Analysis Of Public Debt-Threshold Effect On Output Growth In Nigeria[1]

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Abstract

The history of debt accumulation by the Nigerian government indicates that the country's economy has oscillated between credit-fueled booms and default-driven bursts. Moreover, recent build-up of government debt tends to raise concern. Therefore, it becomes necessary to examine the threshold effects of public debt types on output growth in Nigeria. The study adopted an eclectic methodological approach by focusing on basic least squares, autoregressive distributed lag and global optimization methods. The global optimization procedures are useful for identifying multiple breaks and associated regression coefficients which minimize the sums of squared residuals. Moreover, the rebased GDP figures from 1981 to 2015 at 2010 constant prices were employed. The findings in respect of the three public debt types are as follows: the optimal domestic debt-GDP threshold for Nigeria is 13.6% and this implies that, a significant threshold effect of domestic debt on output growth exist once the 13.6% threshold is exceeded; empirical evidence indicates that there is no external debt induced threshold effect on output growth in Nigeria up to 50% of GDP; and, there is supporting evidence that the optimal total public debt-GDP threshold for Nigeria is 55.2%. The paper recommends the exercise of caution in the accumulation of domestic debts while encouraging more external borrowings at advantageous terms.

Keywords: Public Debt, Threshold, Output Growth, Least Square, ARDL, Global Optimization

1 The views expressed in this paper are those of the authors and do not represent those of the institution where they work.

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1. Introduction

The history of public debt accumulation in Nigeria indicates that the country's economy fluctuated between debt-fueled booms and default-driven bursts. Between 1970 and 1977, the foreign debts contracted were on concessional terms from bilateral and multilateral sources with long repayment periods and low interest rates. The basic argument underlying the acquisition of debt capital was that private and public savings were inadequate to finance critical social and economic overheads such as roads, ports, irrigation, railways, power, health and education which are germane to rapid economic development. The growth enhancing attribute of public debt has important policy implications for employment and poverty reduction. According to economic theory, if the price level remains relatively unchanged, the rise in government spending through borrowed funds leads to an increase in aggregate demand, output and employment.

Furthermore, Cecchelti, Mohanty, and Zampoli (2013) avers that public debt matters to the government because it complements tax revenues when there is surge in expenditures; it helps to smooth consumption not only in the lifetime of people who are currently alive but also across generations. Thus, a transfer of resources from future to current generations can raise the society's inter-temporal welfare; and government debt crowds in investment through the provision of liquidity services which eases the credit conditions faced by firms and households.

However, the accumulation of public debt in Nigeria took a significant turn for the worse after the collapse of crude oil prices in 1978 (Rahman, Adeola, Abiodun and Tolulope 2010). Thereafter, an increasing portion of borrowings from private oversea lenders was on non-concessionary terms involving shorter maturities and market determined rate of interest. As the

years went by, the scheduling of debt on harder terms led to a steep rise in debt service payment for Nigeria.

The above scenario indicates that unbridled and uncontrolled appetite for borrowed funds may have deleterious consequences. For instance, a steep rise in public debt may have serious policy implications for domestic price stability and foreign exchange management. The financing of persistent government deficits and associated fiscal expansion over the years has posed enduring challenge to the management of monetary policy by the Central Bank of Nigeria. Another profound criticism of public borrowing is that it crowds out private investment by putting pressure on loanable funds. Moreover, a more insidious problem associated with public debt relate to its misapplication, maladministration and corrupt misuse (Izedonmi and Ilaboya 2012; Babu, et al., 2015 and Adejuwon et al., 2010).

The unpleasant experience of Nigeria with the problem of debt overhang calls for caution in public debt management. Debt overhang dissuades current investment and limits the capacity of a sovereign nation to repay its stock of existing debts. With the onset of global economic recession in early 1980's, Nigeria began to default on its debt service obligations which caused further lines of credit to dry up. Consequently, the economy faced severe downturn that necessitated the introduction of austerity measures and eventually, the structural adjustment programme (SAP) in 1986. In 2016, Nigeria began to be confronted with a similar scenario as in 1980s such as severe threat to the diminution of external reserves and rising austerity measures. Moreover, the nation's total debt stock climbed to the current level of US$61.45 billion (over N16 trillion) as at June 2016, (DMO 2016) as compared to $17.3 billion external debt in 1985. To compound the issues at stake, the 2016 budget for Nigeria clearly indicates that government borrowing for the year will be principally directed to fund capital projects of N1.8 trillion, while N1.36 trillion has been provided

for foreign and domestic debt service. Thus, there is palpable fear of an imminent problem of another debt overhang.

Accordingly, certain questions naturally arise: If we agree that indeed public debt is a useful tool to moderate macroeconomic volatility, when is a good thing too much? In other words, what is the saturation point beyond which public debt begins to exert negative effects on economic growth? What are the tipping points for both the domestic and foreign debt components? These are some of the crucial policy questions that precipitated this study. Therefore, the specific objectives of this study include a determination of the optimal total public debt threshold for Nigeria beyond which economic growth declines. Also, we shall determine the tipping points for domestic and foreign debts in Nigeria. Henceforth, throughout this paper, total public debt refers to total Federal Government of Nigeria (FGN) debt which is disaggregated into domestic and foreign components. Inter alia, this work differs from other studies in relation to Nigeria in that we adopted a more comprehensive analytical framework, including basic least squares, autoregressive distributed lag (ARDL) and global optimization technique. Finally, this work contributes to the extant literature on country-specific debt-threshold studies.

2. Trends in Government Debt and Economic Growth in Nigeria

The debt and growth trends are depicted in Figure 1 and Appendix 1. The total debt-GDP ratio rose from 9.34% in 1981 to 23.53% in 1985. The global economic recession during this period led to a decline in the demand for the nation's crude oil output which notably reduced official revenue receipts, thereby constraining the government to rely heavily on borrowed off-shore funds. According to Todaro and Smith (2009:679), "As a result, massive debt service obligations accumulated, so that countries like Nigeria . . . were experiencing negative economic growth in the 1980s and consequently faced severe difficulties in paying even the interest on their debts out of export earnings. They could no longer borrow funds in the world's private capital markets." According to Ogbe 1992 (cited in Rahman

et al 2010), the debt stock grew rapidly from $3.4 billion in 1980 to $17.3 billion in 1985.

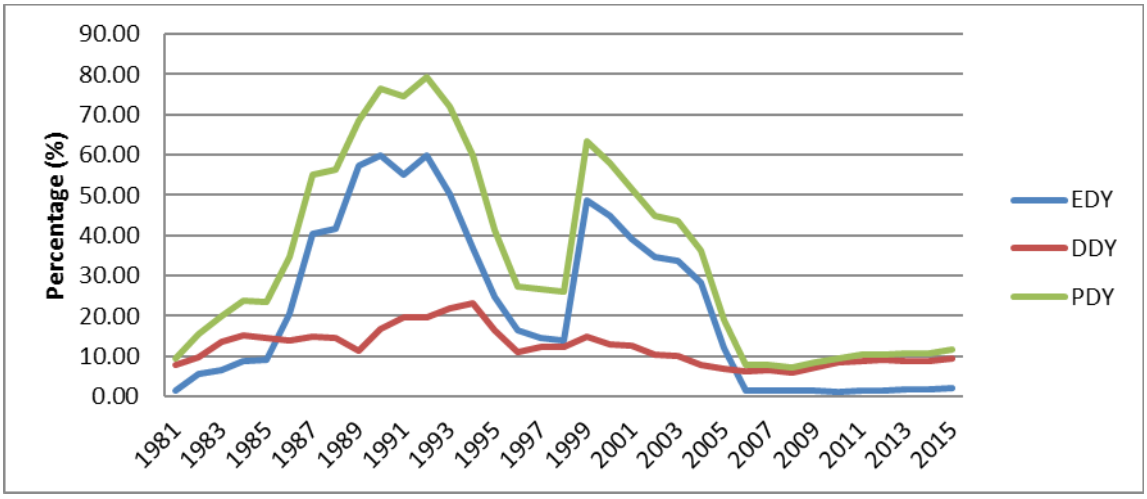

Figure 1. Debt Indicators in Nigeria

The situation became so precarious that private lending dried up by 1984.The negative economic growth rate during the period in turn aggravated the debt problem. Thereafter, the total public debt-GDP ratio jumped from 55.16% in 1987 to an all-time high of 79.38% in 1992. By 1990, the nation's debt stock has reached a figure of US$32.9 billion. In part, this situation reflected the development during the period of structural adjustment programme (SAP) when Nigeria accepted the painful policy adjustments of the International Monetary Fund (IMF) in order to secure further loans. In consequence, the external debt-GDP ratio rose astronomically within the period. At this juncture, we note that the external debt-GDP ratio (EDY) is the major driver of the trend observed for the total debt-GDP ratio (PDY) between 1981 and 2006. However, beyond 2006, the domestic debt-GDP became the dominant force propelling PDY.

In 1998, PDY nose-dived to 26% before rising to the second all-time peak of 64% in 1999 when the Paris Club component alone of the nation's debt stock stood at US$21.6 billion and remained high all through the succeeding years up to 2004. Thus, it was no wonder that the Nigerian

government sought and secured Africa's largest debt relief from the Paris Club of creditors in April 2006. The creditors wrote off a total debt of US$30 billion after Nigeria agreed to repay the balance of US$12.4 billion in one swoop. Following the debt relief, PDY fell to 8% in 2006 and never exceeded 12% between 2006 and 2015.

After the period of negative growth in the early 1980s, there

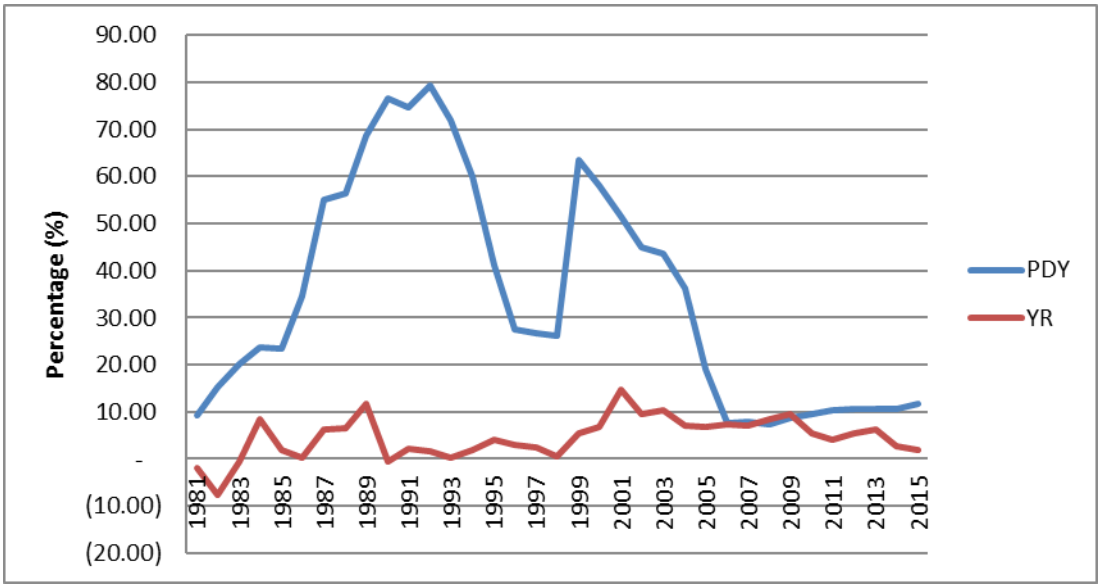

Figure 2. Public Debt and Economic Growth in Nigeria

was notable growth in national output from 1984 to 1990. This period corresponds to the time when the public-debt to GDP ratio was high. However, due to the likely problem of debt overhang, there was subdued growth between 1990 and 1998 but growth picked up afterwards as a result of large public borrowing. The growth momentum slowed down from 2010 to 2015 due likely to the precipitous decline in external funding. Clearly, the trend analysis of public debt and economic growth in Nigeria indicates that sometimes, rapid growth occurred during periods of high public debt to GDP ratio. At other times, public debt and growth appeared to be negatively correlated. Thus, it becomes an empirical question as to whether the long run impact of public debt on economic growth was positive or not. Similarly, it is an empirical issue as to which short-run dynamics prevailed

3. Review of Literature

3.1 Theoretical Framework

In general, economic theory provides the rationale that reasonable levels of borrowing (debt capital) would be expected to enhance economic growth which in turn would allow for timely debt repayment as marginal product of capital exceeds its cost (Pattillo, Poirson and Ricci 2002). However, following the debt crisis suffered by developing countries in the 1980s, a new paradigm emerged to explain the observed real life experience that excessive debt accumulation could be inimical to growth. For instance, a very high debt stock may be perceived as a future tax on returns to investment, which in turn dissuades investors, lowers output and growth (Krugman 1988 and Sachs 1989 cited in Nasa 2009). Furthermore, high levels of indebtedness translates into high debt servicing costs which may engender inflationary financing of budget deficits and currency devaluation with growth decline being the ultimate outcome (Nasa 2009).

The third theoretical scenario is that debt-growth relationship may be nonlinear, implying that debt is growth-enhancing at lower debt-GDP levels and growth-reducing at higher levels (Mupunga and le Roux 2016 and Nasa 2009). In Figure 3, it is seen that increases in the debt-GDP ratio up to point A is associated with a corresponding rise in economic growth at a decreasing rate until the optimal growth-maximizing threshold is reached. An increase in the debt ratio beyond point A will cause a deceleration in the growth rate and ultimately, negative growth will be experienced. According to Mupunga and le Roux (2015) before the tipping point (region OA), public debt is growth

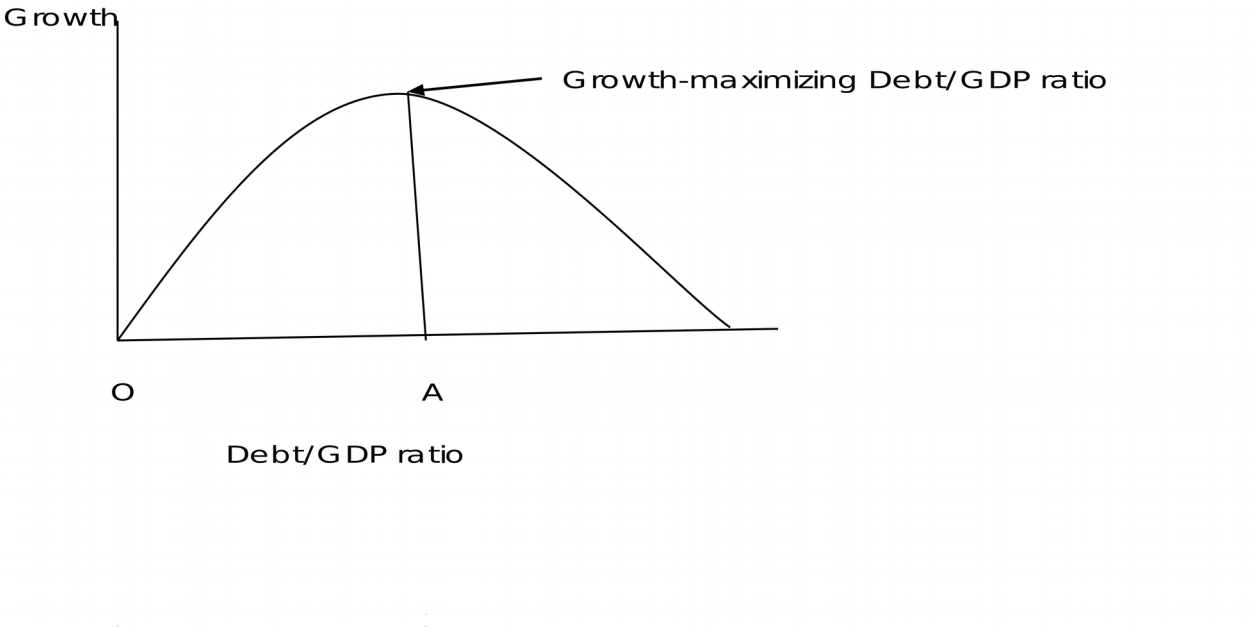

Figure 3. The Growth Maximizing Public Debt Threshold

Source: Mupunga and le Roux (2016)

enhancing because “the crowding-in effect dominates the crowding-out effect, and increases in public debt promote economic growth. However, beyond this threshold, public debt will have a negative effect on growth, as the crowding-out effect outweighs the crowding-in effect. The crowding-in effect occurs when increased public sector spending replaces, or drives down, private sector spending, while the crowding-out effect refers to a situation where government borrowing to finance the deficit reduces the quantum of loanable funds available to the private sector, thereby effectively crowding them out.” Thus, it is imperative to determine the turning point at which further borrowing becomes inimical to growth, especially in the case of Nigeria.

The theoretical and empirical plausibility that large levels of accumulated debt will result in subdued growth is best explained by the “debt overhang” theories which posit that in the future, as debt capital rises, a country’s repayment ability may be compromised as the burden of debt service hinders growth (Pattillo, Poirson and Ricci 2002). In Figure 4, the right hand side of the vertical

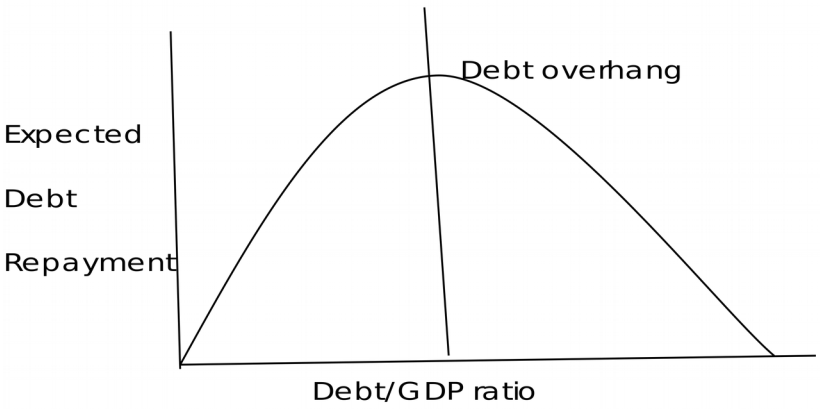

Figure 4. The Debt Laffer Curve

Source: Adapted from Pattillo, Poirson and Ricci 2002

line is the region of unsustainable debt or debt overhang. Figure 4 is commonly referred to as the debt Laffer curve and the basic information conveyed is that higher public borrowings or debt ratios correspond to lower repayment probabilities.

3.2 Empirical Review

Megersa (2014) employed a sample of twenty-two low income sub-Saharan African economies (excluding Nigeria) to study the existence of 'Laffer curve' relationship between public debt and economic growth covering the time frame 1990 to 2011. The study draws from the debate in the literature on the widespread view that high debt levels are a drag to economic growth but on the other hand, growth theories claim that poor countries need to borrow in order to finance their development. The study employed a typical neo-classical non-linear growth regression to test whether or not an inverted U-shape relationship exists between debt and growth. The study provides robust evidence that the contribution of debt to growth is positive at lower levels and negative at higher levels. In other words, higher and lower debt values are associated with lower and higher growth rates.

Mupunga and le Roux (2015) estimated the optimal growth-maximizing public debt threshold for Zimbabwe using several non-linear regression techniques. A quadratic econometric model was applied to fit a non-linear relationship between public debt and growth. For robustness checks, different functional forms for polynomials ranging from 1.2 to 3 were applied to assess the sensitivity of the results to different functional forms. The findings indicate that there exist an inverted U-shape relationship between debt and growth with the optimal growth-maximizing public debt threshold determined at a public debt-to-GDP ratio of between 40 and 50 per cent. The sensitivity analysis conducted using different functional forms did not significantly changed the debt-growth threshold for Zimbabwe. Furthermore, the study investigated the relationship between public debt and economic growth in selected Low Income Countries (LICs) in sub-Saharan Africa over the period 1980–2012 using the panel regression of a quadratic bivariate equation and the finding revealed a threshold of 80 – 120 per cent for the selected LICs.

Pescatori, Sandri, and Simon (2014) sought to find out if a magic threshold exists between debt and growth by using IMF Fiscal Affairs Department recently compiled and comprehensive database on gross government debt to GDP ratios dating back to 1875 for 24 advanced economies. The study concludes that there is no simple threshold for debt to GDP ratios beyond which medium-term growth prospects are severely compromised. Nonetheless, they found that higher debt levels tend to correlate with higher output growth volatility which can hurt economic welfare.

Reinhart and Rogoff (2010), inter alia, studied the relationship between high public debt and growth in advanced economies using long time series that span 200 years. The findings indicate that the debt-growth link is relatively weak at “normal” debt levels but strong otherwise. For instance, when debt is low (below 30%), the average growth rate is 3.7%; when debt levels range from 30 to 90%, the mean growth rate for the countries in the data set declined to 3%. However, at high debt-GDP levels (in excess of 90%), the growth rate was found to decelerate significantly to 1.7%.

Chudik, Mohaddes, Pesaran and Raissi (2015) applied the autoregressive distributed lag (ARDL) and the distributed lag (DL) approaches to investigate the debt-threshold effect in a panel comprising both developing and advanced countries. Estimates of threshold are between 60-80% for full sample; 30-60% for developing countries; and 80% for the advanced economies. However, when cross-sectional error dependence is accounted for, the authors were unable to find a universally applicable threshold effect.

Ikudaysi, Akin-Olagunju, Babatunde, Irhivben and Okoruwa (2015) used instrumental variable analysis to study the non-linear (inverted U-shape) relationship between economic growth and domestic/external debts. The data set covers the period 1981 to 2011. The findings show that debt-to-GDP ratios of 21.4% exist for domestic debt and 26.9% for external debt. The authors aver that Nigeria can benefit from borrowed funds provided it stays within the limits.

Omotosho, Bawa and Doguwa (2016) claimed to employ quarterly data from 2005 to 2015 to empirically test for an inverted U-shape relationship between public debt types and economic growth in Nigeria. The findings show the following debt-growth thresholds: total public debt-GDP (73.70%); external debt-GDP (49.4%); and domestic debt-GDP (30.9%). The greatest drawback of this study is that a completely different, unknown and unstated data set (different from the 2005-2015 range claimed by the authors) was employed in the analysis, perhaps, inadvertently (see Omotosho, Bawa and Dguwa 2016, page 14).

Babu, Kiprop, kalio and Gisore (2015) used an augmented Solow model to assess the effect of domestic debt on Economic Growth in East African Community (EAC) over the period 1990 to 2010. The findings revealed that domestic debt expansion has a significant and positive effect on economic

growth of the EAC member countries. Specifically, a 10 per cent rise in domestic debt-to-GDP ratio generates a 1.17 per cent increase in economic growth. The authors note that the favorable effect of domestic debt on growth is due to the fact that domestic debt levels in EAC countries are still moderate and sustainable and therefore promotes growth.

Obademi (2012) analyzed the impact of public debt on economic growth in Nigeria based on data from 1975 to 2005. The study used the Engle and Yoo three stage cointegration technique. The findings show that the impact of public debt on economic growth is negative and quite significant in the long-run whereas in the short run a positive effect was detected.

Izedonmi and Ilaboya (2012) examined the nexus between public debt and economic growth in Nigeria over the period 1980 to 2010 using the two-stage Engle Granger technique. The authors found a significant negative relationship between public debt and growth in the long run. A further outcome was that the debt service ratio has a significant and negative effect on economic growth in Nigeria.

Owusu-Nantwi and Erickson (2016) employed the Johansen cointegration and error correction modeling techniques to investigate the long run and causal relationship between public debt and economic growth in Ghana with data spanning from 1970 to 2012. Empirical findings indicate that the coefficient for debt-to-GDP ratio is statistically significant and has a positive long-run effect on economic growth, suggesting that public debt is an important contributor to long term economic performance in Ghana.

Adegbite, Ayadi and Ayadi (2008) investigated the effect of external debt servicing on economic growth in Nigeria employing the neoclassical growth model on GDP, public capital expenditure, foreign debt stock, exports, debt servicing, savings, exchange rate and public investment using annual data covering the period 1975 to 2005. They employed both OLS and GLS approaches and established a negative effect of debt on growth in Nigeria.

They found evidence of positive contribution of external debt to growth up to a threshold after which its contributions become undesirable indicating nonlinearity effects.

Onyiewu (2012) examined the relationship between domestic debt and economic growth in Nigeria using quarterly data spanning the period between 1994 and 2008. He employed the Johansen cointegration technique and the error correction model using GDP, foreign exchange rate, credit to private sector, budget deficit and money supply. His findings revealed that the domestic debt stock of the government was over the suggested benchmark of 35.0 per cent of bank deposits, which resulted in a negative effect on economic growth.

Sulaiman and Azeez (2012) examined the effect of external debt on the economic growth of Nigeria using annual data spanning 1970 to 2010 on GDP, external debt, external debt to exports ratio, inflation and exchange rate. Their analysis employed the Error Correction Model (ECM) and Johansen cointegration technique and observed that external debt although insignificant, has a positive relationship with GDP. Furthermore, the external debt to exports ratio had a significant negative effect on GDP. Their findings suggest that even though external debt was useful to Nigeria's economy, it was not crucial to the growth of the economy.

Panizza and Presbitero (2012) used the instrumental variable approach to determine if public debt had a causal impact on economic growth in some selected OECD countries. The variables used in their analysis included GDP, national gross savings, population growth, schooling, trade openness, foreign currency debt, exchange rate, banking crisis, amongst others spanning 1946 to 2009. Their findings revealed a negative relationship between debt and economic growth, even though the link fades when an instrument that accounts for valuation effect of exchange rate was used.

Emmanuel (2012) employed an augmented Cobb Douglas model to examine the impact of public debt on Nigerian economic growth using annual data for the period 1975-2005 on GDP, budget deficit, total public

debt, and domestic and external debts. He used the vector error correction model (VECM) and the Johansen cointegration technique and observed that public debt had a short-run positive effect on growth, however, debt and budget deficit had a long-run negative impact on growth. He concluded that the impact of huge debt on economic growth may not be abrupt but could be inimical in the long run.

Aero and Ogundipe (2016) attempted to evaluate the relationship between fiscal deficit and economic growth and the threshold level of fiscal deficit that is favourable to Nigeria from 1981-2014. The study used the Threshold Autoregressive (TAR) model, as well as the Johansen cointegration technique and the vector error correction mechanism. The empirical result suggested that a unit increase in fiscal deficit will negatively impact growth by 7.5 units in the long run. The study also identified the threshold level for fiscal deficits in Nigeria at 5.0 per cent.

Nwali and Nkwede (2016) analyzed the impact of internal and external debt burden on the growth of the Nigerian economy using annual data spanning 1961 to 2013. They adopted the Vector Error Correction Model (VECM). The results suggest that public debt had a negative impact on economic growth both in the short-run and in the long-run. They also found evidence of a strong negative relationship between external debt, debt servicing and exchange rate.

Research Gap

The few country specific studies on debt-growth threshold in Nigeria focus either on total public debt or one of its components – external or domestic debts. The only study known to us that dwelt holistically on total public debt and its components is the work of Omotosho, Bawa and Doguwa (2016) who obtained optimal thresholds of 73.7%, 49.4% and 30.9% for total public, external and domestic debt types respectively. These threshold values are completely outside the 2005-2015 data set claimed to have been used in the paper, implying that the actual data set is unknown. This seems to invalidate the outcomes of the study.

The discrepancy in the paper by Omotosho Bawa and Doguwa (2016) is further highlighted. The computed percentage shares of total public debt to GDP used in the analysis indicates a range of 27.19 – 111.33% (p.18). This range is not in harmony with the minimum/maximum range of 7.28 – 17.98% in the actual data set (2005 – 2015) (pp.7 and 14). Additionally, the external debt to GDP ratios employed in the study has a range of 4.27 – 85.28% (p.19) which is at variance with the actual data set (2005 – 2015) (pp.7 and 14) with a range of 1.26 – 11.48%. A similar scenario applies to domestic debt as well.

Apart from the observation that the few available country-specific studies on the threshold effect of debt on output growth in Nigeria are not sufficiently robust, the only study that examined holistically the three public debt types is vitiated with unexplained lacuna. Thus, there is need for further studies to resolve the conundrum. This present study is an attempt in this direction.

4. Methodology

4.1 Data Sources and Description

The data for the study come principally from the 2015 Statistical Bulletin of the Central Bank of Nigeria (CBN). The annual data set runs from 1981 to 2015. Variables that comprise the basic data include: real Gross Domestic Product (GDP) at 2010 constant prices, nominal GDP; Nigeria's Total Debt, External Debt, Domestic Debt, Inflation, Trade Openness and nominal exchange rate.

The three debt variables are expressed as a percentage of GDP and these are: External Debt to GDP: External Debt to GDP, Domestic Debt to GDP and Total Public Debt to GDP. Except for inflation, the other two variables (Trade Openness and nominal exchange rate) were log transformed and in

first differences. In line with Hansen (2015), all the debt variables and log of real GDP are in first differences.

4.2 Model Specification

The basic non-linear threshold model may be specified as:

$$g_t = \begin{cases} \alpha_1 d_t + \varepsilon_{1t} & if\ d_t > \pi \\ \alpha_2 d_t + \varepsilon_{2t} & if\ d_t \leq \pi \end{cases} \quad \text{.........} \quad (1)$$

Economic growth is represented by g and $d_t = \pi$ is the assumed threshold. There are two regimes in *(1).* The sequence g=$\alpha_1 d_t + \varepsilon_{1t}$ depicts the scenario whenever the debt-GDP ratio (d_t) is above the threshold while $\alpha_2 d_t + \varepsilon_{2t}$ shows the situation when the debt-GDP ratio is below the threshold. ε_{1t} and ε_{2t} are the stochastic disturbance terms.

If we assume the variance of the two error terms to be equal, the basic threshold model would be given as:

$$g_t = \alpha_1 I_t d_t + \alpha_2 (I - I_t) d_t + \varepsilon_t \quad \text{.........} \quad (2)$$

In equation(2), all other symbols are as previously defined, except for I_t, which stands for threshold dummy or an indicator function. I_t=1 if $d_t >$0 and I_t=0, if $d_t \leq$0.

Furthermore, we may re-write (2) as:

$$g_t = I_t[\alpha_{10} + \alpha_1 d_t] + (1 - I_t)[\alpha_{20} + \alpha_2 d_t] \quad \ldots\ldots(3)$$

When the threshold model is in regime 2 (below the threshold) the coefficient of the debt-GDP variable measures the effect on economic growth. However, when the model is in regime 1 (above the threshold) the sum of coefficients of the debt-GDP ratio and the threshold dummy measures the effect on growth as indicated below.

$$g_t = \alpha_0(\alpha_1 + \theta_1 I_t) + \varepsilon_t \quad (4)$$

Where I_t =1 if $d_t > \pi$ and I_t=0 if $d_t \leq \pi$

The specific form of the augmented basic threshold model employed in this study is given by (see Chudik, *et al.* 2015).

$$\Delta lng_t = \alpha_1 I_t[d_t > (\pi)] + \alpha_2 I[d_t \leq (\pi)] + \sum_{i=3}^{n} \alpha_i \Delta lnx_t + \varepsilon_t \quad \ldots\ldots(5)$$

Alternatively,

$$\Delta lng_t = \alpha_0 + (\alpha_1 + \theta I_t)d_t + \sum_{i=2}^{n} \alpha_i \Delta lnx_t + \varepsilon_t \quad \ldots\ldots(6)$$

Note that the usual indicator or dummy variable condition applies. Other regressors aside the debt and dummy variables are represented by x_t. The additional regressors used in the basic threshold model (threshold model in the context of traditional regression model) are inflation, trade openness and exchange rate. However, the model with only debt and inflation variable provided the best parsimonious outcome. In$^{(6)}$, α_1

measures the effect of debt-GDP on economic growth when $d_t \leq \pi$, while $\alpha_1 + \theta$ measures debt effect when $d_t > \pi$ (Enders 2010).

We employ the autoregressive distributed lag specification of the following form:

$$\Delta lng_t = \beta + p\ lng_{t-1} + wd_{t-1} + \lambda\ I_t d_t + \gamma x_{t-1} + \sum \theta\ \Delta lng_{t-1} + \sum \alpha d_{t-1} + \sum \alpha x_{t-1} + \varepsilon_t \quad (7)$$

x_t is a $kx1$ vector of regressors.

Furthermore, empirical investigations were carried out with the global estimation method. For *d* potential thresholds, there is d + 1 regimes. Thus, for two regimes with a threshold π, the following representation applies (IHS Global Inc. 2015):

$$g_t = a_t'\ \beta + b_t'\vartheta_1 + \varepsilon_t if -\infty < d_t < \pi_t \quad (8)$$

$$g_t = a_t'\ \beta + b_t'\vartheta_2 + \varepsilon_t if\ \pi_t \leq d_t < \infty \quad (9)$$

Where g_t is the growth rate in real GDP; a_t' is a kx1 vector of regressors whose parameters do not vary across regimes (in this study, the constant term does not vary across regimes); b_t' is a vector of regressors that are regime specific; d_t is the threshold regressor; π_t is the assumed threshold, while $\beta\ and\ \vartheta$ are parameters.

5.0 Empirical Analysis

5.1 Stationarity Test

The unit root test was conducted based on the Phillips-Perron (PP) method. The outcome of the PP tests shows that the following time series – PDY, DDY, EDY, LTOP, and LY - are integrated to order one, that is, I(1). While DPDY, DDDY, DEDY, DLY and INFL are I(0). The variables are clearly defined in Appendix 2. Some of the variables are significant at the 1% level and others at the 5% level. Given that there is no I(2) variable, the ARDL approach comes in as an analytical tool in this study.

Table 1. Unit Root Test

Variable	*Phillips-Perron*		
	Test Statistic		Order
	Level	First Difference	
DDY	-2.7755	-4.6498***	I(1)
EDY	-1.1320	-4.2983***	I(1)
LTOP	-1.2243	-7.1564***	I(1)
LY	-2.3113	-3.2202**	I(1)
PDY	-0.8666	-4.1314***	I(1)
INFL	-2.9853**		I(0)
DPDY	-4.1314***		I(0)
DEDY	-4.2983***		I(0)
DDDY	-4.6498***		I(0)
DLY	-3.2202**		I(0)
DLTOP	-6.92468***		I(0)
DLEXR	-4.9483***		I(0)
LEXR		-6.0680	I(1)

*** significant at 1 per cent level ** significant at 5 per cent level

5.2 Empirical Analysis and Findings

In this section, we estimate the following debt thresholds – domestic debt, external debt and total public debt using the rebased GDP at 2010 constant prices. In order to ensure a robust analysis, several approaches were adopted and these include the basic least squares, autoregressive distributed lag and the global estimation technique. Furthermore, we provide some diagnostics as well as sensitivity analysis.

5.2.1 Estimation of Domestic Debt Threshold (Basic/ARDL Models)

The estimation results in respect of the domestic debt threshold are presented in Table 1. The results show that there is a negative relation between domestic debt and economic growth. Several studies have found that public debt is negatively correlated to growth (see Panizza and Presbitero 2012; Onyiewu 2012 and Sulaiman and Azeez 2012). The important question, however, is that, is there a threshold effect on output growth and is it significant? The underlying hypothesis explored in this study is that output growth will decelerate once the debt-to-GDP ratio exceeds its optimal level.

The optimal tipping point, π, is found to be (12 %<π<14%) and it corresponds to the minimum of the sum of squared residuals but it's not statistically significant. However, beyond the turning point, we observe significant threshold effect of domestic debt on output growth at (16%<π<18%). Therefore, we conclude that the optimal domestic debt-GDP threshold is between 13-17% for Nigeria. Figure 5 is a representation of the domestic debt threshold. At low threshold levels and up to the threshold point, the relationship between debt and output growth is attributable to the coefficient of the threshold debt dummy, θ (equation 6) but above the threshold, the debt-growth relationship is governed by the sum of the coefficients (α_1+ θ) (see Khan and Senhaji 2001 and enders 2010).

Table 1. Domestic Debt Threshold (Basic Model)

Threshold (%)	Parameter/Statistic (Basic Model)				
	C	DDDY (ϰ1)	INFLA	D (θ)	SSR
6	0.0774*	-0.0057*	-0.0008**	-0.0177	0.0472
8	0.0801***	-0.0052*	-0.0006*	-0.0272	0.0441
10	0.0675***	-0.0056*	-0.0006	-0.0191	0.0449
12	0.0683***	-0.0038	-0.0005	-0.0280*	0.0423
14	0.0617***	-0.0052	-0.0007	0.0100	0.0469
16	0.0613***	-0.0062*	-0.0009*	0.0118	0.0470
18	0.0599***	-0.0055*	-0.0007	-0.0049	0.0474
20	0.0632***	-0.0064*	-0.0010*	0,0248	0.0468
22	0.0614***	-0.0059*	-0.0008*	0.0137	0.0473

*** significant at 1 per cent level ** significant at 5 per cent level *significant at 10 percent

Figure 5. Domestic Debt Threshold (Basic Model)

Below the saturation point, a significant domestic debt threshold effect of 0.0024% on growth becomes evident when SSR is 0.0470. Beyond the threshold, the impact of the dummy (θ) is positive but not statistically different from zero, implying that growth is only accounted for by $ϰ_1$. It is obvious from Table 1 that economic growth declined significantly (10% level) after the optimal threshold is attained and this development supports the hypothesis of a domestic debt threshold effect on economic growth in Nigeria of between 13-17%. This is in contrast to a domestic debt threshold effect of 30.9% of GDP obtained by Omotosho, Bawa and Doguwa (2016) which cannot be validated because the data set used is unknown.

It would be recalled that Nigeria' domestic debt increased dramatically after Nigeria secured the Paris Club debt relief of $18 billion in 2005. The

domestic debt level rose from N1,525.91 billion in 2005 to N8,837 billion in 2015, representing an increase of 479%. Concurrently, the domestic debt-GDP ratio leaped from 6.85% to 9.39% during the 10-year period. Given the findings of this study, the threshold effect of domestic debt on growth will turn significantly negative if the trend in domestic debt accumulation continues unabated.

The outcome of the investigation based on the ARDL model (equation 7) is depicted in Table 2 and Figure 6. The optimal threshold consistent with the minimum of squared residuals is (16%<π<18%), that is, 17%. The finding supports the hypothesis of a threshold effect of domestic debt on output growth, though not statistically significant.

Table 2. Domestic Debt Threshold (ARDL)

Threshold (%)	Parameter/Statistic (ARDL)				
	C	DDY	INFL	D	SSR
6	0.1215	-0.0037	0.0002	-0.0335	0.0308
8	0.0944***	-0.0033	0.0002	-0.0114	0.0309
10	0.1156***	-0.0081*	0.0006	0.0307	0.0252
12	0.1124*	-0.0072	0.0005	0.0242	0.0297
14	0.1127**	-0.0066	0.0004	0.0231	0.0304
16	0.0839**	-0.0029	0.0001	-0.0174	0.0246
18	0.0903*	-0.0038	0.0002	-0.0070	0.0310
20	0.0865**	-0.0039	0.0005	-0.0385	0.0297
22	0.0820**	-0.0036	0.0007	-0.1257	0.0291

*** significant at 1 per cent level ** significant at 5 per cent level *significant at 10 percent

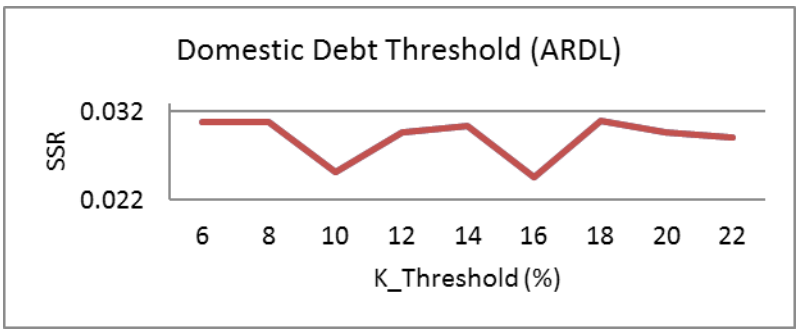

Figure 6. Domestic Debt Threshold (ARDL)

5.2.2 Estimation of External Debt Threshold (Basic/ARDL Models)

The estimation results for the determination of the external debt threshold in Nigeria using the basic least squares technique is given in Table 3 and Figure 7. The outcome show external debt-GDP threshold level of (20%<π<30%) at which the sum of squared residuals is minimized. However, beyond the threshold, output growth increased significantly by 0.0348%, being the sum of (γ_1+ θ). Therefore, it is clear that the hypothesis of an external debt threshold effect cannot be supported by empirical findings. If there were to be a debt threshold effect, then output growth would have declined after the optimal tipping point. Beyond the threshold, output growth continued to appreciate significantly (at the 10% level) by 0.002% and 0.006% respectively, thus providing further evidence of the non-existence of external debt threshold effect on output growth in Nigeria up to 50% of GDP (the possible or potential thresholds considered range from 10% to 50%).

The external debt-to-GDP data for Nigeria (see Appendix 1) unequivocally supports the above finding. We note that between 2004 (shortly before Nigeria was granted a Paris Club debt relief of $18 billion) and 2015, the external debt-GDP ratio fell precipitously from 28.23% to 2.24%. Furthermore, World Bank (2012) notes that "Following the successful exit [of Nigeria] from the Paris and London clubs in 2006, there has been a strong reluctance to public borrowing. As a result, debt levels, especially external debt, remain low and not at risk of default. The total FGN debt to GDP ratio is estimated at 17.4 percent of GDP at the end of 2011. External debt to GDP was recorded as 2.4 percent while domestic debt had marginally grown to 15.1 percent of GDP". Consequently, Nigeria has plenty of room to accommodate prudent external borrowing. However, our finding differ remarkably from the work of Omotosho, Bawa and Doguwa (2016) who claimed the existence of a threshold effect of external debt at

49.4% of GDP, an outcome that is misleading because an incorrect data set was employed.

Table 3. External Debt Threshold (Basic Model)

Threshold (%)	Parameter/Statistic (Basic Model)				
	C	DEDY	INFL	D	SSR
10	0.0550***	-0.0014*	-0.0011**	0.0186	0.0459
20	0.0556***	-0.0020**	-0.0014***	0.0364**	0.0406
30	0.05580***	-0.0020**	-0.0014***	0.0368**	0.0408
40	0.0611***	-0.0018*	-0.0011**	0.0192	0.0468
50	0.0623***	-0.0014*	-0.0010**	0.0179	0.0472

*** significant at 1 per cent level ** significant at 5 per cent level *significant at 10 percent

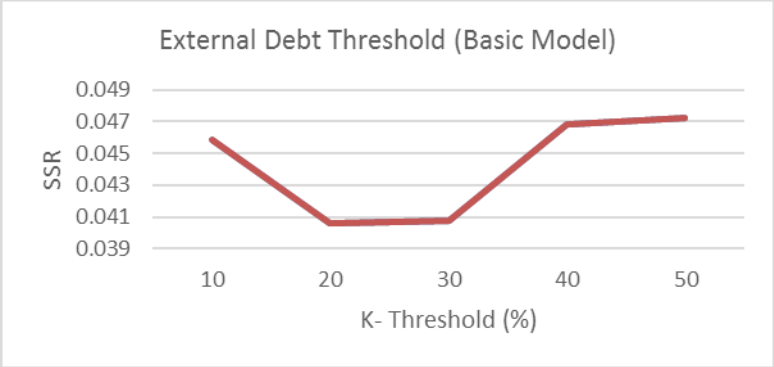

Figure 7. External Debt Threshold (Basic Model)

The estimation results from the ARDL model is presented in Table 4 and Figure 8. An optimal threshold, π, of (30%<π<40%) is indicated for the external debt-growth nexus. However, in tandem with the arguments and analysis under the basic model, there is no threshold effect of external debt on output growth. Although not statistically significant, the growth effect of external debt on output beyond the optimal threshold is positive rather than negative.

Table 4. External Debt Threshold (ARDL)

Threshold (%)	Parameter/Statistic (ARDL))				
	C	EDY	INFL	D	SSR
10	0.0563***	0.0013	-0.010	-00312	0.0311
20	0.0551**	-0.0006	-0.0010	0.0550	0.0309
30	0.0732***	-0.0027**	-0.0012**	0.1608***	0.0209
40	0.0579***	0.0002	-0.0011	0.0243	0.0312
50	0.0431*	0.0012	-0.0008	-0.0564	0.0294

*** significant at 1 per cent level ** significant at 5 per cent level *significant at 10 percent

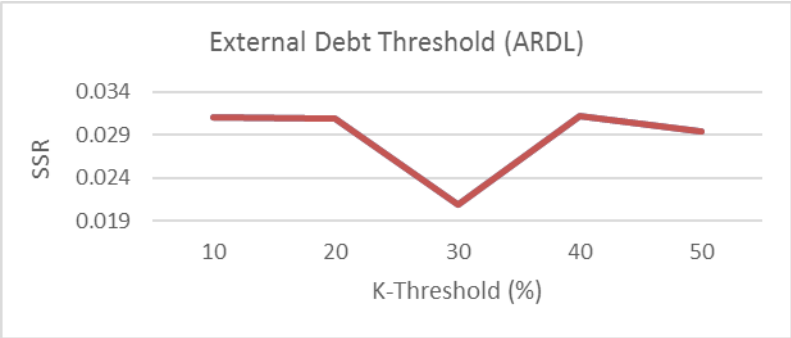

Figure 8. External Debt Threshold (Basic Model)

5.2.3 Estimation of Total Public Debt Threshold (Basic/ARDL Models)

The basic least squares results of equation 6 for total public debt threshold are displayed in Table 5 and Figure 9. Once again, the hypothesis of interest is that high debt-to- GDP ratio has an adverse effect on growth after a certain level is exceeded. An optimal total public debt threshold, π, of (35%<π<50%) is identified in this study for Nigeria. At a threshold value of 35%, the sum of squares residuals is minimized. However, a significant debt threshold effect on output growth is observed only after the 45% threshold value, given that γ_1+ θ becomes negative (see equation 6). Therefore, beyond 45% but less than 50% threshold values, output growth rate significantly declines by 0.002% (10% level of significance). Our findings differ from the outcome of Omotosho, Bawa and Doguwa (2016) who asserted that the total public debt threshold for Nigeria is 73.70%.

Table 5. Total Public Debt Threshold (Basic Model)

Threshold (%)	Parameter/Statistic (Basic Model)				
	C	DPDY	INFL	D	SSR
10	0.0818***	-0.0013*	-0.0008**	-0.0248	0.0442
15	0.0684***	-0.0013**	-0.0008**	0.0107	0.0459
20	0.0622***	-0.0014*	-0.0009**	0.0016	0.0466
25	0.0565***	-0.0016**	-0.0011***	0.0191	0.0441
30	0.0562***	-0.0019***	-0.0014***	0.0357**	0.0389
35	0.0569***	-0.0018***	-0.0014***	0.0384**	0.0377
40	0.0592***	-0.0019***	-0.0015***	0.0365**	0.0394
45	0.0621***	-0.0019**	-0.0012**	0.0222	0.0444
50	0.0621***	-0.0019**	-0.0012**	0.0222	0.0444
55	0.0630***	-0.0120**	-0.0013**	0.0247	0.0444
60	0.0624***	-0.0018**	-0.0011**	0.0205	0.0451
65	0.0630***	-0.0016**	-0.0011**	0.0219	0.0449
70	0.0628***	-0.0014**	-0.0009**	0.0057	0.0465
75	0.0618***	-0.0016**	-0.0010**	0.0394	0.0438

*** significant at 1 per cent level ** significant at 5 per cent level *significant at 10 percent

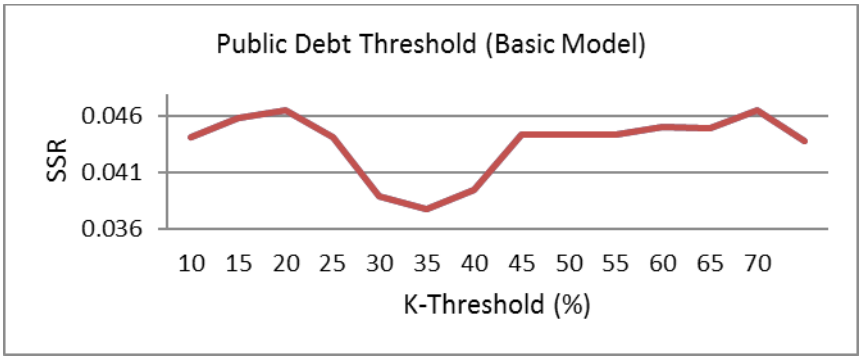

Figure 9. Total Public Debt Threshold (Basic Model)

The outcome of the ARDL model supports the earlier analysis. The optimal total public debt threshold of 40-45% is linked to the minimum sum of squared residuals but there is no evidence of a threshold effect on output growth. These results are shown in Table 6 and Figure 10.

Table 6. Public Debt Threshold (ARDL)

Threshold (%)	Parameter/Statistic (ARDL)				
	C	PDY	INFL	D	SSR
10	0.7777***	0.0092*	-0.0109	-0.5051*	2.9194
15	0.5638	0.0104	-0.0106	-0.3700	3.0580
20	0.5025***	0.0061	-0.0079	-0.1527	3.0577
25	0.4690**	0.0072	-0.0098	-0.1149	3.2292
30	0.5981***	-0.0075	-0.0093	0.6509	3.0048
35	0.7123***	-0.0157*	-0.0096*	1.1028**	2.5948
40	0.7756***	-0.0160*	-0.0119**	1.1718**	2.5258
45	0.7365***	-0.0080	-0.0130*	0.8322	2.6536
50	0.7365***	-0.0080	-0.0130*	0.8322	2.6536
55	0.5779**	0.0005	-0.0115	0.3264	3.1813
60	0.3617	0.0108	-0.0098	-0.4912	3.1030
65	0.3790	0.0087	-0.0085	-0.3930	3.0598
70	0.3221	0.0091	-0.0048	-0.7621	2.7977
75	0.3945*	0.0093	-0.0105	-0.8507	2.6345

*** significant at 1 per cent level ** significant at 5 per cent level *significant at 10 percent

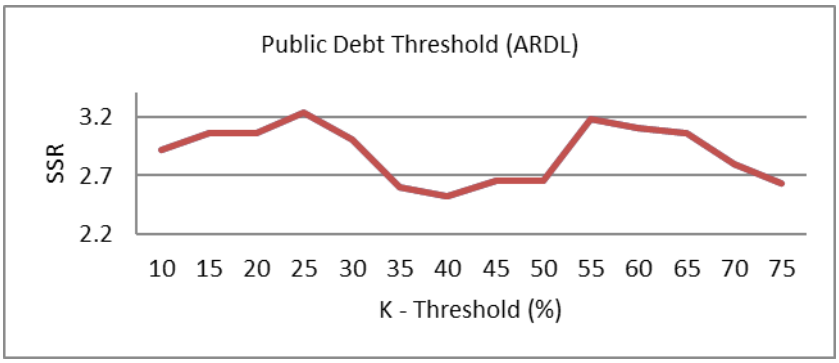

Figure 10. Total Public Debt Threshold (ARDL)

5.2.4 Estimation of Domestic, External and Total Debt Threshold (Global Tests)

Furthermore, we applied the global optimization procedure to threshold estimation (see IHS Inc. 2015). The focus is on the threshold regression with the minimum sum of squared residuals. The relevant regimes are presented in Tables 7, 8 and 9.

The various analyses indicate that all the public debt variables are negatively related to growth as shown in Tables 7, 8 and 9. The estimates of domestic debt threshold in Table 7 show that the hypothesis of a

threshold effect cannot be rejected as there was a significant decline in real GDP growth rate between regime 1 to regime 2 at the 1% level of significance. The regime change resulted in growth deceleration of 0.0251%. This finding agrees somewhat with the theory that a 'Laffer-curve' scenario exist between domestic debt and economic growth in Nigeria. That is, the contribution of debt to growth is positive (or its negative impact is inconsequential and insignificant) at lower debt levels but negative and significant at higher debt levels. Thus, on the average, growth will decline once the domestic debt-GDP ratio exceeds the 13.6 % threshold.

Table 7. Global Estimates of Domestic Debt Threshold

	DDDY	INFL
Regime 1	-0.0005	0.0003
Regime 2	-0.0256***	-0.0002
SSR 0.0127		
Threshold (13.6%)		

*** significant at 1 per cent level

Table 8 presents the external debt threshold effect on output growth. We find that the change in output growth between regimes 1 and 2 amounts to a decrease of 0.0017%. This finding provides a weak evidence of an external debt-GDP threshold effect on output growth if the optimal threshold of 20.5% is exceeded at the 10% level of significance.

Table 8. Global Estimates of External Debt Threshold

	DEPY	INFL
Regime 1	-0.0018	-0.0042***
Regime 2	-0.0035*	-0.0016***
SSR 0.0151		
Threshold (20.5%)		

*** Significant at 1 per cent level *significant at 10 percent

Table 9 depicts the global estimates for total public debt in Nigeria. The change between the two regimes resulted in a decline in growth rate of 0.0015% and we conclude that economic growth will decline significantly (1% level) if the total public debt-to-GDP exceeds the optimal threshold of 55.2%. In this instance, a regime change produces a threshold effect of total public debt on output growth.

Table 9. Global Estimates of Total Public Debt Threshold

	DPDY	INFL
Regime 1	-0.0006	-0.0009
Regime 2	-0.0021***	-0.0010***
SSR 0.0151		
Threshold (55.2%)		

*** significant at 1 per cent level

5.2.5 Model Diagnostics (Global Tests)

The diagnostics of optimal thresholds based on the global test is presented in Table 10. In all the tests, the null hypothesis is that there is no heteroscedasticity, no serial correlation, normally distributed errors and the equations are correctly specified. The p-values indicate that the models employed in the estimation of the domestic, external and public debt thresholds pass all the diagnostic tests. The cusum and cusum squares for all the models in Figures 11, 12 and 13 provide evidence of model stability.

Table 10 Model Diagnostic

Test	Test Statistic	p-Value	Conclusion
Domestic Debt			
Breusch-Pagan_Godfrey	1.531	0.190	Homoscedasticity
Breusch-Godfrey LM test	1.136	0.342	No Serial Correlation
Jarque-Bera	0.924	0.630	Normally Distributed
Ramsey RESET	0.163	0.873	No misspecification
External Debt			
Breusch-Pagan_Godfrey	1.700	0.735	Homoscedasticity
Breusch-Godfrey LM test	0.491	0.250	No Serial Correlation
Jarque-Bera	0.966	0.617	Normally Distributed
Ramsey RESET	1.800	0.433	No misspecification
Total Debt			
Breusch-Pagan_Godfrey	0.826	0.624	Homoscedasticity
Breusch-Godfrey LM test	0.301	0.743	No Serial Correlation
Jarque-Bera	3.603	0.165	Normally Distributed
Ramsey RESET	0.912	0.373	No misspecification

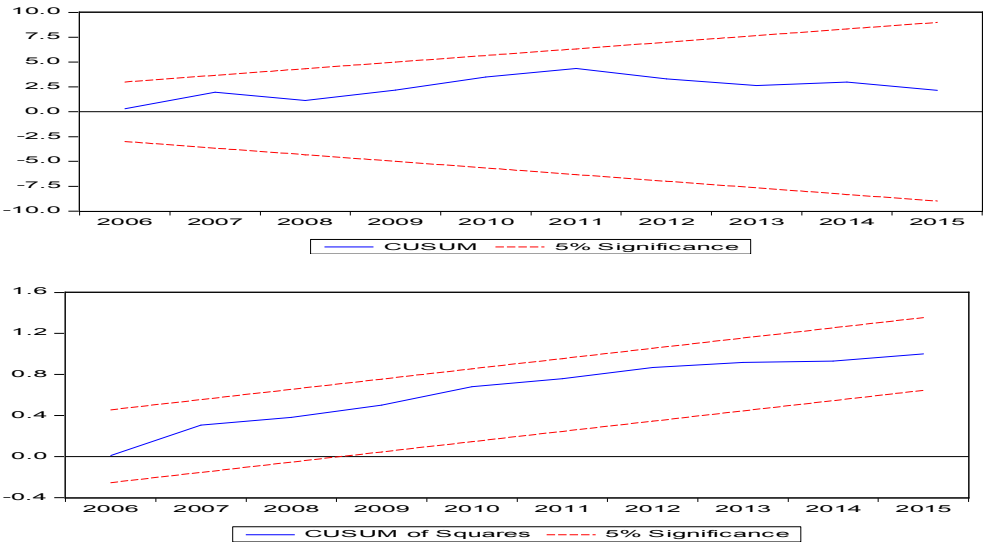

Figure 11. Cusum and Cusum Squares for Domestic Debt

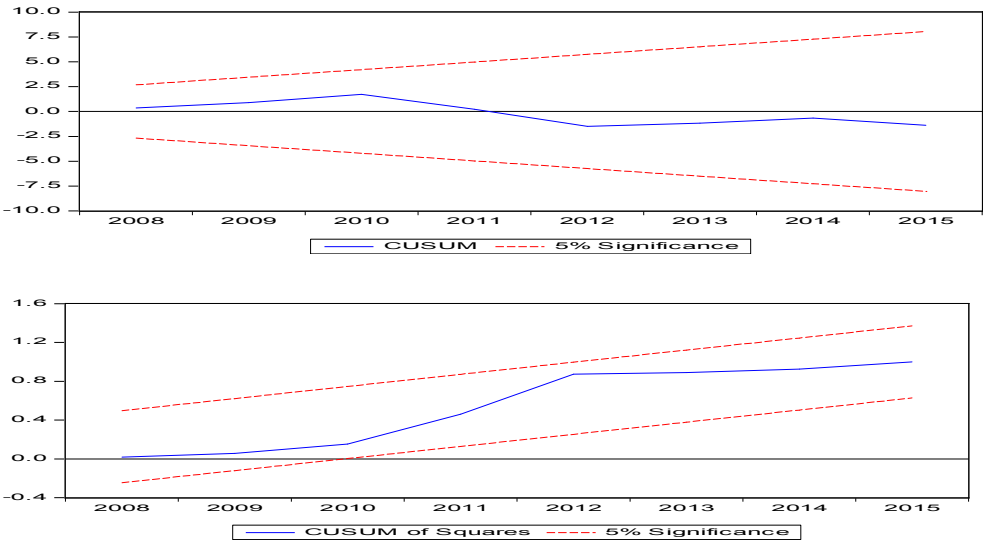

Figure 12. Cusum and Cusum Squares for External Debt

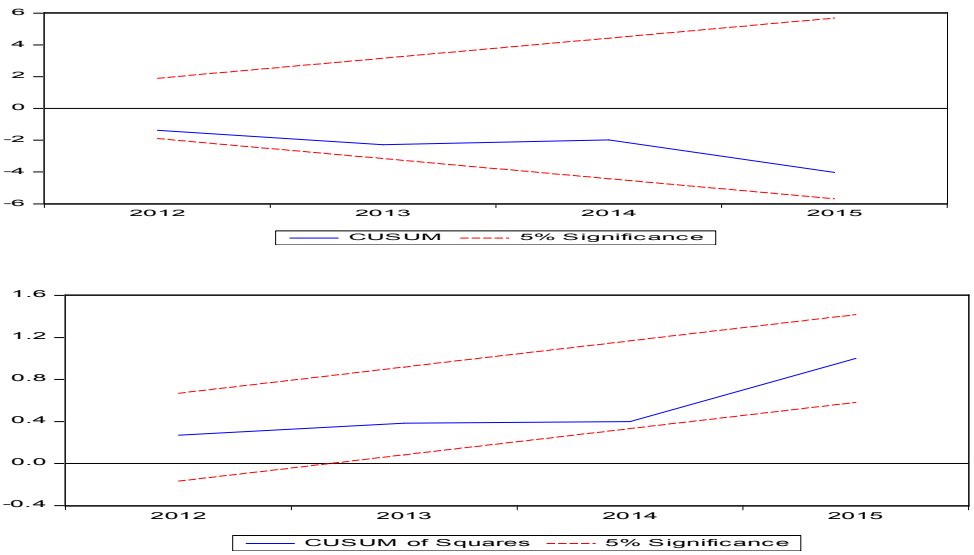

Figure 13. Cusum and Cusum Squares for Total Public Debt

5.2.6 Sensitivity of Debt Threshold to Regressors

Further robustness checks show that when an additional regressor – trade openness – is added in the specification, the optimal threshold results remain unchanged.

Table 11. Sensitivity of Debt Threshold to Additional Regressor

Debt Type	DEBT[1], INFL, DLTOP
Total Debt	55.2%*
External Debt	20.5%***
Domestic Debt	13.6%***

1. Debt refer to either total debt, external debt or domestic debt
2 *** significant at 1 per cent level * significant at 10 per cent level

5.2.7 Summary of Debt Threshold Findings (Basic, ARDL and Global Methods)

The major outcomes of threshold analysis in this study are presented concisely in Table 12. The standard 5% level of significance is used to test the hypothesis of a debt threshold effect on output growth. Table 12 presents statistically significant evidence (1% level) that the optimal domestic debt-GDP (DDY) ratio for Nigeria is 13.6%. Thus, output growth falls once the 13.6% DDY is exceeded. This result is in contrast with the optimal domestic debt threshold of 21.4% obtained by Ikudaysi, Akin-Olagunju, Babatunde, Irhivben and Okoruwa (2015). It also contrast with the work of Omotosho, Bawa and Doguwa (2016) who obtained a threshold of 30.9% (estimate was based on an unknown data set which tend to invalidate their result ab initio).

Furthermore, both the basic and ARDL models could not identify any threshold effect of external debt on output growth in Nigeria up to 50% of GDP (the possible or potential thresholds considered in this study range from 10% to 50%). However, the global method produced a weak evidence of an optimal threshold of 20.5% (at 10% significance level). Thus, there is uniform evidence based on the 5% level of significance, from the three methods employed in data analysis that there is no external debt induced threshold effect on output growth in Nigeria. This outcome differ from that of Ikudaysi, Akin-Olagunju, Babatunde, Irhivben and Okoruwa (2015) who found an external debt threshold effect of 26.9% using un-rebased GDP data. Our result also differs from Omotosho, Bawa and Doguwa (2016) who found an external debt threshold effect of 49.4% of GDP (estimate was based on an unknown data set which tend to invalidate their result ab initio). Finally, there is evidence to support the assertion that the optimal

total public debt-to-GDP ratio for Nigeria does not exceed 55.2%. Again, our result contrast with the 73.7% threshold computed by Omotosho, Bawa and Doguwa (2016).

Table 12. Summary of Findings

Debt	Basic	ARDL	Global	Sensitivity to additional Regressor (Global)
				Debt[1], Infl, Dltop
Domestic	13-17%*	17%	13.6%***	13.6%***
External	NTE	NTE	20.5%*	20.5%***
Total Debt	35-50%**	NTE	55.2% ***	55.2%*

1. Debt[1] refer to either total debt, external debt or domestic debt
2. NTE – No Threshold Effect
3. *** significant at 1 per cent level **significant at 5 percent *significant at 10 percent

6.0 Conclusion and Recommendation

The history of the federal government debt accumulation in Nigeria indicates that the country's economy has oscillated between credit-fueled booms and default-driven bursts. The implication is that debt capital may have serious disruptive effects on the economy. Consequently, there is the need to examine the threshold effect of public debt types on output growth in order to ensure moderation and avoid harmful excesses.

The findings of the study includes the following: the optimal domestic debt-GDP threshold for Nigeria is 13.6% and this implies that, a significant threshold effect of domestic debt on output growth exist once the 13.6% threshold is exceeded; empirical evidence indicates that there is no external debt induced threshold effect on output growth in Nigeria up to 50% of GDP; and, there is supporting evidence that the optimal total public debt-GDP threshold for Nigeria is 55.2%.

The study has important policy implication for government's fiscal policy. It shows clearly that there is plenty of room in the case of foreign borrowings

for the government to leverage on debt capital to finance critical social and economic overheads in order to engender rapid economic development. For instance, actual 2015 data (Appendix 1) for external, domestic and total debt ratios are: 2.24%, 9.39% and 11.63% respectively. Furthermore, our finding has serious implication for domestic borrowing. With 13.6% as the optimal domestic debt-GDP threshold, it becomes glaring that the actual figure of 11.63% for 2015 is too close to the optimal threshold for comfort.

Based on empirical analysis, the following recommendations emerge:

- There is need for the federal government to exercise rigid restrain in the accumulation of domestic debts to avoid the possibility of crowding out effect as domestic debt has grown quite significantly since the nation secured debt forgiveness from the Paris club of creditors. Among all the public debt types, domestic debt ratio is closest to its threshold.
- The government can focus more on external borrowings at advantageous terms to finance economic development since external debt ratios are quite low and moreover, this study finds no threshold effect of external debt on output growth in Nigeria.

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Appendix 1. Debt Statistics for Nigeria

	GDP 2010 Const.	Real GDP	Nominal GDP	External Debt	Domestic Debt	Total FGN Debt
Year	N billion	Growth	N billion	to GDP (EDY)	to GDP (DDY)	to GDP (PDY)
1981	15,258.00	-1.79	144.83	1.61	7.73	9.34
1982	14,985.08	-7.58	154.98	5.69	9.68	15.37
1983	13,849.73	-0.51	163.00	6.49	13.63	20.12
1984	13,779.26	8.52	170.38	8.69	15.07	23.76
1985	14,953.91	1.90	192.27	9.00	14.54	23.53
1986	15,237.99	0.17	202.44	20.48	14.05	34.52
1987	15,263.93	6.23	249.44	40.41	14.75	55.16
1988	16,215.37	6.66	320.33	41.82	14.68	56.50
1989	17,294.68	11.63	419.20	57.35	11.22	68.57
1990	19,305.63	-0.55	499.68	59.76	16.83	76.59
1991	19,199.06	2.19	596.04	55.11	19.49	74.60
1992	19,620.19	1.57	909.80	59.82	19.56	79.38
1993	19,927.99	0.26	1,259.07	50.29	21.75	72.04
1994	19,979.12	1.87	1,762.81	36.81	23.12	59.93
1995	20,353.20	4.05	2,895.20	24.76	16.50	41.26
1996	21,177.92	2.89	3,779.13	16.33	11.11	27.45
1997	21,789.10	2.50	4,111.64	14.49	12.20	26.70
1998	22,332.87	0.52	4,588.99	13.79	12.22	26.02
1999	22,449.41	5.52	5,307.36	48.56	14.98	63.54
2000	23,688.28	6.67	6,897.48	44.91	13.02	57.93
2001	25,267.54	14.60	8,134.14	39.05	12.50	51.55
2002	28,957.71	9.50	11,332.25	34.71	10.29	44.99
2003	31,709.45	10.44	13,301.56	33.67	10.00	43.66
2004	35,020.55	7.01	17,321.30	28.23	7.91	36.14
2005	37,474.95	6.73	22,269.98	12.10	6.85	18.95
2006	39,995.50	7.32	28,662.47	1.58	6.12	7.69
2007	42,922.41	7.20	32,995.38	1.33	6.58	7.91
2008	46,012.52	8.35	39,157.88	1.34	5.93	7.26
2009	49,856.10	9.54	44,285.56	1.33	7.29	8.62
2010	54,612.26	5.31	54,612.26	1.26	8.33	9.60
2011	57,511.04	4.21	62,980.40	1.42	8.93	10.35
2012	59,929.89	5.49	71,713.94	1.43	9.12	10.55
2013	63,213.72	6.22	80,092.56	1.71	8.89	10.60
2014	67,152.79	2.79	89,043.62	1.83	8.88	10.71
2015	69,023.93		94,144.96	2.24	9.39	11.63

Source: CBN Statistical Data Base (EDY, DDY and PDY computed by authors)

Appendix 2. Definition of Variables

Variable	Definition
DDY	Domestic Debt-GDP (%)
EDY	External Debt-GDP (%)
PDY	Total Public Debt-GDP (%)
INFL	Inflation (%)
DPDY	First difference of total public debt-GDP ratio
DEDY	First difference of external debt-GDP ratio
DDDY	First difference of domestic debt-GDP ratio
DLY	First difference of log of real GDP
DLTOP	First difference of log of trade openness
DLEXR	First difference of log of exchange rate