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# A Nonlinear ARDL Approach to External Debt and Economic Growth in Nigeria

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## Abstract

This study investigates the asymmetric short- and long-run effects of external debt dynamics on economic growth in Nigeria over the period 1981 to 2023. Specifically, it examines how variations in external debt stock, debt servicing, and interest rates influence the growth rate of real GDP. Employing the Nonlinear Autoregressive Distributed Lag (NARDL) model, the analysis captures both positive and negative shocks in external debt variables. Preliminary tests such as the Augmented Dickey-Fuller (ADF) unit root test and optimal lag selection criteria were conducted, followed by cointegration analysis using the bounds testing approach. The results reveal significant asymmetries in the debt-growth relationship. In the long run, increases in external debt stock have an insignificant effect on growth, while reductions in debt stock significantly hinder output. Rising external interest rates negatively and significantly affect growth, whereas lower rates show a limited positive impact. Similarly, reductions in debt servicing enhance long-term growth, while increases yield statistically insignificant outcomes. In the short run, the economy responds negatively to rising interest rates and declining debt stock, while reductions in servicing costs exert a positive effect. Exchange rate movements and debt accumulation, however, are largely insignificant in the short term. The study concludes that external debt impacts growth in Nigeria asymmetrically, with greater economic sensitivity to negative shocks. It recommends a phased, productivity-driven debt reduction approach, renegotiation of borrowing terms to lower interest burdens, and enhanced fiscal discipline to ensure efficient utilization of borrowed funds.

**Keywords:** External debt, Economic growth, Debt servicing, NARDL model, Debt interest rate

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## 1. Introduction

In recent decades, external borrowing has become a prominent feature of fiscal policy in many developing countries, including Nigeria, as governments seek to fill the gap between limited domestic resources and rising developmental needs. Defined as the total public and private debt owed to non-resident creditors, external debt is often employed to finance large-scale infrastructure projects, social investments, and macroeconomic stabilization efforts (Mehtar, 2021). However, the efficacy of external borrowing in fostering sustained economic growth is highly contingent upon the nature of debt utilization, repayment capacity, and the prevailing macroeconomic environment. While some studies underscore its growth-inducing potential when invested in productive ventures, others raise concerns about debt sustainability and its crowding-out effects on public investment (Döğan & Bilgili, 2014; Chukwu, 2023).

Nigeria presents a paradigmatic case in the discourse on debt-growth dynamics. Since the boom of the late 1970s and early 1980s, the country has accumulated substantial external debt, with the stock rising from US\$10.32 billion in 2015 to US\$41.79 billion in 2022 (Debt Management Office [DMO], 2023). However, this growing indebtedness has not translated into proportionate gains in real sector performance. The role of agriculture, manufacturing, and

construction in GDP remained stagnant at approximately 23%, while growth in these sectors stood at a mere 1.5% in 2022 (National Bureau of Statistics [NBS], 2023). Moreover, debt servicing obligations have become increasingly onerous, accounting for 96.3% of government revenue in the same year (Central Bank of Nigeria [CBN], 2022). This situation raises critical questions about the productivity of borrowed funds and the overall sustainability of Nigeria's debt profile.

Theoretical perspectives such as the Debt Overhang Hypothesis offer critical insights into the inconsistent effects of external borrowing on economic performance. Krugman (1988) and Sachs (1989) argue that when a country's external debt exceeds its anticipated repayment capacity, it creates a disincentive for both domestic and foreign investment due to expectations of future taxation or austerity. This "crowding-out" effect is particularly salient in the Nigerian context, where large volumes of borrowed funds have historically been diverted toward recurrent expenditure rather than productivity-enhancing capital investments (Ogunjimi, 2019). Nigeria's debt challenges are further compounded by structural weaknesses such as fiscal indiscipline, corruption, and policy volatility, which diminish the developmental impact of external loans (Adefabi, 2023; Ekanem & Ekpo, 2021). High-profile examples such as the stalled US\$5.8 billion Mambilla Hydropower Project and irregularities in security-related borrowings illustrate the fiscal inefficiencies endemic to Nigeria's external debt management regime.

Moreover, Nigeria's economic exposure to global commodity cycles, particularly crude oil, has magnified its debt vulnerabilities. Oil exports account for over 80% of the nation's foreign exchange earnings, making the economy highly susceptible to external shocks. The 2020 oil price crash and the economic disruptions caused by the COVID-19 pandemic significantly reduced government revenues while escalating debt service obligations on foreign-denominated loans (Udejaja & Audu, 2023). The growing reliance on high-interest borrowing, especially Eurobonds yielding over 10%, further constrains fiscal space and raises concerns about Nigeria's long-term debt sustainability.

Despite various debt reform initiatives—such as the creation of the Debt Management Office (DMO) in 2000, the 2005 Paris Club relief, and recent bilateral financing agreements with China—Nigeria has struggled to convert borrowed funds into broad-based, sustainable development. Critical sectors such as agriculture, education, and health remain persistently underfunded. For instance, agriculture grew by just 1.2% in 2022, while education and health accounted for only 5.2% of the national budget and a mere US\$15 per capita, respectively (World Bank, 2022; WHO, 2023). These outcomes underscore a persistent disconnect between external borrowing and real sector performance, driven by institutional inefficiencies and weak public financial management.

Importantly, the empirical literature on the debt-growth nexus in Nigeria remains theoretically and methodologically fragmented. While some studies (e.g., Eke & Akujuobi, 2021; Tama & Habila, 2022) document negative growth effects attributed to rising debt service burdens and inefficient debt allocation, others (e.g., Ijirshar et al., 2016; Sulaimon & Azeez, 2012) suggest that when deployed for productive purposes, external borrowing can support both short- and long-term economic growth. However, many of these studies adopt linear modeling frameworks, which may fail to capture the nuanced, asymmetric dynamics through which external debt variables interact with macroeconomic outcomes under different conditions.

This study addresses this critical gap by employing the Nonlinear Autoregressive Distributed Lag (NARDL) model to investigate whether increases and decreases in external debt stock, servicing, and interest rates have differential effects on Nigeria's economic growth. The use of the NARDL framework enables a more realistic assessment of potential asymmetries and policy trade-offs that are typically missed in traditional linear models.

Additionally, this research is timely and contextually relevant for several reasons. First, Nigeria's external debt stock has quadrupled over the last decade, reaching over US\$41.69 billion as of June 2023 (DMO, 2023), with debt servicing consuming nearly all government revenue. Second, fiscal authorities continue to rely on external borrowing to finance infrastructure and budget deficits, yet empirical guidance on the optimal composition, timing, and structure of such debt is limited. Third, with mounting debt service obligations threatening macroeconomic stability, there is an urgent need for empirical insights to inform sustainable debt management strategies that prioritize economic growth.

In sum, this study contributes to the literature by offering new empirical evidence on the asymmetric short- and long-run effects of external debt variables on economic growth in Nigeria. By doing so, it not only extends the application of the Debt Overhang Theory but also provides policy-relevant guidance for improving fiscal resilience and debt sustainability in emerging economies.

## **2. Literature Review**

### **2.1 Conceptual Review**

#### **2.1.1 External Debt**

Governments often finance budgetary shortfalls through borrowing, and in developing countries, such borrowing frequently involves external sources. According to the Central Bank of Nigeria (2018), debt constitutes past financial obligations undertaken by the government, with specified repayment timelines. Public or national debt encompasses all liabilities acquired through borrowing, either domestically or from international sources such as multilateral financial institutions. Specifically, external debt refers to the financial liabilities owed to non-resident entities, including payments denominated in foreign currencies, goods, or services (World Bank, 2014).

External borrowing, as described by Yerima and Tahir (2020), involves credit obtained from international sources such as foreign governments, private financial institutions, or global bodies like the IMF or World Bank. Ogbeifuna (2017) attributes the need for foreign debt to structural imbalances between domestic savings and expenditure, which compel nations to borrow externally to bridge fiscal gaps. Zaki (2015) emphasizes that such obligations are repaid in foreign currency, thereby necessitating international trade to generate the required funds.

Furthermore, the International Monetary Fund (2013) views external debt as the existing stock of liabilities owed to non-residents, which requires future repayments of both principal and interest. The Organisation of African Unity, as cited by Al-Mahdi (2019), frames external debt as a set of liabilities borne by state entities, public enterprises, or private actors under state guarantee. Saleh (2013) elaborates this by stressing the long-term nature of such loans and their repayment in foreign currencies or through international trade.

Consistently, the World Bank (2019) defines external debt as financial obligations to non-residents involving foreign-denominated payments and covering both long- and short-term credit, including overdue interest. Based on these perspectives, this study adopts an operational definition of external debt as funds borrowed by a national government from external creditors commercial banks, international organizations, or foreign states, with repayment in the original borrowing currency and inclusive of interest liabilities.

#### **2.1.2 External Debt Burden and Economic Growth in Nigeria**

Nigeria's external debt burden has affected its economic growth trajectory, restricting the ability of the government to invest in sectors such as power, roads, healthcare, education, and industrial development. While external borrowing is often justified as a means to finance capital projects and stimulate economic growth, the rising cost of debt servicing has placed immense fiscal pressure on the country. As of June 2023, Nigeria's external debt stood at

\$41.69 billion, with annual debt servicing exceeding \$4.56 billion (DMO, 2023). This growing debt burden has led to a misallocation of resources, where funds that could have been used for productive investments are instead redirected to servicing outstanding obligations (Ezeabasili, 2011; Ayadi & Ayadi, 2008).

The manufacturing sector, which relies heavily on government support for infrastructure and access to credit, has been constrained by limited public investment due to high debt obligations (Obadan, 2004). Between 2015 and 2022, the sector recorded sluggish growth due to persistent power shortages, inadequate infrastructure, and limited financing opportunities (CBN, 2022; Uchenna et al., 2020). Instead of channeling funds toward industrial development and export-driven manufacturing, a substantial portion of government revenue is used for debt repayment, thereby reducing Nigeria's competitiveness in global markets (Ogunmuyiwa, 2018). Similarly, the agriculture sector, which remains a crucial driver of employment and food security, has suffered from inadequate funding. In 2022, only 1.8% of Nigeria's budget was allocated to agriculture, well below the Maputo Declaration's 10% target, mainly due to the growing external debt servicing burden (CBN, 2022; Oyejide et al., 2019).

According to UNESCO, countries are expected to allocate 15-20% of their budgets to education. However, Nigeria's education budget has remained below 7%, largely due to debt obligations (World Bank, 2023; Adebisi & Olowookere, 2019). This chronic underfunding has led to deteriorating infrastructure, poorly paid teachers, and declining academic performance, ultimately affecting human capital development and long-term economic growth (Todaro & Smith, 2015). Similarly, the healthcare sector has faced significant funding constraints. Despite the Abuja Declaration's recommendation of 15% allocation to health, Nigeria spends only 3.9% of its GDP on healthcare, which is grossly inadequate (WHO, 2023; Ajakaiye & Jerome, 2019). The shortage of funding has resulted in poor healthcare services, high maternal mortality rates, and increased medical brain drain, further weakening Nigeria's labor force and productivity levels (Okonjo-Iweala & Osafo-Kwaako, 2007).

While loans are often secured to fund major infrastructure projects, debt servicing requirements have delayed or halted several crucial projects (Ezeabasili, 2011). For instance, projects like the Lagos-Ibadan Expressway rehabilitation and the Second Niger Bridge, which were initially funded through external borrowing, have faced significant delays due to government cash flow constraints (Budget Office, 2022; Nwosu, 2021). The power sector, which is vital for industrialization, has also been affected. The Power Sector Recovery Plan (PSRP), aimed at improving Nigeria's electricity generation and distribution, has suffered from inconsistent funding, leading to persistent power outages, high electricity tariffs, and reliance on alternative power sources such as generators (Adenikinju, 2005; Akinyemi et al., 2019). These energy challenges further increase the cost of production for businesses, reducing overall economic output (Ogunleye & Oni, 2013).

The increasing debt burden has also heightened concerns about Nigeria's fiscal sustainability. The World Bank (2023) warns that the debt-to-revenue ratio in Nigeria has reached unsustainable levels, with over 90% of government revenue in 2022 allocated to debt servicing (DMO, 2022; IMF, 2023). This has left little fiscal space for development projects, social welfare programs, and economic diversification initiatives (Adegbite et al., 2008). The situation has created a vicious cycle, where the government continues to borrow more funds to service existing debts, further deepening Nigeria's financial crisis (Ajayi, 1991). As a result, economic growth remains constrained, as limited public investment in key sectors hampers productivity, industrialization, and overall national development (Iyoha, 1999; Ayadi & Ayadi, 2008).

### **2.1.3 Overview of External Debt and Economic Growth in Nigeria**

The external debt-to-GDP ratio in Nigeria increased from 13.9% in 1980 to 64.6% in 1988, and remained high at 65.02% between 2000 and 2003, significantly limiting the country's economic development (DMO, 2010). As of early 2024, Nigeria's external debt had escalated to approximately N56.02 trillion (US\$42.12 billion), a figure that forms a substantial part of the nation's overall public debt of N121.67 trillion (US\$91.46 billion) (National Bureau of Statistics, 2024). This trend underscores the dual-edged nature of external debt; on one hand, it is a critical instrument for development, and on the other, it can impose severe burdens on national economies if not managed prudently (CEIC, 2024). Moreover, Nigeria's external debt portfolio has increasingly come to include loans from bilateral partners, notably China, which is now the country's largest bilateral lender. As of 2024, Chinese loans to Nigeria were estimated at US\$5 billion, underscoring the growing importance of Sino-Nigerian financial relations (Reuters, 2024).

## **2.2 Empirical Review**

The relationship between external debt and economic growth has attracted significant scholarly attention, yet findings remain mixed and methodologically diverse. Study by Eke and Akujuobi (2021) employed a co-integration framework to examine the influence of public debt on Nigeria's economic growth between 1981 and 2018. They reported that while both domestic and external debts significantly influenced growth, the negative impact of external debt contradicted theoretical expectations. The authors attributed this to mismanagement and inefficiencies in debt allocation. However, their model did not consider possible asymmetric effects, nor did it capture nonlinearities, which limits the depth of their policy conclusions.

Koneh (2022) applied the ARDL and Pairwise Granger Causality methods to investigate the external debt-growth nexus in Nigeria from 1971 to 2020. While short-term debt accumulation showed positive influence, long-term effects were found to be detrimental. The study emphasized the burden of debt servicing as a key constraint but did not account for differential impacts of rising versus falling debt levels. This oversight leaves room for further inquiry into potential asymmetric relationships. Tama and Habila (2022) also focused on Nigeria, analyzing data from 1986 to 2019. Their findings associated rising external debt with persistent stagnation, emphasizing the negative consequences of rising debt servicing costs. While the study acknowledged misalignment between borrowing and development outcomes, it relied on symmetric estimation techniques, which may overlook directional sensitivities in debt variables.

Moving beyond Nigeria, Manasseh et al. (2022) used Dynamic System GMM to assess 30 Sub-Saharan African countries from 1997 to 2020. They found that external debt volatility suppressed economic growth, but institutional quality helped mitigate this effect. Although insightful, the study's regional focus dilutes country-specific dynamics, and the panel structure precludes the asymmetric time-series modeling necessary for national policy formulation. Adekunle et al. (2021) adopted threshold regression analysis to explore nonlinearities in Nigeria's debt-growth relationship (1981–2015). Their confirmation of a Debt Laffer Curve suggests a threshold beyond which debt becomes growth-inhibiting. They recommended a debt ceiling at 6.81% of GNI, underscoring the importance of maintaining sustainable debt levels. However, their focus was solely on stock variables, neglecting servicing and interest rate effects.

Ijirshar et al. (2016) distinguished between debt stock and debt servicing, finding the former to be growth-enhancing and the latter growth-inhibiting. Despite offering valuable insights, their linear modeling approach may fail to detect whether increases and decreases in these variables exert unequal effects—a key motivation for adopting an asymmetric framework. Ugwuanyi et al. (2021) used OLS to show a positive link between prudent debt management

and economic development. While this affirms the role of effective governance, the model used was static and linear, and thus limited in its ability to capture time-varying or shock-related asymmetries in debt dynamics. Tarawalie and Jalloh (2021) conducted a panel study across ECOWAS nations (2000–2019) and identified an optimal debt-to-GDP threshold of 111%, beyond which debt hampers growth. While informative, the panel design obscures country-specific idiosyncrasies and does not address asymmetric effects or interest rate impacts specific to dollar-denominated loans. Kur et al. (2021) applied the ARDL model to differentiate the roles of external and domestic debt. They observed a positive impact of external debt on investment but highlighted the negative role of domestic debt servicing. Though methodologically sound, the study didn't explore whether the effects of increasing versus decreasing debt are symmetric.

Recent studies such as Uji (2023) and Babatunde et al. (2023) further corroborated the short-run negative effects of external debt on growth. Babatunde et al., however, also noted potential long-term benefits where debt is well-managed and productively applied. These contributions highlight the critical role of fiscal governance but remain limited by their linear frameworks. Existing literature provides details on the nexus of the external debt-economic growth relationship in Nigeria and similar economies. However, many studies rely on symmetric models that assume equal effects of rising and falling debt metrics. Few explore the distinct effects of debt servicing and interest rates. To fill these gaps, the present study adopts a Nonlinear Autoregressive Distributed Lag (NARDL) model to capture asymmetric, short- and long-run effects of external debt stock, servicing obligations, and interest rates on Nigeria's economic growth. This approach offers a better understanding of the debt-growth nexus and informs targeted, evidence-based policy recommendations.

### **3. Methodology**

#### **3.1 Theoretical Framework**

The DOT by Krugman (1988) and expanded by Sachs (1989) provides an underpinning theory for analyzing the impact of external debt on economic growth. The theory suggests that excessive debt creates uncertainty about future fiscal policies, discouraging investment and stifling economic growth. When debt levels become unsustainable, investors anticipate higher taxes or potential default, reducing capital inflows and economic expansion. This study applies the theory to assess how Nigeria's external debt burden, proxied by the growth rate of external debt stock (EDS), the growth rate of external debt servicing (EDC), and the external debt interest rate (EDI), impacts the growth rate of real Gross Domestic Product (GDPGR). In line with the theory, excessive external debt is expected to hinder growth by discouraging investment (Krugman, 1988; Sachs, 1989).

#### **3.2 Model Specification**

Grounded in the theoretical foundations of the DOT, this study adopts and extends the model framework proposed by Tama and Habila (2022) to examine the impact of external debt on economic growth. Specifically, external debt is proxied through the EDS, EDC, and EDI, while economic growth is proxied by GDPGR. Accordingly, the initial functional model is specified as:

$$GDPGR = f(EDS, EDC, EDI) \quad 1$$

These variables collectively embody the burden of external debt, which, according to debt overhang theory, can constrain investment and stifle long-term economic development.

To enrich the model and address gaps identified in Tama and Habila (2022), this study incorporates the real exchange rate (EXR) as an additional explanatory variable, acknowledging its beneficial role in inducing the cost of international trade and, consequently, economic output (Uji, 2023; Kanbi et al., 2022).

Thus, the extended model becomes:

$$GDPGR = f(EDS, EDC, EDI, EXR) \quad 2$$

To capture potential asymmetries nexus of external debt change and economic growth in both the short and long run, this study applies the NARDL model, following the methodological approach of Shin et al. (2014). Specifically, the NARDL framework decomposes each regressand into positive and negative partial sums to detect possible asymmetric effects. Formally, for any explanatory variable  $X_t$ , It is decomposed as:

$$X_t = X_0 + X_t^+ + X_t^- \quad 3$$

Where:

$$X_t^+ = \sum_{j=1}^t \max(\Delta X_j, 0) \text{ and } X_t^- = \sum_{j=1}^t \min(\Delta X_j, 0)$$

Accordingly, the asymmetric long-run regression model is given as:

$$GDPGR_t = \beta_0 + \beta_1^+ EDS_t^+ + \beta_2^- EDS_t^- + \beta_3^+ EDC_t^+ + \beta_4^- EDC_t^- + \beta_5^+ EDI_t^+ + \beta_6^- EDI_t^- + \beta_7^+ EXR_t^+ + \beta_8^- EXR_t^- + \varepsilon_t \quad 4$$

Where:  $\beta_0$  – is the intercept;  $\beta_{1-4}$  are the coefficients of the explanatory variables to be estimated,  $t = 1981-2023$ . The associated dynamic NARDL error correction model (ECM) specification is therefore expressed as:

$$\begin{aligned} GDPGR_t = & \alpha_0 + \phi GDPGR_{t-1} + \lambda_1^+ EDS_{t-1}^+ + \lambda_2^- EDS_{t-1}^- + \lambda_3^+ EDC_{t-1}^+ + \lambda_4^- EDC_{t-1}^- \\ & + \lambda_5^+ EDI_{t-1}^+ + \lambda_6^- EDI_{t-1}^- + \lambda_7^+ EXR_{t-1}^+ + \lambda_8^- EXR_{t-1}^- + \sum_{j=1}^q \rho_i \Delta GDPGR_{t-1} \\ & + \sum_{j=1}^P \theta_{1i}^+ \Delta EDS_{t-1}^+ + \sum_{j=1}^P \theta_{2i}^- \Delta EDS_{t-1}^- + \sum_{j=1}^P \theta_{3i}^+ \Delta EDC_{t-1}^+ \\ & + \sum_{j=1}^P \theta_{4i}^- \Delta EDC_{t-1}^- + \sum_{j=1}^P \theta_{5i}^+ \Delta EDI_{t-1}^+ + \sum_{j=1}^P \theta_{6i}^- \Delta EDI_{t-1}^- + \sum_{j=1}^P \theta_{7i}^+ \Delta EXR_{t-1}^+ \\ & + \sum_{j=1}^P \theta_{8i}^- \Delta EXR_{t-1}^- + \varepsilon_t \end{aligned} \quad 5$$

$\varepsilon$  is the error term, capturing other factors that might influence GDDGR but are not in the model  $\Delta$  denotes the first difference operator;  $\phi$  captures the error correction term, reflecting the speed of adjustment towards the long-run equilibrium,  $\lambda_i$  and  $\theta_{ij}$  are the long-run and short-run coefficients for the positive and negative partial sums, respectively, and  $\varepsilon_t$ , the stochastic disturbance term. This approach allows the study to evaluate not only the symmetric but also the asymmetric responses of economic growth to changes in external debt variables and real exchange rate dynamics.

**Table 3.1: Variables Measurement**

Variables	Description	Unit of Measurement (Source)
EDS	The annual increase in the total amount of external debt a country owes to foreign creditors.	Calculated as the percentage change in external debt stock from one year to the next (World Bank).
EDC	The annual rate of change in total payments made by the country to service its external debt, including both interest and principal repayments.	Calculated as the percentage change in external debt service from one year to the next (World Bank).

EDI	The rate of interest charged on external debt by foreign creditors reflects borrowing costs.	In percentage (World Bank).
GDPGR	% increase or decrease in a country's Gross Domestic Product reflects overall economic performance.	Calculated as the percentage change in GDP from one year to the next (World Bank).
EXR	The amount of the Nigerian Naira relative to the USD, adjusted for inflation, indicates international competitiveness.	Measured as the nominal exchange rate adjusted for relative inflation between Nigeria and its trading partners (NBS).

### 3.3 Estimation Technique

The empirical analysis begins with descriptive statistics to reveal the summary of the characteristics of the variables. This initial step facilitates an understanding of the central tendencies, dispersion, and distributional properties of the dataset over the study period, thereby offering preliminary insights into the underlying trends and potential anomalies.

Robustness and reliability of the econometric estimations were carried out with the use of the stationarity test using the Augmented Dickey-Fuller (ADF) test. This is to correct any potential random walk behavior inherent in non-stationary time series data, thereby avoiding spurious results (Dickey & Fuller, 1981; Said & Dickey, 1984). Conducting the tests ensures that any inherent asymmetries and structural shifts within the data are properly accounted for, thereby strengthening the empirical validity of the findings.

Following the confirmation of stationarity properties, a long-run test using the NARDL Bound test is conducted to determine long-run equilibrium relationships among the variables. If individual time series are integrated of order one,  $I_1$ , but a linear combination of them is stationary, then the series are cointegrated (Engle and Granger, 1987). This would imply that, despite short-term fluctuations, the variables share a related long-term stochastic trend, which is critical for the theoretical propositions of the debt overhang framework.

For the main estimation, this research employs the NARDL model by Shin et al. (2014). The NARDL model is particularly suitable for this analysis as it accommodates both long-run and short-run asymmetries, allowing for the detection of differential effects of positive and negative changes in the regressands on the regressor. The model represents an advancement over the traditional linear ARDL approach proposed by Pesaran et al (2001), as it captures nonlinear dynamics and asymmetric adjustment processes within a single-equation framework. Importantly, the NARDL methodology relaxes the conventional restriction that all variables must be integrated of the same order. It allows for a mix of  $I_0$  and  $I_1$  variables, provided none are integrated of order two or higher, making it particularly flexible for applied economic research. Furthermore, as suggested by Granger and Yoon (2002), the NARDL approach also enables the identification of potential hidden cointegration, wherein traditional linear cointegration techniques might fail to identify equilibrium relationships masked by asymmetries. Post-estimation tests, such as serial correlation, heteroscedasticity, and normality, are performed to validate the findings' robustness



## 4. Data Analysis and Presentation of Results

### 4.1 Descriptive Statistics

#### 4.1 Summary of Statistics

	GDPGR	EXR	EDS	EDC	EDI
Mean	3.042141	112.9787	7.172148	187.1478	2.731628
Median	3.251681	111.2313	6.619700	-39.26777	2.560000
Maximum	15.32916	425.9792	48.94575	16575.51	6.800000
Minimum	-13.12788	0.546781	-48.02595	-6672.978	1.200000
Std. Dev.	5.255826	119.0566	16.19536	2773.590	1.148427
Skewness	-0.839215	1.050324	-0.330699	4.595466	1.265114
Kurtosis	4.845801	3.278607	6.075115	30.63191	5.059668
Jarque-Bera	11.15153	8.045202	17.72635	1519.326	19.07102
Probability	0.003789	0.017906	0.000142	0.000000	0.000072
Sum	130.8121	4858.084	308.4024	8047.357	117.4600
Sum Sq. Dev.	1160.196	595327.5	11016.16	3.23E+08	55.39319
Observations	43	43	43	43	43

#### Source: Authors' Computation (2025)

The outcome in Table 4.1 shows that GDPGR recorded a mean of 3.04%, indicating modest average economic growth during the period. The distribution of GDPGR is slightly negatively skewed ( $-0.84$ ), suggesting a longer left tail, and it exhibits leptokurtic behavior (kurtosis =  $4.85$ ), reflecting the presence of extreme values such as economic contractions. The minimum growth rate was  $-13.13\%$ , while the maximum was  $15.33\%$ , with a standard deviation of  $5.26\%$ , implying moderate to high variability. The Jarque-Bera statistic ( $11.15$ ,  $p < 0.05$ ) confirms a significant departure from normality.

The Real Exchange Rate (EXR) had an average value of ₦112.98, reflecting long-term depreciation trends in the naira. The variable is positively skewed ( $1.05$ ) and moderately leptokurtic (kurtosis =  $3.28$ ), implying infrequent but large fluctuations in the exchange rate. The standard deviation is high at  $119.06$ , while values ranged from ₦0.55 to ₦425.98. The Jarque-Bera statistic ( $8.05$ ,  $p < 0.05$ ) indicates significant non-normality.

EDS averaged  $7.17\%$ , with a standard deviation of  $16.20\%$ , suggesting substantial year-to-year variation. The range extends from  $-48.03\%$  to  $48.95\%$ . Although the skewness ( $-0.33$ ) suggests a slight left tail, the kurtosis of  $6.08$  reveals a heavy-tailed distribution, consistent with periods of sharp debt accumulation or reduction. The Jarque-Bera test ( $17.73$ ,  $p < 0.05$ ) rejects the normality assumption.

EDC shows an average value of  $187.15\%$ , driven largely by extreme outliers and structural adjustments. The standard deviation of  $2,773.59$  indicates extremely volatile behavior, further confirmed by the maximum ( $16,575.51\%$ ) and minimum ( $-6,672.98\%$ ) values. The distribution is highly positively skewed ( $4.60$ ) and extremely leptokurtic (kurtosis =  $30.63$ ), indicating multiple large spikes, likely due to irregular debt repayments or rescheduling events. The Jarque-Bera statistic ( $1,519.33$ ,  $p < 0.05$ ) confirms a very strong deviation from normality. External Debt Interest Rate (EDI) had an average value of  $2.73\%$ , ranging from  $1.20\%$  to  $6.80\%$ . The standard deviation is  $1.15\%$ , reflecting moderate variability in borrowing costs. The distribution is positively skewed ( $1.27$ ) and leptokurtic (kurtosis =  $5.06$ ), suggesting occasional high-interest periods. The Jarque-Bera statistic ( $19.07$ ,  $p < 0.05$ ) indicates that the data is not normally distributed.

#### 4.2 Pre-Estimation Test

**Table 4.2: Result of Stationarity Test**

Variables	Levels Difference	1 <sup>st</sup> Difference	Remark
<b>GDPGR</b>	-3.2446** [0.0244]	-10.6805** [0.0000]	I <sub>0</sub>
<b>EDS</b>	-5.505448** 0.0000	-9.845981**    0.0000	I <sub>0</sub>
<b>EDC</b>	-2.359747** [0.1590]	-4.783481** [ 0.0004]	I <sub>1</sub>
<b>EDI</b>	-4.946282** [ 0.0002]	-6.578702** [0.0000]	I <sub>0</sub>
<b>EXCR</b>	-2.9163** [1.000]	-4.2415** [0.0017]	I <sub>1</sub>

**\*\*are ADF test statistics and [ ] are probability values**

**Source: Authors' Computation (2025)**

The outcome of Table 4.2 above shows that the ADF test to determine the stationarity of the variables shows that GDPGR is stationary at level, with an ADF test statistic of -3.2446 ( $p = 0.0244$ ), suggesting an I<sub>0</sub> variable. This implies that the GDPGR series is mean-reverting and does not require differencing for stationarity.

Similarly, EDS is also stationary at the level. The test statistic ( $-5.5054$ ;  $p < 0.01$ ) indicates strong evidence against the H<sub>0</sub> of stationarity, confirming that EDS is also I<sub>0</sub>. The External Debt Servicing Growth (EDC) variable, however, is non-stationary at level ( $-2.3597$ ;  $p = 0.1590$ ) but becomes stationary after first differencing ( $-4.7835$ ;  $p < 0.01$ ). This indicates that EDC is I<sub>1</sub>. The External Debt Interest Rate (EDI) is stationary at the level with an ADF statistic of  $-4.9463$  ( $p = 0.0002$ ), confirming it is I<sub>0</sub> and does not exhibit a unit root. The Real Exchange Rate (EXCR) is non-stationary at level ( $-2.9163$ ;  $p$  not significant) but becomes stationary after first differencing ( $-4.2415$ ;  $p = 0.0017$ ), implying it is I<sub>1</sub>.

**Table 4.3: Lag Selection Criterion**

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-117.5239	NA	23.10657	5.976774	6.185746	6.052870
1	-112.4131	8.725658*	18.92511*	5.776250*	6.027017*	5.867565*
2	-109.5959	4.672504	17.34152	5.687604	5.980165	5.794138

**Source: Authors' Computation (2025)**

Table 4.3 shows the results of lag selection criteria. Based on the minimum values of the AIC, lag length 1 is optimal for the model. This suggests that including one lag provides the best model fit with the lowest forecast error and information criteria values.

**Table 4.4 ARDL BOUND Test**

Test Statistic	Value	k
F-statistic	3.359894	8
Critical Value Bounds		
Significance	I0 Bound	I1 Bound
10%	1.95	3.06
5%	2.22	3.39
2.5%	2.48	3.7
1%	2.79	4.1

**Source: Authors' Computation (2025)**

The NARDL bounds result in Table 4.4 reveals an F-stat of 3.359894 with  $k = 8$  regressors. When compared with the critical bounds from Pesaran et al. (2001), the computed F-stat  $> I_0$  (2.22) and the  $I_1$  (3.39) at the 0.05 level. This confirms a long-run asymmetric cointegrating relationship between the variables.

This outcome supports the hypothesis that external debt changes have a long-run nonlinear impact on GDPGR behavior. The adoption of the NARDL framework is justified here due to its ability to capture potential asymmetries in the short- and long-run adjustment mechanisms.

### 4.3 Estimation of NARDL

**Table 4.5: Short-run Estimates**

Dependent Variable: GDPGR				
Variable	Coefficient	Std. Error	t-Statistic	Prob.*
C	-8.986577	3.365784	-2.669980	0.0118
GDPGR(-1)	0.189990	0.150344	1.263701	0.2155
D(EXR_POS)	0.027732	0.027775	0.998445	0.3256
D(EXR_NEG)	0.194900	0.293555	0.663931	0.5115
D(EDS_POS)	0.069092	0.050330	1.372780	0.1794
D(EDS_NEG)	-0.125367	0.047697	-2.628396	0.0131
D(EDI_POS)	-1.894026	0.847763	-2.234145	0.0326
D(EDI_NEG)	0.911358	0.625443	1.457141	0.1548
D(EDC_POS)	-0.000017	0.000247	-0.070033	0.9446
D(EDC_NEG)	0.000992	0.000416	2.384407	0.0232
CointEq(-1)	-0.810010	0.150344	-5.387704	0.0000
R-squared	0.538750	Mean dependent var		3.427142
Adjusted R-squared	0.409023	S.D. dependent var		4.665651
S.E. of regression	3.586720	Akaike info criterion		5.596610
Sum squared resid	411.6659	Schwarz criterion		6.010341
Log likelihood	-107.5288	Hannan-Quinn criter.		5.748259
F-statistic	4.152965	Durbin-Watson stat		2.303283
Prob(F-statistic)	0.001283			

**Source: Authors' Computation (2025)**

The short-run NARDL estimation, as displayed in Table 4.5, reveals that fluctuations in external debt exert asymmetric impacts on GDPGR in the short run. The CointEq(-1) is both negative and statistically significant at the 5% level (coefficient = -0.810010;  $p < 0.05$ ), thereby validating the presence of a stable long-run relationship. The coefficient value implies that around 81% of any short-term deviation from the long-run equilibrium is corrected annually, indicating a relatively swift adjustment process back to equilibrium.

The short-run estimates reveal that changes in the EDS exhibit an asymmetric influence on GDPGR. A negative shock in the EDS (EDS\_NEG), implying a deceleration in the accumulation of external debt, depicts a significant contractionary effect on GDPGR ( $\beta = -0.1254$ ,  $p = 0.0131$ ). This suggests that a 1% decline in the annual growth of external debt stock reduces GDPGR by approximately 0.13%, indicating the potential short-term reliance of the Nigerian economy on foreign borrowing to finance output expansion. Conversely, positive shocks in debt accumulation (EDS\_POS) are not statistically significant ( $p = 0.1794$ ), indicating that increases in external debt growth do not immediately stimulate economic growth within the same period.

A positive shock (EDI\_POS) representing an increase in external borrowing costs significantly hampers short-run GDP growth ( $\beta = -1.8940$ ,  $p = 0.0326$ ), confirming that rising interest burdens crowd out productive investments or impose fiscal constraints. Likewise, a

negative shock (EDI\_NEG), indicating a reduction in external debt interest rates, yields a positive but statistically insignificant effect on output growth ( $\beta = 0.9114$ ,  $p = 0.1548$ ), suggesting that while cheaper debt is theoretically growth-enhancing, the effect may be dampened by structural inefficiencies or delayed policy transmission.

A reduction in the growth rate of debt service payments (EDC\_NEG) significantly enhances short-run economic growth ( $\beta = 0.000992$ ,  $p = 0.0232$ ), reinforcing the proposition that easing the debt service burden releases fiscal space for growth-inducing expenditure. However, an increase in debt service growth (EDC\_POS) has a negative but insignificant effect ( $\beta = -0.000017$ ,  $p = 0.9446$ ) on GDPGR, implying that the economy may temporarily absorb debt repayment pressures without immediate output loss, possibly through reserve drawdowns or donor support.

Turning to the real exchange rate (EXR), both positive (EXR\_POS) with ( $\beta = 0.0277$ ,  $p = 0.3256$ ) and negative (EXR\_NEG) shocks with a coefficient ( $\beta = 0.1949$ ,  $p = 0.2155$ ) indicating, respectively that a depreciation and appreciation of the naira against the U.S. dollar, are statistically insignificant on GDPGR. Although depreciations in ₦/USD will result in a slight increase in GDPGR by 0.03%, while an appreciation will result in a 0.19% insignificant rise in GDPGR, neither shock is significant in the short term, suggesting that exchange rate changes may affect output through longer-run competitiveness channels rather than instantaneously. The  $R^2$  of 0.538750 shows that the regressands (EDI, EDS, EXR, EDI) explained about 53% variations in the regressor (GDPGR), while the model is statistically significant (F-stat,  $p = 0.0013$ ). The Durbin-Watson statistic (2.30) suggests the absence of autocorrelation in the residuals.

**Table 4.6: NARDL Long-run Coefficient**

Long Run Coefficients				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
EXR_POS	0.034236	0.034304	0.998038	0.3257
EXR_NEG	0.240615	0.361172	0.666206	0.5101
EDS_POS	0.085298	0.059944	1.422953	0.1644
EDS_NEG	-0.154772	0.054728	-2.828021	0.0080
EDI_POS	-2.338276	0.936914	-2.495720	0.0179
EDI_NEG	1.125120	0.779621	1.443161	0.1587
EDC_POS	-0.000021	0.000304	-0.070152	0.9445
EDC_NEG	0.001225	0.000539	2.272338	0.0299
C	-11.094404	3.339007	-3.322666	0.0022

**Source: Authors' Computation (2025)**

Table 4.6 presents the long-run estimates from the NARDL model. The results confirm the presence of long-run asymmetries in how exchange rates, external debt dynamics, and debt servicing costs affect economic growth in Nigeria.

Starting with the real exchange rate, both the positive change (EXR\_POS) and negative change (EXR\_NEG) coefficients are statistically insignificant (0.034 and 0.241, respectively;  $p > 0.05$ ). This indicates that a 1% appreciation or depreciation in the EXR does not exert a statistically meaningful long-run effect on GDPGR. Thus, while exchange rate fluctuations may influence macroeconomic stability in the short term, their long-term effects on output growth are muted.

In contrast, the EDS reveals a clear asymmetry. A 1% increase in external debt stock (EDS\_POS) will result in a 0.085% rise in GDPGR, which is statistically insignificant ( $p = 0.1644$ ). However, a 1% reduction in the external debt stock (EDS\_NEG) leads to a statistically significant 0.155% decline in GDP growth ( $p = 0.008$ ). This indicates that while debt accumulation may not always stimulate growth, aggressive debt reduction may contract

economic activity, possibly due to the dampening effects of austerity or constrained public investment.

Similarly, the external debt interest rate (EDI) reveals asymmetric growth effects. A 1 percentage point increase in EDI (EDI\_POS) significantly reduces GDP growth by approximately 2.34 percentage points ( $p = 0.0179$ ), highlighting the detrimental long-run burden of higher borrowing costs. Conversely, a 1 percentage point decrease in EDI (EDI\_NEG) corresponds to a 1.13% rise in GDPGR, although this effect is statistically insignificant ( $p = 0.1587$ ). These results support the debt overhang theory (Krugman, 1988), wherein rising debt service costs crowd out productive expenditures, while easing costs may not sufficiently stimulate growth without complementary policy support.

Regarding external debt servicing (EDC), the effects are again asymmetric. A 1% increase in debt servicing payments (EDC\_POS) has an almost negligible and statistically insignificant impact ( $-0.000021$ ;  $p = 0.9445$ ). In contrast, a 1% decrease in debt servicing (EDC\_NEG) significantly raises GDP growth by 0.00123 percentage points ( $p = 0.0299$ ). Although small in magnitude, this positive effect underlines the role of fiscal space in fostering long-term growth, as reductions in servicing obligations free up resources for development expenditure.

Hence, the findings showed that increases in borrowing costs and reductions in debt stock tend to have stronger negative effects on growth, compared to the relatively muted or statistically insignificant impacts of their positive counterparts. These findings reinforce the policy relevance of prudent debt management, with attention to not just the size, but also the structure and cost of external debt obligations (Reinhart & Rogoff, 2010; Presbitero, 2012).

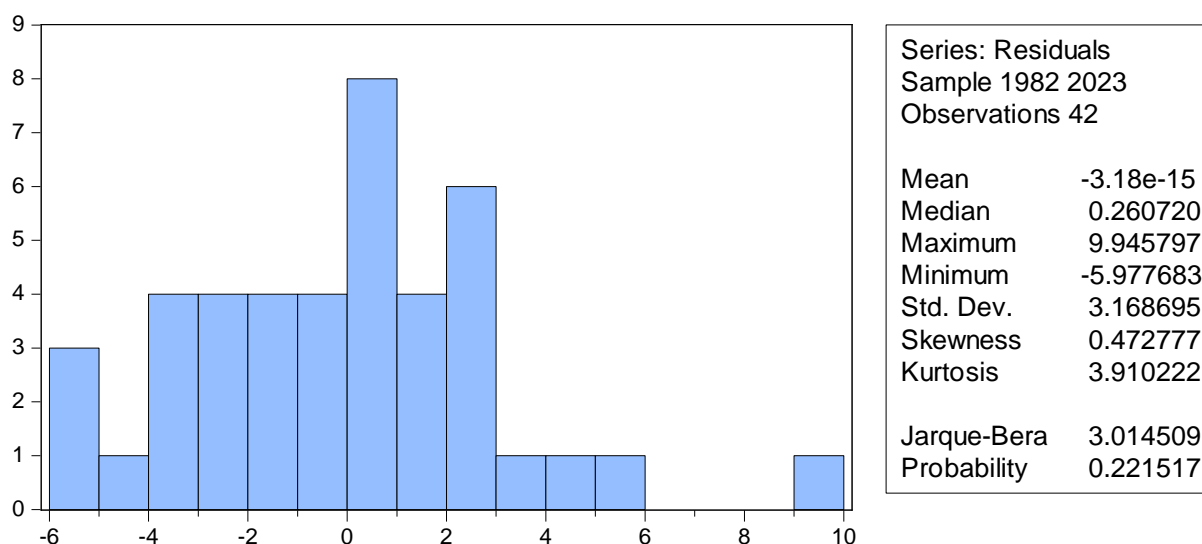
#### 4.4 Post Estimation

**Table 4.7: Diagnostic Checks**

Test	Test Statistic	df	p-Value	Decision
Serial Correlation LM Test	2.4326	78	0.1290	No serial correlation
Heteroskedasticity Test	0.4463	78	0.8990	Homoskedasticity is not rejected
Ramsey RESET Test	0.4567	78	0.5042	The model is correctly specified

**Source: Authors' Computation (2025)**

The diagnostic test outcome in Table 4.7 affirms the validity of the estimated NARDL model used to analyze the asymmetric effects of external debt changes on economic growth in Nigeria within the period under study. The serial correlation LM test reports a p-value of 0.1290, which is above the 5% significance level. This implies that there is an absence of serial correlation in the model's residuals, thereby validating the dynamic specification and ensuring that the error terms are not autocorrelated (Godfrey, 1978). The heteroskedasticity test returns a high p-value of 0.8990, suggesting the presence of constant variance (homoskedasticity) in the error terms. This implies that the model is efficient and that the standard errors are not biased due to unequal variances (White, 1980). The Ramsey RESET test, which evaluates the model's functional specification, yields a p-value of 0.5042 ( $> 0.05$ ), indicating that there is an absence of model misspecification. Therefore, the model is specified correctly, capturing the essential dynamics of the data without omitted non-linear relationships (Ramsey, 1969). Taken together, these diagnostics confirm the econometric adequacy of the model, enhancing the credibility of its long-run and short-run estimates.



**Figure 4.1: Normality Test of Residuals**

The histogram and accompanying Jarque-Bera test statistics (JB) in Figure 4.1 assess the normality of the residuals from the NARDL model. The residuals have a mean close to zero ( $-3.18 \times 10^{-15}$ ), with a median of 0.2607, suggesting a symmetric distribution. The skewness value of 0.4728 indicates mild rightward asymmetry, while the kurtosis value of 3.91 is slightly above the normal distribution benchmark of 3, indicating a modestly leptokurtic shape. The JB 3.0145 (p-value of 0.2215 > 0.05), the  $H_0$  of normally distributed residuals is accepted. Therefore, the residuals conform reasonably to the normality assumption, a crucial diagnostic requirement for reliable inference in regression models (Jarque & Bera, 1980).

#### 4.5 Discussion of Findings

The findings from this study revealed that the significant point **Eq(-1) of  $-0.8100$  ( $p < 0.05$ )** confirms the existence of a long-run equilibrium relationship among the variables, indicating that any deviation from the long-run GDPGR equilibrium due to external debt and exchange rate shocks is rapidly corrected at 81% speed of adjustment. In the short run, the impact of **real exchange rate fluctuations (EXR\_POS and EXR\_NEG)** on economic growth is found to be insignificant, aligning with the long-run results where both appreciation and depreciation have negligible effects on GDPGR within the period under study. This outcome supports the findings of Uji (2023) and Babatunde et al. (2023), who argue that exchange rate policies in Nigeria tend to influence **short-term price stability** rather than contribute meaningfully to long-term output expansion. The insignificance of exchange rate changes may reflect structural rigidities in the Nigerian economy, such as limited export diversification and weak industrial competitiveness, which constrain the growth-enhancing potential of currency adjustments.

The growth rate of external debt stock (EDS) exhibits a notable asymmetric effect in the short run. While positive shocks (EDS\_POS) in debt accumulation do not significantly influence GDP growth, a 1% reduction in external debt stock growth (EDS\_NEG) significantly reduces GDP growth ( $\beta = -0.1254$ ,  $p = 0.0131$ ). This supports the DOT's prediction that excessive austerity or aggressive deleveraging may generate contractionary effects by curbing public investment and fiscal space. As highlighted by Eke and Akujubi (2021), the mismanagement of external borrowings in Nigeria exacerbates the negative growth impact when debt stock declines, especially in contexts where foreign debt has been used to finance consumption rather than productive infrastructure.

Regarding the external debt interest rate (EDI), the findings are consistent across horizons. In the long run, a rise in interest rates (EDI\_POS) significantly reduces GDP growth, reflecting the crowding-out effect, where higher debt servicing costs reduce fiscal space for productive

investment. This aligns with Krugman (1988) and Manasseh et al. (2022), who emphasize that the debt service burden hampers public investment. In the short run, the same dynamic is evident; EDI\_POS exerts a negative and significant effect on GDP growth ( $p = 0.0326$ ), reinforcing the sensitivity of Nigeria's growth trajectory to changes in borrowing costs. Interestingly, reductions in EDI (EDI\_NEG) do not yield significant long-run or short-run growth effects. This suggests that lower interest rates alone are insufficient to spur growth, particularly in the absence of institutional reforms or efficient allocation of fiscal savings. This asymmetry mirrors the findings of Presbitero (2012), who highlights the limited efficacy of concessional borrowing when structural weaknesses persist.

External debt servicing (EDC) shows asymmetric effects as well. While increases in debt servicing costs (EDC\_POS) do not significantly impact GDP growth, a reduction (EDC\_NEG) significantly improves growth outcomes both in the long run ( $p = 0.0299$ ) and short run ( $p = 0.0232$ ). This indicates that relieving fiscal pressure through lower debt obligations enables the government to reallocate resources toward growth-enhancing sectors such as infrastructure, health, and education, an argument well supported by the work of Reinhart and Rogoff (2010).

#### **4.6 Comparison with Previous Studies**

The asymmetric short-run effects identified in this study resonate with the findings of Koneh (2022), who noted that while external debt can boost output in the short term, it tends to be detrimental in the long run if poorly managed. Likewise, Tama and Habila (2022) found that rising debt service obligations contribute to underdevelopment by diverting resources away from productive uses. These patterns validate the core tenets of the **Debt Laffer Curve**, as advanced by Adekunle et al. (2021), which posits that beyond a certain threshold, additional borrowing generates diminishing returns and may ultimately reduce economic performance. The present study's results underscore the critical importance of debt sustainability, interest rate moderation, and efficient debt utilization as pathways for achieving inclusive growth in Nigeria.

#### **5. Conclusion and Recommendation**

This study provides empirical evidence on the asymmetric short- and long-run effects of changes in external debt on economic growth in Nigeria. The findings suggest that the effects of debt on growth are not uniform; rather, they vary depending on whether debt indicators are rising or falling. While modest increases in debt stock or servicing may not yield noticeable improvements in growth, sudden or large-scale reductions, particularly under tight fiscal conditions, can impose economic strain. Notably, the analysis reveals that higher external debt interest rates have a significantly negative effect on growth, reflecting the strain that rising repayment costs place on public investment capacity.

These observations call for a more calculated and forward-looking approach to external debt management. Rather than aiming for rapid debt contraction, which may undermine economic stability, policymakers should consider gradual, well-sequenced strategies that prioritize productive investments. Borrowing should be concentrated on initiatives that are likely to generate economic returns, such as infrastructure development, technological advancement, and human capital formation. Additionally, the terms of borrowing should be reassessed to minimize interest-related pressures through renegotiation or restructuring where feasible.

To mitigate the adverse effects of debt servicing, the government must improve revenue mobilization mechanisms, plug fiscal inefficiencies, and ensure that public spending is both targeted and efficient. Enhancing transparency and accountability in external loan usage will also be essential, ensuring that borrowed funds are directed toward projects that deliver measurable economic benefits. The evidence presented here reinforces the view that

sustainable growth does not depend solely on limiting the scale of external borrowing, but rather on optimizing the quality, cost, and purpose of such debt.

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