

Exploring The Debt Laffer Curve: Evidence From Nigeria's Public Debt And Sustainable Economic Growth Nexus (1970- 2022)

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Abstract

This study explores the debt Laffer curve hypothesis in the relationship between public debt and sustainable economic growth over the study period 1970 to 2022 in Nigeria. The estimation methods employed are quadratic autoregressive distributed lag (ARDL) and structural quadratic autoregressive distributed lag. The ARDL results revealed that debt Laffer curve hypothesis prevailed in the nexus between total, internal and external between public debt and sustainable economic growth in the long run respectively, whereas the structural ARDL results showed that debt Laffer curve prevailed in the nexus between external public debt and long run sustainable economic growth during 1999-2022 only in Nigeria. Going forward, Government should discourage public debt on short-run but cautiously seek public debt in the long run. Furthermore, Government should consolidate on massive human capital development and capital formation investment as well as effective utilization of petroleum earnings to achieve a sustainable economic growth at short-run and long run in Nigeria.

Keywords: Public debt, Sustainable economic growth, Debt Laffer curve, ARDL, and Structural ARDL.

JEL Classification: C32; H63; H68; O47

1. INTRODUCTION

The pursuits of fourth industrial revolution, sustainable development goals (SDGs) 2030 agenda, and the swift recovery from COVID-19 pandemic have continued to soar many government debts. Globally, public debt has increased unabatedly from \$56.29 trillion in 2016 to \$97 trillion in 2023 amounting to 72.3% global public debt growth (Yildirim & Erdogan, 2022; International Monetary Funds (IMF), 2023, United Nations (UN), 2023).

While only 30% of the global public debt is owed by the developing countries, the developed and emerging nations owe the remaining 70% of the global public debt (UN, 2023).

Public debt has been widely accepted in the literature as an inevitable financing alternative in the prevailing mismatch and disequilibrium between government revenue and expenses to drive GDP growth for all nations (Yusuf & Mohd, 2023). For instance, US and China are the highest indebted countries accounting for 32% and 17.7% of global public debt and correspondingly, US and China have the highest contributions to the world GDP based on purchasing power parity (PPP) by 18.44% and 15.54% in 2022 (IMF, 2023; Pettis, 2023). This data-driven evidence justify the positive association between public debt and economic growth.

Unfortunately, the positive association between public debt and economic growth has been widely contested in the diverse public debt theories as well as among some developed and developing countries. Several public debt theories, except Debt Laffer Curve hypothesis, argue that higher public debt impedes country's economic growth and even causes debt overhang and crowding-out effect. For instance, the United Kingdom (UK) debt-to-gdp rose significantly from 28.4% in 2000/01 to 84.9% in 2022/23, causing debt overhang and crowding-out effects. This has undoubtedly confirms an inverse associations between public debt and economic growth.

The Debt Laffer Curve Hypothesis which is a non-linear public debt theory contends with the inconclusive association between public debt and economic growth in the literature. Debt Laffer curve theory assumes that an optimal debt-growth nexus drives sustainable economic growth while maximizing a lower tax rate with a minimum debt level (Arcabic, Tica, Lee, & Sonora, 2018). Debt Laffer Curve Hypothesis argues that public debt is conditional to the state of the economy, and not inevitable by earlier public debt theories.

There is no doubt that the state of developing economies economy, especially Africa, is incomparable with the developed economies economy in terms of the fourth industrial revolution investments size, SDGs 2030 achievements, COVID-19 shocks recovery, and macroeconomic indicators performance. Many African countries, including Nigeria, have been characterized with the longstanding bedeviled low domestic savings, deficit budget, poor infrastructure, low per capita income, high unemployment, high inflation, low economic growth, rising insecurity, and other socio-economic issues. For instance, the study of Oluyomi, Obasa and Daisi (2023) found that African countries require an annual \$1.8 trillion public spending to meet the 17 SDGs goals by 2030. In same vein, the report of Organization for Economic Cooperation and Development (OECD) (2024), found that Africa average tax-to-gdp ratio is about 16% of \$2.8 trillion GDP worth, amounting to \$0.45 trillion revenue for all African countries in 2024.

This prevailing mismatch between Africa's public spending and tax-to-gdp ratio as evidenced in Oluyomi et al. (2023) and OECD (2024), justify the need for public debt for African countries. Earlier public debt studies have examined a diverse cause and effects in the literature. Many studies (Kim, Ha, & Kim, 2017; Koffi, 2021; Rutayisire, 2021; Obiero & Topuz, 2023) focus on public debt and economic growth nexus. However, Kim, Ha, & Kim (2017) extends the scope of public debt-growth nexus, while considering the direct and interactive effects among public debt, corruption, and sustainable economic growth in the literature. Yet, there has been a less research that test Debt Laffer Curve Hypothesis in the nexus between public debt and sustainable economic growth in the literature.

This empirically gap to explore debt Laffer curve hypothesis in the nexus between public debt and sustainable economic growth in Nigeria between 1970 and 2023 is filled by answering three research questions as follows: First, what is the effect of external public debt, domestic public debt and total public debt on sustainable economic growth in the short run and long run respectively? Second, does debt Laffer curve hypothesis exists in the relationship between external public debt, domestic public debt and total public debt and sustainable economic growth in the short run and long run respectively? Third, does structural periods matter in the testing of debt Laffer curve relationship between external public debt, domestic public debt and total public debt and sustainable economic growth in the short run and long run respectively in Nigeria?

While the introduction has been explored, the remaining parts of this study are organized as follows: Section 2 reviews the relevant literature; Section 3 describes methodology; Section 4 presents empirical results and discussion; and Section 5 offers conclusion and policy recommendations.

2. LITERATURE REVIEW

2.1 Theoretical Review

In the light of mismatch and disequilibrium between government revenue and expenses, public debt is inevitable to drive growth of gdp in any economy. The public debt and economic growth theoretical review over times have been diverse. The public debt–growth theories are discussed from two strands, the linear debt–growth theories and the nonlinear debt–growth theories.

On one hand, the linear debt–growth theories review the Classical and Neoclassical theories (Adam Smith, Ricardian Equivalence Hypothesis (REH)), the Keynesian theories (Adolf Wagner’s law of increasing state activity and the fiscal multiplier theory of Keynesian), and the Monetary theory (monetary financing). These public–growth theories postulate that public debt is unconditional for all economies in any prevailing circumstances.

The Classical theories did not recognize the importance of public debt to spurs country’s economic growth (Yildirim & Erdogan, 2022). Importantly, Adam Smith postulates that government plays a neutral role and the fiscal policies intervention like public debt is ineffective to restore the long run economic growth. Meanwhile, the so-called Classical theories upholds private debt in form of credit availability to the private sectors to spurs economic growth (Yusuf & Mohd, 2023).

The Ricardian Equivalence Hypothesis (REH), a Neoclassical public debt theory acknowledge the importance of government in any economy but contends that public debt has no direct effects on economic growth but indirectly influences consumption and savings (Yildirim & Erdogan, 2022). Meanwhile, REH assume that higher public debt or public debt accumulation will results to a future higher tax rate imposition to finance debt interest payments, leading to reduction in consumer’s purchasing power, which will ultimately cause a crowding out private investment and also retards present and future economic growth in any economy (Salmon, 2021; Yusuf & Mohd, 2023).

The Keynesian public theories assume higher public debt directly spurs economic growth and thus, strongly departed from the Classical and Neoclassical debt–growth theories that public debt are ineffective, neutral and has no direct impact on economic growth (Yildirim & Erdogan, 2022). These two theories, Adolf Wagner’s law of increasing state activity and fiscal multiplier theory of Keynesian, both advocate for a fiscal deficit–financing approach to directly spur economic growth of an economy. They assume that higher public debt causes increasing country’s infrastructure, purchasing and above all increases aggregate demand which ultimately promotes economic growth (Panizza & Presbitero, 2013). However, Keynesian public debt theories undermine the debt overhang and crowding-out effects when public debt level is not optimal and conditional.

On a contrary to Classical and Keynesian public debt theories, the monetary theory opines the use of money creation/monetary financing to stimulate economic growth through a fixed supply of money to the government only at the expense of private sector (Yusuf & Mohd, 2023). By printing more money to the government, Government purchasing power increases and thus drive economic growth rather than borrowing money. However, this monetary theory has been associated with inflationary pressure and lower country’s gdp rate due to raising interest rate that limits credit availability, crowd–out private investment, increase workers–layoff and ultimately impedes economic growth despite a lower or zero public–debt ratio (Yusuf & Mohd, 2023).

On the other hand, the non–linear debt–growth theories review debt Laffer curve and endogenous growth theories. The debt Laffer curve theory assume that an optimal debt drives sustainable economic growth

while maximizing a lower tax rate and a minimum debt level (Arcabic, Tica, Lee, & Sonora, 2018). The debt Laffer curve theory emphasizes on the state of economy conditions.

Another theory of non-linear debt-growth theory is the endogenous thresholds theories. The endogenous threshold theories drawn from the endogenous growth theories, such as Human Capital Theory, Knowledge Theory, and Innovation Theory, is an extension of debt Laffer curve hypothesis. A country's sustainable economic growth depends on optimal level of human capital, optimal knowledge and optimal innovation respectively that are drawn from optimal debt level.

Having established the importance of debt Laffer curve hypothesis to endogenous thresholds theories, many empirical research have considered a number of endogeneity factors, such fiscal discipline, procyclical fiscal policy, proactive debt management office (DMO), sound financial system, regulations, and quality of democracy (Panizza & Presbitero, 2013; Arcabic, Tica, Lee, & Sonora, 2018; Salmon, 2021; Pettis, 2023). The less research to explore debt Laffer curve hypothesis earmarks the theoretical gap in this study.

2.2 Empirical Review

The empirical review of the nexus between public debt and economic growth has been extensive, while the existing studies on debt Laffer curve has been less researched. The existing studies are review from linear and nonlinear relationship.

Zouhaier and Fatima (2014) employed dynamic panel regression (GMM) to examine the relationship between external debt on economic growth of 19 developing countries from 1990 to 2011. They found that an increase in the debt ratio by 10 percent causes a fall in real GDP growth by 0.28 percent. In their study, Siddique, Selvanathan, and Selvanathan (2016), expand Zouhaier and Fatima (2014) country sample size and scope, to 40 indebted countries and from 1970 to 2007. Their ARDL technique found that debt has a negative and significant impact on GDP in both the short run and long run. Snieska and Burksaitiene (2018) departed from the earlier reviewed studies only methodology only. They used both OLS and autoregressive (AR) model to examine the effects of current, one-lag and two-lags public debt on economic growth of 24 European Union (EU) countries. They concluded that public debt at zero, one and two-year lags has negative influence on economic growth in EU. Similarly, Abubakar and Mamman (2020) employed a two-stage least squares, improving earlier studies methodology. They decomposed public debt effect into permanent and transitory effect. Findings revealed a larger negative permanent effect than a positive transitory effect.

Musa and Ojonugwa (2024) used a quarterly dataset from 1996Q1 to 2022Q4 to investigate the impact of external debt burden on economic growth in Nigeria. Results from the ARDL found that external debt burden has a positive and insignificant impact on economic growth in the short run and long run in Nigeria.

The study of Ashogbon, Onakoya, Obiakor and Lawal (2023) considered not only public debt but also institutional quality, which is one of endogeneity factors, to drive economic growth, unlike previous studies. Using ARDL method to investigate the effect of public debt and institutional quality on economic growth in Nigeria for the period 1981- 2021. Results revealed that domestic and external public debt have positive and negative significant impact on long run economic growth in Nigeria respectively. Also, their study found that institutional quality significantly impedes long run economic growth by 0.72% while a change institutional quality also retards economic growth in the short run by 0.19% when compared with the long run period. Similarly, Otieno (2024) examined the relationship among public debt, investment and economic growth dynamics: do geographical proximity and spatial spillover effects matter? His study employed spatial autoregressive model (SAR) and spatial error model (SEM) and found that foreign public debt crowd out private investment and also retards economic growth among the regions in the long run.

Kim, Ha, and Kim (2017), unlike earlier studies, investigated the direct and interactive effects of public debt, corruption, and sustainable economic growth across 77 countries of high-income and low-income economies during the period 1990-2014. In this study, sustainable economic growth is proxy as growth of real gdp per capita and the GMM dynamic panel regression was employed while the robustness was checked with

three panel static regression methods, pooled OLS (POLS), random regression (RE), and fixed regression (FE). Results from dynamic panel regression found that public debt significantly retards sustainable economic growth but the interaction term of public debt and corruption has significantly enhances economic growth. The study confirmed that corruption plays a significant role in the impact of public debt on economic growth.

Koffi (2021) investigated non-linear impact of public debt on economic growth among 44 sub-Saharan African countries. He employed a system generalized methods of moments (s-GMM) to establish non-linear debt–growth nexus and test the presence of U-shaped. His findings revealed the presence of non–linear debt–growth nexus and an invested U-shaped prevailed among the selected sub-Saharan African countries. He concluded that the 36.18% debt threshold beyond will cause a lower economic growth in this study. Similarly, Rutayisire (2021) investigated the non–linear public debt impact on economic growth in the short run and long run in Rwanda, using a quadratic ARDL for the study period of 1970 to 2018. His study found the presence of non–linear debt–growth nexus and estimated a 50.2% debt threshold beyond the marginal debt inhibiting economic growth of Rwanda in the long run. The study of Obiero and Topuz (2023), departed from reviewed studies by examining the threshold effect of public and internal debt on economic growth, using the smooth transition regression model for the period 1970 to 2018 in Kenya. Their finding found the presence of U-shaped relationship between domestic and public debt and economic growth in Kenya, unlike the invested U-shaped relationship in previous studies. In addition, they found that 17.31% and 33.29% domestic and public debt threshold beyond will contract economic growth and invariably, below domestic and public debt threshold will enhances economic growth in Kenya.

Nzeh (2020) investigated the extent of public debt aid an economy, employing ARDL to validate the optimal threshold for the study period of 1981 and 2018. He found that 40.2% is the optional threshold that will make public debt leads to declining economic growth in both the long run and short–run in Nigeria.

Despite the extensive linear public debt-growth studies in Nigeria and other continents, there is less studies on non-linear public debt-growth nexus and no study has investigated the structural break effects of non-linear public debt-growth nexus in Nigeria.

3. METHODOLOGY

3.1 Theoretical Framework

The theoretical framework for this study is Debt Laffer curve. The Debt Laffer curve assumes that optimal debt level will maximizes economic growth and any debt level beyond the optimal will retards economic growth.

In this context, the economic growth is a function of debt level. Economic growth according to Solow (1956) states that growth of gdp is a function of growth of labour and growth of capital and the level of technological progress, which is expressed as:

$$Y = Af(L, K) \quad (1)$$

Where the Y represents the growth of real gross domestic product, followed by A which is the level of technological progress that is exogenous in the economy, and the L and K are the growth of labour and capital inputs to explicitly drive gdp growth.

Equation 1 is further divided by growth of labour to obtain per capita growth and this establish the Harrod and Dormar capital accumulation proposition that growth per capita only leads to growth of gdp per capita, and not by the growth of labour size, which is expressed as :

$$\frac{Y}{L} = Af\left(\frac{L}{L}, \frac{K}{L}\right)$$

$$\frac{Y}{L} = Af\left(\frac{K}{L}\right)$$

$$y = Af(k) \quad (2)$$

As shown in equation 2, show that y is the gdp per capita, and k is the capital per capita.

The endogenous growth model recognizes the role of government spending as an important determinant of economic growth (Romer, Aghian & Howitt, 1996; Grossman & Helpman 1991; Barro, 1990). These endogenous growth theories assume that government should spend on innovation and knowledge to achieve a sustainable economic growth, and it is expressed as:

$$A = f(I, W) \quad (3)$$

$$I, W = f(GS) \quad (4)$$

$$GS = f(PD) \quad (5)$$

Equation (3) states that technological progress depends on innovation and knowledge. The innovation and knowledge is denoted as I and W . Furthermore, equation (4) states that both innovation and knowledge depends on government spending, denoted as GS . Similarly, equation (5) acknowledges the presence of government and states that the public (government) spending depends on public debt (Van, Nguyen, Barbier-Gau Chard & Le, 2019; Onuoha, 2025).

Furthermore, the study of Heimberger (2021) posits that when the government witnesses economic turbulent, there is a strong association between higher spending and higher public debt. For instance, many governments during COVID-19 witness higher public spending which resulted to higher public debt, and thus, the higher public debt is added into the public spending function and expressed as:

$$Gs = f(PD, PD^2) \quad (6)$$

Equation (6) indicates that government spending depends on public debt and public debt squared. While public debt exists when the country's economy is stable (equilibrium), the public debt squared arises when a country's economy is at disequilibrium.

Replacing equations (3) and (6) as equation (7):

$$A = f(PD, PD^2) \quad (7)$$

Similarly, equation (2) which is an exogenous growth model is converted to endogenous growth model because the technological progress now becomes an endogeneity factor and expressed as:

$$y = f(A, k) \quad (8)$$

$$y = f(PD, PD^2, k) \quad (9)$$

Where y is the sustainable economic growth, represented as the dependent variable. The independent variables, public debt and public debt squared are the main variables while the K is the control variables as shown in equation 9.

3.2 Model Specification

The model for this study adapts the endogenous growth framework by incorporating public debt and public debt squared as the main endogeneity (internal) factors that determines sustainable economic growth. The quadratic regression model that estimates the Debt Laffer curve in this study adopts the works of Herridon, Ash & Pollin (2013) and Rutayisire (2021).

Specifically, the public debt is decomposed into three forms, such as the total public debt (TPD), domestic public debt (DPD) and external public debt (EPD) as shown in the work of Omotosho, Bawa and Doguwa (2016). The functions for the models are shown in Equations (10)-(12):

$$SEG = f(TPD, TPD^2, GFCF, HC, GCAPX, INT, PE) \text{-----} (10)$$

$$SEG = f(DPD, DPD^2, GFCF, HC, GCAPX, INT, PE) \text{-----} (11)$$

$$SEG = f(EPD, EPD^2, GFCF, HC, GCAPX, INT, PE) \text{-----} (12)$$

The baseline econometric equations for the above functions are expressed in equations (13) to (15):

$$SEG = \hat{\beta}_0 + \hat{\beta}_1 \ln TPD_t + \hat{\beta}_2 TPD_t^2 + \hat{\beta}_3 GFCF_t + \hat{\beta}_4 HC_t + \hat{\beta}_5 GCAPX_t + \hat{\beta}_6 INT + \hat{\beta}_7 PE + \varphi_t \quad (13)$$

$$SEG = \hat{\beta}_8 + \hat{\beta}_9 \ln DPD_t + \hat{\beta}_{10} DPD_t^2 + \hat{\beta}_{11} GFCF_t + \hat{\beta}_{12} HC_t + \hat{\beta}_{13} GCAPX_t + \hat{\beta}_{14} INT + \hat{\beta}_{15} PE + \varphi_t \quad (14)$$

$$SEG = \hat{\beta}_{16} + \hat{\beta}_{17} \ln EPD_t + \hat{\beta}_{18} EPD_t^2 + \hat{\beta}_{19} GFCF_t + \hat{\beta}_{20} HC_t + \hat{\beta}_{21} GCAPX_t + \hat{\beta}_{22} INT + \hat{\beta}_{23} PE + \varphi_t \quad (15)$$

Where SEG is sustainable economic growth, representing the dependent variable. The main variables are total public debt as percent of GDP, domestic public debt as percent of GDP and external public debt as percent of GDP, denoted as TPD, DPD, and EPD respectively as well as the total public debt squared as percent of GDP, domestic public debt squared as percent of GDP, and external public debt squared as percent of GDP proxied as TPD^2 , DPD^2 and EPD^2 respectively, justify the presence of both linear and non-linear public debt-growth equation. The control variables include, GFCF is gross fixed capital formation as percent of gdp, HC is human capital as percent of gdp, GCAPX is government capital expenditure as percent of gdp, INT is nominal interest rate, and PE is petroleum export as percent of gdp. The $\hat{\beta}_0 - \hat{\beta}_{23}$, e_t and t represent estimated parameters, error term and time series as shown in equations (13)-(15).

A quadratic autoregressive distributed lag (ARDL) technique was to estimate the long run and short run dynamic relationship between public debt and sustainable economic growth and test the Debt Laffer Curve. Both unit root and cointegration tests were carried verify the time series econometric properties and determine the appropriate estimation method. Augmented-Dickey Fuller (ADF), Phillips-Perron (PP) and Kwiatkowski-Phillips-Schmidt-Shin (KPSS) are the unit root tests used to determine the stationarity levels for the included variables. When the unit root tests exhibit same order of integration, either $I(0)$ or $I(1)$, a single cointegration method prevails. On a contrary, when the unit root tests exhibit a mixed order of integration of zero $I(0)$ and one $I(1)$, a multivariate cointegration method, called Bounds test is preferred. Bounds test developed by Pesaran, Shin and Smith (2001) is to ascertain the existence of long run relationship or not.

The autoregressive distributed lags (ARDL) is preferred over other ordinary least squares (OLS) estimation techniques, for it aligns with the study objectives to estimate both short-run and long run relationship. Also, the quadratic ARDL regression method is employ to test the Debt Laffer Curve Hypothesis. This estimates test whether the nature of the relationship is U-shaped or inverted U-shaped. While the U-shaped suggests a positive nonlinear relationship etween public debt and economic growth, the inverted U-shaped indicates a negative nonlinear relationship between public debt and economic growth(Yusuf & Mohd, 2013; Nzeh, 2020).

Equations (16)-(18) show the three quadratic ARDL-UECM regression models for the nexus between public debt and sustainable economic growth in Nigeria as follows:

Total Public debt- Sustainable Economic Growth ARDL-UECM model:

$$\Delta SEG_t = \beta_0 + \sum_{i=1}^p \beta_{0i} \Delta SEG_{t-i} + \sum_{j=0}^{q_1} \beta_{1j} \Delta TPD_{t-j} + \sum_{j=0}^{q_2} \beta_{2j} \Delta TPD^2_{t-j} + \sum_{j=0}^{q_3} \beta_{3j} \Delta GFCF_{t-j} + \sum_{j=0}^{q_4} \beta_{4j} \Delta HC_{t-j} + \sum_{j=0}^{q_5} \beta_{5j} \Delta GCAPX_{t-j} + \sum_{j=0}^{q_6} \beta_{6j} \Delta INT_{t-j} + \sum_{j=0}^{q_7} \beta_{7j} \Delta PE_{t-j} + \phi ECT_{t-1} + \alpha_0 SEG_{t-1} + \alpha_1 TPD_{t-1} + \alpha_2 TPD^2_{t-1} + \alpha_3 GFCF_{t-1} + \alpha_4 HC_{t-1} + \alpha_5 GCAPX_{t-1} + \alpha_6 INT_{t-1} + \alpha_7 PE_{t-1} + \varepsilon_t \quad (16)$$

Domestic Public debt-Sustainable Economic Growth ARDL-UECM Model

$$\Delta SEG_t = \beta_0 + \sum_{i=1}^p \beta_{0i} \Delta SEG_{t-i} + \sum_{j=0}^{q_1} \beta_{1j} \Delta PD_{t-j} + \sum_{j=0}^{q_2} \beta_{2j} \Delta PD^2_{t-j} + \sum_{j=0}^{q_3} \beta_{3j} \Delta GFCF_{t-j} + \sum_{j=0}^{q_4} \beta_{4j} \Delta HC_{t-j} + \sum_{j=0}^{q_5} \beta_{5j} \Delta GCAPX_{t-j} + \sum_{j=0}^{q_6} \beta_{6j} \Delta INT_{t-j} + \sum_{j=0}^{q_7} \beta_{7j} \Delta PE_{t-j} + \phi ECT_{t-1} + \alpha_0 SEG_{t-1} + \alpha_1 PD_{t-1} + \alpha_2 PD^2_{t-1} + \alpha_3 GFCF_{t-1} + \alpha_4 HC_{t-1} + \alpha_5 GCAPX_{t-1} + \alpha_6 INT_{t-1} + \alpha_7 PE_{t-1} + \varepsilon_t$$

External Public debt-Sustainable Economic Growth ARDL-UECM Model.

$$\Delta SEG_t = \beta_0 + \sum_{i=1}^p \beta_{0i} \Delta SEG_{t-i} + \sum_{j=0}^{q_1} \beta_{1j} \Delta PD_{t-j} + \sum_{j=0}^{q_2} \beta_{2j} \Delta PD^2_{t-j} + \sum_{j=0}^{q_3} \beta_{3j} \Delta GFCF_{t-j} + \sum_{j=0}^{q_4} \beta_{4j} \Delta HC_{t-j} + \sum_{j=0}^{q_5} \beta_{5j} \Delta GCAPX_{t-j} + \sum_{j=0}^{q_6} \beta_{6j} \Delta INT_{t-j} + \sum_{j=0}^{q_7} \beta_{7j} \Delta PE_{t-j} + \phi ECT_{t-1} + \alpha_0 SEG_{t-1} + \alpha_1 PD_{t-1} + \alpha_2 PD^2_{t-1} + \alpha_3 GFCF_{t-1} + \alpha_4 HC_{t-1} + \alpha_5 GCAPX_{t-1} + \alpha_6 INT_{t-1} + \alpha_7 PE_{t-1} + \varepsilon_t$$

Where ECT_t is the speed of adjustment coefficient to converge to its long run equilibrium and it is expected to be negative and statistically significant in the ARDL-UECM. While the short run and long run estimated parameters are $\beta_0 - \beta_8$ and $\alpha_0 - \alpha_7$ for each equation. Also, the $p, q_1, q_2, q_3, q_4, q_5, q_6$, and q_7 represent the optimal number of lags for dependent variable and independent variables respectively while the i and j are the minimum number of lags for the dependent variable and independent variables. Also, Δ , t and ε_t indicate first difference, annual time series and error term of the models respectively. Lastly, the presence of debt Laffer curve which is known as an inverted U-shaped curve exists when the coefficients of β_1 and β_2 are positive and negative in the ARDL-UECM models. The debt Laffer curve implies that a lower debt is expected to have a positive impact on sustainable economic growth, whereas, the debt squared variable implies that a higher debt is theoretically expected to have a negative impact on sustainable economic growth (Gashim & Rexhepi, 2024).

3.3 Data

This study uses an annual time series data which range from 1970 to 2023. This secondary data was sourced from the Central bank of Nigeria (CBN), Debt Management Office (DMO) and the National Bureau of Statistics (NBS). All data were expressed in same monetary currency, Naira and kobo and converted to percentage form in this study. Table 1 shows the summary of the variables description in this study.

Table 1 Summary of variables description

Variable	Description	Symbol	Data Source	Expected Sign
Sustainable economic growth	This is a continuous economic growth without harm the inhabitants is measured GDP per capital divided by consumer price	SEG	CBN, 2023 NBS 2023	

	index as expressed in percentage.			
Total public debt	Total public debt is the total government indebtedness from both domestic and external debt. It is measured by public debt divided by nominal GDP in percentage.	TPD	CBN, 2023	+ or -
Domestic public debt	Domestic public debt is sourced internally and measure as a ratio of domestic public debt to nominal gdp, expressed in percentage	DPD	CBN, 2023	+ or -
External public debt	External public debt is sourced from foreign financial institutions and measure as a ratio of external public debt to nominal gdp, expressed in percentage	EPD	CBN, 2023	+ or -
Total public debt squared	Total public debt is the total accumulation government indebtedness from domestic and external debt. It is measured as square of total public debt to gdp as expressed in percentage.	PD ²	CBN, 2023	-
Domestic public debt squared	The accumulation of domestic public debt and measured as square of domestic public debt to gdp as expressed in percentage.	DPD ²	CBN, 2023	-
External public debt squared	The accumulation of external public debt and measured as square of external public debt to gdp as expressed in percentage.	EPD ²	CBN, 2023	-
Gross Fixed Capital Formations	Gross fixed capital formation is the stock of domestic capital investment. It is measured by dividing GFCF by GDP at current price, as expressed in percentage.	GFCF	CBN, 2023	+
Human Capital	Human capital is the quality of labour force and not size of labour force. It measured government expenditure on education divided by nominal GDP, as expressed in percentage.	HC	CBN, 2023	+
Government Capital expenditure	Government capital expenditure is government spending on social amenities It is measured as Government capital expenditure divided by GDP at current price, as expressed in percentage..	GCAPX	CBN, 2023	+
Lending Interest rate	Lending interest rate is the cost of borrowing in an economy. It is independently determined by the CBN, expressed on percentage.	INT	CBN, 2023	-
PE	Oil and gas petroleum export earnings is the income accrued from the oil and gas	PE	CBN, 2023	+

	exportation. It is measured OGE divided by GDP at current price, as expressed in percentage.			
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Note: + and – are denoted as positive and negative sign

Source: Authors' compilation, 2025.

4. RESULTS AND DISCUSSION OF FINDINGS

4.1 Preliminary Results

Tables 2 and 3 present the descriptive statistics and correlation matrix result of this study.

Table 2. Descriptive Statistics

Variable	SEG	TPD	DPD	EPD	GFCF	HC	GCAPX	INT	PE
Mean	82.12	27.12	10.69	15.75	87.24	2.28	3.66	15.42	17.21
Minimum	-1303.9	4.53	3.62	0.63	14.16	0.024	0.637	6.00	4.22
Maximum	9646.6	79.71	23.04	60.37	394.14	71.06	9.08	29.80	31.48
Skweness	5.81	1.02	0.84	1.14	1.63	7.03	0.96	0.10	0.002
Jarque Bera	3222.21 (0.000)	9.06 (0.000)	6.84 (0.03)	11.48 (0.003)	28.732 (0.000)	544.82 (0.000)	7.88 (0.000)	0.46 (0.79)	2.38 (0.30)
Obj	51	53	53	53	53	53	53	53	53

Source: Authors' Compilation from EViews Output, 2025

Results in Table 2 presents the descriptive statistics for variables used in the nexus between public debt and sustainable economic growth in Nigeria from 1970 to 2022. First, Table 2 finds that the average external public debt of N15.75 billion is far higher than the average domestic public debt of N10.69 billion, implying that Nigeria borrows more from external sources. Second, the skewness values for all variables are far from zero and all exhibit a positive skewed distribution. This implies that all variables are not relatively stable during the study periods. Third, the Jarque–bera test reveals that all variables, except interest rate and petroleum export, cannot accept the null hypothesis of a normal distribution in this study. This implies that only interest rate and petroleum variables are stable and normally distributed at $p > 0.10$ during the study periods. Lastly, the number of observations for all variables are equal, except sustainable economic growth that is 51 annual time series.

Table 3. Correlation Matrix, 1970 – 2022

Variable	SEG	TPD	DPD	EPD	GFCF	HC	GCAPX	INT	PEXP
SEG	1.00								
TPD	0.091	1.00							
DPD	-0.0023	0.814	1.00						
EPD	0.1076	0.991	0.730	1.00					
GFCF	0.00068	-0.323	-0.344	-0.302	1.00				
HC	0.0134	-0.097	-0.036	-0.106	0.459	1.00			

GCAPX	0.3142	0.146	0.084	0.152	0.634	0.374	1.00		
INT	0.044	0.681	0.483	0.691	-0.686	-0.234	-0.270	1.00	
PE	-0.0096	0.029	-0.229	0.087	0.156	0.057	0.305	0.19 1	1.00

Source: Authors' Compilation from EViews output, 2025

Table 3 results show the bivariate association degrees among the included variables and also to detect high collinearity possibility. Findings in Table 3 shows a mixed of positive and negative associations among the variables. Also, the bivariate direct associations results reveal that external public debt has a strong association over domestic and total public debt and only domestic public debt has a negative association with sustainable economic growth.

Results in Table reveals that all correlation coefficients are less than the acceptable threshold limit of ± 0.80 , except the bivariate between total public debt and domestic public debt, as well as between total public debt and external public debt of 0.81 and 0.99 respectively. This implies the presence of serial correlation if these decomposed public debt variables are combined in the estimated models in this study

Table 4. ADF, PP and KPSS stationarity tests results

Variable	ADF level	ADF 1 st Difference	R	PP level	PP 1 st Difference	R	KPSS level	KPSS 1 st Difference	R
SEG	-7.03***	-8.14***	I(0)	-7.03***	-31.06***	I(0)	0.06***	0.09***	I(0)
TPD	-1.996	-4.96***	I(1)	-1.85	-4.94***	I(1)	0.18***	0.12***	I(0)
TPD_squared	-0.95	-4.26***	I(1)	-2.68*	-10.32	I(0)	0.176***	0.29***	I(0)
DPD	-1.99	-6.12***	I(1)	-2.13	-6.11***	I(1)	0.162***	0.149***	I(0)
DPD_Squared	-2.12	-6.08***	I(1)	-2.30	-5.96***	I(1)	0.167***	0.009***	I(0)
EPD	-2.06	-5.16***	I(1)	-1.92	-5.17***	I(1)	0.18***	0.10***	I(0)
EPD_Squared	-1.77	-5.67***	I(1)	-2.21	-5.67***	I(1)	0.17***	0.07***	I(0)
GFCF	-17.36***	-3.73***	I(0)	-1.59	-6.70***	I(1)	0.66***	0.07***	I(0)
HC	-7.03***	-16.39***	I(0)	-7.03***	-40.23***	I(0)	0.25***	0.43	I(0)
GCAPX	-2.79*	-10.22***	I(0)	-2.88***	-9.81***	I(0)	0.39***	0.10***	I(0)
INT	-1.81	-10.87***	I(1)	-2.31	-10.92***	I(1)	0.45***	0.18***	I(0)
PEXP	-3.21**	-7.14***	I(0)	-3.21**	-9.85***	I(0)	0.12***	0.18***	I(0)

Note: *, **, and *** denote the rejection of the null hypothesis at 1%, 5% and 10% significance levels respectively. ADF, PP and KPSS are Augmented Dickey–Fuller, Phillips–Perron, and Kwiatkowski–Phillips–Schmidt–Shin respectively.

Source: Authors' compilation from EViews output, 2025

As shown in Table 4, all the three unit root tests, except KPSS reveal that all included variables have mixed stationary levels of integrated order of zero and one. Based on the first two unit root tests, the ARDL bounds

cointegration method is employed over residual and Johansen cointegration methods to ascertain the long run relationship of the variables.

Table 5. ARDL Bounds test results

Model	Variable	F – statistics	Degree of Freedom (DOF)	Upper Critical Value @ 10%	Upper Critical Value @ 5%	Upper Critical Value @ 1%
I	All variables	12.87	7	2.89	3.21	3.9
II	All variables	5.87	7	2.89	3.21	3.9
III	All variables	10.07	7	2.89	3.21	3.9

Source: Authors' Compilation from EViews output, 2025.

Note: Models I, II and III represent total public debt, domestic public debt and external public debt respectively.

The ARDL Bounds test results in Table 5 reveal that the F–statistic values for the three models of 12.87, 5.87 and 10.07 exceeds all critical values at 10%, 5% and 1% significantly levels respectively. This implies that all null hypotheses of no long run relationship cannot be accepted, hence, a long run relationship prevails among the included variables in the three estimated models.

Table 6. Var Lag Length Test Results

Lag	Log L	LR	FPE	AIC	SC	HQ
0	-1480.563	NA	1.64e+17	59.50253	59.77021	59.60447
1	-1294.480	312.6196*	6.94e+14*	54.01921*	56.16067*	54.83469*

Note: * indicates lag order selection by the criterion LR, FPE, AIC, SC and HQ are LR test, Final prediction error, Akaike information Criterion, Schwarz information criterion, and Hannan 0 Quinn information criterion

Source: Authors' compilation from EViews output, 2025

Results in Table 6 shows that lag 1 is the optimal lag length to estimate the short run dynamics and long run OLS without the presence of serial correlation in the residuals of the ARDL.

4.2 Quadratic ARDL Long run and Short run Estimates

Table 7. Quadratic ARDL short run and Long run estimates of Public Debt and Sustainable Economic Growth in Nigeria (1970-2022).

Dependent: Sustainable economic growth (SEG)

Estimation Method: ARDL

Variables	Total Public Debt	Domestic Public Debt	External Public Debt
PART (A): SHORT-RUN ESTIMATES			

<i>D(Total public debt)</i>	98.17*** (10.04)		
<i>D(domestic public debt_squared)</i>		-1.092 (-0.577)	
<i>D(External public debt)</i>			98.651*** (8.078)
<i>D(Interest rate)</i>	23.72 (1.05)		
<i>ECT (-1)</i>	-0.968*** (0.19)	-1.008*** (-7.925)	-0.983*** (-10.451)
PART (B): LONG – RUN ESTIMATES			
Total public debt	20.52 (0.99)		
Total public debt_squared	-0.472** (-2.129)		
Domestic public debt		108.14 (0.839)	
Domestic public debt_squared		-6.048 (-1.21)	
External public debt			4.471 (0.174)
External public debt_squared			-0.471 (-1.27)
Gross fixed capital formation	0.0018 (0.067)	-0.046 (-0.789)	-0.02 (-0.45)
Human capital	-0.10 (-0.06)	-0.096 (-0.035)	-0.68 (-0.312)
Government capital expenditure	139.23* (1.92)	0.627 (1.25)	0.394 (0.969)
Interest rate	79.32* (1.61)	30.105 (1.01)	74.69 (1.55)
Petroleum export earnings	13.365 (0.766)	-0.039 (-0.491)	-0.033 (-0.47)
<i>C</i>	-1885.92***	-633.278	-693.13

	(-3.28)	(-0.846)	(-1.57)
<i>Does Debt-Sustainable Economic Growth Relationship Exists?</i>	YES	YES	YES
<i>Type of Debt-Sustainable Economic Growth Relationship in Nigeria</i>	Debt Laffer Curve	Debt Laffer Curve	Debt Laffer Curve
R^2	0.6135	0.1644	0.533
<i>Adjusted R^2</i>	0.514	-0.024	0.413
<i>F-Statistic</i>	6.19***	0.874	4.45***

Note: *,** and *** are 10%, 5% and 1% significance levels. The standard error is in parenthesis.

Source: Authors' compilation from EViews output, 2025

Table 7 presents the quadratic ARDL short run and long run estimations for the nexus between public debt–sustainable economic growths over the period 1970 and 2022 in Nigeria. The quadratic ARDL results show the total public debt effect on sustainable economic growth in the second column while the last two columns show the domestic and external public debt effects on sustainable economic growth in Nigeria respectively.

First, the estimated error correction terms (ECT) coefficients across all public debt models are negative and statistically significant at 1% significance levels. These results confirm that the disequilibria in the models have been corrected to long run equilibria. In addition, Table 7 finds that the total public debt disequilibrium recovery to long run sustainable economic growth is faster than domestic and external public debt disequilibria recovery in this study.

The short-run estimations results in Table 7 finds that all changes in the variables except a change in domestic public debt and interest rate, have positive and significant effects on the change in sustainable economic growth in this study. Findings in Table 7 shows that a 1% change in total public debt and external public debt has a statistically significant impact on a change in sustainable economic growth by 98.17% and 98.65% respectively. This findings imply that changes in external public debt only is preferred to changes in total public debt to cause significant change in sustainable economic growth in Nigeria. This finding aligns with Omotosho, Bawa and Doguwa (2016) that external public debt induces economic growth, whereas the study of Ashogbon , Onakoya, Obiakor and Esther (2023) did not support this findings.

The Long run ARDL results in Table 7 reveals that total public debt, external public debt and domestic public debt have a positive and insignificant impact on sustainable economic growth in the long run. This results conform to the linear public-debt growth nexus of expected positive coefficient, implying, a low debt level increases sustainable economic growth. Additionally, Table 7 reveals that total public debt squared, domestic public debt squared, and external public debt squared have a negative and insignificant impact on the long run sustainable economic growth and only total public debt squared significantly retards long run sustainable economic growth in Nigeria. This results conform to the non-linear public debt-growth nexus of expected negative coefficient, implying that a higher public debt retards sustainable economic growth.

Results in Table 7 reveals the Debt-Laffer Curve Hypothesis test and finds that the linear and non-linear nexus between total public debt, domestic public debt and external public debt and sustainable economic growth respectively conforms to expected positive and negative signs in the long run only and thus, a Debt Laffer Curve hypothesis cannot be rejected in the long run public debt-growth nexus in Nigeria over the period 1970 to 2023. This findings is supported by the works of Omotosho, Bawa, and Doguwa (2016) and Nzeh (2020) that found a Debt Laffer Curve (inverted -U shaped) relationship between public debt and economic growth in Nigeria.

Table 8. Post Estimation Diagnostic Tests Results

Diagnostic tests	Models	Coefficients	Prob	OLS Assumptions Decision
Ramsey Reset	Total public debt	11.91	0.000	No Linearity Regression
	Domestic public debt	1.009	0.320	Linearity Regression
	External public debt	11.356	0.000	No Linearity Regression
Breusch–Godfrey LM Test	Total public debt	1.063	0.356	No Serial Correlation
	Domestic public debt	0.287	0.752	No Serial Correlation
	External public debt	1.770	0.185	No Serial Correlation
Breusch–Pagam– Godfrey	Total public debt	0.018	0.895	No Heteroskedasticity
	Domestic public debt	0.872	0.557	No Heteroskedasticity
	External public debt	0.061	0.805	No Heteroskedasticity

Source: Authors' compilation from EViews output, 2025

Table 8 displays the diagnostic test results to validate that the ARDL estimations in line with OLS assumptions. All the post-estimations tests in table 8 conforms with the OLS assumptions, except the Ramsey reset test for domestic public debt in this study. This implies that only domestic public debt model cannot reject the null hypothesis of linearity and thus, the quadratic ARDL estimation is inadequate in this study. Additionally, Figures 1A-1C reveals that all public debts models are statistically stable at 5% level of significance as the blue lines fall within the two extreme lines.

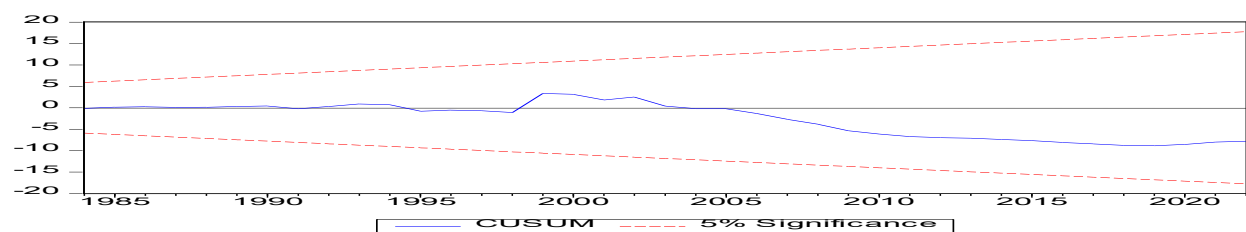


Figure 1A: Total public debt model

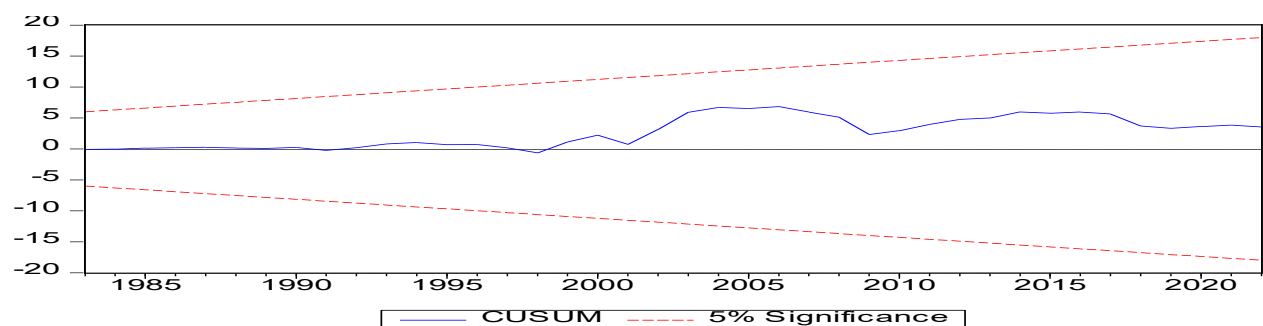


Figure 1B: Domestic public debt model

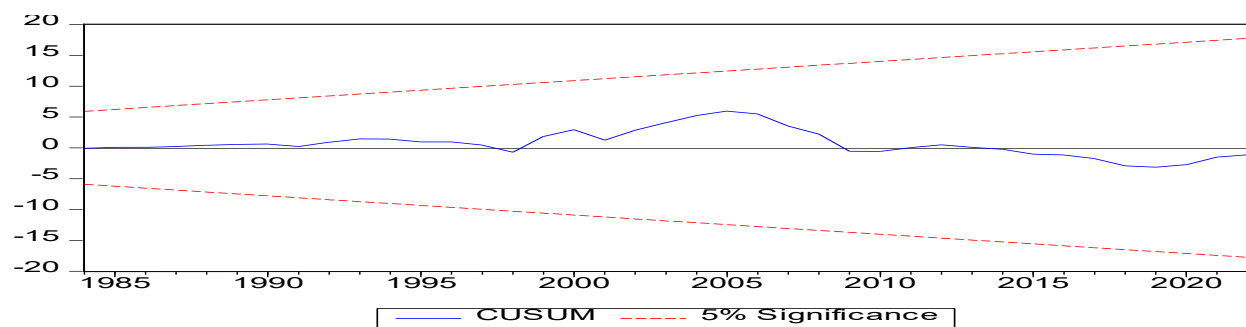


Figure 1C: External public debt model

4.3 Robustness Check

Following the long study periods that spanned over 50 years and the high possibility of a number of policy changes as well as the insignificant of normality test and CUSUMSQ test necessitate the robustness check for the estimated ARDL estimations and to validate the Debt Laffer Curve hypothesis.

First, Table 9 displays the multiple break points test by Bai and Perron (2003a) and found that the most structural dates are 1999 and 2006 and thus justify the need for structural ARDL estimations.

Table 9. Multiple Break Points Test

Break Dates	Total Public Debt Excluded variables: GFCF	Domestic Public Debt Excluded variables: GFCF and HC	External Public Debt Excluded variables: GFCF and HC
1	1992	1999	1992
2	1999	2006	1999
3	2006	nil	2006

Source: Authors' computation from EViews output, 2025

Table 10. Structural Quadratic ARDL Long run and Short run Estimates

Dependent variable: SEG						
Estimation Method: Structural Quadratic ARDL						
Models	Total Public Debt		Domestic Public Debt		External Public Debt	
Break dates ranges	1970-1990	1999-2022	1970-1990	1999-2022	1970-1990	1999-2022
PART (A): SHORT-RUN ESTIMATES						
D(total public debt)		25.66** (2.03)				
D(total public debt_squared)		1.31*** (8.27)				
D(domestic public debt)			-58.03** (-2.47)	-1.504*** (-7.31)		
D(domestic public debt_squared)			1.32 (1.33)	89.72*** (8.53)		

D(external public debt)					21.42** (3.85)	18.33 (4.58)
D(external public debt_squared)					-0.26** (-3.37)	2.36*** (11.46)
D(human capital)						266.60** (2.47)
D(Gross fixed capital formation)		370.55*** (2.89)				
D(Gross capital expenditure)			51.28*** (6.69)	297.35** (7.80)		
D(Interest rate)				179.72*** (10.41)		
D(Petroleum earnings)	-0.566 (-0.246)	17.31** (2.63)	-7.20*** (-3.55)		0.065 (0.03)	21.73*** (3.61)
Error correction term (ECT)	-1.06*** (-11.33)	-1.006*** (-38.49)	-1.114*** (-14.03)	-0.706*** (-12.83)	-1.145*** (-13.37)	-1.13*** (-44.95)
PART (B): LONG-RUN ESTIMATES						
total public debt	6.98 (1.003)	92.114 (2.69)				
total public debt_squared	-0.127 (-1.25)	-1.106* (-1.91)				
domestic public debt			21.43 (0.52)	94.65* (4.79)		
domestic public debt_squared			-1.25 (-0.60)	-55.75 (-0.74)		
external public debt					-2.73 (-0.57)	69.23*** (3.02)
external public debt_squared					-0.02 (-0.15)	-0.858* (-1.55)
Human capital	33.02 (1.63)	-451.56* (-1.77)		-679.00 (-1.72)	-1.35 (-1.06)	-738.50*** (-1.06)
Gross fixed capital formation	-1.61 (-1.02)					
Gross capital expenditure		-37.74 (-0.63)	65.27* (2.11)		20.10 (1.15)	-53.11 (-1.06)
Interest rate	0.145 (0.010)	36.15* (-1.92)	-10.33** (-2.44)	162.72** (2.11)	0.78 (0.05)	25.13 (1.59)
Petroleum earnings	-6.99 (-1.02)	50.50*** (3.26)	-20.03*** (-2.63)	-10.52 (-0.32)	-4.19 (-0.77)	37.99*** (3.51)

Does Debt-Sustainable Economic Growth Relationship Exist?	YES	YES	YES	YES	YES	YES
Type of Debt-Sustainable Economic Growth Relationship in Nigeria	Debt Laffer Curve	Debt Laffer Curve	Debt Laffer Curve	Debt Laffer Curve	No Debt Laffer Curve	Debt Laffer Curve
R ²	0.693	0.98	0.845	0.97	0.808	0.697
F-Statistic	2.54* [0.09]	116.53*** [0.00]	2.98* [0.10]	47.41*** [0.00]	2.94* [0.08]	136.06*** [0.00]
Jarque-Bera (Normality) test	0.003 [0.99]	1.92 [0.38]	0.77 [0.68]	0.06 [0.97]	1.67 [0.43]	0.37[0.83]
Serial LM test	0.716 [0.521]	0.659 [0.54]	0.451[0.67]	2.18 [0.16]	2.34 [0.19]	0.17 [0.85]
Heteroskedasticity	1.51 [0.28]	0.829 [0.618]	0.787 [0.65]	0.836 [0.61]	0.360 [0.93]	2.51 [0.12]
CUSUMSQ (Recursive) test	Stable	Stable	Stable	Stable	Stable	Stable

Note: *, ** and *** are 10%, 5% and 1% significance levels. Standard errors and statistical probabilities are in parenthesis and brackets.

Source: Authors' compilation from EViews output, 2025

Results in Table 10 shows that all structural ARDL models, except the external public debt during 1970-1990, conforms to Debt Laffer curve hypothesis in Nigeria. This finding is in line with the work of Yamaka and Maneejuk (2025) that found that the public debt and economic growth relationship exhibited both inverted U shaped and U shaped relationship, implying existence and no existence of debt Laffer curve in Nigeria. In contrast, Findings in Table 10 shows that Debt Laffer curve hypothesis is rejected in the short run in Nigeria. This implies that changes in higher public debt of all types lead to a positive change impact on sustainable economic growth during the structural periods in the short-run. Also, Table 10 shows that the normality and recursive tests are normally distributed and statistically stable for all structural ARDL models, unlike Table 7, in this study.

5. CONCLUSION AND POLICY RECOMMENDATIONS

This study test the existence of debt Laffer curve relationship between public debt and sustainable economic growth in the long run only during the period 1970 to 2022 in Nigeria, using autoregressive distributed lag (ARDL) estimation method. The study concludes that only external public debt significantly induces sustainable economic growth in the short-run, whereas, only total public debt squared significantly retards long run sustainable economic growth in Nigeria. Also, the structural ARDL findings conclude that there is existence and non-existence of debt Laffer curve in the long run in Nigeria

The recommendations for this study are drawn from these findings as follows. First, the Debt Management Office (DMO), which is a government agency should be cautious to accumulate higher total public debt than higher domestic debt for its permanent negative impact on sustainable economic growth, due to exchange rate volatility leading to higher interest repayment as shown in Tables 7 and 10. Second, the Ministry of Budget and planning should deliberately pursue a high budget deficit in the short run to provide more capital

expenditure allocations to sub-nationals (state governments) for gross capital formation, human capital and petroleum sector development in achieving a transitory sustainable economic growth. Lastly, the Central Bank of Nigeria (CBN) authority should continue to lower interest rates to encourage domestic public debt sourcing in the face of persisting global economic uncertainty to achieve a long run sustainable economic growth in Nigeria.

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