

Determining the Optimal Public Debt Threshold for Nigeria¹

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This paper investigates the existence of threshold effects in the relationship between public debt and economic growth in Nigeria using quarterly data. Generally, we found empirical support for an inverted U-shape relationship between public debt types and economic growth. For total public debt as percentage of GDP, model results identified a threshold level of 73.70 per cent, while the estimated inflexion points for external and domestic debts were 49.4 and 30.9 per cent, respectively. The implication of this finding is that debt accumulation in excess of the estimated threshold levels could hurt economic growth. A retrospective examination of the country's total and external debts profile indicated that the estimated threshold levels were exceeded prior to the debt forgiveness negotiated in 2005 and largely within limits afterwards. In addition, the study found empirical support for external debt accumulation opportunities, however, we caution that such additional debt incurrence be done in a manner that is consistent with the country's growth objectives.

Keywords: Public Debt, Economic Growth, Threshold Effects

JEL Classification: F34, E62, H62, H63

1.0 Introduction

The justification for government borrowing has its foundation in the neoclassical growth models, which prescribes the need for capital scarce countries to borrow in order to increase their capital accumulation and steady state level of output per capita. The occurrence of global economic crises has provided further impetus for countries (especially the developing ones) to borrow as they are often confronted with the need for increased expenditure levels and declining capital inflows (Greenidge et al, 2012). This is evident in countries like Portugal, Italy, Cyprus, Greece, Belgium and the US which recorded debt/GDP ratio of over 100 per cent in 2015. It approached 250 per cent of GDP in Japan during the same period (IMF, 2016). These increasing levels of debt have continued to generate curiosity amongst policy makers and

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researchers regarding the level of debt accumulation that is conducive for economic growth.

According to Cecchetti *et al.* (2011), debt is a two-edged sword. In other words, it is capable of improving welfare when used wisely and in moderation, but can also be disastrous when used recklessly. This assertion suggests that borrowing is only appropriate under certain circumstances and government needs to exercise caution while crafting their debt policies. For instance, some believe that the automatic increases in government borrowing that occur during recessions help the economy by maintaining income and spending levels. Such borrowing occurs in response to the reduced tax receipts that result from the recession and the increased need for the government to boost the economy via infrastructural financing and other growth propelling ventures. However, it has also been argued that the accumulation of debt beyond certain limits could offset the positive impacts of public borrowing, as typified by the Euro-crisis.

The debate on the growth implications of debt accumulation is an ongoing one and results from empirical works are still inconclusive. A strand of the literature has argued that high levels of debt are associated with large negative effects on growth. An influential work in this regard is Reinhart and Rogoff (2010) which found empirical support for a significant threshold effect in the relationship between debt and economic prosperity. They analyzed data for 44 countries and their results showed that debt above 90.0 per cent of GDP is injurious to economic growth⁵. In similar studies, Baum *et al.* (2012) found a debt/GDP threshold level of 95.0 per cent for a group of 12 Euro-Area countries while Cecchetti *et al.* (2011) estimated 85.0 per cent for a group of 18 OECD countries. The consensus amongst these authors is that there exists a non-linear effect of debt on economic growth and that higher debt levels beyond some thresholds confer significant negative effects on subsequent growth through both the debt overhang and crowding out effects. The prescription in this regard is that countries that have accumulated debt levels above their optimal thresholds must deliberately pursue policies to resolve their fiscal problems and lower their indebtedness to sustainable levels.

Another strand of literature has opposed the view that there exists a debt threshold above which debt constrains output growth. These works raised

⁵ Studies with similar findings include Kumar and Woo (2010), Dessy and Vencatachellum (2007), Ekperiware and Oladeji (2012) and Iyoha (1999).

endogeneity concerns and argued that weak growth is actually the cause of high levels of debt. According to this view, the priority should be increasing growth rather than reducing debt. The proponents of this view argue that foreign borrowing has a net positive effect on output and income as long as the net inflow of borrowed funds exceeds interest payments and the marginal productivity of investment is greater than the rate of interest on debt (Green and Kahn, 1990). In other words, foreign borrowing is at optimal up to the point where the marginal productivity of capital or investment equals the rate of interest on external debt.

While the incurrence of debt has been known to be helpful in bridging government financing gap, economists and policy makers generally worry when debt level becomes quite large relative to GDP. This is because high tax rates will be required to meet the debt interest burden and this may produce disincentive effects. Indeed, some countries have enacted laws to constrain the government from borrowing outside sustainable limits⁶.

Notwithstanding the two opposing views regarding the impact of debt accumulation on economic growth, economists and policy makers seem to have reached a consensus that excessive debt can cause negative growth effects and macroeconomic distortions through debt overhang and crowding out effects. The critical task, therefore, is that of determining the point of inflexion in the debt and economic growth relationship. In Nigeria, there is a growing body of literature in this regard. These include Ezeabasili *et al* (2011) and Boboye and Ojo (2012) whose estimated regressions showed that external debt confer negative effects on economic growth. On the other hand, Sulaiman and Azeez (2012) found empirical support for a positive relationship. These studies focused on the direction of impact rather than the establishment of threshold levels.

To the best of our knowledge, no study has focused on the determination of the threshold point beyond which the incurrence of additional debt injures economic growth in Nigeria, especially following the debt cancelation of 2005 and the rebasing of the country's GDP from 1990 base year to 2010. Therefore, this study aims to determine the threshold point beyond which public debt begins to hamper Nigeria's economic growth prospects. The findings are expected to guide policy makers in the design of an optimal

⁶ An example of this is the UK code for fiscal stability enacted in 1998 which commits the government to a medium-term objective of financing all current government spending out of current revenues (Begg *et al*, 2003).

public debt strategy that is conducive for Nigeria's economic growth objectives.

The paper is structured into six sections. Following the introduction, section two presents developments in Nigeria's debt profile and its sustainability. Section three reviews relevant literature while the econometric framework for the empirical analysis is presented in section four. The empirical results are presented and discussed in section five while section six concludes the paper.

2.0 Nigeria's Public Debt Profile and its Sustainability

2.1 Nigeria's Debt Profile

Nigeria, like other developing countries, has benefitted from both external and domestic borrowing to finance its developmental goals over the years. For instance, the country's external debt was US\$35.94 billion in 2004, having doubled from US\$18.9 billion recorded in 1985. At that time, Nigeria's total debt as percentage of its GDP stood at 34.1 per cent, higher than the international threshold of 30.0 per cent (Fig. 1). Consequently, a move for external debt relief commenced and it was obtained from the Paris Club in 2005, leading to the cancellation of about 60 per cent of the US\$30.85 billion being owed by the country. The debt relief negotiation was largely motivated by the need to free up resources for investment and faster economic growth in the country.

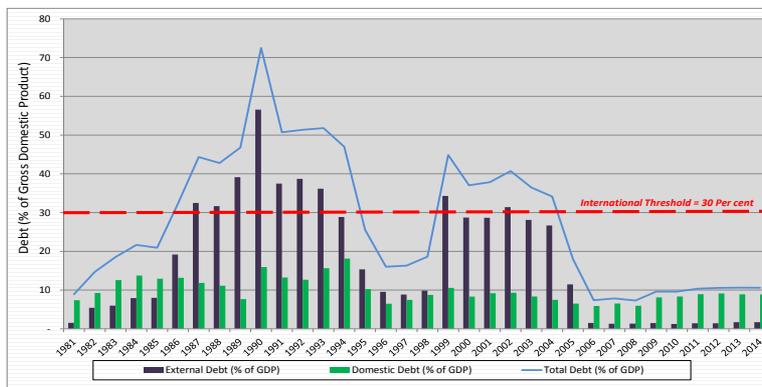


Figure 1: Nigeria's Public Debt (% of GDP, 1981 - 2014)

Source: CBN, DMO, NBS

As shown on Figure 1, total external debt as percentage of GDP grew systematically from about 1.5 per cent in 1981 to 39.1 per cent in 1989 before reaching its peak in 1990 (56.6 per cent). However, there was a subsequent

gradual reduction in the ratio from its level of 37.5 per cent in 1991 to about 1.5 per cent in 2006, following the completion of the debt cancellation package in 2005.

As in external debt, domestic debt stock trended upwards during the 1980s while there was a steady decline during 1994 – 2008. Total debt as a percentage of GDP remained at single digit during 2006 – 2009 and inched to a little above 10.0 per cent during 2011 - 2014. Between 1981 and 2014, there were 15 episodes in which total debt to GDP ratio exceeded the international threshold of 30 per cent (Fig. 1).

Irrespective of the size of public debt accumulated by an economy, a critical empirical question that confronts researchers and policy makers relates to the point beyond which such debt accumulation becomes injurious to economic growth. This question presupposes a non-linear relationship between output growth and public debt. A visual inspection of the scatterplot of Nigeria’s real GDP growth and total public debt presented in Figure 2(a) seems to suggest a nonlinear relationship between the duo during 2005 – 2015.

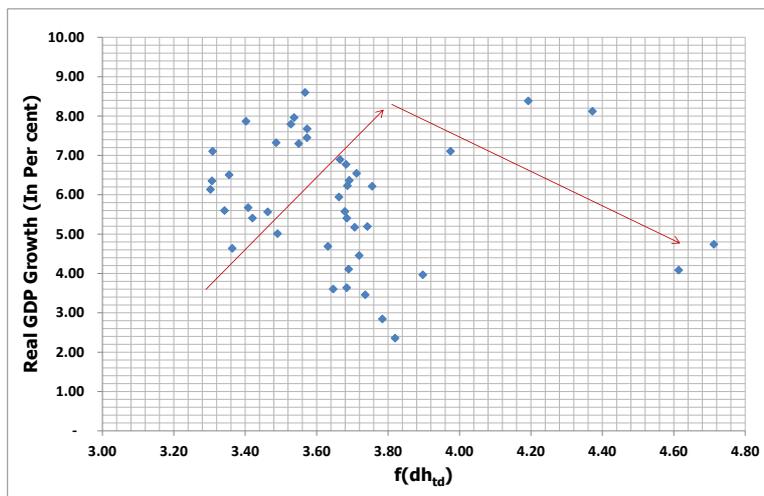


Figure 2(a): Non-linear Relationship between Economic Growth and Total Debt as % of GDP in Nigeria, 2005 – 2015

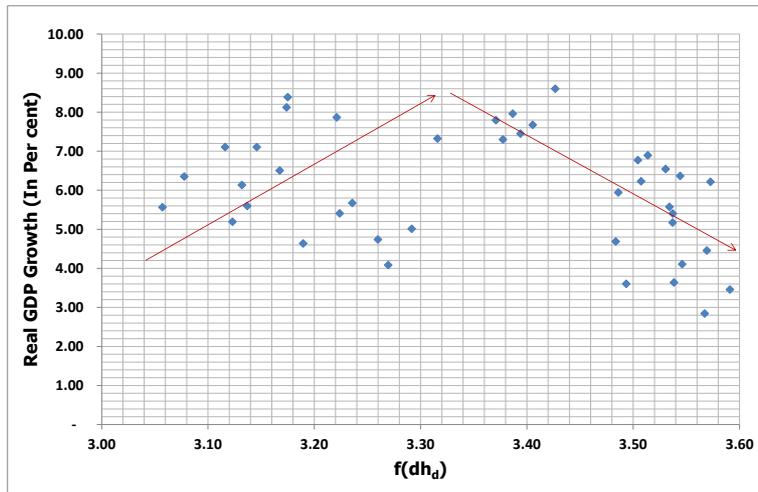


Figure 2(b): Non-linear Relationship between Economic Growth and Domestic Debt as % of GDP in Nigeria, 2005 - 2015

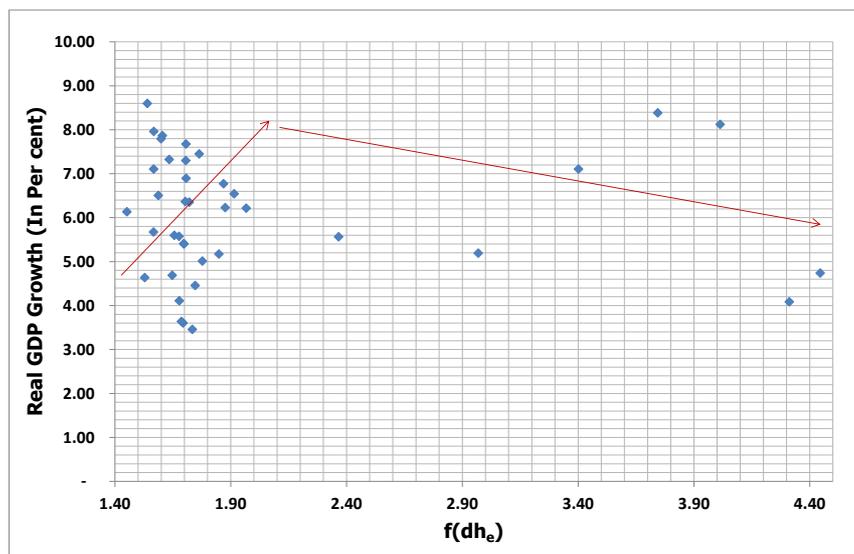


Figure 2(c): Non-linear Relationship between Economic Growth and External Debt as % of GDP in Nigeria, 2005 - 2015

Similarly, a non-linear relationship seems to exist between domestic debt and GDP (Figure 2b) and between external debt and GDP (Figure 2c). However, the identification of the threshold point beyond which debt begins to hurt

growth is not realistically possible by visual inspection and thus constitutes subject of empirical investigation.

2.2 Nigeria's Debt Sustainability

The country's debt profile has remained largely within internationally acceptable limits since the external debt forgiveness that was received in 2005 (Fig. 3). However, in 2000, the ratio of total debt to total government revenue was 669.0 per cent, substantially above the international threshold of 250 per cent (Fig. 3). At N3, 097.38 billion, total external debt constituted 78.0 per cent of total public debt and represented 159.2 per cent of total exports (this is above the international threshold of 100.0 per cent). However, total debt service as percentage of government retained revenue was 18.2 per cent, a little lower than the internationally set debt sustainability threshold. Of the six debt sustainability indicators presented in Figure 3, the thresholds were exceeded in three, namely: total debt/GDP, total debt/government revenue and total external debt/exports. This implies that Nigeria's debt in 2000 was near been unsustainable. The situation was similar in 2001 and 2002 with the country exceeding her debt thresholds in the three aforementioned indicators while total external debt grew by 5.0 and 21.6 per cent in 2001 and 2002, respectively.

Table 1: Selected Debt Related Macroeconomic Variables

Year	Total Debt Stock (N' Billion)	External Debt Stock (N' Billion)	Domestic Debt Stock (N' Billion)	Total Debt Service (N' Billion)	Total Exports (N' Billion)	Total Govt Revenue (N' Billion)	Total Govt. Exp. (N' Billion)	Overall Deficit (N' Billion)	Nominal GDP (N' Billion)	External Reserves (N' Billion)	Total Debt/GDP (%)	External Debt/GDP (%)	Domestic Debt/GDP (%)
2000	3,995.64	3,097.38	898.25	108.49	1,945.72	597.28	701.06	(103.78)	10,788.50	1,032.94	37.04	28.71	8.33
2001	4,193.27	3,176.29	1,016.97	155.40	1,867.95	796.98	1,018.03	(221.05)	11,080.32	1,164.80	37.84	28.67	9.18
2002	5,098.89	3,932.88	1,166.00	170.64	1,744.18	716.75	1,018.16	(301.40)	12,527.55	974.73	40.70	31.39	9.31
2003	5,808.01	4,478.33	1,329.68	200.00	3,087.89	1,023.24	1,225.97	(202.72)	15,930.61	1,023.09	36.46	28.11	8.35
2004	6,260.59	4,890.27	1,370.33	203.64	4,602.78	1,253.60	1,426.20	(172.60)	18,337.20	2,252.47	34.14	26.67	7.47
2005	4,220.98	2,695.07	1,525.91	150.45	7,246.53	1,660.70	1,822.10	(161.40)	23,479.15	3,648.00	17.98	11.48	6.50
2006	2,204.72	451.46	1,753.26	222.57	7,324.68	1,836.61	1,938.00	(101.40)	29,832.60	5,425.58	7.39	1.51	5.88
2007	2,608.53	438.89	2,169.64	252.70	8,309.76	2,333.66	2,450.90	(117.24)	33,195.49	6,055.67	7.86	1.32	6.54
2008	2,843.56	523.25	2,320.31	471.30	10,161.49	3,193.44	3,240.82	(47.38)	39,043.22	7,025.86	7.28	1.34	5.94
2009	3,818.47	590.44	3,228.03	478.70	8,356.39	2,642.98	3,452.99	(810.01)	39,843.32	6,339.62	9.58	1.48	8.10
2010	5,241.66	689.84	4,551.82	354.20	11,532.02	3,089.18	4,194.58	(1,105.40)	54,612.26	4,872.23	9.60	1.26	8.33
2011	6,519.69	896.85	5,622.84	537.40	14,822.61	3,553.54	4,712.06	(1,158.52)	62,980.40	5,165.90	10.35	1.42	8.93
2012	7,564.44	1,026.90	6,537.54	720.55	14,736.10	3,629.61	4,605.39	(975.78)	71,713.94	6,895.84	10.55	1.43	9.12
2013	8,506.31	1,387.33	7,118.98	888.27	14,840.72	4,031.83	5,185.32	(1,153.49)	80,092.56	6,738.17	10.62	1.73	8.89
2014	9,431.73	1,527.71	7,904.03	851.35	12,988.30	3,899.39	4,600.79	(701.40)	89,043.62	5,810.10	10.59	1.72	8.88

Federal government's fiscal operations in 2003 resulted in an overall deficit of N202.7 billion and total debt stock in the year rose by 13.9 per cent above its level in 2002 to N5, 808.01 billion (Table 1). This level of debt stock represented 36.5 per cent of the country's GDP and 567.6 per cent of government revenue, surpassing the international thresholds for debt sustainability (Fig. 3). The developments were similar in 2004 as three (total debt/GDP, total debt/government revenue and total external debt/exports) of

the indicators presented in Figure 3 showed that the county's debt was unsustainable.

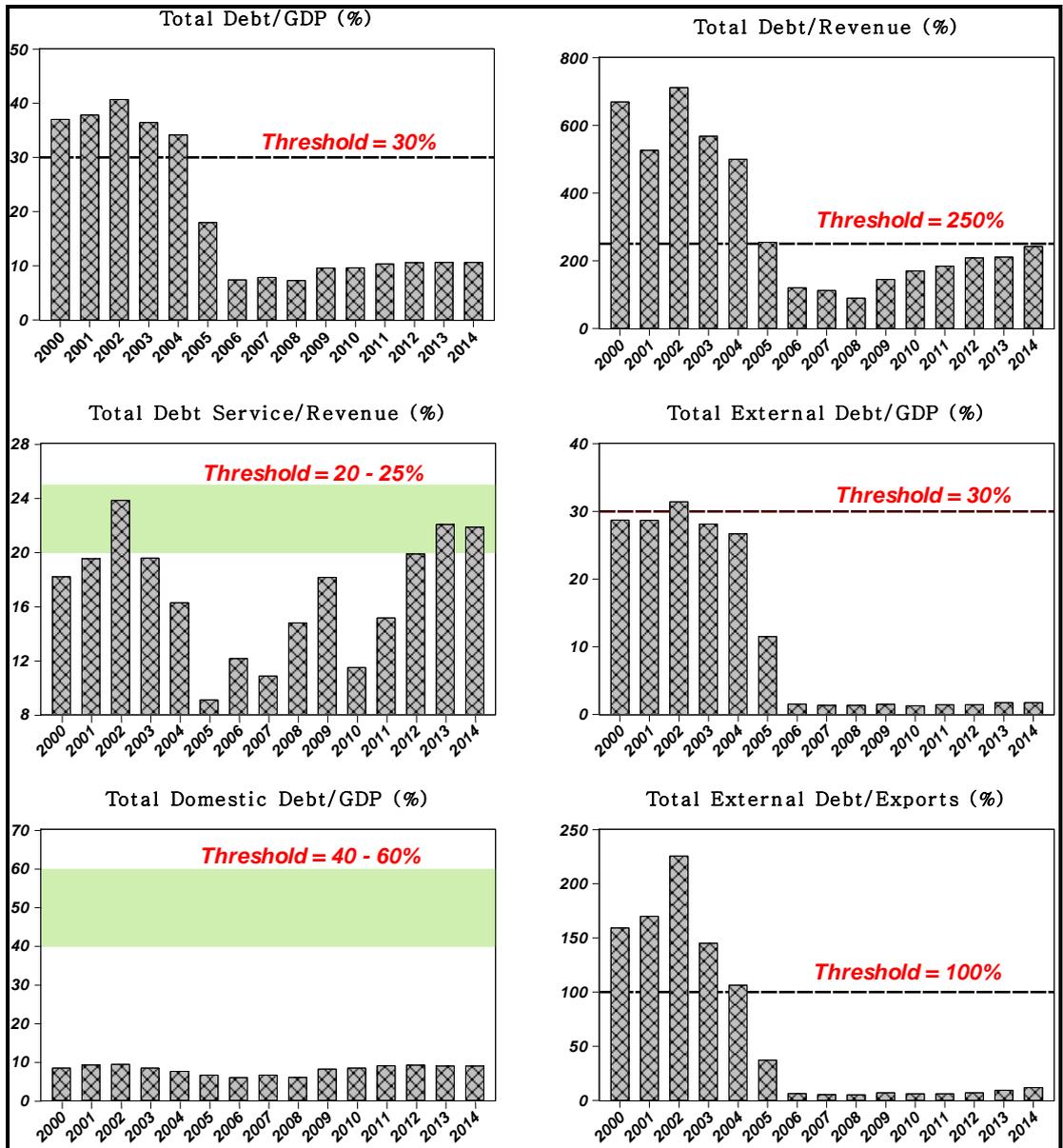


Fig. 3: Selected Debt Sustainability Indicators

However, in 2005, the stock of total debt declined significantly by 32.6 per cent below the level in 2004 to N4, 220.98 billion due to the external debt relief package secured for the country. Consequently, external debt stock declined by 44.9 per cent while domestic debt stock rose by 11.4 per cent. All

the indicators presented in Figure 3 (except total debt stock to government revenue ratio) revealed that the country's debt was sustainable in 2005.

In the aftermath of the debt cancellation of 2005, a combination of factors including adherence to the fiscal rule in line with the medium term expenditure framework (MTEF) and the entrenchment of fiscal consolidation assisted the government in realizing lower overall deficit until the occurrence of the global financial crisis of 2008/09. Consequently, apart from the ratio of total debt service to government revenue, the other indicators presented in Figure 3 showed that the country's debt remained sustainable during 2005 – 2014. While the international thresholds discussed in this section were internationally set to guide countries in their debt policies, it is important to empirically determine the optimal debt threshold for Nigeria.

3.0 Literature Review

Public debts can influence the economy both in the short-run and the long-run. It can stimulate aggregate demand and national output in the short-run, but crowd out capital and reduce output in the long-run. Many empirical studies examining the relationship between public debts and economic growth exists, with some of them identifying the point at which the relationship switches.

For instance, Reinhart and Rogoff (2010) examine the relationship between high public debt levels, economic growth and inflation in 44 countries utilizing data for about 2 centuries. The authors indicated that high debt/GDP ratio of 90 per cent and above is associated with lower growth outcomes in both advanced and emerging market economies. The authors found no obvious link between debt and growth for 20 advanced countries until public debt reaches a threshold of 90 per cent. The observations with debt to GDP over 90 per cent have median growth roughly 1 per cent lower than the lower debt burden groups and mean levels of growth were almost 4 per cent lower. The study, however, found that lower levels of external debt/ GDP (about 60 per cent) are associated with adverse reactions for the emerging market economies growth outcomes.

Reinhart, Reinhart and Rogoff (2012) identified 26 episodes of public debt overhang in advanced economies since 1800: that is, cases where the ratio of gross public debt to GDP exceeded 90 percent in a given country on a sustained basis. The study indicated that such public debt overhang episodes were associated with lower growth than during other periods, further confirming Reinhart and Rogoff (2010) findings.

Nasa (2009) examine the sustainable level of debt that is desirable for economic growth by estimating the debt threshold using the Hansen's endogenous threshold model and annual datasets for 56 countries for the period 1970 to 2000. The study found a debt/GDP threshold ratio of 45 per cent, indicating that public debt becomes detrimental to output growth once the debt ratio reaches this threshold. The author also showed that the growth maximizing level of debt, which debtors should aim for, was estimated at 7 per cent.

Herndon, Ash and Pollin (2013) replicated Reinhart and Rogoff (2010) and found that coding errors, selective exclusion of available data, and unconventional weighting of summary statistics led to errors that inaccurately represented the relationship between public debt and GDP growth among 20 advanced economies. The authors showed that the average real GDP growth rate for countries carrying a public-debt-to-GDP ratio of over 90 per cent was actually 2.2 percent, not 0.1 per cent, as indicated by Reinhart and Rogoff, indicating that average GDP growth at public debt/GDP ratios over 90 per cent is not significantly different than when public debt/GDP ratios are lower.

Wright and Grenade (2014) indicated a non-linear relationship between debt and growth in a panel OLS and threshold dynamics in 13 Caribbean countries. The study found a debt/GDP ratio of 61 per cent for the sample countries, with a debt/GDP ratio exceeding that threshold having an adverse impact on investment and growth. The results showed marked divergence between actual debt/GDP ratios and the calibrated optimal ratios at the country levels. The study indicated that the negative debt-growth relationship reinforced the point that government borrowing must be done not only on terms that are consistent with entrenching debt sustainability, but also on terms that yields growth dividends in the long run.

Pescatori, Sandri and Simon (2014), however, could not find any evidence of a debt threshold above which medium-term growth prospects is undermined. The study indicated that the relation between the level of debt and growth is importantly influenced by the trajectory of debt. In other words, countries with high but declining levels of debt have historically grown just as fast as their peers. In spite of the absence of debt thresholds, the authors showed that higher debt was associated with more volatile output growth, which can be damaging to economic welfare.

Metwally and Tamaschke (1994) indicated that Algeria, Egypt and Morocco devoted over one-quarter of their export earnings in 1989 to service external debts. Thus, their study examined the impact of the debt burden on economic growth and development in the three countries, utilizing both the single-equation and simultaneous equation models and data for 1975 to 1989. The authors showed that debt servicing has adversely affected economic growth in the three economies, while growth declines have constrained their capacity to service their debts. They added that improvements in current account, inflow of direct private investments and increase in domestic savings may contribute in reducing the magnitude of the debt problems.

Calderon and Fuentes (2013) set out to test whether public debt hinders growth and examine whether economic policies ameliorate these effects utilizing a large panel data of 136 countries for the period 1970 – 2010. Results from the analysis indicated negative and robust effect of public debt on economic growth. They also indicated that strong institutions, good economic policies and outward-oriented policies mitigate these adverse effects. The authors showed that a sharp reduction in public debts and an improvement in the policy environment induced an increase in the growth rate per capita of 1.7 percentage points for the Caribbean and 2 percentage points for South America. A more conservative scenario, however, yielded lower growth benefits for the 2 regions.

Utilizing an overlapping generations model of endogenous growth, Lin (2000) showed that an impact of public debt on growth depends on the magnitude of real interest rates. The study indicated that government debt affects the growth rate by affecting the real interest rates and government spending on human capital production. According to the author, public debts will only decrease per capita growth rates if growth rates were less than real interest rates. However, public debts increases per capita growth rates if the growth rates were more than real interest rates. Singh (1999) investigated whether domestic public debts in India has an adverse impact on growth or follow the Ricardian Equivalence Hypothesis (REH) using the cointegration and Granger causality tests and annual data for 1959 – 1995. The author's analysis lends support to the REH implying the neutrality of domestic public debts to economic growth in the economy.

Siddique and Malik (2001) examined the debt-growth relationship in 3 South Asian countries, test the non-linearities in the relationship and showed the threshold levels for the 3 economies. Their analysis supported the presence of

a nonlinear relationship between economic growth and all their debt burden indicators. The study indicated two thresholds of 61 and 88 per cent, for the two debt/GDP ratios computed, with Pakistan's debt impact on economic growth being negative having crossed the threshold debt indicators. Sri Lanka and India, however, has debt ratios lower than the critical levels, and their impact on growth was positive. Their critical values for debt service-to-exports and total debts-to-exports were 12.75 and 197.0 per cent, respectively.

Egert (2012, 2013) indicated that that the nonlinear relation from debt to growth is not very robust and that the negative association between debt and growth may set in at debt levels as low as 20 per cent of GDP. Further and greater thresholds may exist but their magnitude was highly uncertain. He added that individual country estimates reveal a large amount of cross-country heterogeneity in debt-growth thresholds. Their result was an econometric confirmation that the 90 per cent public debt threshold identified in Reinhart and Rogoff (2010) does not hold.

Koeda (2008) found that the extent of debt overhang and the effectiveness of debt relief depend on a recipient country's initial economic conditions and level of total factor productivity. Lower initial income makes the recipient country to borrow more concessional loans to finance current consumption, thereby becoming more likely to be trapped in the low steady state level. Meanwhile, the lower the level of TFP, the more likely it becomes that the benefit of remaining at the cutoff exceeds the long-run benefit of achieving a higher steady state. The study advocated for a one-time-debt-relief stock treatment, which may be effective in helping a country move below the debt overhang threshold, raise TFP and achieve growth.

Akram (2011) examined the consequence of public debt for economic growth and investment in Pakistan. The study found a negative and significant relationship between public external debt and per capita income growth and investment, confirming the presence debt overhang in the country. Meanwhile, domestic debts tended to crowd out private investments, but don't inhibit per capita income growth.

Kraay and Nehru (2006) indicated that the risk of debt distress depends significantly on a small set of factors: debt burdens, policies and institutions and shocks. According to the study, there is a significant tradeoff between debt burdens and policy: countries with better policies and institutions can

carry substantially higher debt burdens than countries with worse policies and institutions without increasing the risk of debt distress. For their estimates based on low-income countries, a country with average growth and poor policy (corresponding to a Country Policy and Institutional Assessment - CPIA score of 3) would be able to tolerate a present value of debt to exports of about 100 percent. However, a country with good policy (corresponding to a CPIA score of 4) would be able to tolerate a debt level nearly three times higher.

Wijnbergen (1991) indicated that Mexico faced acute economic crises in the 1980s, with the country's GDP remaining stagnant between 1982 and 1988, while the country transferred about 6 per cent of its GDP on average to external creditors. The 1989 – 90 debt restructuring programme under the “Brady deal” was implemented, bringing the restoration of economic growth to the country within reach. Cordella et al (2010) provided evidence of debt overhang when the net present value of debt rises above 20-25 per cent of GDP in countries with good policies and institutions. However, debt becomes irrelevant - the marginal effect of debt on growth stops being negative – at about 70-80 per cent threshold. Overhang and irrelevance thresholds were found to be substantially lower (10-15 and 15-35 percent of GDP, respectively) in countries with bad policies and institutions. Their results also indicated that the effect of debt relief on growth also depends on the quality of policies and institutions, as well as on countries' indebtedness levels.

Pattillo et al (2003) found the impact of debt on growth to be very different at low levels of debt and at high levels. At high levels of debt, doubling debt from any initial debt level at or above a threshold will reduce per capita income growth by about 1 percentage point. At low levels, however, the effect was generally positive but often not significant. Meanwhile, the negative impact of high debt on growth operated through both a strong negative effect on physical capital accumulation and on total factor productivity (TFP) growth. Thus, reducing debt levels would contribute to growth by boosting both capital accumulation and productivity growth.

Kumar and Woo (2010) examined the impact of high public debts on long-run economic growth utilizing panel data involving 38 advanced and emerging economies and annual data for the period 1970 to 2007. Empirical results from the analysis indicated an inverse relationship between initial debt levels and subsequent growth. A 10 percentage point increase in the initial debt-to-GDP ratio was found to be associated with a slowdown in annual real per

capita GDP growth of about 0.2 percentage points per annum, with the impact found to be smaller in advanced economies. The adverse effect reflects a slowdown in labour productivity growth through reduced investment and slower growth of capital stock.

Sichula (2012) investigated debt overhang in five Heavily Indebted Poor Countries (HIPC) of the Southern African Development Community (SADC), utilizing data for the period 1970 to 2011. The study showed a significant relationship between external debt and GDP. As external debt decreases, GDP increases. As those countries attain HIPC completion point, they witnessed increases in their real GDP occasioned by declines in debt service payments.

Ekperiware and Oladeji (2012) indicated that the debt relief for Nigeria in 2005 caused a structural break in the relationship between external debt and economic growth in the country. This was induced by the freeing of resources for economic growth projects in health and education sectors. Boboye and Ojo (2012) showed that external debt burden had an adverse effect on Nigeria's national income and its per capital income, as high level of external debts led to devaluation of the Naira, retrenchment of workers, continuous industrial strike and poor educational system, depressing the country's economy. Ezebalisi et al (2011) found a negative relationship between external debt and economic growth in Nigeria. The study indicated that a 1 per cent increase in external debt stock resulted in a decline of 0.027 per cent in Gross Domestic Product, while a 1 per cent increase in total debt service resulted to 0.034 per cent decrease in GDP. It added that considerations about low debt to GDP and low debt service to GDP ratios should guide future debt negotiations. Suleiman and Azeez (2012), however, proved that external debts contributed positively to economic growth during the period 1970 to 2010.

4.0 Data and Methodology

4.1 Data

The econometric analysis was conducted using quarterly time series data for the period 2005 – 2015, sourced from the Statistics Portal of the Central Bank of Nigeria. The relevant variables included nominal gross domestic product (NGDP), growth in real gross domestic product (rgdpg) at 2010 constant prices, total domestic debt, total external debt and the total public debt. In order to obtain proxies for the county's indebtedness, necessary ratios were computed. These include the total debt to NGDP ratio (*td*), external debt to

NGDP ratio (*ed*) and domestic debt to NGDP ratio (*dd*). The ratios were converted into their log forms in order to smoothen the time trend in the dataset and provide an improved fit (Khan and Senhadji, 2001). In order to avoid the problem of spurious regression, Augmented Dickey Fuller (ADF) as well as Zivot Andrews (ZA) unit root tests were conducted on each of the transformed variables to ascertain their order of integration.

4.2 Econometric Methodology

In order to understand the possible non-linear relationship between public debt and economic growth in Nigeria, we adopted the Khan and Senhadji (2001) approach. This approach has been largely used in the investigation of the relationship between inflation and economic growth. This approach derives from the estimation techniques developed by Chan and Tsay (1998) and Hansen (2000) for panel models with threshold effects. While the original specification by Khan and Senhadji (2001) was also for panel analysis, the modified version of the model implemented by Doguwa (2012) is adopted in this study. The respective equations for the total debt, external debt and domestic debt threshold models are specified in equations (1), (2) and (3).

$$rgdpg_t = \alpha_{id} + \beta_1 d_t^{td} (td_t - td^*) + \beta_2 (1 - d_t^{td}) (td_t - td^*) + \varphi_{id} \mu_{t-1} + \varepsilon_t \tag{1}$$

$$rgdpg_t = \alpha_{ed} + \lambda_1 d_t^{ed} (ed_t - ed^*) + \lambda_2 (1 - d_t^{ed}) (ed_t - ed^*) + \varphi_{ed} \mu_{t-1} + \varepsilon_t \tag{2}$$

$$rgdpg_t = \alpha_{dd} + \gamma_1 d_t^{dd} (dd_t - dd^*) + \gamma_2 (1 - d_t^{dd}) (dd_t - dd^*) + \varphi_{dd} \mu_{t-1} + \varepsilon_t \tag{3}$$

where *rgdpg*, *td*, *ed* and *dd* are as earlier defined; μ_{t-1} is an autoregressive component used to mop up the effects of other control variables with φ as the respective coefficients. The variables *td**, *ed** and *dd** are the values used for the iteration process in our search for the optimal threshold point. The effect of public debt types on GDP growth is captured by β_1 , λ_1 , and γ_1 for periods in which the debt to RGDP ratio is greater than the threshold (high debt regime) while β_2 , λ_2 and γ_2 represent the effect of public debt types on *rgdpg* when the public debt level is lower than the threshold value (low debt regime). The dummy variables for total debt, external debt and domestic debt denoted as d_t^{td} , d_t^{ed} and d_t^{dd} , respectively, in equations 1 to 3 are defined as:

$$d_t^{td} = \begin{cases} 1, & \text{if } td_t > td^* \\ 0, & \text{elsewhere} \end{cases};$$

$$d_t^{ed} = \begin{cases} 1, & \text{if } ed_t > ed^* \\ 0, & \text{elsewhere} \end{cases}; \text{ and}$$

$$d_t^{dd} = \begin{cases} 1, & \text{if } dd_t > dd^* \\ 0, & \text{elsewhere} \end{cases}$$

The optimal threshold point for each of the debt ratio is determined by iterating equations 1 – 3, using different values of debt threshold levels. The optimal threshold is identified at the point where the Sum of Squared Residuals (*SSR*) of the iterated regressions is minimized.

5.0 Results

5.1 Descriptive Statistics

The summary statistics presented in Table 2 showed that total debt, external debt and domestic debt as percentage of GDP averaged 41.8, 12.2 and 29.6 per cent during the estimation period of 2005 – 2015. This implied that the country accumulated more domestic debt as a share of GDP than external debt during the period. However, in terms of the maximum shares attained during the study period, external debt as percentage share of GDP recorded 85.3 per cent in the first quarter of 2005, compared to a lower value of 40.4 per cent for domestic debt recorded in the first quarter of 2015. Of the three ratios, external debt appeared most volatile with a standard deviation of 18.2, compared to 17.4 for total debt and 5.2 for domestic debt.

Table 2: Summary Statistics

	Total Debt/GDP	Domestic Debt/GDP	External Debt/GDP
Mean	41.83	29.62	12.21
Median	39.09	29.78	5.52
Maximum	111.33	40.43	85.28
Minimum	27.19	21.27	4.27
Std. Dev.	17.39	5.19	18.19

5.2 Unit Root Tests

We employed both the Augmented Dickey-Fuller (ADF) and Zivot Andrews (ZA) tests to ascertain the time series properties of the variables. Results from

both tests presented in Table 3 indicated that the null hypothesis of a unit root was rejected for *rgdpg* and *td*. Also, *ed* was found stationary at level based on the ADF while *dd* was non stationary. However, the ZA test (which accommodates structural break in the series) confirmed that *dd* was stationary at level. Thus, we treated all the variables included in the model as I(0).

Table 3: Unit Root Tests

Variable	Augmented Dickey Fuller Test		Zivot Andrews Test	
	t-statistics	P-value	Z-A test statistics	P-value
rgdpg	-2.9273	0.0507	-4.2016	0.0353
td	-4.3462	0.0013	-4.3748	0.0022
dd	-1.0498	0.7265	-4.8671	0.0006
ed	-4.8972	0.0002	-3.7258	0.0795

5.3 Estimation Results

Table 4 presents the results of the Khan and Senhadji (2001) model estimated to determine the threshold levels for total, domestic and external debts with respect to output growth in Nigeria. The regressions presented In Table 4 relate to the point where the SSR for equations 1 – 3 were minimized.

Table 4: Threshold Regression Results

Parameter	Total Debt (td)	Parameter	Domestic Debt (dd)	Parameter	External Debt (ed)
β_1	-2.6614	γ_1	-13.1398*	λ_1	-26.3248*
β_2	-28.6286*	γ_2	1.2333	λ_2	-2.4225***
φ_{td}	0.6783**	φ_{dd}	0.3429**	φ_{ed}	0.7314*
α_{td}	3.6396**	α_{dd}	6.7500*	α_{ed}	0.2062
td Threshold	73.70	dd Threshold	30.88	ed Threshold	49.40
R ²	0.5051	R ²	0.4550	R ²	0.5281
SSR	50.5459	SSR	55.6535	SSR	48.1885
F - statistic	12.9252	F - statistic	10.5765	F - statistic	14.1772
P-value	0.0000	P-value	0.0000	P-value	0.0000

*, ** and *** indicate significance at 1, 5 and 10 per cent levels

The computed percentage shares of total public debt to GDP indicated a minimum 27.19 and a maximum of 111.33. A log transformation of the series translated to total public debt ratios (td) ranging from 3.30 to 4.71. Consequently, the threshold search range was set at 3.75 to 4.50 with an interval of 0.05. The iterative procedure conducted on equation 1 revealed that the SSR was minimized at a threshold value of 4.30 (i.e. td = 4.30). Inverting the log transformation of the value produced a threshold estimate of 73.70 per cent of GDP for the total public debt (Fig. 4-a).

The sum of the coefficients of β_1 and β_2 measures the effect of total public debt on growth. At the optimal threshold level, the sum of two threshold coefficients is expected to be negative.

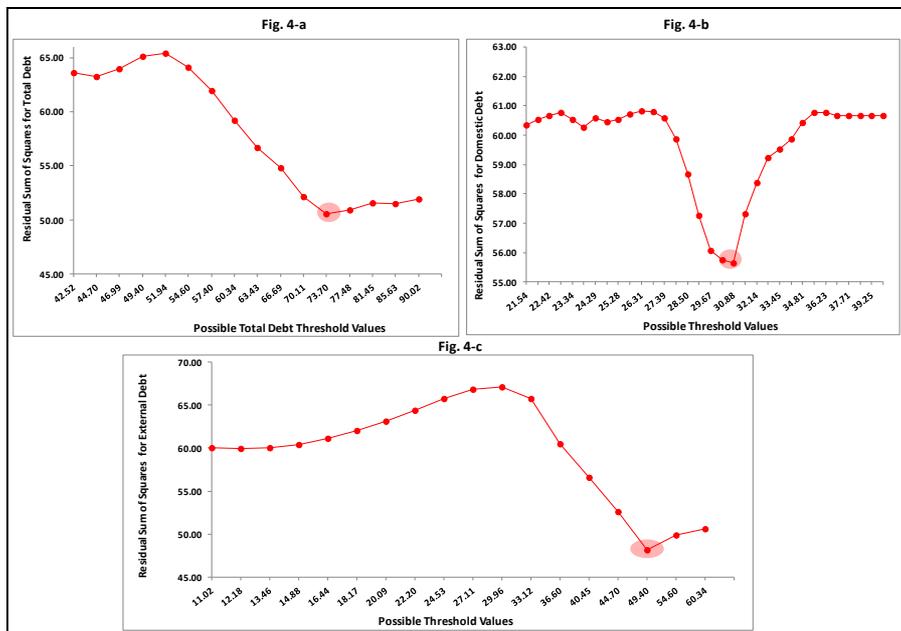


Figure 4: Residual Sum of Squares for the Iterative Regressions of the Debt Types

Even though the sum of the two coefficients turned negative at debt to GDP ratio of about 42 per cent, the negative effect hovered around zero per cent up until a threshold of about 50 per cent. At threshold levels above about 52.0 per cent, negative impact of public debt on growth becomes quite larger (Figure 5-a). Since the SSR was minimized at a threshold level that corresponds to a total debt ratio of 73.70 per cent, we conclude that accumulation of total debt above this threshold would be highly detrimental to output growth. However,

public debt ratio below 51.94 per cent of GDP seems to have no substantial detrimental effect on economic growth.

The threshold search range (in logs) for the domestic debt was set at 3.07 to 3.69 with an interval of 0.02, as the log values of the domestic debts to GDP ratio ranged between 3.06 and 3.70. Empirical results from the analysis indicated that the threshold level for domestic public debt was 30.88 per cent of GDP (Figure 4-b). The SSR was minimized at that level while sum of γ_1 and γ_2 was negative at the threshold level. The sum of the two threshold coefficients became negative when domestic debt to GDP ratio was 22.42 per cent, indicating that a domestic debt ratio below 22.42 is conducive for growth. However, when domestic debt accumulation exceeds 30.88 per cent of GDP, its impact on economic growth becomes detrimental (Figure 5-b).

The external debt ratio for the country ranged between 4.27 and 85.28 per cent (implying a log-transformed range of 1.45 to 4.45) during the period. Consequently, the threshold level was searched between 2.40 and 4.20. Empirical results from the estimation of equation 3 showed that the threshold level for external debt was 49.40 per cent of GDP, as the SSR was minimized at that level (Figure 4-c).

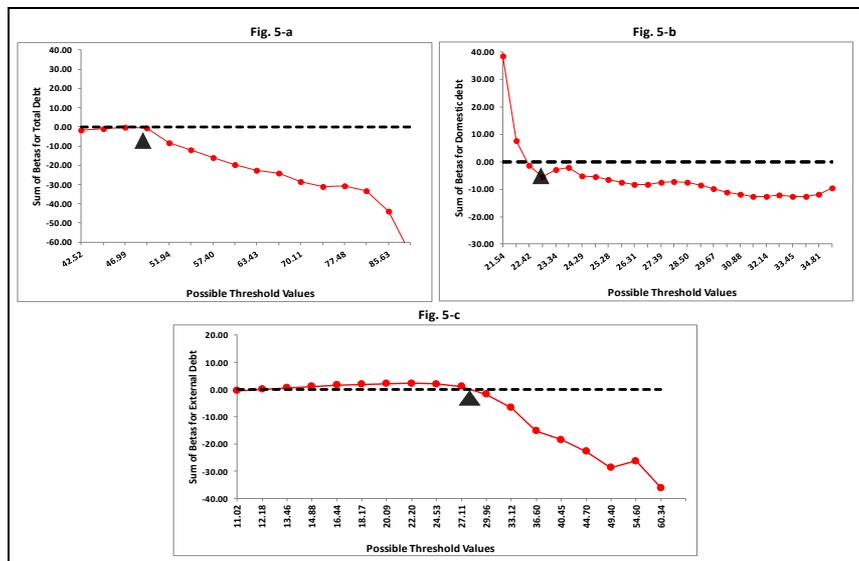


Figure 5: Sum of Threshold Coefficients for the Iterative Regressions of the Debt Types

The sum of the coefficients of λ_1 and λ_2 was also negative at the threshold level. It became negative when external public debt to GDP was 29.96 per

cent, indicating that a ratio below that level could be conducive to economic growth. However, when external debt as a share of output goes beyond 49.40 per cent of GDP, the negative output effect becomes substantial. Thus, a ratio between 29.96 and 49.40 could be described as a region of caution, with external debt having mild effects on output growth.

A retrospective analysis of Nigeria's public debt profile indicated that the country's external and total public debt ratios exceeded their respective threshold limits during the first three quarters of 2005, prior to the debt forgiveness (Figures 6-a and 6-c). On the average, the ratios were largely below their threshold levels in estimation period. On the other hand, domestic debt ratio consistently exceeded its threshold limit since the first quarter of 2011 (Figure 6-c).

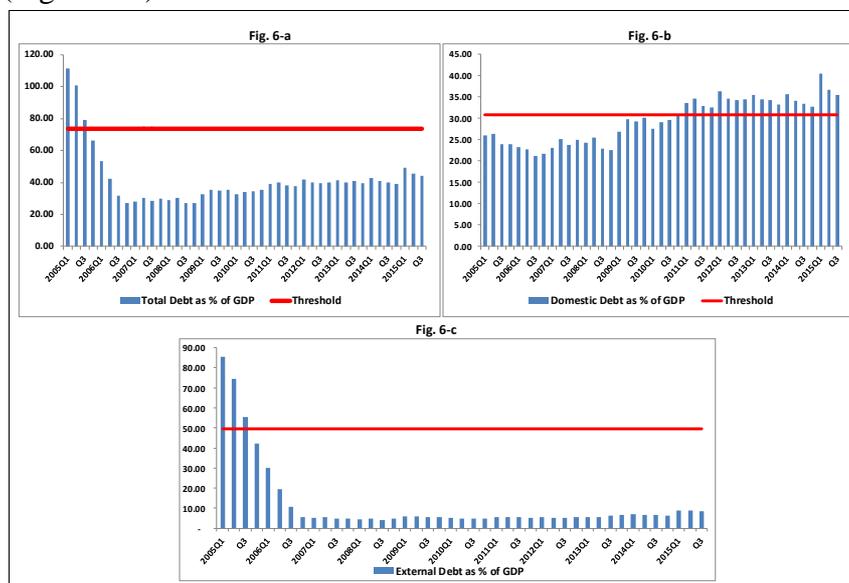


Fig 6: Actual Debt Types Ratios Vis-a-vis their Estimated Threshold Level (2005 – 2015)

6.0 Conclusion and Policy Implications

A reasonable level of borrowing is expected to enhance capital accumulation and boost economic growth. However, excessive borrowing could be inimical to growth. Several arguments have been put forward regarding the negative effects of excessive public debt on future growth and its different channels of transmission, including the debt overhang and crowding out theories. In this paper, we contribute to the empirical literature on the debt-growth relationship

by investigating the existence of threshold effects in the relationship between public debt and economic growth in Nigeria. We applied quarterly data to a Khan and Senhadji (2001) type of model. Our objective was to determine the point of inflexion, below which public debt contributes to growth and beyond which debt hurts growth, a point usually referred to as the optimal debt threshold level. This was motivated by the need to re-assess Nigeria's debt profile, especially in the aftermath of the rebasing of the economy.

Regression results confirmed the existence of a non-linear (inverted U-shape) relationship between public debt and economic growth in Nigeria. For public debt (sum of external and domestic debts) as a ratio of GDP (in per cent), a threshold level of 73.7 per cent was found. This suggests that the accumulation of public debt in excess of the estimated threshold exerts negative effects on growth in Nigeria. A retrospective examination of the country's debt profile indicated that the threshold was exceeded during the early part of 2005. In the case of external debt to GDP ratio (per cent), model results indicated a threshold level of 49.4 per cent beyond which further accumulation of external debt hurts growth. The country also exceeded the estimated threshold level during the first three quarters of 2005. Lastly, a domestic debt threshold level of 30.9 per cent of GDP was identified. Nigeria's domestic debt was been above the estimated threshold since 2011. These results implied that periods during which the thresholds were exceeded could be associated with periods of sub-optimal growth.

The findings of this study contributed to the economic discourse on debt accumulation and its growth implications in Nigeria. It also provided policymakers with quantifiable estimates of the growth impacts of high indebtedness. It is recommended that deliberate policies be put in place to ensure that the accumulation of debt in Nigeria is consistent with the country's growth objectives. Also, the government is encouraged to put in place, fiscal reforms that would help in the better management of domestic debt and the acceleration of economic growth. Governments must move decisively to address the imperatives of fiscal consolidation and domestic debt reduction, through comprehensive reforms that tackle both expenditure and revenue. Furthermore, the obtained inverted U-shape effect of public debt on GDP reinforces the point that government borrowing must be done not only on terms that are consistent with entrenching debt sustainability, but also on terms that yields growth dividends to the country in the long run.

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