Public Debt and Economic Growth in Nigeria: Nonlinear Dynamics and Optimal Threshold Analysis

**Abstract**

*This paper explored the non-linear effect of public debt on the growth of the Nigerian economy from 1981 to 2022. The inspiration for the paper hinged on the rising debt/GDP ratio recorded in Nigeria in recent times, which points to an impending greater debt burden on the economy. In executing this study, the autoregressive distributed lag (ARDL) model and the threshold regression analysis were employed in the analysis. Findings from the analysis indicated there is a non-linear relationship between debt and economic growth, and established a debt/GDP threshold level of 26.85% and the debt-revenue threshold level of* 22.86%*. It has been established that above this threshold level, public debt exerted a negative and significant effect on growth, while below the threshold level, debt is growth-enhancing. It therefore follows that the government must not exceed this threshold level to avoid an unbearable burden on the economy. It is recommended that vital the government take urgent action to meet the fiscal consolidation and public debt reduction imperatives by implementing comprehensive reforms that target both revenue and expenditure.*

**Key Words:** Public Debt, Economic Growth, Non-Linear Effect, Public Debt Threshold.

**JEL Classification:**E62; F34; H68; O47.

**Introduction**

The rationale for public debt accumulation is multidimensional. One of such is the inability of the government to mobilize adequate domestic savings for productive investments (Omotosho, Bawa, &Doguwa, 2016). Thus, this perspective views debt accumulation to be dependent on the need to finance the escalating public expenditure programmes. Consequently, debt is accumulated to bridge the gap between public revenue and public expenditure (Charles, 2012); hence, it is a tool for financing the budget deficit. Earlier studies by Bacha (1990) and Taylor (1993) have employed the three-gap model to showcase the rationale for debt accumulation in an economy. The savings-investment gap, centres on the fact that developing economies have a deficiency in investment capital to finance their investments, hence, they resort to borrowing. Moreover, the fiscal constraint gap arises from the need for the government to bridge the gap between revenue and expenditure for public works, while the foreign exchange gap arises because developing countries do not have adequate foreign exchange to finance their imports hence they resort to borrowing. Public debt increase as experienced by many developing countries of the world had been come global concern, following the fall in oil prices, variation on exchange rate etc which has brought adverse effect to some developing nations of the world such as Nigeria. Also in reflecting on the economic implication of the country’s growing debt record, it is a very important policy issue which needs broad public debate. The rate of country’s indebtedness is problems that are facing many growing nation since the beginning of the 21st Century. Therefore increasing levels of public debt of a country can be harmful to the growth of the economy of any country if not well utilized (Obed et al., 2017; Akhanolu et al., 2018).

Despite the need for borrowing, excessive borrowing can be detrimental to the economy as a whole. An excessive amount of borrowing increases the economy's susceptibility to macroeconomic shocks. As pointed out by Buriel *et al*. (2020), an excessive amount of public debt might cause short-term economic disruption, limit economic recovery, or worsen instability. This is because having a high debt profile hinders the ability to implement countercyclical fiscal policy and throws up negative externalities for the private industry. Furthermore, the high-risk premia and borrowing costs that reflect perceived sovereign weakness have the potential to spread to other international industries or jurisdictions. According to Ekong, Effiong, & Inyang (2021), a nation with a high level of public borrowing may also experience "liquidity shocks and defaults." Secondly, excessive governmental borrowing may impede economic expansion (Checherita& Rother, 2012). Checherita-Westphal*et al*. (2014) contend that debt contraction to support wasteful spending or above growth-maximizing levels of the public capital stock can impede growth. Masuch, Moshammer &Pierluigi (2016) contended that a nation's institutional quality has a significant impact on how debt affects growth. Thus, low growth and high debt are possible in nations with poor institutions, while debt will be pro-growth in those economies with good institutions.

Cohen (1993) and Clements *et al*. (2003) noted that the negative effects of debt on growth are caused by both the debt's stock and the debt's service payments, which have the potential to "crowd out" public investment. This is the case when governmental investments are decreased, and resources are drained by service payments and debt repayments. Due to the reduction in government spending brought by debt-induced liquidity constraint, Taylor (1993) noted that debt service has a negative effect on growth. The debt-servicing obligations imply a liquidity constraint that might cause the budget to divert from public investments or the social sector(Folorunso & Felix, 2008). Public spending is probably going to be a big factor influencing the economic activity in many functional areas; therefore, this has to be taken into consideration (Fosu, 2007).

Due to the "debt overhang" impact, an accumulated debt stock lowers economic performance. A substantial debt stock acts as a tax disincentive, discouraging investment since prospective investors believe that future revenue would be subject to taxes in order to pay off the debt. Increases in the budget deficit, unpredictability brought on by extraordinary financing, depreciation of the currency, potential monetary expansion, and expected inflation are all factors contributing to macroeconomic instability (Claessens *et al*., 1996). Audu (2004) emphasized the significance of the "debt overhang" theory. He maintained that the burden of debt servicing has exacerbated social issues and impeded Nigeria's economic progress. Deteriorating infrastructure arising from inadequate financing hindered the provision of services by important institutions intended to improve the living situations of disadvantaged people. It seems that the government has limited private sector investment and growth through lost externalities by reducing spending on social and economic infrastructure. Given that a sizeable amount of all investments in the nation are made by the government, this has decreased overall investment (Folourunso& Felix, 2008). Nigeria has not been able to save enough and continues to carry a huge fiscal deficit despite rallying oil prices. With the increase in Nigeria’s fiscal deficits and high debt servicing costs, public debts may increase over the medium term. The IMF has recommended fiscal tightening to help address debt vulnerabilities, and a deliberate cooperation between the fiscal and monetary policies/authorities to navigate present challenges (Nwachukwu, 2022; Chenge & Oigbochie, 2023).

The ratio of debt stock to GDP is a traditional debt indicator that compares a country’s debt stock with its productive capacities. By implication, the higher a country’s debt stock compared to its output, the greater the debt burden or indebtedness of that country. This ratio shows that there has been a rising trend in the debt/GDP ratio in Nigeria in recent times. Nigeria’s ratio did not decline substantially from the 1980s until the debt relief was granted by the Paris Club in 2006. Between 1981 to 1984, the public debt of Nigeria averaged N27.66 billion. With the real GDP of N17,68.85 billion, the debt/GDP ratio was 0.162%. Afterwards, the debt/GDP ratio maintained an upward trend, reaching an average of 16.459% in the period 2000-2004. There was a substantial decline in the debt/GDP ratio to 7.165% between 2005-2009 due to the debt relief granted by the Paris Club as of 2006. Consequently, between 2010-2014, the debt/GDP ratio increased to an average of 12.091% with a further increase to 47.712% between 2020 and 2022. The ratio has increased tremendously from 0.07% in 1981 to 15.71% in 2000, with a further increase to 26.55% and 54.73% in 2017 and 2022, respectively.

The rising debt/GDP ratio in recent times therefore spurs concerns as to the magnitude of debt burden that Nigeria faces, and the implications on the overall economy. Consequently, the paper aims at establishing the linearity and non-linearity effect of public debt on economic growth, and to establish the optimal threshold level of debt that will not be deleterious to the overall economy. To achieve this, the paper utilizes the autoregressive distributed lag (ARDL) model and the threshold regression analysis to examine time series data that covers the period 1981 to 2022. The selected period is long enough to capture the dynamics in the public debt situation of Nigeria across different economic and political epochs.

**Literature Review**

**Conceptual Literature**

 **Public Debt**

Public debt is defined as the total debts of a country, which include debts of governments at all levels, such as local, state, and federal, which can either be external or domestic. Public debt thereby shows how much public spending is financed through borrowing instead of taxation (Makau, 2008, cited in Christabell, 2013). Public debt is one of the major sources used in financing government projects. Public debt has been generally described as one of the major indicators of the macroeconomic variables that form the image of countries in the international markets. Generally, it is one of the determinants of foreign direct investment flows. However, the prudent management of public debt increases economic growth and stability via resource mobilization with low borrowing costs and limited financial risk exposure (Christabell,2013).

**Economic Growth**

The concept of economic growth entails the rapid increase in total output of the economy in real terms. This is measured as the growth rate of real gross domestic product (GDP) over a period of time. The concept of economic growth portrays the health status of the economy, as a positive growth rate indicates economic progress, while a negative growth rate indicates a decline in the total output of the economy. The concept of economic growth, therefore, has significant implications on other macroeconomic variables such as employment and price stability. The growth of the economy is often believed to be driven by labour and capital inputs, with an element of technological progress.

 **Non-Linear Effect/ Public Debt Threshold**

The nonlinearity effect is a term used to present the fact that there is no linear relationship between public debt and growth. This concept was introduced by Cohen (1994) where he discussed the Debt Laffer Curve. The theory stipulates a nonlinear relationship between foreign debt and growth. It follows that the nonlinearity effect assumes that the relationship between public debt and economic growth is expressed as an inverted U-shaped. This implies that public debt contributes to growth initially up to a certain point, after which it stifles growth. This has been discussed in the empirical literature as the threshold level of public debt. Therefore, public debt threshold refers to the optimal level of government borrowing, beyond which, if exceeded, can be detrimental to economic growth.

 **Theoretical Literature**

Some of the theories explored in this study include the neo-classical growth theory, the growth-cum-debt theory, the debt overhang theory, the crowding out theory of public debt, and the debt Laffer Curve.

**Neo-Classical Growth Theory**

This theory was postulated in 1956 by Robert Solow when he [[1]](#endnote-1)put forward a formal model that postulated that the key variable in growth is labour productivity (i.e., output per worker). For this model, the role of technological change became imperative and even more important than capital accumulation. The model assumed that output (Y) is produced by employing technology, labour, and physical capital. The model is expressed as Y = f(A, K, L); where Y is the aggregate output, A is the number based on the current state of technology, K is the quantitative measure of the size of the stock of manufactured capital and L the quantity of labour employed during that period of time K, A and L are the only factors of production explicitly included in the model. All factors are relative for the production of output, with the exponents in the equation indicating their relative contribution and productivity that increases as a result of technological change, in addition to changes in organization and practices. Thus, an increase in government expenditure could be justified if it results from a rise in education and health services because they are assumed to be the most important investments in human capital. It is against the backdrop that the neo-classical growth theory was adopted considering the fact that public debt if borrowed to finance health, education and development investments, it is referred to as being productive, which can contribute positively to economic growth via increased labour, capital and technology (Precious, 2013; Eze, Nweke and Atuma, 2019.

***The Growth-cum-Debt Theory***

Chenery and Strout (1966) established the growth-cum-debt theory, which is based on the typical neoclassical growth model. External borrowing, according to the theory, is utilized to bridge the gap between domestic savings and investment. External borrowing contributes favourably to economic growth when capital mobility is complete (allowing nations to borrow and lend). It is assumed under the growth -cum- debt paradigm that debt was incurred for investment purposes and that the investment will have a multiplier impact on economic growth (Nyong, 2005). The growth-cum-debt model evaluates debt capacity in terms of the advantages and costs of borrowing during the economic growth process (Ekong, Effiong, & Inyang, 2021). The primary idea is that a country's ability to service debt will be maintained as long as debt increases contribute significantly to growth over time. According to the model, in order to sustain debt servicing capacity over time, production growth should equal or surpass the cost of borrowing, as measured by the interest rate (Hjertholm, 1999). Thus, the debt plan will only thrive in the long run if there is substantial economic growth to support it.

***Debt Overhang Theory***

Krugman (1988) proposed that there is a possibility that a country's cumulative debt may surpass its repayment capabilities in the near future. In other words, the predicted cost of service will start to discourage both internal and foreign investments, because efforts to achieve economic expansion through lucrative operations would still result in increased debt acquisition (Omodero, 2019). Debt overhang dampens economic growth by discouraging private-sector internal and foreign investments that might otherwise support economic progress (Krugman, 1988). Potential investors would be deterred on the grounds that they would be less eager to incur investment costs today in order to increase future output, since governments would tax them more heavily the more production there is (Gordon & Cosimo, 2018).

According to Krugman (1988), mounting public debt lowers incentives for saving and investment while also acting as a levy on future output. The idea specifically maintained that because the cost of debt servicing affects the amount of money available for investment, a legally imposed liquidity constraint on debt would limit investment and slow growth even more. According to the theory, both the total amount of public debt and the cost of servicing it have an impact on economic growth by deterring private investment or changing the makeup of government spending. By reducing the public resources available for investment in infrastructure and human capital, debt service may deter growth (Coccia, 2017).

Debt overhang is a major contributor to stifled economic growth in heavily indebted countries (Yusuf & Mohd, 2021). As Àkos and Istvàn (2019) highlighted in the context of impoverished nations, servicing enormous public debts may deplete the indebted country's revenue to the point that the country's potential to return to development routes is bleak, even if the country implements effective reform programs. According to Krugman (1988),

*“If a country's debt exceeds its ability to repay, projected debt payments will be a rising fraction of the country's future production level”.*

As a result, investment and growth will be inhibited due to the anticipation of high tax rates on local sector returns provided to current international creditors. Due to the uncertainty and bad incentive effects that debt overhang causes, private investment programs are hampered (Spilioti & Vamvoukas, 2015). A high debt load also stimulates capital flight by increasing the danger of depreciation and taxes, and hence the urge to safeguard the true worth of financial assets (Yusuf & Mohd, 2021).

***Crowding Out Theory of Public Debt***

Consistent with the crowding out hypothesis, debt servicing may become such a burden that government income may no longer be enough for the provision of public services that complement private investment and increase private sector engagement in the economy (Omodero, 2019). Serieux &Yiagadeesen(2001) noted that

*“significant debt obligation implies that the government's short-term earnings must be spent to service the debt, squeezing out public investment in the economy”.*

Due to the fact that certain private and public investments are complementary, reducing public investment may result in a decline in private investment (Diaz-Alejandro, 1981; Taylor, 1983). In line with Panizza, Sturzenegger, and Zettelmeyer (2010), excessive domestic borrowing causes financial instability, crowds out the private sector, and lowers public sector investment due to the negative effects of debt servicing.

The funding of the government's deficit through domestic and foreign borrowing may lead to higher interest rates, less disposable income, and higher wages, all of which diminish corporate profitability and, consequently, private investment. As a result, this might deter or crowd out private investment and reduce the amount of production in an economy (Spilioti & Vamvoukas, 2015). Fiscal expansion, according to Keynesian economists, has the inclination to boost aggregate demand for private sector products via the fiscal multiplier, hence supporting the rise of private investment. Increased government expenditure backed by borrowing reduces private sector savings. This is due to two major factors: First, when fiscal policy is expansionary, private sector savers buy government bonds, resulting in less savings to finance private sector investment. Moreover, increased government borrowing tends to raise interest rates, and higher interest rates squeeze out private investment. Furthermore, present borrowing crowds out private investment by transferring the tax burden to future generations (Gordon & Cosimo, 2018).

Classical economists believe that governmental debt is harmful to the economy, especially if it weakens both the financial discipline of the budget process and the private sector's access to credit. This concept contended that governmental debt repayments, mostly from foreign sources, choke out economic growth by discouraging private investment and discouraging potential foreign investors. The Ricardian equivalence theory, on the other hand, “claims that budgetary stabilization efforts have no effect on economic growth”. This hypothesis assumes that changes in government spending and income are matched by changes in private savings (Saungweme, Odhiambo, & Camarero, 2019).

***The Debt Laffer Curve Theory***

According to Cohen (1993), the Debt Laffer Curve theory posits “a nonlinear relationship between foreign debt and growth”. He maintained that

*“there is an appropriate amount of debt that may stifle growth and going over that leads to economic stagnation”.*

The Debt Laffer Curve depicts the link between the face value of debt and investment by explaining that once outstanding debt exceeds a particular level, repayment ability begins to decline (Senadza, Fiagbe, & Quartey, 2018). Borrowing above such a level results in debt overhang and debt servicing issues, which may slow growth (Pattillo, Poirson, & Ricci, 2002).

**Empirical Literature Review**

Diverse scholars have explored the debt-growth nexus over the years. Taking Nigeria and South African economies into consideration, Folorunso & Felix (2008) investigated the impact of foreign borrowing on the growth. The result revealed that the debt service ratio accelerated production growth in Nigeria but slowed it in South Africa. The basis for their results was the repayment patterns of such debts. During their study time, Nigeria barely repaid a small portion of her foreign debt, but South Africa repaid it substantially. Furthermore, while debt servicing is expected to have a favourable influence on production growth in Nigeria, the more the debt is huge, the more likely it is to retard output growth.

Nasa(2009) explored the desirable quantity of debt for economic development by estimating the debt threshold using Hansen's endogenous threshold model and yearly information for 56 nations from 1970 to 2000. The study revealed a debt/GDP threshold ratio of 45%, indicating that once this level is reached, public debt becomes detrimental to production growth. The author also established that the ideal level of debt for growth that debtors should aspire for is 7%.

For Pakistan between 1972 and 2005, Malik, Hayat, & Hayat (2010) used Ordinary Least Squares to analyze the link between foreign debt and economic growth. Based on the research, “foreign debt has a negative and significant association with economic growth”, pointing out that an increase in foreign debt will limit economic growth. Similarly, empirical result suggests that “debt servicing has a significant and negative impact on GDP growth”, implying that rising debt servicing costs will reduce economic growth possibilities. Kumar and Woo (2010) deliberated on the effects of high public debt on long-run economic growth across four decades, accounting for a wide range of determinants of growth as well as significant estimation issues such as "reverse causality and endogeneity." According to the data estimation results, there is a negative association between debt and growth.

Rais & Anwar (2012) examined the effects of external debt on the Pakistani economy between 1972 and 2010. This study employed a simple Ordinary Least Squares regression approach to probe whether both domestic debt as a percentage of GDP and foreign debt as a percentage of GDP had a negative connection with growth. According to the research, both types of debt have a negative impact on the nation's economy since they are not effectively managed and utilised. The study, conversely, revealed that beneficial outcomes may be attained if debt is efficiently managed and deployed largely in productive regions, while avoiding unscrupulous individuals.

Adofu &Abula(2010) examined the empirical link between domestic debt and economic growth in Nigeria using yearly data from 1986 to 2005 and the OLS regression approach. The findings demonstrated how severely domestic debt has impacted the expansion of the economy. The study utilized an estimating approach that was unable to provide reliable coefficient estimates for the study variables and concentrated on domestic debt, which makes up a portion of the total debt stock. Egbetunde (2012) examined the relationship between Nigeria's public debt and economic growth using the vector autoregressive approach and yearly data from 1970 to 2010. The results of the VAR model showed that Nigeria's economic growth and its broken-down components of public debt are causally related in both directions.

Chinaemerem & Anayochukwu(2013) studied the impact of foreign loan financing on Nigerian economic development using time series data from 1969 to 2011. The Vector Error Correction Model (VECM) was used for estimation. The findings of the VECM revealed that foreign debt financing had a favourable and considerable impact on Nigeria's economic development. The findings revealed that debt financing in terms of London Club had a beneficial influence on economic development. However, the findings revealed that Paris debt, multilateral debt, and promissory loan funding had a considerable detrimental influence on Nigeria's economic development.

Forgha, Mbella, &Ngangnchi(2014) explored how foreign debt affects Cameroon's economic growth via investments. The study made use of yearly data from 1980 to 2013. In the estimate phase, the two-stage least squares method was applied. Their findings demonstrated that investments enhance development in the Cameroonian economy whereas debt slows growth. As a result, their findings backed up the debt overhang theory in Cameroon.

Using the Solow-Swan growth model enhanced for debt, Babu, Kiprop, Kalio, & Gisore(2015) investigated the impact of domestic debt on economic development in East African nations over the 1990–2010 period. The panel fixed-effect model was chosen and adjusted for heteroscedasticity using the Hausman specification test. The findings demonstrated that domestic debt significantly boosted economic growth in East African nations.

Omotosho, Bawa, &Doguwa(2016) studied the likelihood of threshold effects in the connection between public debt and economic progress in Nigeria using quarterly data. Overall, they found empirical support for a reversed U-shape relationship between various types of governmental borrowing and economic development. The model results suggested a threshold level of 73.70 percent for total public borrowing as a percentage of GDP, whereas the expected inflexion points for foreign and domestic debts were 49.4% and 30.9%, respectively. This study concluded that debt accumulation over the projected threshold levels may be harmful to economic growth.

Ujuju &Oboro(2017) used simple and multiple regression analysis to demonstrate an empirical association between the structure of Nigeria's public indebtedness and the country's economic performance from 1990 to 2015. According to the study's findings, the effect of aggregate public debt on Nigeria's GDP is positive and substantial. Furthermore, external debt has a negative and large impact on Nigeria's GDP, but domestic debt has a positive and significant impact. The study conclude that Nigeria's public debts are useful in forecasting partial fluctuations in the country's economic performance.

Ndubuisi (2017) surveyed the sway of external debt on Nigerian economic development using yearly time series data from 1985 to 2015. The data was analyzed using the least squares regression technique, the Johannsen cointegration test, and the error correction method. According to the regression outcome, debt servicing had a negative and moderate impact on economic development, whereas the foreign debt stock had a significant positive impact on Nigeria's economic growth. As a result, the study recommended that foreign debt be used to fund infrastructure development.

Eze, Nweke, &Atuma(2019) investigated the bearing of public debt on the Nigerian economy. Annual time series data obtained were analyzed using the ARDL technique of analysis and the Chow breakpoint test from 1981 to 2017. According to the study's findings, “external debt had a negative and significant impact on GDP in Nigeria”, but the influence of domestic debt was negative but inconsequential. Following from the findings, the paper recommended that the Nigerian government should stop utilizing foreign debt to cover its budget deficit.

Inyang & Effiong (2020) investigated the sway of external debt on economic growth of Nigeria from 1981 through 2019 with the aid of the ARDL approach within the error correction model. The study revealed that a positive but insignificant influence of debt burden on growth; while the effect of debt overhang and debt crowding out were all negative and significant in influencing economic growth. The study put forth a recommendation that external debt should be channelled through good investment channels to prevent the negative consequences of abuse of such resources.

Yusuf & Mohd (2021) used yearly data from 1980 to 2018 and the Autoregressive Distributed Lag approach to examine the impact of government debt on Nigeria's economic growth. The research findings indicated that foreign debt hampered long-term growth while promoting it in the short run. Domestic debt has a strong favourable influence on long-term growth while having a negative impact on short-term growth. Long-term and short-term debt service payments slowed growth, confirming the debt overhang impact. According to the conclusions, the government should direct borrowed funds toward diversifying the economy's productive base.

Ekong, Umoh &Akpan (2025), investigated the influence of public debt and government expenditure on inflation as well as their threshold levels that is sustainable for inflation in Nigeria, for the period between 1981 to 2022.The paper employed the autoregressive distributed lag model and the threshold regression analysis techniques as the methods of data

analysis. Findings from the study indicated that both public debt and government expenditure had a negative and significant short run effect on inflation while the effect is negative but insignificant in the long run. The disaggregated model indicated that domestic debt exerted a negative and significant short run effect on inflation in Nigeria while external debt exerts a positive and significant effect. The study recommended amongst others that government, through its budget, must resort to increasing its capital expenditure component while ensuring that the recurrent expenditure component is not rapidly increased and also be cautious of its borrowing pattern

The study of Ekong, Effiong & Inyang (2021) was geared towards detecting the influence of public debt on the real sector of the Nigerian economy, along with determining an optimal debt threshold for Nigeria. With data from 1981 through 2019, the study employed the ARDL approach and threshold regression analysis. The study’s findings revealed that the effect of domestic debt and external debt on economic growth were all negative and significant, which supports the debt crowding out theory. Further, the study estimated a threshold of 15.021% for Debt/GDP ratio that could be sustainable for growth. The study suggested for a proper management of public debt to avoid undesirable policy outcomes.

The study by Aiyedogbon *et al.*(2022) explored “the short-run and long-run impact of debt on Nigeria’s economic growth”. With data for the period 1990 through 2020 and analysed with the use of autoregressive distributed lag (ARDL) bounds testing approach to cointegration for the long-run investigation, the study reported the existence of a long-run relationship concerning debt and economic growth. Further, the estimated coefficients revealed that the significant effect of external debt and debt service on economic growth is negative, while that of domestic debt is positive. The report advocated for the government to favour domestic borrowing more than international borrowing, which should only be used in emergencies.

The empirical literature reviewed portrays diverse findings on the threshold level of public debt that is sustainable for growth. This study utilizes recent data along with two analytical techniques of ARDL and threshold regression to establish the existence of the non-linear effect between debt and growth, and to establish the optimal threshold level of debt/GDP ratio that is sustainable for growth. This is crucial in this period given the tremendous increase in the public debt in Nigeria and with the rising debt/GDP ratio in recent times.

**Methodology**

This section captures the model to be estimated and the analytical techniques, as well as presenting the nature and sources of data used in the study.

**Model Specification**

In specifying the model for this study, the model employed by Yusuf & Mohd, (2021) is modified to incorporate key macroeconomic variables that could affect the growth of the Nigerian economy. The modification introduced in the original model is the introduction of the following into the growth model: transactions in the Nigerian Stock Exchange, unemployment rate, and exchange rate. The model for this study is therefore specified as follows:

$$RGDP\_{t}=f\left(GFCF\_{t},DEBT\_{t},INF\_{t},EXC\_{t},INT\_{t},NSE\_{t},LAB\_{t}\right) (1)$$

Where RGDP is the growth rate of real gross domestic product (a proxy for economic growth), GFCF is the gross fixed capital formation (a proxy for capital), DEBT is total public debt, INF is the inflation rate, EXC is the naira-dollar exchange rate, NSE is the transactions in the Nigerian Stock Exchange, and LAB is labour force participation rate. The Equation (1) is therefore further explicitly written to incorporate the parameters to be estimated and the error term as:

$$RGDP\_{t}=δ\_{0}+δ\_{1}GFCF\_{t}+δ\_{2}DEBT\_{t}+δ\_{3}INF\_{t}+δ\_{4}EXC\_{t}+δ\_{5}INT\_{t}+δ\_{6}NSE\_{t}+δ\_{7}LAB\_{t}+μ\_{t} (2)$$

In which the constant of the regression model is $δ\_{0}$, $δ\_{1} to δ\_{7}$ are the partial slope coefficients of the regressors, and $μ\_{t}$ is the error term.

Incorporating the non-linear effect of public debt on growth, Equation (2) is further modified to incorporate the square of public debt which signifies the likelihood of a turning point in the debt-growth nexus. The model to be estimated is therefore presented as follows:

$$RGDP\_{t}=δ\_{0}+δ\_{1}GFCF\_{t}+δ\_{2}DEBT\_{t}+δ\_{2}^{'}DEBT\_{t}^{2}+δ\_{3}INF\_{t}+δ\_{4}EXC\_{t}+δ\_{5}INT\_{t}+δ\_{6}NSE\_{t}+δ\_{7}LAB\_{t}+μ\_{t} (3)$$

Where the parameters and variables are as earlier defied, $DEBT\_{t}^{2}$ is simply the square of public debt, $δ\_{2}^{'}$ measures the non-linear relationship of the debt-growth nexus and is expected to be negative while $δ\_{2}$ is expected to be positive for the non-linear relationship to be valid.

Note: The variables (except for INF, INT, INF, and LAB) are all transformed into their natural logarithm form to reflect the elasticity of the respective variables.

**Sources of Data**

The data used for this study are purely obtained from secondary sources. These sources were the Central Bank of Nigeria statistical bulletin, and the National Bureau of Statistics. Data on labour force participation rate were obtained from the National Bureau of Statistics while data on all other variables were obtained from the Central Bank of Nigeria statistical bulletim. The data, which are time series in nature, covers the period of 1981 to 2022 which gives a total of forty-two (42) observations.

**Technique of Analysis**

The autoregressive distributed lag (ARDL) model and the threshold regression analysis were employed to analyze the data.

 **Pre-Estimation Diagnostic Test**

The unit root test was carried out to ascertain the order of integration of the time series variables. As stated earlier, the variables must be in mixed order of levels and first difference before the ARDL approach could be considered appropriate. In this study, we utilize the Augmented Dickey-Fuller (ADF) unit root test developed by Dickey & Fuller (1979) based on the constant and trend assumption. In its general form, the model for the test is specified thus.

$$∆y\_{t}=φ+δt+β\_{1}y\_{t-1}+\sum\_{i=1}^{p}ρ\_{i}∆y\_{t-i}+ε\_{t} (4)$$

The variable to be tested for unit root is $y$, p represents the lag length, which is to be automatically selected, t captures the trend, $φ$ represents the drift or constant terms, the summation part of the model represents the augmented component of the test to account for serial correlation, $∆$ is the difference operator, and $ε$ is the error term. The test is conducted by testing the null hypothesis that $β\_{1}=1$ as against the alternative that $β\_{1}<1$. The rejection of the null hypothesis implies that there is no unit root. This is only obtainable when the ADF statistic is more negative than the 5% critical value of the test.

The use of the ARDL bounds test for cointegration is derived from the integration of some of the variables at levels and others by first difference. This method of cointegration analysis developed by Pesaran, Shin and Smith (2001) is appropriate in this scenario compared to the usual Engel-Granger cointegration test which is valid when all the variables are stationary at first difference. The general form of the test s specified thus;

$$∆RGDP\_{t}=τ'\_{0}+π\_{i}^{'}X\_{i}^{'}+\sum\_{i=1}^{n}γ\_{i}'∆RGDP'\_{t-i}+\sum\_{i=0}^{m}ϑ'\_{i}∆X'\_{t-i}+ϵ\_{t} (5)$$

Where:*X* represents all the explanatory variables in in the model, *n* is the optimal lag length of the dependent variables while *m* captures that of the explanatory variables. The parameter $π\_{i}^{'}$ denotes the long-run estimates of the model’s parameters while $γ\_{i}'$ and $ϑ'\_{i}$ represents the short-run parameters.

The estimation of the above equation generates an F-statistic which is used for the test. The F- statistics test grounded on the Wald test techniques is applied to ascertain the acceptance or otherwise, the rebuff of the null hypothesis. This is obtainable by matching the theoretical F-statistics value with the Pesaran, Shin, & Smith(2001) bound critical values. If the estimated F-statistics value is more than the upper bound critical value, the null hypothesis is rejected, and cointegration among the variables exists. However, if the estimated F-statistics value is less than the lower bound critical value, the null hypothesis is upheld, and there is no cointegration among the variables. Meanwhile, the result is inconclusive if the estimated F-statistics value lies between the upper and lower bound critical values. The usual cointegration approach must be employed in this scenario to establish the order of integration of the variables. In general, the test is conducted at the 5% level of significance across all the three models.

**Autoregressive Distributed Lag (ARDL) Model**

To examine the influence of public debt on economic growth of Nigeria, the autoregressive distributed lag (ARDL) model was utilized. The ARDL model is a model which contains the lagged values of the dependent variable and the current and lagged values of the regressors. The ARDL model enables us to estimate reliable estimates of our parameters in the situation where the unit root test reported that the series were stationary in mixed order of level and first difference. The model is specified as follows:

$$RGDP\_{t}=θ+\sum\_{i=1}^{p}γ\_{i}RGDP\_{t-i}+\sum\_{i=0}^{q\_{1}}β\_{i}GFCF\_{t-i}+\sum\_{i=0}^{q\_{2}}α\_{i}DEBT\_{t-i}+\sum\_{i=0}^{q\_{3}}δ\_{i}DEBT\_{t-i}^{2}+\sum\_{i=0}^{q\_{4}}π\_{i}INF\_{t-i}+\sum\_{i=0}^{q\_{5}}ϑ\_{i}EXC\_{t-i}+\sum\_{i=0}^{q\_{6}}σ\_{i}INT\_{t-i}+\sum\_{i=0}^{q\_{7}}ρ\_{i}NSE\_{t-i}+\sum\_{i=0}^{q\_{8}}ω\_{i}LAB\_{t-i}+ε\_{t} (6)$$

Where the variables are as earlier defined, p is the optimal lag length for the regressand while q is the optimal lag length for the regressors. In the event where cointegration exist (based on the Bounds test), the error correction model is estimated to showcase how disequilibrium in the model is corrected in order to restore equilibrium in the long run. The error correction model is therefore specified as follows:

$$∆RGDP'\_{t}=τ'\_{0}+\sum\_{i=1}^{n}γ\_{i}'∆RGDP'\_{t-i}+\sum\_{i=0}^{m}ϑ'\_{i}∆X'\_{t-i}+ζECM\_{t-1}+ϵ\_{t} (7)$$

The only difference between Equation (8) and Equation (9) is the introduction of the ECM term in the later plus the exclusion of the long-run component of the model. The ECM term, ζ, measures how fast any distortions in the short-run will likely be corrected in the model to attain long-run equilibrium. This forms the basis for the estimation of the dynamic short-run estimates and the levels or long-run estimates of the models.

**3.3.3 Threshold Regression Analysis**

In establishing the threshold level of public debt that is sustainable for growth, this study utilizes the threshold regression model developed by Khan & Senhadji (2001) which is derived from the work of Chan & Tsay (1998). This approach was further modified by Doguwa (2012) to fit into time series analysis since earlier approach was based on panel analysis. This approach has been widely utilized in studies such as Omotosho, Bawa, and Doguwa (2016) and Ekong, Effiong &Inyang (2021). The model is therefore specified as follows:

$$RGDP\_{t}=β\_{0}+β\_{1}d\_{t}\left(DEBT\_{t}-DEBT^{\*}\right)+β\_{2}\left(1-d\_{t}\right)\left(DEBT\_{t}-DEBT^{\*}\right)+φμ\_{t-1}+ε\_{t} (5)$$

Where $φ$ is the coefficient, an autoregressive component, $μ\_{t-1}$, employed to mop up the effects of other control variables. The variable $DEBT^{\*}$ is employed for the iteration process in the search of the optimal threshold level. The coefficient $β\_{1}$ captures the effect of public debt on GDP in the high debt regime (when the debt-GDP ratio is above the threshold level), while the coefficient $β\_{2}$ denotes the effect of public debt on growth in the low debt regime (when the debt-GDP ratio is below the threshold level). The dummy variable is d is denoted by

$$d\_{t}=\left\{\begin{array}{c}1, if DEBT\_{t}>DEBT^{\*}\\0, elsewjere\end{array}\right.$$

The ideal threshold level is recognised at the point where the sum of squared residuals (RSS) of the repeated regressions is minimized” (Babatunde *et al*., 2016; Ekong, Effiong, & Inyang, 2021).

**Empirical Findings**

 **Public Debt and Economic Growth Data in Nigeria**

**Trend Analysis**

In order to observe the movement of the key variables of interest (GDP and public debt), the trend analysis is conducted, and Figure 1 presents the behaviour of the variables over time.

Figure 1: Trend in GDP and Public Debt in Nigeria, 1981 – 2022.

It is observable from Figure 1 that both real GDP and total public debt exhibited an upward movement along trend. From the linear trend model, real GDP grew by about 16.34% per annum while public debt exhibited an annual growth rate of 6.28% on the average. The upward trending pattern of these variables, especially in public debt in recent times, calls for concern on the burden of public debt in Nigeria.

**Descriptive Statistics**

The descriptive properties of the times eries variables employed in the study is presented in Table 1.

Table 1: Descriptive properties of the time series variables

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|   | GDP | DEBT | EXC | GFCF | INF | INT | NSE | LAB |
|  Mean |  10.428 |  11.917 |  115.741 |  7.7146 |  18.947 |  17.190 |  3.382 |  11.557 |
|  Median |  10.273 |  6.814 |  115.255 |  7.923 |  12.942 |  17.380 |  4.070 |  10.320 |
|  Maximum |  11.222 |  54.731 |  425.981 |  11.086 |  72.836 |  29.800 |  7.763 |  33.280 |
|  Minimum |  9.693 |  0.068 |  0.610 |  4.468 |  5.388 |  7.750 | -1.537 |  1.900 |
|  Std. Dev. |  0.542 |  13.053 |  119.141 |  2.022 |  16.455 |  4.647 |  3.465 |  8.184 |
|  Skewness |  0.224 |  1.635 |  1.021 | -0.205 |  1.877 |  0.308 | -0.224 |  1.184 |
|  Kurtosis |  1.459 |  5.349 |  3.221 |  1.804 |  5.437 |  3.467 |  1.357 |  3.996 |
|  Jarque-Bera |  4.506 |  28.353 |  7.388 |  2.797 |  35.058 |  1.044 |  5.074 |  11.556 |
|  Probability |  0.105 |  0.000 |  0.025 |  0.247 |  0.000 |  0.593 |  0.079 |  0.003 |
|  Observations |  42 |  42 |  42 |  42 |  42 |  42 |  42 |  42 |

Source: Researcher Computation

Over the forty-two (42) years under consideration, the log of real GDP averaged 10.428%, possessed a standard deviation of 0.542 and is positively skewed and platykurtic in nature. The debt/GDP ratio averaged 11.917% with a standard deviation of 13.053 and the variable is positively skewed and leptokurtic in nature. The highest debt/GDP ratio is given as 54.731% while the minimum reported over the years is 0.068%. This phenomenal increase in debt/GDP ratio is a matter of concern as it has implications on the debt burden of the country. The descriptive properties of other variables could be defined in similar pattern as contained in Table 1.

**Correlation Analysis**

In order to check the direction and magnitude of the association among the variables in the model, the correlation analysis was conducted, and the Pearson correlation coefficients are presented in Table 2.

Table 2: Correlation coefficient

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|   | RGDP | DEBT | EXC | GFCF | INF | INT | NSE | LAB |
| RGDP | 1.000 |  |  |  |  |  |  |  |
| DEBT | 0.750 | 1.000 |  |  |  |  |  |  |
| EXC | 0.899 | 0.449 | 1.000 |  |  |  |  |  |
| GFCF | 0.948 | 0.698 | 0.595 | 1.000 |  |  |  |  |
| INF | -0.339 | -0.197 | -0.290 | -0.297 | 1.000 |  |  |  |
| INT | -0.060 | -0.136 | -0.154 | 0.020 | 0.332 | 1.000 |  |  |
| NSE | 0.938 | 0.666 | 0.617 | 0.455 | -0.399 | -0.039 | 1.000 |  |
| LAB | 0.690 | 0.462 | 0.579 | 0.715 | -0.337 | -0.255 | 0.662 | 1.000 |

Source: Researcher Computation

The result of the correlation analysis presented in Table 2 shows that real GDP correlated negatively with both inflation and interest rate, and the degree of association is a weak one. Meanwhile, real GDP is strongly correlated with the rest of the variables positively. For the regressors, no perfect correlation exists among them which therefore rule out the possibility of multicollinearity in the model.

**Unit Root Test**

The stationarity property of the time series variables was explored using the augmented Dickey-Fuller (ADF) unit root test. The test was conducted using the constant and trend assumption and Table 3 presents the result. An I(0) series implies that the variables are stationary at level while an I(1) series implies that the series is stationary at first difference.

Table 3: Unit root test result

|  |  |  |  |
| --- | --- | --- | --- |
| Variables | ADF Statistic at Level | ADF Statistic at First Difference | Order of Integration |
| ADF Statistic | p-value | ADF Statistic | p-value |
| RGDP | -1.9319 | 0.6173 | -3.9010 | 0.0212\* | I(1) |
| GFCF | -1.7409 | 0.7146 | -4.1565 | 0.0113\* | I(1) |
| DEBT | -0.0738 | 0.9936 | -3.6425 | 0.0441\* | I(1) |
| DEBT2 | -2.2188 | 0.4667 | -4.6081 | 0.0035\* | I(1) |
| INF | -4.1301 | 0.0121\* | ------ | ------- | I(0) |
| EXC | 0.0981 | 0.9962 | -4.9358 | 0.0014\*\* | I(1) |
| INT | -3.3290 | 0.0758 | -6.4944 | 0.0000\*\* | I(1) |
| NSE | -1.1252 | 0.9122 | -5.9305 | 0.0001\*\* | I(1) |
| LAB | -2.4557 | 0.3473 | -8.3203 | 0.0000\*\* | I(1) |

*Note: \* and \*\* implies significance at 5% and 1% respectively*

Source: Researcher Computation

Given the result in Table 3, the unit root test result revealed a mixed order of integration among the variables. Clearly, inflation rate is stationary at level while other variables are reported to be stationary at first difference. This mixed order of integration in I(0) and I(1) therefore prompted the need to explore the existence of long run relationship in the model. **Cointegration Test**

With the unit root test reporting that some of the variables were stationary at first difference while inflation rate was stationary at level, the Bounds test for cointegration was employed to examine the existence of long run relationship in the model. Table 4 presents the result.It is expected that the F-statistic must lie outside the 5% lower and upper bounds for cointegration to exists.

Table 4: Bounds test for cointegration result

|  |  |
| --- | --- |
| F-Bounds Test | Null Hypothesis: No levels relationship |
| Test Statistic | Value | Significance | I(0) | I(1) |
| F-statistic |  5.58087 | 10%   | 1.85 | 2.85 |
| K | 8 | 5%   | 2.11 | 3.15 |
|  |  | 2.5%   | 2.33 | 3.42 |
|   |   | 1%   | 2.62 | 3.77 |

Source: Researcher Computation

The cointegration result in Table 4 indicates that the F-statistic is 5.58087 and the 5% critical I(0) and I(1) values are 2.11 and 3.15 respectively. Since the F-statistic lies outside these lower and upper bounds, cointegration exists. Thus, we estimated both the short run and long run estimates for the model using the autoregressive distributed lag (ARDL) model.

 **Autoregressive Distributed Lag (ARDL) Model Estimation**

The ARDL model was estimated for both the short run and long model to ascertain how public debt could affect the growth of an economy.

**The Short Run Model**

The error correction model was estimated to showcase how the short run distortions in the model is corrected. The result in Table 5 indicates that 15.48% of the short run distortions in the model is corrected annually to restore long run equilibrium. Also, the model explains about 88.34% of the total variations in economic growth during the study period.

Table 5: Short run error correction model result

|  |
| --- |
| Dependent Variable: D(GDP) |
| Selected Model: ARDL(2, 2, 2, 2, 1, 2, 2, 1, 1) |
| Variable | Coefficient | Standard Error | t-Statistic | Probability |
| D(GDP(-1)) | -0.1818 | 0.1176 | -1.5454 | 0.1418 |
| D(GFCF) | 0.0627 | 0.0245 | 2.5640 | 0.0208\* |
| D(GFCF(-1)) | 0.1191 | 0.0259 | 4.6005 | 0.0003\*\* |
| D(DEBT) | 0.0167 | 0.0035 | 4.7272 | 0.0002\*\* |
| D(DEBT(-1)) | 0.0191 | 0.0042 | 4.5400 | 0.0003\*\* |
| D(DEBT2) | -0.1036 | 0.0139 | -7.4616 | 0.0000\*\* |
| D(DEBT2(-1)) | -0.0841 | 0.0170 | -4.9598 | 0.0001\*\* |
| D(INF) | -0.0005 | 0.0002 | -2.1976 | 0.0430\* |
| D(EXC) | -0.0009 | 0.0003 | -2.6078 | 0.0190\* |
| D(EXC(-1)) | -0.0011 | 0.0003 | -3.2571 | 0.0049\* |
| D(INT) | 0.0059 | 0.0011 | 5.4473 | 0.0001\*\* |
| D(INT(-1)) | 0.0067 | 0.0011 | 6.1365 | 0.0000\*\* |
| D(NSE) | 0.0056 | 0.0068 | 0.8240 | 0.4221 |
| D(LAB) | 0.1026 | 0.1214 | 4.7940 | 0.0001\* |
| ECM(-1) | 0.1548 | 0.0166 | 9.3382 | 0.0000\*\* |
| R-squared | 0.8834 |     Mean dependent var | 0.0350 |
| Adjusted R-squared | 0.8180 |     S.D. dependent var | 0.0441 |
| S.E. of regression | 0.0188 |     Akaike info criterion | -4.8267 |
| Sum squared resid | 0.0089 |     Schwarz criterion | -4.1934 |
| Log likelihood | 111.5347 |     Hannan-Quinn criterion | -4.5977 |
| Durbin-Watson stat | 1.8679 |   |   |   |

*Note: \* and \*\* implies significance at 5% and 1% respectively*

Source: Researcher Computation

The coefficient of RGDP(-1) portrays that the previous period’s RGDP reduces the current period’s RGDP but such is not statistically significant. Gross fixed capital formation and its one-period lag both had positive and significant effect on economic growth. Thus, a 1% increase in capital leads to a 0.0627% increase in economic growth while the previous period’s stock of capital increases the current period’s RGDP by 0.1191% on the average. It is further observed that public debt and its one-period lag exerts a positive and significant effect on growth while the square (non-linear) of public debt and its one-period lag exerted negative and significant effect. Thus, it is clear from this finding that public debt contributes positively to growth up to a certain level, after which it becomes detrimental to growth. Thus, there is need to establish the optimal (threshold) level of debt that is sustainable for growth. This is explored in the subsequent segment of this paper. The coefficient signifies that a 1% increase in public debt leads to a 0.0167% increase in economic growth while the one-period lag of public debt leads to a 0.0191% increase in economic growth. On the other hand, the square of public debt and its one-period lag leads to a decrease in economic growth by 0.1036% and 0.0841% respectively.

Inflation rate and exchange rate are all observed to exert negative and significant short run effect on economic growth during the period of analysis. Thus, rising inflation is detrimental to growth as it stifles production (especially since inflation in Nigeria is cost-push), and exchange rate depreciation stifles growth since it discourages the importation of crucial inputs for production. A 1% increase in inflation and exchange rate is associated with a 0.0005% and 0.0009% decrease in economic growth in Nigeria during the study period. The one-period lag of exchange rate also reduces the growth of the economy by about 0.0011% on the average.

The rate of interest during the study period exerted a positive and significant effect on economic growth in the short run. The implication of this is that interest rate during the study period was favourable for investments which therefore stimulates growth. the coefficient indicates that a 1% increase in interest rate leads to a 0.0059% increase in RGDP while the one-period lag of interest rate increased growth by 0.0067% on the average. The transaction in the Nigerian Stock Exchange is observed to exert a positive but insignificant short run effect on growth. The implication of this is that stock market transactions are merely transfer of financial assets which may not translate to stimulating the real sector of the economy. Labour force is noted to exert a positive and significant short run effect on economic growth. Hence, a 1% increase in labour employment will lead to a 0.1026% increase in growth.

**The Long Run Model**

In the long run, the result in Table 6 indicates that public debt exerted a positive but insignificant effect on economic growth. However, the squared of public debt exerted a negative and significant effect on growth. Thus, a 1% increase in the squared of public debt (debt beyond the threshold level) will lead to a 0.2734% decrease in economic growth.

Table 6: Long run estimates

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Variable | Coefficient | Std. Error | t-Statistic | Probability  |
| GFCF | 0.8121 | 0.3616 | 2.2457 | 0.0392\* |
| DEBT | 0.0312 | 0.0297 | 1.0505 | 0.3091 |
| DEBT2 | -0.2734 | 0.1272 | -2.1498 | 0.0472\* |
| INF | 0.0081 | 0.0049 | 1.6544 | 0.1175 |
| EXC | 0.0046 | 0.0022 | 2.0715 | 0.0548 |
| INT | -0.0156 | 0.0215 | -0.7253 | 0.4787 |
| NSE | 0.1258 | 0.1247 | 1.0085 | 0.3282 |
| LAB | 0.0560 | 0.0189 | -2.9721 | 0.0090\*\* |
| C | 4.4474 | 2.3843 | 1.8653 | 0.0806 |

*Note: \* and \*\* implies significance at 5% and 1% respectively*

Source: Researcher Computation

Labour force and capital both exert a significant effect on growth. Thus, a 1% increase in capital will lead to a 0.8121% increase in growth while a 1% increase in labour rate employment will lead to a 0.0560% increase in growth on the average.

**Threshold Regression Analysis**

The result from the ARDL model portrays that debt is growth enhancing up to a certain level after which it becomes detrimental to growth. Thus, the threshold regression analysis facilitates the estimation of the threshold level of public debt beyond which debt becomes detrimental to growth. The result is therefore presented in Table 7, where the estimation is based on the smooth threshold regression analysis.

Table 7: Smooth threshold regression result for debt-GDP ratio

|  |
| --- |
| Dependent Variable: RGDP |
| Method: Smooth Threshold Regression |
| Transition function: Logistic |
| Threshold variable: DEBT |
| Starting values: Grid search with concentrated regression coefficients |
| Convergence achieved after 123 iterations |
| Variable | Coefficient | Std. Error | t-Statistic | Probability |
| Threshold Variables (linear part) |
| DEBT | 0.1067 | 0.0345 | 3.0938 | 0.0014\*\* |
| C | 9.7327 | 2.1005 | 4.6336 | 0.0002\*\* |
| Threshold Variables (nonlinear part) |
| DEBT | -0.0850 | 0.0307 | 2.7684 | 0.0145\* |
| C | 0.5331 | 4.7203 | 2.5163 | 0.0432\* |
| Slopes |
| SLOPE | 38.7753 | 3.3348 | 11.6275 | 0.0000\*\* |
| **Thresholds** |
| THRESHOLD | 26.8543 | 4.1435 | 6.4811 | 0.0000\*\* |
| R-squared | 0.7757 |     Mean dependent var | 10.4275 |
| Adjusted R-squared | 0.7445 |     S.D. dependent var | 0.5422 |
| S.E. of regression | 0.2741 |     Akaike info criterion | 0.3808 |
| Sum squared resid | 2.7043 |     Schwarz criterion | 0.6290 |
| Log likelihood | -1.9960 |     Hannan-Quinn criterion | 0.4718 |
| F-statistic | 24.8946 |     Durbin-Watson stat | 1.9194 |
| Prob(F-statistic) | 0.0000\*\* |   |   |   |

*Note: \* and \*\* implies significance at 5% and 1% respectively*

Source: Researcher Computation

The threshold regression result presented in Table 7 shows two components – the linear and the non-linear. On the linear component (below the threshold level) where the slope coefficient is 0.1067, public debt exerted a positive and significant effect on economic growth. On the non-linear component (above the threshold level) with the coefficient of -0.0850, public debt exerted a negative and significant effect on economic growth. The threshold level of public debt is established to be 26.85% approximately. This indicates that a debt-GDP ratio beyond 26.85% will be detrimental to growth as it will impose an undesirable debt burden on the country. The threshold level obtained for this study is consisted with those obtained in earlier works such as 20% (Egert, 2013), 30.9% (Omotosho, Bawa, &Doguwa, 2016), 15.021% (Ekong, Effiong, &Inyang, 2021), 19.70% (Siddique & Malik, 2001), and 20-25% (Cordella *et al*., 2010).

It is also pertinent to explore the debt-revenue threshold since it is out of revenue that debt is being repaid. The result is presented in Table 8 presents the result.

Table 8: Smooth threshold regression result for debt-revenue ratio

|  |
| --- |
| Dependent Variable: RGDP |
| Method: Smooth Threshold Regression |
| Transition function: Logistic |
| Threshold variable: DEBT |
| Starting values: Grid search with concentrated regression coefficients |
| Convergence achieved after 15 iterations |
| Variable | Coefficient | Std. Error | t-Statistic | Probability |
| Threshold Variables (linear part) |
| DEBTREV | 0.2542 | 0.1670 | 1.5221 | 0.1367 |
| C | 4.5464 | 1.4134 | 3.2167 | 0.0027\* |
| Threshold Variables (nonlinear part) |
| DEBTREV | -0.1919 | 0.1707 | -1.1244 | 0.2683 |
| C | -8.4561 | 3.1750 | -2.6634 | 0.0115\* |
| Slopes |
| SLOPE | 0.7101 | 0.7673 | 0.9254 | 0.3609 |
| **Thresholds** |
| THRESHOLD | 22.8601 | 1.1959 | 19.1161 | 0.0000\*\* |
| R-squared | 0.4864 |     Mean dependent var | 3.0153 |
| Adjusted R-squared | 0.4151 |     S.D. dependent var | 5.3443 |
| S.E. of regression | 4.0874 |     Akaike info criterion | 5.7853 |
| Sum squared resid | 601.4520 |     Schwarz criterion | 6.0335 |
| Log likelihood | -115.4906 |     Hannan-Quinn criterion | 5.8763 |
| F-statistic | 6.8183 |     Durbin-Watson stat | 1.9669 |
| Prob(F-statistic) | 0.0001\*\* |   |   |   |

*Note: \* and \*\* implies significance at 5% and 1% respectively*

Source: Researcher Computation

The result presented in Table 8 portrays that the threshold level of the debt-revenue ratio is 22.86%. This implies that debt incurred above this threshold level will pose difficulties in repayments with attendant macroeconomic tremors that will stifle growth.

**Post Estimation Diagnostic Test**

The various post diagnostic tests conducted include stability test, normality test, serial correlation test, and heteroscedasticity test.

**Stability Test**

The stability test was conducted to ascertain whether the parameter estimates of the ARDL model are stable for policy simulation. The test is presented in Figure 2 and is based on the cumulative sum (CUSUM) of squares test. The test demands that for stability to exists, the CUSUM line must lie within the 5% critical lower and upper bounds.



Figure 2: The cumulative sum of squares test for stability

It is observed from Figure 2 that the CUSUM of squares line lies within the 5% critical lower and upper bounds. Consequently, the stability of the parameter estimates is guaranteed in the estimated model.

**4.8.2 Normality Test**

The normality test was done using the histogram normality test for residuals. Figure 3 presents the result from which inferences are made using the Jarque-Bera statistic.



Figure 3: Normality test for residuals

The Jarque-Bera statistic of 1.144527 with the accompanying p-value of 0.48471 is a clear indication that normality assumption is satisfied in the estimated model.

 **Serial Correlation Test**

The serial correlation test is presented in Table 9 and is conducted using the Breusch-Godfrey serial correlation LM test.

|  |
| --- |
| Table 9: Breusch-Godfrey Serial Correlation LM Test Result |
| F-statistic | 2.3106 |     Prob. F(3,13) | 0.12410 |
| Obs\*R-squared | 13.91087 |     Prob. Chi-Square(3) | 0.00300 |

Source: Researcher’s Computation.

Given that the F-statistic of 2.3106 is statistically insignificant at the 5% level, it is a clear indication that the null hypothesis of no serial correlation is accepted.

**Heteroscedasticity Test**

The test for the constant variance assumption of the error terms (heteroscedasticity test) was conducted using the Breusch-Pagan-Godfrey test. Table 10 presents the result obtained.

|  |
| --- |
| Table 10: Heteroskedasticity Test Result: Breusch-Pagan-Godfrey |
| F-statistic | 1.4370 |     Prob. F(23,16) | 0.2298 |
| Obs\*R-squared | 26.9526 |     Prob. Chi-Square(23) | 0.2580 |
| Scaled explained SS | 2.9362 |     Prob. Chi-Square(23) | 1.0000 |

Source: Researcher’s Computation.

The result in Table 10 shows that the F-statistic of 1.4370 is statistically insignificant at the 5% level. It therefore becomes pertinent to reject the null hypothesis and conclude that the error terms are homoscedastic.

 **Discussion of Major Findings**

The major findings of this study are as follows:

1. Public debt was observed to exert a negative and significant effect on economic growth in Nigeria within the nonlinear path. This therefore implies that higher debt level beyond a certain limit could stifle economic growth both in the short run and in the long run. Hence, the need to estimate such a limit.
2. The threshold level of public debt was segmented into debt-GDP ratio and debt-revenue ratio with each having varying coefficient. The result indicated that the threshold level of the debt-GDP ratio was 26.85% while that of the debt-revenue ratio was 22.86%. This implies that sustainable borrowing should consider these key coefficients since exceeding them could pose the risk of default.

 **Conclusion**

Improving capital accumulation and accelerating economic growth are anticipated when borrowing is kept within sustainable bounds (Omotosho *et al*., 2016). On the other hand, incurring too much debt may hinder economic expansion. The debt overhang and crowding out theories are two of the many arguments made on how high public debt may harm future growth and its many routes of transmission. We examined whether threshold effects exist in the link between public debt and economic growth in Nigeria in this research. The Khan &Senhadji (2001) model was applied to annual data from 1981 to 2022 to examine the threshold level of public debt on growth. Our goal was to identify the inflexion point – also known as the ideal debt threshold level – below which public debt promotes growth and above which debt hinders growth. The necessity to reevaluate Nigeria's debt profile served as the driving force behind this, particularly given the nation's mounting debt load.

The findings of the regression analysis supported the presence of an inverted U-shaped, nonlinear link between Nigeria's public debt and economic growth. This is evident from the positive effect of public debt and the negative effect of the square of public debt on growth. A threshold level of 26.85% was identified for the ratio of GDP (in percentage terms) to public debt (the total of both domestic and external loans). Further, the debt-revenue ratio was estimated to be 22.86%. This implies that Nigeria's growth is negatively impacted by the public debt buildup that exceeds the projected threshold. An analysis of the debt profile of the nation retrospectively revealed that the threshold was surpassed in 2018, as the debt-to-GDP ratio of the nation was 29.11%. This finding suggested that periods of less-than-ideal growth could be linked to times when the thresholds were surpassed.The study's conclusions added to the conversation on debt accumulation and the effects it has on Nigeria's economic growth. Additionally, it gave decision-makers quantitative assessments of how high levels of debt affect growth.

 **Recommendations**

Based on the findings of the study, it is recommended that;

1. Intentional measures be used to guarantee that Nigeria's debt buildup aligns with the nation's growth targets.
2. Furthermore, the implementation of fiscal reforms by the government should be promoted to facilitate better management of the public debt and boost economic growth. It is vital that governments take urgent action to meet the fiscal consolidation and public debt reduction imperatives by implementing comprehensive reforms that target both revenue and expenditure.
3. The discovered non-linear relationship between public debt and GDP further supports the idea that borrowing by the government must be done on terms that will both support long-term debt sustainability and spur economic growth.

Disclaimer (Artificial intelligence)

Option 1:

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

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Details of the AI usage are given below:

1.

2.

3.

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Appendix

Table 1: Average Real GDP, Public Debt, and Debt/GDP ratio in Nigeria, 1981-2022.

|  |  |  |  |
| --- | --- | --- | --- |
| Year | Real GDP(N’ billions) | Total Public Debt Outstanding(N’ billions) | Debt/GDP Ratio(%) |
| 1981-1984 | 17,689.85 | 27.66 | 0.162 |
| 1985-1989 | 18,101.53 | 144.23 | 0.776 |
| 1990-1994 | 22,080.67 | 702.59 | 3.174 |
| 1995-1999 | 23,288.30 | 1,579.12 | 6.714 |
| 2000-2004 | 30,641.60 | 5,071.28 | 16.459 |
| 2005-2009 | 44,221.62 | 3,139.25 | 7.165 |
| 2010-2014 | 61,248.01 | 7,473.53 | 12.091 |
| 2015-2019 | 70,053.85 | 17,538.27 | 24.968 |
| 2020-2022 | 72,978.58 | 34,913.30 | 47.712 |

Source: Central Bank of Nigeria (2022).

1. Data used for Analysis

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Year | GDP(N billions) | GFCF(N billions) | DEBT(N billions) | INF(%) | INT(%) | NSE(N billions) | EXC(%) | UNM(%) |
| 1981 | 19,748.53 | 124.52 | 13.52 | 20.81 | 7.75 | 0.30 | 0.61 | 7.20 |
| 1982 | 18,404.96 | 128.10 | 23.83 | 7.70 | 10.25 | 0.22 | 0.67 | 8.70 |
| 1983 | 16,394.39 | 120.26 | 32.80 | 23.21 | 10.00 | 0.40 | 0.72 | 10.20 |
| 1984 | 16,211.49 | 97.78 | 40.48 | 17.82 | 12.50 | 0.26 | 0.76 | 7.90 |
| 1985 | 17,170.08 | 87.14 | 45.25 | 7.44 | 9.25 | 0.32 | 0.89 | 6.10 |
| 1986 | 17,180.55 | 108.87 | 69.89 | 5.72 | 10.50 | 0.50 | 2.02 | 5.30 |
| 1987 | 17,730.34 | 122.46 | 137.58 | 11.29 | 17.50 | 0.38 | 4.02 | 7.00 |
| 1988 | 19,030.69 | 138.10 | 180.99 | 54.51 | 16.50 | 0.85 | 4.54 | 5.10 |
| 1989 | 19,395.96 | 217.75 | 287.44 | 50.47 | 26.80 | 0.61 | 7.39 | 4.50 |
| 1990 | 21,680.20 | 262.77 | 382.71 | 7.36 | 25.50 | 0.23 | 8.04 | 3.50 |
| 1991 | 21,757.90 | 285.59 | 444.65 | 13.01 | 20.01 | 0.24 | 9.91 | 3.10 |
| 1992 | 22,765.55 | 396.61 | 722.23 | 44.59 | 29.80 | 0.49 | 17.30 | 3.50 |
| 1993 | 22,302.24 | 559.15 | 906.98 | 57.17 | 18.32 | 0.80 | 22.05 | 3.40 |
| 1994 | 21,897.47 | 744.09 | 1,056.40 | 57.03 | 21.00 | 0.99 | 21.89 | 3.20 |
| 1995 | 21,881.56 | 1,153.47 | 1,194.60 | 72.84 | 20.18 | 1.84 | 21.89 | 1.90 |
| 1996 | 22,799.69 | 1,494.75 | 1,037.30 | 29.27 | 19.74 | 6.98 | 21.89 | 2.80 |
| 1997 | 23,469.34 | 1,697.77 | 1,097.68 | 8.53 | 13.54 | 10.33 | 21.89 | 3.40 |
| 1998 | 24,075.15 | 1,948.65 | 1,193.85 | 10.00 | 18.29 | 13.57 | 21.89 | 3.50 |
| 1999 | 24,215.78 | 2,098.54 | 3,372.18 | 6.62 | 21.32 | 14.07 | 92.69 | 17.50 |
| 2000 | 25,430.42 | 2,404.82 | 3,995.64 | 6.93 | 17.98 | 28.15 | 102.11 | 13.10 |
| 2001 | 26,935.32 | 2,473.47 | 4,193.27 | 18.87 | 18.29 | 57.68 | 111.94 | 13.70 |
| 2002 | 31,064.27 | 3,078.78 | 5,098.89 | 12.88 | 24.85 | 59.41 | 120.97 | 12.20 |
| 2003 | 33,346.62 | 3,846.23 | 5,808.01 | 14.03 | 20.71 | 120.40 | 129.36 | 14.80 |
| 2004 | 36,431.37 | 4,723.72 | 6,260.59 | 15.00 | 19.18 | 225.82 | 133.50 | 13.40 |
| 2005 | 38,777.01 | 5,772.64 | 4,220.98 | 17.86 | 17.95 | 262.94 | 132.15 | 11.90 |
| 2006 | 41,126.68 | 7,948.12 | 2,204.72 | 8.23 | 17.26 | 470.25 | 128.65 | 12.30 |
| 2007 | 43,837.39 | 6,997.62 | 2,608.53 | 5.39 | 16.94 | 1,076.02 | 125.83 | 12.70 |
| 2008 | 46,802.76 | 7,535.27 | 2,843.56 | 11.58 | 15.14 | 1,679.14 | 118.57 | 14.90 |
| 2009 | 50,564.26 | 9,177.08 | 3,818.47 | 12.54 | 18.99 | 685.72 | 148.88 | 19.70 |
| 2010 | 55,469.35 | 9,183.06 | 5,241.66 | 13.74 | 17.59 | 799.91 | 150.30 | 21.10 |
| 2011 | 58,180.35 | 9,897.20 | 6,519.69 | 10.83 | 16.02 | 638.93 | 153.86 | 6.00 |
| 2012 | 60,670.05 | 10,281.95 | 7,564.44 | 12.22 | 16.79 | 808.99 | 157.50 | 10.60 |
| 2013 | 63,942.85 | 11,478.08 | 8,506.31 | 8.50 | 16.72 | 2,350.88 | 157.31 | 10.00 |
| 2014 | 67,977.46 | 13,593.78 | 9,535.53 | 8.05 | 16.55 | 1,338.60 | 158.55 | 7.80 |
| 2015 | 69,780.69 | 14,112.17 | 10,948.51 | 9.01 | 16.85 | 978.05 | 193.28 | 10.44 |
| 2016 | 68,652.43 | 15,104.18 | 14,537.12 | 15.70 | 16.87 | 577.82 | 253.49 | 14.23 |
| 2017 | 69,205.69 | 16,908.13 | 18,377.00 | 16.50 | 17.56 | 1,078.49 | 305.79 | 20.42 |
| 2018 | 70,536.35 | 24,550.24 | 20,533.64 | 12.10 | 19.33 | 1,203.37 | 306.08 | 22.60 |
| 2019 | 72,094.09 | 35,863.98 | 23,295.07 | 11.40 | 15.53 | 931.48 | 306.92 | 16.92 |
| 2020 | 70,800.54 | 41,253.55 | 28,729.50 | 13.25 | 12.32 | 1,086.18 | 358.81 | 33.28 |
| 2021 | 73,382.77 | 58,293.95 | 35,097.79 | 16.95 | 11.48 | 953.87 | 400.24 | 32.50 |
| 2022 | 74,752.42 | 65,227.13 | 40,912.62 | 18.85 | 12.34 | 1,168.53 | 425.98 | 33.00 |

Source: CBN, World Bank [↑](#endnote-ref-1)