Non-linear Relation between External Debt and Economic Growth in Nigeria: Does the Investment Channel Matter?

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22 November 2018

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Abstract

Large external debt stock has been identified as one of the most important factors which have restricted the development of many poor countries. The consensus in the literature remains that external debt promotes growth to the extent that a country does not exceed its debt carrying capacity. Otherwise, additional debt accumulation would serve as a tax on future investment returns capable of creating disincentive to invest in the highly indebted countries. In the light of these arguments, this study investigated the possible role of domestic investment in the non-linear relation between external debt and economic growth in Nigeria over the period from 1981 to 2015. Based on the results of threshold regression analysis employed in this study, the overall findings showed that the impact of external debt on economic growth is sensitive to both measures of external debt used, and whether or not the role of domestic investment is accounted for. Specifically, this study confirmed the existence of the debt Laffer curve associated with the debt overhang theory arising from excessive external debt accumulation. Similarly, empirical support was obtained for the crowding-out effect of excessive external debt servicing. Also, accounting for the role of domestic investment in the non-linear relation between external debt and economic growth reduces the optimal debt carrying capacity of the country. It is therefore suggested that the Nigerian government internalizes a maximum ceiling of 6.81% as the share of external debt stock in gross national income (GNI) so as to enjoy the resulting growth benefits. External debt financing sources that are free of interest charge could also be explored so as to circumvent the burden imposed by excessive external debt servicing.

Key words: External debt, Economic growth, Domestic investment, and Threshold analysis

1. Introduction

Owing to the dearth of sufficient capital to finance developmental projects, developing countries have found an alternative in contracting external debt. High external debt profile of developing countries in recent times has plunged most of them into crisis, thereby leaving them with an option of seeking debt relief. This scenario has in turn sparked off wide-ranging debates among academia and policy makers alike concerning the growth potentials of external debt. The consensus in the literature remains that external debt promotes growth to the extent that a country does not exceed its debt carrying capacity, otherwise additional debt accumulation would serve as a tax on future investment returns capable of creating disincentive to invest in such highly indebted countries. As noted by Dŏgan and Bilgili (2014), high external debt contracted by developing countries in the second half of the 1990s has become one of the most important factors which have restricted the development of some of these poor countries.

The Nigerian economy is not completely insulated from the issue of external debt sustainability. The country's large external debt profile dates back to the heydays of oil price increases during the late 1970s and early 1980s. Statistics show that Nigeria's external debt stock (as percentage of GDP) exhibited an upward trend between 1980 and 2008 with external debt-to-GDP ratio rising from 13.9% in 1980 to 64.6% in 1988. The high external debt in the 1990s led to government's inability to fully service it thereby making unpaid debt service to build up as fresh debt. External debt-to-GDP ratio later stood at 65.02% between 2000 and 2003. In reaction to the upward and unsustainable nature of external debt, the Nigerian

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government in 2005 concluded a debt relief agreement with Paris Club resulting in a debt cancellation to the tune of US$ 18 billion registered as Official Development Assistance (ODA) by creditor countries. Consequently, the debt relief agreement helped reduce the country's debt stock from US$ 36 billion in 2004 to US$ 4 billion in 2006, and since then Nigeria's external debt-to-GDP ratio has remained at relatively low levels (Jarju *et al*., 2016).

To this end, the present study revisits the external debt-growth nexus debate in the following distinct ways. The majority of the previous studies utilized a single measure of external debt, namely, external debt-to-GDP ratio while ignoring other debt indicators with exceptions in few cases, such as, Clements *et al*. (2003), Forgha *et al*. (2014), Jarju *et al*. (2016), and Mathew and Mordecai (2016), Onakoya and Ogunade (2017), Ademola *et al*. (2018). This study, therefore, innovates by following the works of Clements *et al*. (2003), most especially, to utilize all available measures of external debt to serve as robustness checks.

From the literature, it is also observed that only few country-specific studies had explored the threshold regression modeling framework (see, for instance, Schclarek, 2005; Osinubi and Olaleru, 2006; Omotosho *et al*., 2016) to uncover the non-linear relation between external debt and economic growth. This approach has also been explored in other areas such as the study by Mehrara (2007) which unveiled the threshold beyond which inflation becomes harmful to economic growth with focus on Iran. The vast majority, however, explored other approaches ranging from autoregressive distributed lag (ARDL), ordinary least squares (OLS), two-stage least squares (2SLS) to Markov-switching and error correction modeling techniques (see, for instance, Tuffour, 2012; Dŏgan and Bilgili, 2014; Forgha et al, 2014; Mathew and Mordecai, 2016; Saifuddin, 2016; Ebi and Imoke, 2017; Onakoya and Ogunade, 2017; Ademola *et al*., 2018, among others). The present study would employ the threshold regression modeling approach to complement evidence on non-linear external debt-growth relation in the Nigerian case, in addition to making use of alternative measures of external debt ignored by most of the past studies.

Moreover, the available literature scarcely examines the effect of external debt on economic growth via the investment channel (see, for instance, Pattillo *et al*., 2004; Tuffour, 2012; Checherita and Rother, 2010; Forgha et al, 2014; Ebi and Imoke, 2017). The present study contributes additionally to knowledge through its investigation of the possible role of investment in the non-linear relation between external debt and economic growth in Nigeria. This empirical exercise would also be subject to robustness checks via the use of different measures of external debt.

The rest of the study proceeds as follows: Section two contains a review of both the theoretical and the empirical literature. Methodology and data are issues discussed in Section three. Section four discusses empirical results, and Section five concludes the paper.

2. Review of the Literature

2.1 The Theoretical Literature

Several theories have emerged to explain the non-linear relationship between external debt (stock and service) and economic growth. However, two theories, namely the debt overhang theory and the crowding-

out effect hypothesis, have rather been subjected to widespread empirical scrutiny. According to Krugman (1988), debt overhang is the presence of an existing, "inherited" debt sufficiently large that creditors do not expect with confidence to be fully repaid. Further, a country has a debt overhang problem when the expected present value of potential future resource transfers is less than its debt.

The debt overhang theory states that when a debtor country is unable to meet its external debt obligations, debt repayments become linked to the country's economic performance. The country benefits partially from an increase in output or exports because a fraction of the increase is used to service the debt and accrues to the creditors. The debt overhang acts like a high marginal tax rate on the country lowering the return to investment and providing disincentive to domestic capital formation. The theory in turn raises the possibility of a "Debt Laffer Curve, DLC" (Savvides, 1992).

The DLC shows that along the left or "good side" of the curve, increases in the face value of debt service are associated with increases in debt repayment, while increases in the face value lower expected repayment on the right or "wrong" side of the curve. The peak of the curve is the point where large debt stocks begin acting as a steep marginal tax on investment. This also relates to the point at which debt begins to have a negative marginal impact on growth (Pattillo *et al*., 2002). In other words, high level of indebtedness discourages investment and negatively affects growth as future higher taxes are expected to repay the debt (Ali and Mustapha, 2012).

Similarly, the crowding-out effect hypothesis holds that the accumulation of a large debt may stifle economic growth through lower investment. External debt would be beneficial to investment up to a certain threshold, beyond which excessive debts start to place constraints on investment (Banayed *et al*., 2015). The crowding out of private investment occurs when government services debt on a recurring basis. High external debt has the effect of raising government's interest bill and the budget deficit thereby reducing public savings, and this in turn raises interest rates or crowd-out credit available for private investment with the consequence of dampening economic growth (Clements *et al*., 2003).

2.2 The Empirical Literature

A number of studies have investigated the non-linear relation between external debt and growth, and therefore confirmed the validity of the debt overhang theory of external debt stock and crowding-out effect hypothesis of external debt servicing. For instance, Osinubi and Olaleru (2006) utilized the threshold regression and reported the existence of the debt Laffer curve or non-linear effects of external debt on growth in Nigeria. Similarly, Omotosho *et al*. (2016) revisited the nexus between public debt (including domestic and external debt) and Nigeria's economic growth with the aid of threshold regression. Their results confirmed the existence of an inverted U-shaped relationship between public debt and economic growth in Nigeria. Tuffour (2012) examined the nexus between external debt and economic growth in Ghana using OLS, and the author established the presence of a U-shaped debt Laffer curve for the Ghanaian economy.

Moreover, Dŏgan and Bilgili (2014) employed the Markov-switching model to investigate the impact of private and public external debt on Turkish growth. The authors reported a negative impact of external debt on growth, with public external debt having an overwhelming impact. Also, Jarju *et al*. (2016)

explored the relation between external debt and growth in West African Monetary Zone (WAMZ) countries using panel data estimators. The authors offered evidence in favour of the debt overhang theory arising from the negative effect of excessive external debt stock on growth. They also confirmed the crowding out effect arising from the dampening growth effect of excessive external debt servicing. Similarly, Takanlou (2014) revealed that budget deficit financing (through issuance of debt instruments, for instance) crowded out private investment in Algeria while crowding in private investment in Iran.

Checherita and Rother (2010) identified the channels through which government debt influences economic growth in Euro Area as including private saving, public saving, public investment, total factor productivity (TFP), and sovereign long-term nominal and real interest rates. In the same vein, Clements *et al*. (2003) found evidence in support of the debt overhang theory in a panel of 55 low-income countries. Pattillo *et al*. (2002, 2004) established a non-linear relationship between external debt and economic growth in a panel of 93 countries. The authors also found the existence of an investment channel through which external debt impacts growth. In addition, the threshold regression analysis of Mupunga and Roux (2015) confirmed the existence of an inverted U-shaped relationship (or the debt Laffer curve) between public debt and economic growth in Zimbabwe.

On a final note, this study offers few innovations. First, the study investigates the possible role of investment in the non-linear relation between external debt and economic growth in Nigeria. Second, the present study utilizes the threshold regression analysis seldom used in the literature. Lastly, this study employs alternative measures of external debt for robustness checks.

3. Methodology and Data Issues

3.1 Model Specification

To investigate the presence of nonlinearities in the relationship between external debt and growth, this study adapts the panel threshold regression approach proposed by Hansen (1999) to time-series analysis of the Nigerian economy. Assume initially that the external debt-growth relation is specified in a linear regression model as below.

$$LRGDP_t = \alpha_0 + \alpha_1 DEBT_t + \beta' Z + \varepsilon_t \quad (1)$$

Where $LRGDP$ is the natural log of real GDP (a proxy for economic growth), $DEBT$ is external debt indicators (debt stock and debt services both expressed as percentages of gross national income and exports), Z is a vector of control variables including gross capital formation and trade openness, α_0, α_1, β are regression parameters, and ε is the stochastic error term while subscript t is the time dimension.

Following the threshold framework developed by Hansen (1999), eq. (1) becomes

$$LRGDP_t = \alpha_0 + \alpha_1 X_t I(DEBT_t \leq \gamma) + \alpha_2 X_t I(DEBT_t > \gamma) + \beta' Z + \varepsilon_t \quad (2)$$

Where $DEBT$ is the threshold variable and it is used to test for the presence of threshold effect of external debt on growth, γ denotes a threshold parameter. $I(.)$ is an indicator function that takes the value of 1 if external debt ($DEBT$) is below a determined threshold value (γ) and 0 otherwise.

Eq. (2) can conveniently be divided into two regimes depending on whether the threshold variable is above or below the estimated threshold. The two regimes are distinguished by different regression slopes α_1 and α_2 in two equations as follows.

$$LRGDP_t = \alpha_0 + \alpha_1 X_t + + \beta' Z + \varepsilon_t \text{ if } DEBT_t \leq \gamma \quad (3)$$

$$LRGDP_t = \alpha_0 + \alpha_2 X_t + + \beta' Z + \varepsilon_t \text{ if } DEBT_t > \gamma \quad (4)$$

where eq. (3) represents the regime below the threshold, while eq. (4) describes the regime above the threshold. The vector of control variables (Z) is regime invariant.

Additionally, there is need to identify the debt threshold and test for its presence. In order to identify the threshold, the first step eq. (2) is estimated by ordinary least squares (OLS). Then, the sum of squared errors (S_1) is computed for all possible values of the threshold variable (external debt indicators in the present case), where $S_1 = \hat{\varepsilon}(\gamma)'\hat{\varepsilon}(\gamma)$. In the second step, the threshold parameter is obtained by minimizing S_1, such that $\hat{\gamma} = argmin\gamma\, S_1(\gamma)$. Similarly, once the endogenous threshold is estimated, it is essential to test whether the threshold effect is statistically significant. The null hypothesis is that there is no threshold effect, that is,

$$H_0: \beta_1 = \beta_2 \quad (5)$$

The null hypothesis implies that the slope coefficients are equivalent in the two regimes. Therefore, under the H_0, the threshold model (eq.(2)) is equivalent to the linear model (eq.(1)). The likelihood ratio test of the null hypothesis is based on the F-statistic:

$$F_1 = \left(S_0 - S_1(\hat{\gamma})\right) \Big/ \widehat{\sigma^2} \quad (6)$$

Where S_0 and S_1 are the sum of squared errors under the null and alternative hypotheses, while $\widehat{\sigma^2}$ is the estimate of the regression error variance (σ^2). Given that the threshold value is not identified under the null hypothesis, the asymptotic distribution of F_1 is not standard. As a solution, Hansen (1999) proposed a bootstrap method to simulate the probability value for the F-statistic (F_1).

In order to test for the role of domestic investment in the non-linear relation between external debt and growth, the study leans on the approach of Tuffour (2012) by estimating two strands of growth models, with one omitting the investment variable while the other accounts for domestic investment. The idea is to examine if the inclusion of the investment variable alters the magnitude of the debt threshold or not. For threshold effect to exist, it is expected that from eq. (2), $\alpha_1 > 0$ and $\alpha_2 < 0$.

3.2 Data Scope and Sources

The data on relevant variables employed in this study, such as, real GDP (a proxy for economic growth), various measures of external debt (namely, external debt stock-to-GNI ratio, external debt-to-exports ratio, external debt servicing-to-GNI ratio, and external debt servicing-to-exports ratio), and other growth determinants including gross capital formation (a proxy for domestic investment) and trade openness (a proxy for macroeconomic environment) were collected from the World Bank's World Development Indicators (WDI, 2017) over the period of 1981 and 2015.

4. Empirical Results and Discussion

Here, the results of preliminary analysis including descriptive statistics and unit root test are presented. This section also discusses the Threshold regression results.

4.1 Descriptive Statistics

Table 1 presents the summary statistics on the main variables used in the study over the period of 1981 to 2015. The average value of real GDP (log-levels) is approximately 25.95. Other variables including external debt stock (% of GNI), external debt stock (% of exports), external debt service (% of GNI), external debt service (% of exports), gross capital formation (% of GDP), and trade openness have their respective means as 70.26%, 159.69%, 5.64%, 13.05%, 12.59%, and 51.12%. The greater shares of external debt stock in GNI and exports reflect the high external debt profile of the Nigerian economy even until date. This has the implication that additional external debt serves as increasing tax on the country's national income and export proceeds as the government makes debt repayment. In terms of volatility as measured by the coefficient of variation of each variable, the external debt indicators are highly volatile while the remaining variables are relatively less volatile. In terms of the shape of the probability density of each variable as accounted for by Jarque-Bera statistic, all variables except gross capital formation follow normal distribution ($p > 0.1$). Despite that the majority of the variables are well-behaved statistically, it is important to check the stationarity status of the variables, the issue which is addressed in the next section.

Table 1: Summary Statistics

Variable	Obs.	Mean	Standard deviation	Coefficient of variation (%)	Jarque-Bera stat
LRGDP	35	25.946	0.492	1.896	4.370[0.112]
ED_G	35	70.255	59.828	85.158	3.151[0.207]
ED_X	35	159.69	123.87	77.569	2.441[0.295]
ES_G	35	5.644	4.595	81.414	2.439[0.295]
ES_X	35	13.047	10.322	79.114	3.044[0.218]
GCF	35	12.588	6.122	48.633	40.859[0.000]
TOP	35	51.116	16.603	32.481	1.551[0.461]

***Source**: Authors' computation.*

4.2 The ADF Unit Root Test Result

The result of Augmented Dickey-Fuller (ADF) unit root test is shown in Table 2. Here, only test regressions that are close to rejecting the null hypothesis of nonstationarity are reported. Accordingly, it can be observed that the natural log of real GDP, external debt stock (% of GNI), external debt stock (% of exports), and trade openness become stationary after first differencing; hence, they are said to be integrated of order one, that is, I(1). Other variables including external debt service (% of GNI), external debt service (% of exports), and gross capital formation are stationary at levels; hence, they are said to be integrated of order zero, that is, I(0).

Table 2: Results of ADF Unit root Test

Variable	Level	First Difference	I(d)
LRGDP	-2.068[a]	-4.912[a]***	I(1)
ED_G	-2.561[a]	-5.624[a]***	I(1)
ED_X	-3.120[a]	-4.639[a]***	I(1)
ES_G	-4.008[a]**	……†	I(0)
ES_X	-5.072[a]***	…….	I(0)
GCF	-4.447[b]***	…….	I(0)
TOP	-1.916[b]	-7.999[b]***	I(1)

Note: ***, ** indicate the rejection of the null hypothesis of a unit root at 5% and 10%, respectively; I(d) is the order of integration and it refers to the number of differencing required for

a series to become stationary; †implies that a series that is stationary at levels does not require its first difference being reported; a and b denote model with intercept and trend, and model with intercept only, respectively.
***Source**: Authors' computation.*

4.3 The Threshold Regression Results

Tables 3 and 4 show the results of estimated threshold regression using external debt stock indicators without and with the investment variable. Also, Tables 5 and 6 present the results of estimated threshold regression using external debt service indicators without and with the investment variable. In line with Jarju *et al*. (2016), the first panel of models is a test for the validity of the debt overhang theory of external debt stock (see Tables 3 and 4) while the second strand of models verifies the predictions of the crowding-effect hypothesis of external debt servicing (see Tables 5 and 6). Both strands of models are interpreted in turn.

4.3.1 Threshold analysis of external debt stock-growth nexus

From Table 3, external debt stock, % of GNI is used as the debt indicator, whereas the study employs external debt stock, % of exports as the debt indicator in Table 4. In both tables, Panel A is a model without the investment variable, while Panel B is a model that accounts for investment. In Panel A, there is an estimated threshold range of 26.05% to 64.16%, which in turn breaks up the sample size into two regimes: regime 1 and regime 2, respectively. It can be observed that within this threshold range, an increase in external debt by 1 percentage point reduces real GDP on average by 6.7% (in regime 1) and 1.2% (regime 2) keeping other variables constant. Irrespective of regimes, trade openness has a positive effect on real GDP, though the impact coefficients are not statistically significant at the 10% level.

However, by accounting for the influence of domestic investment in Panel B, the minimum threshold gets reduced to 6.81%. When the external debt is less than this threshold, an increase in external debt stock by 1 percentage point leads to a decline in real GDP by 9.9% on average (in regime 1). However, when external debt is greater than or equal to this threshold but is less than the maximum threshold (64.161%), a reduction in real GDP to the tune of 0.9% is induced for every 1 percentage point in external debt stock, % of GNI (in regime 2). This result confirms the existence of an inverted U-shaped relationship between external debt stock and real GDP in Nigeria.

Similarly, irrespective of regimes, domestic investment dampens growth as every 1 percentage point increase in gross capital formation reduces real GDP on average by 3% in both regimes. The impact coefficient (-0.03) is also statistically significant at 1% level of significance. However, trade openness raises real GDP by the same magnitude (3%) only that the impact coefficient is statistically significant at the 5% level. The incorporation of the role of investment improves the explanatory power of the external debt-growth threshold model as reflected in the rise of the adjusted coefficient of determination from 89% (in Panel A) to 96% (in Panel B). In both panels, the large values of the F-statistics testify to the overall significance and adequacy of the estimated threshold models at 1% level of significance.

Moreover, from Table 4 where external debt stock (% of exports) is used as the debt indicator, trade openness and gross capital formation cease to be significant determinants of output growth in both Panels A and B. As against what obtains in Table 3, only one threshold is identified and that is 58.78%. Below the

threshold, a 1 percentage point increase in external debt, % of exports is capable of raising real GDP on average by 0.1% (in regime 1), but beyond this threshold, the same magnitude generates a reduction in real GDP by an average of 0.1% (in regime 2). However, the impact of external debt stock, % of exports is only significant in regime 2 at 1% level of significance. This same result holds even when the effect of domestic investment is accounted for in Panel B. By implication, Nigeria would be on the right side (declining portion) of the debt Laffer curve if and only if external debt stock, % of exports exceeds the estimated threshold of 58.78%. Additionally, accounting for the role of investment improves the explanatory power of the external debt-growth threshold model as reflected in the rise of the adjusted coefficient of determination from 86% (in Panel A) to 87% (in Panel B). In both panels, the large values of the F-statistics testify to the overall significance and adequacy of the estimated threshold models at 1% level of significance. It can be convincingly argued that irrespective of the measures of external debt stock used, this study offers evidence in favour of validity of the debt overhang theory which stipulates a non-linear relationship between external debt and economic growth[2].

Table 3: Threshold regression of the nexus between external debt stock indicator and growth

Indicator 1: External debt stock (% of GNI)				
Dependent variable: $LGDP_t$				
	Panel A		**Panel B**	
	Model without investment		Model with Investment	
	Regime 1: $(DEBT_t < \gamma_1)$	Regime 2: $(\gamma_1 \leq DEBT_t < \gamma_2)$	Regime 1: $(DEBT_t < \gamma_1)$	Regime 2: $(\gamma_1 \leq DEBT_t < \gamma_2)$
$DEBT_t$	-0.067***(0.008)	-0.012***(0.002)	0.099***(0.019)	-0.009***(0.002)
GCF_t			-0.03***(0.003)	-0.03***(0.003)
TOP_t	0.003(0.002)	0.003(0.002)	0.003**(0.001)	0.003**(0.001)
C	26.874***(0.137)	26.414***(0.002)	26.665***(0.163)	26.638***(0.117)
Identification of Thresholds (γ)				
γ_1	26.046		6.806	
γ_2	64.161		64.161	
Other diagnostics				
Adj. R^2	0.890		0.955	
F-stat	46.857[0.000]		103.291[0.000]	

Note: ***, ** indicate the statistical significance of coefficients at 1% and 5%, respectively; the values in parentheses and block brackets are, respectively, the standard errors and the probabilities.
***Source**: Authors' computation.*

Table 4: Threshold regression of the nexus between external debt stock indicator and growth

Indicator 2: External debt stock (% of exports)				
Dependent variable: $LGDP_t$				
	Panel A		**Panel B**	
	Model without investment		Model with Investment	
	Regime 1: $(DEBT_t < \gamma_1)$	Regime 2: $(DEBT_t \geq \gamma_1)$	Regime 1: $(DEBT_t < \gamma_1)$	Regime 2: $(DEBT_t \geq \gamma_1)$
$DEBT_t$	0.004(0.004)	-0.001**(0.0004)	0.003(0.007)	-0.001**(0.0005)
GCF_t			-0.009(0.007)	-0.009(0.007)
TOP_t	0.002(0.002)	0.002(0.002)	-0.00004(0.003)	-0.00004(0.003)
C	26.420***(0.179)	25.753***(0.150)	26.649***(0.304)	26.007***(0.343)
Identification of Threshold (γ)				
γ_1	58.779		58.779	
Other diagnostics				
Adj. R^2	0.861		0.865	
F-stat	53.481[0.000]		44.586[0.000]	

Note: ***, ** indicate the statistical significance of coefficients at 1% and 5%, respectively; the values in parentheses and block brackets are, respectively, the standard errors and the probabilities.
***Source**: Authors' computation.*

[2]This result complements the previous findings on the existence of debt Laffer curve in the Nigerian economy (see, for instance, Osinubi and Olaleru, 2006 and Omotosho *et al.*, 2016).

4.3.2 Threshold analysis of external debt service-growth nexus

From Table 5, external debt service, % of GNI is used as the debt indicator, whereas the study employs external debt service, % of exports as the debt indicator in Table 6. In both tables, Panel C is a model without the investment variable, while Panel D is a model that accounts for investment. In both panels, the estimated threshold is 2.786, which in turn breaks up the sample size into two regimes: regime 1 and regime 2. From Table 5, it can be observed that below this threshold, an increase in external debt service by 1 percentage point reduces real GDP on average by 28% (in regime 1) and 1.6% (in regime 2) keeping other variables constant. The effect of external debt service is magnified by accounting for the role of domestic investment in panel D as a 1 percentage point increases further decreases real GDP by the magnitude of 0.9 percentage point (in regime 1) and 0.8 percentage point (in regime 2). The impact coefficients on external debt service, % of GNI are statistically significant at 1 to 5%. In both panels, trade openness has no significant impact on output growth.

Similarly, irrespective of regimes, domestic investment dampens growth as every 1 percentage point increase in gross capital formation reduces real GDP on average by 1.4% in both regimes. The impact coefficient (-0.014) is also statistically significant at 5% level of significance. The incorporation of the role of investment improves the explanatory power of the external debt-growth threshold model as reflected in the rise of the adjusted coefficient of determination from 81% (in Panel C) to 83% (in Panel D). In both panels, the large values of the F-statistics testify to the overall significance and adequacy of the estimated threshold models at 1% level of significance.

Moreover, from Table 6 where external debt service (% of exports) is used as the debt indicator, trade openness appears to be an insignificant determinant of output growth in Panels C and D. However, in both panels, domestic investment has a negative and significant effect on output growth. Based on this measure of external debt service (that is, as % of exports), a higher threshold is estimated at 5.93%. Below the threshold, a 1 percentage point increase in external debt service, % of exports is capable of reducing real GDP on average by 0.9% (in regime 1), but beyond this threshold, the same magnitude generates a reduction in real GDP by an average of 1.7% (in regime 2). However, the impact of external debt service, % of exports is only significant in regime 2 at 1% level of significance. This same result holds even when the effect of domestic investment is accounted for in Panel D except that the effect of external debt service gets magnified in both regimes.

Irrespective of the measures of external debt service (see Table 5 and Table 6), the negative impact of external debt service obtained under the two regimes indicates that excessive external debt servicing is capable of inducing investment cuts with negative spill-over effects on output growth. This result therefore lends empirical support to the crowding-out effect of excessive debt servicing in the Nigerian economy[3]. In addition, accounting for the role of investment improves the explanatory power of the external debt-growth threshold model as reflected in the rise of the adjusted coefficient of determination from 81% (in Panel C) to 83% (in Panel D). In both panels, the large values of the F-statistics testify to the overall significance and adequacy of the estimated threshold models at 1% level of significance.

[3]This result parallels the findings of Jarju *et al*. (2016).

Table 5: Threshold regression of the nexus between external debt service indicator and growth

Indicator 1: External debt service (% of GNI)				
Dependent variable: $LGDP_t$				
	Panel C		**Panel D**	
	Model without investment		Model with Investment	
	Regime 1: $(DEBT_t < \gamma_1)$	Regime 2: $(DEBT_t \geq \gamma_1)$	Regime 1: $(DEBT_t < \gamma_1)$	Regime 2: $(DEBT_t \geq \gamma_1)$
$DEBT_t$	-0.280**(0.082)	-0.016(0.013)	-0.289***(0.032)	-0.024**(0.011)
GCF_t			-0.014**(0.006)	-0.014**(0.006)
TOP_t	0.002(0.003)	0.002(0.003)	-0.001(0.003)	-0.001(0.003)
C	26.704***(0.139)	25.704***(0.205)	27.033***(0.189)	26.098***(0.285)
Identification of Threshold (γ)				
γ_1	2.786		2.786	
Other diagnostics				
Adj. R^2	0.807		0.826	
F-stat	36.573[0.000]		33.268[0.000]	

Note: ***, ** indicate the statistical significance of coefficients at 1% and 5%, respectively; the values in parentheses and block brackets are, respectively, the standard errors and the probabilities.
***Source**: Authors' computation.*

Table 6: Threshold regression of the nexus between external debt service indicator and growth

Indicator 2: External debt service (% of exports)				
Dependent variable: $LGDP_t$				
	Panel C		**Panel D**	
	Model without investment		Model with Investment	
	Regime 1: $(DEBT_t < \gamma_1)$	Regime 2: $(DEBT_t \geq \gamma_1)$	Regime 1: $(DEBT_t < \gamma_1)$	Regime 2: $(DEBT_t \geq \gamma_1)$
$DEBT_t$	-0.009(0.052)	-0.017***(0.006)	-0.023(0.058)	-0.02***(0.006)
GCF_t			-0.012*(0.006)	-0.012*(0.006)
TOP_t	-0.002(0.003)	-0.002(0.003)	-0.005(0.004)	-0.005(0.004)
C	26.72***(0.176)	26.057***(0.269)	27.049***(0.269)	26.425***(0.382)
Identification of Threshold (γ)				
γ_1	5.926		5.926	
Other diagnostics				
Adj. R^2	0.813		0.825	
F-stat	37.956[0.000]		33.106[0.000]	

Note: ***, **, * indicate the statistical significance of coefficients at 1%, 5% and 10%, respectively; the values in parentheses and block brackets are, respectively, the standard errors and the probabilities.
***Source**: Authors' computation.*

5. Concluding Remark

The present study revisited the external-growth nexus debate while accounting for the role of domestic investment in the Nigerian economy between 1981 and 2015. In other words, this study tested empirically the validity of the debt overhang theory and crowding out effect hypothesis by exploring alternative indicators of external debt. In order to achieve this empirical exercise, the threshold regression approach of Hansen (1999) was employed. The overall findings showed that the impact of external debt on output growth is sensitive to the measures of external debt used and whether or not the role of domestic investment is accounted for in the threshold regression analysis. Specifically, this study confirmed the existence of the debt Laffer curve associated with the debt overhang theory arising from the excessive external debt stock. Similarly, empirical support was obtained for the crowding-out effect of excessive external debt servicing. Also, accounting for the role of domestic investment in the non-linear relation between external debt and economic growth reduces the optimal debt carrying capacity of the country. By implication, high rate of domestic investment was associated with low external debt stock regime.

Based on these findings, the study suggests that the Nigerian government places a ceiling of 6.81% as this is the optimal threshold that would ensure external debt stock impacts the economy positively given the important role of domestic investment. Similarly, irrespective of thresholds chosen for external debt servicing, a negative output growth would always result. To this end, it is suggested that the Nigerian government should do away with sentiments and therefore explore the sources of external debt financing that are non-interest based. This has the effect of reducing the burden imposed by external debt service payments, capable of building up into fresh debts if not paid as at when due. Lastly, the negative growth impact of domestic investment remains a challenge for the Nigerian government to make efficient use of external debt for infrastructural development that could in turn encourage private investment and boost output growth, eventually.

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Appendix: Data Summary

Year	Real GDP (₦' billion)	External debt service (% of exports)	External debt service (% of GNI)	External debt stock (% of exports)	External debt service (% of GNI)	Gross capital formation (% of GDP)	Trade openness (%)
1981	124.90	9.20	3.01	58.78	19.23	34.02	48.29
1982	123.58	16.23	4.15	93.09	23.83	29.74	37.75
1983	117.34	23.61	7.38	161.77	50.54	21.87	27.04
1984	114.97	32.94	14.68	144.03	64.16	12.42	23.61
1985	124.54	32.78	15.90	138.08	66.98	11.36	25.90
1986	113.63	38.04	10.63	412.07	115.12	15.70	23.72
1987	101.42	14.13	5.10	370.69	133.77	12.66	41.65
1988	109.07	30.37	9.71	406.95	130.15	9.85	35.31
1989	116.12	24.69	9.56	351.26	136.02	11.75	60.39
1990	130.94	22.60	11.97	226.66	120.05	14.43	53.03
1991	130.13	22.06	11.81	251.12	134.45	13.79	64.88
1992	130.70	18.57	9.16	223.23	110.12	12.80	61.03
1993	133.43	13.40	11.09	275.82	228.37	13.61	58.11
1994	134.64	18.95	11.90	334.99	210.33	11.20	42.31
1995	134.23	14.73	6.96	274.01	129.51	7.08	59.77
1996	140.93	13.14	6.80	185.18	95.90	7.30	57.69
1997	144.88	8.71	4.22	175.16	84.76	8.37	76.86
1998	148.82	13.07	4.57	297.55	103.89	8.62	66.17
1999	149.52	7.61	3.12	206.42	84.59	7.01	55.85
2000	157.47	8.76	4.61	152.83	80.46	7.03	71.38
2001	164.42	12.72	6.30	158.33	78.46	7.59	81.81
2002	170.64	8.06	2.79	173.46	59.94	7.02	63.38
2003	188.31	5.93	2.72	133.35	61.19	9.91	75.22
2004	251.84	4.47	2.19	104.28	51.16	7.40	48.45
2005	260.52	15.41	8.91	45.07	26.05	5.47	50.75
2006	281.91	10.98	4.77	15.74	6.83	8.27	64.61
2007	301.16	1.44	0.65	17.33	7.86	9.26	64.46
2008	320.04	0.76	0.36	14.53	6.81	8.33	64.97
2009	342.23	1.28	0.49	26.87	10.29	12.09	61.80
2010	369.06	1.50	0.36	18.50	4.43	17.29	42.65
2011	387.10	0.51	0.13	17.09	4.54	16.21	52.79
2012	403.67	1.34	0.30	18.22	4.13	14.91	44.38
2013	425.44	0.49	0.10	21.08	4.32	14.90	31.05
2014	452.28	5.32	0.83	28.95	4.51	15.80	30.89
2015	464.28	2.87	0.31	56.72	6.15	15.49	21.12

***Source**: Authors' compilation from World Development Indicators (WDI, 2017).*