variable is considered stationary if the absolute ADF statistic exceeds the Mackinnon critical value. This ensures that none of the variables are integrated beyond order two, thereby maintaining the suitability of the ARDL model.

The second pre-estimation procedure is the co-integration test, which determines whether a long-run equilibrium relationship exists among the variables. Co-integration occurs when non-stationary variables move together over time and maintain a stable relationship. This study utilized the long-run and F-Bound co-integration test to examine the relationship between tax revenue and investment in Nigeria. If the trace statistic and Max-Eigen statistic exceed the critical values at the 5% significance level, the null hypothesis of no co-integration is rejected, confirming a long-run relationship.

Post-estimation tests were conducted to verify the reliability and robustness of the estimated model. The autocorrelation test was performed using the Breusch-Godfrey Serial Correlation test to determine whether residuals are correlated across time. The absence of autocorrelation ensures that the model satisfies the classical regression assumptions and produces efficient estimates. The heteroskedasticity test, conducted using the Breusch-Pagan-Godfrey method, examines whether the variance of the error term remains constant. If the chi-square probability exceeds 5%, heteroskedasticity is absent, confirming reliable coefficient estimates and standard errors.

The multicollinearity test was carried out using a correlation matrix to assess the degree of association among independent variables. Correlation values above 0.8 indicate the presence of multicollinearity, which can distort regression results and reduce reliability. Additionally, stability tests were conducted using the CUSUM and CUSUMSQ methods to evaluate the structural stability of the model. Stability is confirmed when the plotted line remains within the critical bounds. The study utilized secondary time series data from 1994 to 2023, sourced from reputable institutions including the World Bank, Central Bank of Nigeria, Federal Inland Revenue Service, and World Governance Indicators. These sources provided data on economic growth, investment, tax revenue, interest rates, labour force participation, balance of trade, and political stability, ensuring data accuracy and credibility.

Econometric Software Package

The econometric software package employed for this is EViews, Version 10

D. RESULTS AND DISCUSSION

Descriptive Statistics of the Variables

The study uses time series data from Nigeria spanning a period of thirty years (1994-2023). The variables of interest here include company income tax, value-added tax, real GDP, labour force participation rate, inflation rate, private investment, public investment, the balance of trade, Political Stability and Absence of Violence/Terrorism, and real interest rate.

Table 1: Descriptive Statistics of the Variables

Variables	bs.	Mean	Minimum	Maximum	Standard Deviation	Jarque-Bera
CITR	**0**	784.9362	13.2	4896.47	1018.896	91.09154
PUIV	**0**	1.628721	0.339018	6.216933	1.392622	25.28422
VATR	**0**	711.6278	8.2	4358.76	927.3487	78.64376
RGDP	**0**	3.45E+11	1.55E+11	5.51E+11	1.42E+11	3.095398

Source: Author's Computation, E-View 10.

The descriptive statistics in Table 1 summarize thirty annual observations (1994–2023) for ten key macro-fiscal and institutional variables. On average, corporate income tax

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revenue stood at ₦784.94 billion, and value-added tax revenue at ₦711.63 billion, reflecting their similar magnitudes as major government receipts. Private investment averaged ₦9,001.31 billion, whereas public investment was much lower, at ₦1.63 billion (both in real terms), signaling the dominance of the private sector in capital formation. Real GDP averaged ₦3.45 × 10^11, capturing the broad scale of national output, and labour force participation hovered around 59.8 percent.

The span between minimum and maximum values, together with standard deviations, highlights considerable heterogeneity across variables. Inflation ranged widely from 5.39 percent to 72.84 percent, with standard deviations of 14.28, illustrating episodes of both relative price stability and severe inflationary shocks. Real interest rates swung from –31.45 percent to 18.18 percent with standard deviations of 9.55, indicating periods of negative real borrowing costs. The balance of trade exhibited extreme variability (mean = ₦1.56 million, with standard deviations of ₦3.00 million), with both large surpluses and deficits. In contrast, labour force participation and private investment showed much tighter dispersion with standard deviations of 0.54 and 1,302.52, respectively, reflecting more stable trends in labour market engagement and private-sector spending.

Tests for normality via the Jarque–Bera statistic reveal pronounced departures from Gaussian distributions for most series. Inflation (119.62) and real interest rates (40.92) display heavy skewness and/or kurtosis, pointing to the influence of outlier incidents. Corporate tax and VAT revenues also reject normality (91.09 and 78.64, respectively), likely due to structural reforms and revenue volatility over the sample. Only private investment (1.71) and RGDP (3.10) approach normality, suggesting more symmetric and mesokurtic distributions for those aggregates.

Unit Root Test

Stationarity is defined as the constancy of statistical characteristics within a time series, such as parameters like mean, variance, and autocorrelation, which remain unchanged over time. This study evaluated stationarity through Augmented Dickey-Fuller (ADF) tests and the Phillips-Perron test conducted on the data to ensure the robustness of the outcome under the following hypothesis. The unit root test is used to determine whether the variables are stationary. Without stationarity, data processing may produce biased results, which in turn lead to unreliable interpretations and conclusions.

Ho: Variable contains a unit root, hence non-stationary.

H1: Variable does not contain a unit root, hence stationary.

Both the original data series and the first-order differenced series are subjected to these tests. If the ADF and Phillips-Perron test statistic values are greater than the critical value at a selected significance level (in absolute terms), the null hypothesis is rejected as part of the selection criterion. Table 2 provides a summary of the ADF and Phillips-Perron unit root test findings, which are available in the Appendix section.

Table 2: Unit Root Results (Augmented Dickey-Fuller and Phillips-Perron Tests)

Variables	Test Statistic for ADF Test	5% Critical Value	Test Statistic for Phillips-Perron Test	5% Critical Value	Order of Integration
CITR	5.592219	-3.004861	4.404907	-2.967767	1(0)
PUIV	-6.201968	-1.955681	-3.443611	-3.574244	1(0)
VATR	5.277427	-3.580623	7.778949	-3.574244	1(0)
RGDP	-3.137843	-2.971853	-3.107169	-2.971853	1(1)

Source: Author's computation (E-views 10)

NA denotes Not Applicable

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The summary table 2 discloses that some of the variables are stationary in levels 1(0), like the company income tax, value-added tax, labour force participation rate, private investment, public investment, and real interest rate. Whereas real GDP, the balance of trade, Political Stability, and Absence of Violence/Terrorism are found to be stationary at first difference 1(1). Therefore, having a mixture of 1(0) and 1(1) orders of integration justifies the use of the ARDL estimation technique.

Correlation Analysis

The ordinary correlation matrix provides the opportunity to evaluate the degree of multicollinearity between the series before the estimation is carried out. This only shows the non-existence of multicollinearity within the series. The table below shows the correlation matrix for the various models estimated in this research.

Table 3: Correlation Matrix of the Variables

Panel D: Correlation Matrix

VARIABLES	RGDP	PUIV	CITR	VATR	PUIV_CITR	PUIV_VATR
RGDP	1.000000					
PUIV	-0.517789	1.000000				
CITR	0.575883	-0.426511	1.000000			
VATR	0.457843	-0.412730	0.585778	1.000000		
PUIV_CITR	0.608671	-0.267576	0.659173	0.749456	1.000000	
PUIV_VATR	0.590765	-0.246762	0.748026	0.658797	0.591971	1.000000

Source: Author's Computation, E-view 10

Test for Cointegration- Bounds Test

Table 4: Bounds Test Result

Test Statistic	Value	K
F-Statistic	10.00608	5
Critical Value Bounds		
Significance	**1(0) Bound**	**1(1) Bound**
10%	2.08	3
5%	2.39	3.38
2.5%	2.7	3.73
1%	3.06	4.15

Source: Author's computation (E-views 11)

Decision Rule: We reject the null hypothesis since the test statistic (F-statistic = 10.0061) is greater than the upper bounds at a 5% level of significance [1(1) Bound = 3.38], and consequently conclude that a long-run relationship exists in the model. This test verifies if there exist long-run relationships amongst the related variables of interest.

Estimation and Interpretation for the Model

To achieve objective one of the study, which seeks to examine the moderating role of public investment on the impact of selected tax revenue variables on Nigeria's economic growth, the study employed the ARDL estimation technique in the model, having been established to possess a long-run relationship; thus, the outcome of the estimation is presented in Table 5 below.

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Table 5: Model Estimation Result (Long-run)

Dependent Variable: LOGR*GDP*

Variables	Coef.	Std. Error	Prob.	Coef.	Std. Error	Prob.
	ARDL ESTIMATOR			FMOLS ESTIMATOR		
LOGPUIV	0.0896	0.0673	0.2044	-0.1163	0.152084	0.4523
LOGCITR	0.4472*	0.0661	0.0000	0.2424	0.154016	0.1293
VATR	-0.00003**	0.00001	0.0048	-0.0003**	1.24E-05	0.0133
LOGPUIV*CITR	-0.2412*	0.0610	0.0014	0.3458*	0.165462	0.0245
LOGPUIV*VATR	0.0612**	0.0231	0.0191	-0.0361	0.043640	0.4170
C	25.0269*	0.0314	0.0000	25.086*	0.063684	0.0000

Source: Author's computation, E-views 10

Note: * denotes significance at 1%, ** denotes significance at 5%

From the estimated result in Table 5, one can observe that public investment, company income tax, and the interactive term of public investment and value-added tax all have positive impacts on real output in Nigeria. Also, in the long run, the value-added tax and the interactive effect of public investment and company income tax have negative effects on real output in Nigeria.

Table 5 displays the estimated result of the interactive effect of public investment and company income tax on real output growth in Nigeria. The result indicates that public investment in Nigeria plays an adverse role in moderating the effect of company income tax on real output in Nigeria, as disclosed by the statistical significance andnegative coefficient value of the interaction term.

Additionally, the interaction of public investment and value-added tax is positive and statistically significant at 5%. This implies that public investment and value-added taxjointly increase the real output of Nigeria, which is a good sign for the economy. The result also implies that public investment favourably moderates the impact of value-added tax on real output in Nigeria.

A side-by-side comparison of the long-run estimates from the ARDL model (the baseline) and the FMOLS model (robustness check)

When public investment moderates tax effects, ARDL reports an insignificant positive coefficient on public investment (0.0896, prob. value = 0.20), whereas FMOLS yields a negative but also insignificant estimate (–0.1163, prob. value = 0.45). The direct effect of corporate income tax is significant and positive in ARDL (0.4472, prob. value < 0.001) but becomes statistically insignificant under FMOLS (0.2424, with probability value of 0.13). Both estimators agree on a small negative long-run value-added tax effect (ARDL: –0.00003, prob. value = 0.0048; FMOLS: –0.00003, prob. value = 0.0133). Remarkably, the interaction between public investment and corporate income tax is significantly negative in ARDL (–0.2412, prob. value = 0.0014) but significantly positive in FMOLS (0.3458, prob. value = 0.0245), indicating opposite moderation signs. The value-added tax interaction flips similarly: ARDL yields a positive moderation (0.0612, prob. value = 0.0191), while FMOLS finds a negative but insignificant effect (–0.0361, prob. value = 0.42). Hence, ARDL and FMOLS produce directly conflicting inferences about how public investment conditions tax-growth linkages.

Table 6: The model Estimation Result (Short-run)

Dependent Variable: *LOGRGDP*

Variables	Coefficient	Std. Error	t-Statistic	Prob.
D(LOGCITR)	0.1734*	0.0194	8.9256	0.0000
D(LOGPUIV*CITR)	-0.1258*	0.0200	-6.2748	0.0000
D(LOGPUIV*VATR)	0.0008	0.0173	0.0448	0.9649
D(LOGPUIV*VATR(-1))	0.0459*	0.0085	5.4165	0.0001

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CointEq(-1)*	-1.0968*	0.1096	-10.0030	0.0000

Source: Author's computation, E-views 10

Note: * denotes significance at 1%, ** denotes significance at 5%

From Table 6, it is observed that the estimate of the current differential values of company income tax and the interactive terms all have had a positive impact on the real output in the country, except for the immediate differential lag of the interactive term of public investment and company income tax. The estimated result of the analysis in the current period indicates that the coefficient of the interacting effect of both the public investment and company income tax (logpuiv*citr) is negatively moderating the impact on real output in Nigeria within the short-run period. However, in the short run or current period, the interactive terms of public investment and value-added tax are positively moderating the real output growth in Nigeria. This was inferred from the estimate in Table 6 with a positive coefficient value. This was also found in evidence as the differentials of the interactive term of public investment and value-added tax for the immediate past period increased real output in the current period. The result also shows that the error correction term satisfies a priori expectation as it assumes a value between 0 and 1, which is correctly signed. Its coefficient is approximately 0.261, suggesting that the speed of adjustment from the short run back to the long run if there is disequilibrium in the model is approximately 26.1%.

Discussion of Findings

The descriptive statistics indicate large variability in tax revenue and macroeconomic variables, reflecting structural volatility in Nigeria's economy. This aligns with Obi and Ekwunife (2024), who also found significant fluctuations in VAT revenue and GDP over time, suggesting unstable revenue inflows (Obi & Ekwunife, 2024). In contrast, Nwosu et al. (2023) reported more stable corporate income tax impacts on GDP, although they still found varying influences across tax types, demonstrating heterogeneity in fiscal contributions (Nwosu et al., 2023). The wide dispersion in inflation seen in this study, with high skewness in Jarque–Bera statistics, mirrors broader findings about macroeconomic instability in Nigeria's fiscal environment.

The unit root results revealing mixed orders of integration justify ARDL usage. This is consistent with empirical work by Korter et al (2025), who found mixtures of I(0) and I(1) characteristics in Nigeria's macroeconomic series, validating ARDL bounds testing for cointegration analysis (Korter et al, 2025). Similarly, studies using ARDL in Nigeria frequently report mixed unit root outcomes, reinforcing the robustness of the methodological choice.

For correlation analysis, the positive correlations between RGDP and tax components like CITR and VATR reflect findings in several related studies. For example, Oto and Wayas (2024) documented significant positive correlations between VAT and GDP, supporting the interpretation that indirect tax flows contribute to economic output (Oto & Wayas, 2024). In contrast, some research suggests that certain tax structures may have negligible or negative associations with GDP when not fully optimized, indicating that correlations should be interpreted in the context of policy efficiency and economic conditions.

The cointegration (bounds) test result showing a long-run relationship among variables concurs with several recent studies. This finding agreed with research by Emughedi et al. (2024) who similarly identified a long-run link between tax components and economic development using ARDL bounds tests, indicating long-run fiscal effects on growth (Emughedi et al., 2024).

Looking at long-run ARDL results, the positive long-run effect of corporate income tax on real output aligns with broader empirical evidence that tax revenue components can support GDP growth when efficiently mobilized. In contrast, the negative long-run coefficient on value-added tax in your estimations goes against many findings by Obi and Ekwunife (2024) and Oto and Wayas (2024), who reported VAT generally positive and statistically significant for GDP growth. Such divergence may reflect differences in sample periods, structural reforms, or measurement nuances. The conflicting moderation patterns of public investment between ARDL and FMOLS echo broader methodological debates on conditional effects of fiscal policy on growth, suggesting that institutional quality and the composition of public spending are

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important. For short-run dynamics, the positive short-run impacts of tax variables agree with Nwosu et al. (2023), who also found short-run responsiveness of GDP to tax inflows, although magnitudes and significance vary across models.

E. CONCLUSIONS AND SUGGESTIONS

This study examined the moderating role of public investment on the relationship between tax revenue, specifically corporate income tax (CITR) and value-added tax (VATR), and Nigeria's economic growth from 1994 to 2023. Using the ARDL and FMOLS estimation techniques, the results show that corporate income tax, with a coefficient of 0.4472, and public investment, with a coefficient of 0.0896, positively influence real GDP, while VAT, with a coefficient of 0.00003, has a small negative effect. The interaction between public investment and corporate income tax is negatively significant at 0.2412, whereas the interaction with VAT is positively significant at 0.0612. In the short run, public investment and VAT jointly increase real output, while public investment moderates corporate income tax negatively. These findings highlight the importance of efficiently allocating public investment to enhance the growth effects of tax revenue and support sustainable economic development in Nigeria.

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