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Research Article

Public Debt Optimal Threshold-Infrastructural Development Nexus: The Nigerian Experience Using Hansen Threshold Technique

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ABSTRACT

The question of optimal threshold has been extensively examined in literature for both country-specific studies and panel studies with respect to the public debt-economic growth threshold nexus without considering infrastructural development which is an integral part of economic growth and development. It is on this basis this paper investigated the threshold at which public debt improves infrastructural development in Nigeria on the assumption of non-existence of structural breaks in the country using Hansen threshold technique. Sources of data for all the selected variables were derived through secondary sources while the Autoregressive Distributed Lag (ARDL) unrestricted version for Bound test was employed whose findings later revealed that cointegration exists among the studied variables in Nigeria. Empirically, the threshold regression analysis result showed that a public debt threshold level of 62.5% is needed for adequate infrastructural development (INFRAD) in Nigeria. The reason being that the threshold level of 62.5% falls within the recommended limit of 70% public debt-to-GDP ratio, as set by the International Monetary Fund (IMF) and the World Bank for countries in the Economic Community of West African States (ECOWAS) sub-region peer group of which Nigeria is not an exemption. The results suggest that adherence to this debt-to-GDP ratio limit can enhance the chances of attaining sustainable and inclusive economic growth through adequate investments in infrastructural development. The study thus concluded that for adequate infrastructural development to be attained in Nigeria, a threshold of 62.5% is required.

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1. Introduction

Over the years, the role of infrastructural developments has received global recognition in the sense that much of the recent global debate on ways to stabilize the economy, stimulate growth, alleviate poverty and improve the standard of living of people more especially in less-developing countries (LDCs) has been hinged on the need for upward government investments in infrastructural developments. Public infrastructure investment is an integral component of government spending which is a determinant of Gross Domestic Product (GDP). Reungsri (2010) opines that the primary source of infrastructure funding is public finance and that capital funding is of the order of an economy's aggregate public budgetary expenditure. Undeniably, infrastructure has a positive and significant effect on the economy and is one of the sole responsibility and priority in public strategy, policy and execution for the country. Again, infrastructure is indispensable towards attaining the key development targets in less developed nations, more especially in the areas of urbanization, industrialization, promotion of export, equitable income redistribution, and sustainable economic development. However, the dearth of infrastructure has hampered growth in less developed nations and Nigeria inclusive. Unarguably, investment in infrastructure has the capacity of contributing to productivity and it is expected to add to growth in the future more especially among less developed nations where infrastructure development is one of the cardinal focuses of the public policies as viewed by the developed nations.

Incontrovertibly, adequate supply of infrastructural facilities is germane in an economy's agenda to accomplish its stated targets of efficient distribution of resources and also to attain economic growth. Unfortunately, in spite of the Public-Private Partnership (P3) initiatives and moves in recent times by government to close the infrastructural gap in Nigeria, the trend of infrastructural decay and deficit is on the high side. This ugly situation might be attributed to the weak institutional arrangements in the nation. Importantly, the World Bank (1994) sees infrastructure as a social overhead capital composed of technical characteristics like economies of scale as well as economic attributes such as spillovers from users to nonusers. Again, the World Bank (2007) therefore advocated for the need for less developed countries to earmark or devote 7% to 9% of

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their Gross Domestic Product (GDP) on infrastructural development in the country. Nonetheless, many countries of the world, especially the third world countries are experiencing infrastructural deficit as a result of huge public debt profile. In the light of this, infrastructural development cannot be attained in the absence of the necessary and sufficient supports of fiscal policies such as public debt, taxation and budgets in an economy.

Public debt also called aggregate government debt is amount owed by all governmental ministries, departments and agencies, including the government at the state and local levels. Public debt can also be regarded as the accumulation of financial responsibilities acquired by governmental organisations in any nation, which constitutes debt owed to private hands, mutual funds, the edge funds, pension funds, and external loans. Similarly, it considers public liabilities, future pension settlements and settlements for goods and services that the levels of government contracted but yet unpaid for. In the same vein, it is disheartening that public debt has impacted poorly on infrastructural development in Nigeria over the years and this scenario is evident in the deficit in infrastructure being witnessed in the country as public funds meant for capital projects are completely diverted to private pockets while others are misappropriated thereby leading to incompletion and abandonment of capital projects. For instance, a government that is corrupt tends to redirect public debt stemming from productive sectors (education and health) to defence and capital projects with lesser value creation and also having the potentiality of corruption (Shleifer and Vishny, 1993). Again, public expenditure on infrastructure in Nigeria appears to be resource wastage at the expense of tax payers because economic growth in the country have not physically depicted infrastructural development (Babatunde, 2018). Moreover, a nation characterized by a poorly developed infrastructure has a potential of boosting its gross output if it develops its infrastructure. Additionally, infrastructural deficiencies and inefficient social services delivery such as information and communication, power, transport, roads, sanitation, water, and host of others have paralyzed transaction costs and this has reciprocally affected trade thereby limiting the competitiveness of Nigeria's goods in the global market (Edame and Fonta, 2014).

Undoubtedly, Nigeria's aggregate public debt stood at ₦39.55Billion at the end of 2021 giving rise to burdensome and worrisome debt servicing (Debt Management Office; DMO, 2021). Nonetheless, the public debt ratio still remains within the self-imposed limit of 40% in the country as the Public Debt-to-Gross Domestic Product (PD_GDP) ratio still lies within 22.47% (Debt Management Office; DMO, 2021). Comparatively, the Public Debt-Gross Domestic Product (PD_GDP) ratio could still be considered prudent when compared with the 55% limit recommended by Bretton Wood (World Bank) and the International Monetary Fund (IMF) for all nations within the Nigeria's peer group (DMO, 2021). Most of Nigeria's public debt are concessionary loans which are obtained from both bilateral and multilateral sources. Nigeria's public debt to GDP ratio is 23% which still remains with the self-imposed bound of 40%, and also lies within the World Bank's and IMF's recommended limit of 55% for nations within Nigeria's peer group, as well as 70% for the ECOWAS sub-region. Deficit budget by the Nigerian government over the years had further necessitated the need for borrowings from both domestic and foreign sources.

Existing literatures by scholars have continued to reveal a mixed results on the public debt threshold effect on growth among less developed nations (LDCs) with different studies revealing different threshold tipping points or values. Among these extant studies are Elbadawi, Ndulu and Ndung'u (1997) who found a public debt threshold of 97% of GDP, Cordella, Ricci Ruiz-Arranz (2005) who discovered a public debt threshold value between 35% and 40% of GDP while Chudik, Mohaddes, Pesaran and Raissi (2017) found a public debt threshold level between 30% and 60%. Howbeit, myriads of techniques of estimation might have been responsible for these varying public debt threshold values discrepancies. For instance, Elbadawi, Ndulu and Ndung'u (1997) adopted a quadratic equation method to identify the possible curvilinear nexus between public debt and growth while Pattillo, Poirson and Ricci (2011) employed the quadratic and spline model technique employing fixed effects and system Generalized Method of Moments (GMM) whereas Chudik, Mohaddes, Pesaran and Raissi (2017) applied the Autoregressive Distributed Lag (ARDL) method. Unfortunately, all these econometric techniques still ended up in an inconclusive result. In view of this, Egert (2015a) opined that threshold effect is a function of a nation's coverage.

Notwithstanding, studies have revealed that there is an optimal level at which public debt can influence infrastructural development in an economy (Butkus and Seputiene, 2018). Meanwhile, studies in this aspect only investigated the optimal threshold effect of public debt on infrastructural development without investigating whether or not threshold effect role would hold in the presence of government's role in the public debt and infrastructural development nexus, hence, this study. Against this above caveat, this paper seeks to determine the threshold at which public debt improves infrastructural development in Nigeria.

2. Literature Review

A. Theoretical Review

The likelihood of a potential resurgence of an impending public debt crisis in developing countries and Nigeria not exempted have become a developmental issue of burning national concern (Ndoricimpa, 2020). More so, the magnitude of public debt profile in Sub Saharan African (SSA) countries has astronomically risen within the post-debt relief granted to Highly Indebted Poor Countries (HIPC) in 2005. This be being that the mean ratio of public debt-to-GDP in Sub Saharan African (SSA) moved from thirty-seven percent (37%) in 2012 to fifty-seven percent (57%) in 2017 (World Bank, 2018a). Again, the sum total of SSA nations with potential high risk of public debt distress is higher than doubled emanating from 8 nations to 18 nations in 2018 within last decade (IMF, 2018). However, some of the factors responsible for this resurfacing public debt crisis in SSA countries are global financial meltdown shocks (2008), adverse price shocks on commodity, imprudent fiscal policies, decline in official development assistance (ODA), multiple classes of lenders or creditors and a huge infrastructural deficits or gaps (Coulibaly, Gandhi and Senbet, 2019). Meanwhile, African Development Bank (AFDB, 2018) suggested that infrastructural financing gap should be at sixty-eight Billon USD ($68Billion) to one and eight Billion USD ($108Billion) and then cautioned that high rates of public debt have adverse impact on growth in the long- run. On one hand, an adequate public debt level when prudently utilized is healthy for poor income economies in order to improve the standard of living of the people while on the contrary, when excessive public debt is not efficiently and effectively utilized, this thus have a negative effect on growth and other several developmental agenda of the government (IMF, 2018). Furthermore, several other factors that impedes investment are excessive debt acquisition, greater long-term rates of interest, higher future tax distortion alongside vast uncertainty about public prospects and policies (Ndoricimpa, 2017).

Theoretically, public debt is sub-divided into four (4) arbitrary regimes which are low public debt countries (30% of GDP), (medium-low public debt countries (30% and 60% of

GDP), medium and high public debt countries (60% and 90% of GDP) and high public debt countries (beyond 90% of GDP) (Reinhart and Rogoff, 2010). Again, public debt scenarios seem to be the same globally but with slight variations as the average public debt comparable among nations in lieu of intensive resources and non-availability of intensive resources for the first three (3) regimes of public debt and for high public debt regime which is beyond ninety percent (90%). More so, intensive resource nations have a greater average debt as against the non-availability of intensive resource nations as could also be seen for nations that have low income and middle income (Ndoricima, 2020).

The Neoclassical theory postulates that debt could have a positive influence on growth. This being that when external or domestic debts are maximally utilized, there is the possibility for investment to increase. In as much that countries maximally utilize the public debt for productive investment and do not experience macroeconomic unstableness, policies that impedes economic incentives or negative shocks, growth would improve thereby create avenue for prompt loan repayment while the reverse is the scenario as the negative effect of public debt on growth is its ripple effects on investment. Consequently, the gateway by which public debt impact growth is its diminishing level on the resources required for investment through debt servicing. Undeniably, public debt serves as implicit tax on resource availability provided in an economy and thereafter leads to a cost on future generation which in turn causes a fall in the income flow from a smaller private stock of capital. Unarguably, this might probably cause a rise in rate of interest in the long run rate, an effusion of private investments required for productive boost together with a fall in stock of capital.

B. Empirical Review

Despite the emergence of public debt crisis in 80s, studies on threshold effects for developing nations still remain relatively low. Extant works by Ndoricimpa (2017) and Mensah, Allotey, Sarpong-Kumankoma and Coffie (2019) for African nations on public debt threshold had a varying result as Ndoricimpa (2017) using non-dynamic and dynamic panel threshold technique discovered a threshold ranging from 92.8% to 102.6% while Mensah, Allotey, Sarpong-Kumankoma and Coffie (2019) found a threshold ranging from 20% to 50% using panel threshold ARDL technique.

Most previous works made use of a single infrastructural measure in their work for a wide variety of objectives. However, there is no data set that could give a geo-coded infrastructural measure. Undeniably, physical stocks and public expenditure are infrastructural measures. Nonetheless, most past works applied physical infrastructural measures and their findings exhibited a positive impact on output and productivity in the long-run. Contrariwise, other past works applied public expenditure as an infrastructural measure and then found a mixed result on infrastructure effect on output performance in the long-run (Straub, 2008). Similarly, a definite infrastructural index such as telephone density, roads or electricity served as proxy for aggregate infrastructure. Meanwhile, their results depict a mixed results as power and communication infrastructures added to growth in the long-run more than water and sanitation infrastructure (Straub, 2010; Calderon and Serven, 2008). Again, data and methodologies were some of the factors causing the inconclusive results among scholars and these are measurement problem of adopting a definite infrastructure variable as substitute for infrastructure, the multicollinearity problem among infrastructural assets, problem of identification of biasness in simultaneity or endogeneity and causality alongside heterogeneity of different quality of infrastructure and output (Romp and De Haan, 2007, Calderon and Serven, 2008, Straub, 2010 and Pereira and Andraz, 2013).

In this paper, the ratio of public debt as a percentage of Gross Domestic Product (PD_GDP) as a proxy for public debt while a single average index was generated for infrastructural development (INFRAD) to capture electricity supply, road construction, telecommunication and water supply infrastructures. Again, the seven institutional qualities (INSTQ) from ICRG which served as the mediating variable was rescaled in order to generate a single average index from the ordinal scale while debt servicing (DEBTSER), inflation rate (INF), real exchange rate (REXR) and real interest rate (RINR) served as control variables in the study. These institutional qualities (INSTQ) are Corruption Control (CC), Bureaucratic Quality (BQ), Democratic Accountability (DA), External Conflict (EC), Government Stability (GS), Internal Conflict (IC) and Law and Order (LO).

3. Methodology

In this paper, the Hansen threshold (2004) approach was used to determine the public debt optimal threshold-infrastructural development nexus in Nigeria. The Hansen threshold modeling rationale is built on the assumption that regression functions vary across observations as the threshold presence divide the regression into different regimes. The rationale behind this is that the coefficients vary in effects beyond or below a specific tipping point (threshold value) of a threshold variables or time (in a situation where time is the threshold variable). Thereafter, this unveils the nonlinearity in the nexus that create a threshold and thus indicates the level at which the coefficient has the measured effect displaying sign and magnitude on the regressand. Meanwhile, since the Hansen (1999, 2000) seminal work on threshold technique, further improvements have emerged to put into consideration the endogeneity with exogenous threshold (Caner and Hansen, 2004). This improvement is considered to be the dynamic panel threshold extended and popularize by Kremer, Bick and Nautz (2013). Therefore, the Hansen threshold specification can be written as;

$$INFRAD_t = \alpha_{PUBDEBT} + \beta_1 d_t^{PD}(PUBDEBT_t - PUBDEBT^*) + \beta_2(1 - d_t^{PUBDEBT})(PUBDEBT_t - PUBDEBT^*) + \delta_{PUBDEBT}\mu_{t-1} + \varepsilon_t \quad (1)$$

C. Model Specification

Applying Hansen Threshold approach**.** Hansen (2000) built a statistical regression analysis which put into consideration threshold effect and also develop an asymptotic confidence interval for the threshold variable. Considering

Hansen (2000), an exogenously given variable also referred to as the threshold variable is applied to split a sample into a two (2) regimes threshold model whose threshold estimation is built on two (2) regime structural equations as expressed in equations (2) and (3).

$$y_i = \theta_1 x_i + e_{1i} \quad \text{if} \quad q_i \le \gamma \quad (2)$$

$$y_i = \theta_2 x_i + e_{2i} \quad \text{if} \quad q_i > \gamma \quad (3)$$

Wherein γ remains the threshold value, the dependent variable is y remains the dependent variable, x remains the independent variable, q remains the threshold variable, θ remains the slope coefficient while θ remains the error term. Consequently, the Hansen's two (2) regimes regression for this paper is expressed as;

Hansen's two regimes regression for this study can also be expressed as;

$$LINFRAD_i = (\beta_{10} + \beta_{11} LINSTQ_i) d[PD\_GDP_i \leq \gamma] + (\beta_{20} + \beta_{21} LINSTQ_i) d[PD\_GDP_i > \gamma] + \varepsilon \quad (4)$$

In which the indicator function is $d[]$; $d[PD\_GDP_i \leq \gamma]$ equals to one (1) and $d[PD\_GDP_i > \gamma]$ equals to zero (0). When PD_GDP_i is equal to or less than the threshold value, this connotes that this is the regression estimate of the 'first regime' (Regime 1). On the contrary, when $d[PD\_GDP_i \leq \gamma]$ equals to zero (0) and $d[PD\_GDP_i > \gamma]$ equals to one (1) when PD_GDP_i is greater than the threshold value, this also connotes that is of the 'second regime' (Regime 2). Furthermore, PD_GDP_i is the proxy for public debt (PUBDEBT), $LINFRAD_i$ is the log of infrastructural development while $LINSTQ_i$ is the log of institutional quality using a country specific study approach.

Scholars like Khan and Senhadji (2009) employed the econometric technique to ascertain the non-linear relationship between public debt and growth. The method originated from the estimation technique by Chan and Tsay (1998) and Hansen (2000) for cross-country panel study with threshold model specifications to determine the public debt threshold effect on growth. Doguwa (2012) modified the Khan and Sendhadji (2001) threshold model to capture the effect of public debt on growth in a panel which can be replicated for a country specific study of this nature as infrastructural development (INFRAD) is an integral component of economic growth. This study employs the modified threshold model proposed by Doguwa (2012) to determine the threshold at which public debt (PUBDEBT) improves infrastructural development (INFRAD). Threshold as a sample split model in econometric framework separates individual observation into subgroups with regards to the numerical value of the variables in the estimation process by minimizing the sum of squared errors. Alternatively, the debt threshold model on infrastructural development (INFRAD) and institutional quality (INSTQ) is specified in equation (5)

$$INFRAD_t = \alpha_{PUBDEBT} e + \beta_1 d_t^{PUBDEBT} (PUBDEBT_t - PUBDEBT^*) + \beta_2 (1 - d_t^{PUBDEBT} e)(PUBDEBT_t - PUBDEBT^*) + \delta_{PUBDEBT} \mu_{t-1} + \varepsilon_t \quad (5)$$

Where $PUBDEBT, INFRAD, INSTQ$ are earlier defined and μ_{t-1} is the autoregressive element employed to remove the impacts of other control variables with δ as the respective coefficients. The variable $PUBDEBT^*$ is the value for the process of iteration in a quest for the optimal threshold tipping point. The effects of public debt (PUBDEBT) on infrastructural development (INFRAD) were captured by β_1, λ_1 and γ_1 for time spans in which public debt to infrastructural development proportion is higher than the threshold tipping point (high public debt tercile) while β_2, λ_2 and γ_2 implies that the effect of public debt on infrastructural development is lower than the threshold tipping point (low public debt tercile).

The optimal public debt threshold tipping point for the selected debt is determined by iterating equation (5) employing different values of public debt threshold tipping points. The optimal public debt threshold level is the tipping point where the Sum of Squared Residuals (SSR) of the iterated regressions is reduced.

Reinhart and Rogoff (2010) constructed a four-regime model which was adopted by Duygu Canbek (2014) as seen in equation (6) while two regimes threshold model and three regimes threshold model equations are expressed in equations (7) and (8) respectively. However, this study adopts the two regimes threshold model as specified in equation (3.21) so as to determine the threshold at which public debt improves infrastructural development in Nigeria from 1984 to 2018.

$$INFRAD_t = \alpha_{PD} + \beta_1 d_t^{PUBDEBT} (PUBDEBT_t - PUBDEBT^*) + \beta_2 (1 - d_t^{PUBDEBT})(PUBDEBT_t - PUBDEBT^*) + \delta_{PUBDEBT} \mu_{t-1} + \varepsilon_t \quad (5)$$

where $INFRAD$ is infrastructural development, $PUBDEBT$ is public debt, ε is error term, t is time period, α and $\beta$are parameters.

A Four Regimes Threshold Model Specification

$$Infrad_t = \begin{Bmatrix} \alpha_1 + \beta_1 PUBDEBT_t + \varepsilon_t \\ \alpha_2 + \beta_2 PUBDEBT_t + \varepsilon_t \\ \alpha_3 + \beta_3 PUBDEBT_t + \varepsilon_t \\ \alpha_4 + \beta_4 PUBDEBT_t + \varepsilon_t \end{Bmatrix} \quad \text{if} \quad \begin{Bmatrix} PUBDEBT < 30\% \\ PUBDEBT 30\% \leq PUBDEBT < 60\% \\ 60\% \leq PUBDEBT < 90\% \\ PUBDEBT > 90\% \end{Bmatrix} \quad (6)$$

A Two Regimes Threshold Model Specification

$$Infrad_t = \begin{Bmatrix} \alpha_1 + \beta_1 PUBDEBT_t + \varepsilon_t \\ \alpha_2 + \beta_2 PUBDEBT_t + \varepsilon_t \end{Bmatrix} \quad \text{if} \quad \begin{Bmatrix} PUBDDEBT < T \\ PUBDEBT > T \end{Bmatrix} \quad (7)$$

where T is the threshold value for two regimes model?

A Three Regimes Threshold Model Specification

$$Infrad_t = \begin{Bmatrix} \alpha_1 + \beta_1 PUBDEBT_t + \varepsilon_t \\ \alpha_2 + \beta_2 PUBDEBT_t + \varepsilon_t \\ \alpha_3 + \beta_3 PUBDEBT_t + \varepsilon_t \end{Bmatrix} \quad \text{if} \quad \begin{Bmatrix} PUBDEBT < T_1 \\ T_1 \leq PUBDEBT < T_2 \\ PUBDEBT \geq T_2 \end{Bmatrix} \quad (8)$$

where T_1 is lower threshold value while T_2 is the upper threshold values in the three regimes model.

4. Discussion of Findings

The primary aim of this paper is to examine the optimal threshold effect in the public debt- infrastructural development nexus in Nigeria. The empirical findings are presented in Tables 1 and 2. As seen in Table 1, the sequential F-statistics determined threshold tipping point at which public debt improves infrastructural development. In the same vein, the equality of coefficients in the two (2) regimes is done by the F-

test while the equality of potential threshold values is done by the likelihood ratio (LR) test (Hansen, 1996; 2000).

Table 1: The Sequential F-statistic

Threshold	F-statistic	Scaled F-scaled	Critical Value
0 vs 1*	117.396	117.396	8.58
1 vs 2	0.984	0.984	10.13
*Significant at the 0.05 level			
**Bai-Perron (Eonometric Journal, 2003) Critical value			
Threshold values:			
	Sequential	Repatriation	
1	62.5	62.5	

Notes Bai-Perron test of L+1 vs L sequentially determined thresholds. Threshold test options: Trimming 0.15, max; Threshold 5, sig. level 0.05

Source: Author's Computation, 2023.

Afterwards, the study proceeded to test for threshold effect with the infrastructural development (LINFRAD) serving as the threshold variable as shown in Table 2. The rationale behind this was to test the null hypothesis (H_0) of the linear model against the alternative hypothesis (H_1) of the two-regime model. Table 2 presents the results of the threshold regression model. The public debt-to-GDP ratio, which is a measure of the country's indebtedness, is the regime dependent and threshold variable. The results show that the model can be split into two regimes. Specifically, the result indicates a threshold level of 62.5 percent. This is within the band of 70 percent debt-to-GDP ratio set by the International Monetary Fund (IMF) and World Bank for ECOWAS member states of which Nigeria is a signatory.

The results presented in Table 2 indicate that public debt has a positive and statistically significant impact on infrastructure when the public debt-to-GDP ratio is within the band of 62.5 percent, as evidenced by a 1 percent level of significance. However, beyond this threshold point, further accumulation of public debt may not lead to a commensurate increase in the level of infrastructure development in Nigeria. This observation is intuitive, given that additional public borrowing would increase the debt service costs, thereby reducing the fiscal space available for investment in critical public infrastructure. As such, policymakers should exercise caution when considering further accumulation of public debt, taking into account the potential trade-offs between the short-term benefits of increased borrowing and the long-term implications for fiscal sustainability and infrastructure investment.

The findings of this study suggest that a threshold value of 62.5% for public debt-to-GDP (PD_GDP) ratio is necessary to ensure adequate infrastructural development in Nigeria. The analysis reveals that when public debt is small (below the threshold value of 62.5%), it has a positive and statistically significant effect on infrastructural development (INFRAD) at a one percent significance level, as observed in Regime 1 of Table 2. However, beyond this threshold level, the reverse is the case, as depicted in Regime 2 of Table 2, where public debt has a negative and insignificant impact on infrastructural development.

This threshold effect implies that beyond the critical level of public debt, further accumulation may lead to diminishing returns in terms of infrastructural development. This outcome is consistent with the observation that as public debt continues to rise, debt service costs increase, reducing the fiscal space available for investment in critical public infrastructure sectors of the economy. Therefore, policymakers should be mindful of the potential trade-offs between the short-term benefits of increased borrowing and the long-term implications for fiscal sustainability and infrastructure investment, particularly beyond the identified threshold level of 62.5% PD_GDP ratio.

Table 2: Threshold Regression. Threshold Variable: PD_GDP

VARIABLE	REGIME 1	REGIME 2
	PD_GDP<62.5%	62.5%<=PD_GDP
LINFRAD	1.880	11.890
	(2.415)	(2.620)
	[0.443]	[0.000]
R-squared	0.926	
Adjusted R-squared	0.913	
Durbin-Watson	1.960	
statistic	0.000	
Prob (F-statistic)		

Notes: ( ) denotes standard errors, [ ] denotes probabilities values and ***, ** and * denote 1%, 5% and 10% level of significance, respectively.

Source: Author's Computation, 2023.

5. Conclusion

According to the findings of the threshold regression analysis, a critical threshold level of 62.5% public debt-to-GDP ratio is imperative for the attainment of adequate infrastructural development (INFRAD) in Nigeria. This threshold level falls within the recommended limit of 70% public debt-to-GDP ratio, as set by the International Monetary Fund (IMF) and the World Bank for countries in the Economic Community of West African States (ECOWAS) sub-region peer group. The results suggest that adherence to this public debt-to-GDP ratio limit can enhance the chances of attaining sustainable and inclusive economic growth through adequate investments in infrastructural development.

In Regime 1, public debt (PD_GDP) exerts positive and significant effect on infrastructural development (INFRAD) in Nigeria at 1% because public debt (PD_GDP) was within the band threshold tipping point (62.5%). This then connotes that the public debt (PD_GDP) incurred by the Nigerian government was actually targeted towards infrastructural development (INFRAD) in Nigeria as the 24 observations (1984-2007) of which 17 out it was within the whole military regime (1984-1999) while the remaining 7 fell within the civilian regime (1999-2007). This scenario might be due to strong institutional quality that characterize the military regime (1984-1999) and the first two terms of the democratic regimes in the country (2000-2007) respectively as several anti-corruption agencies, policies, initiatives, reforms and programmes were put in place.

Similarly, in Regime 2, public debt (PD-GDP) had a negative effect on infrastructural development (INFRAD) in Nigeria because public debt (PD_GDP) crossed above the threshold tipping point (62.5%). This then connotes that the continuous accumulation of public debt by the Nigerian government may not cause a rise in the level of infrastructural development in the country. Again, it denotes that continuous public debt accumulation by the Nigerian government would translate to continuous rise in the costs of debt servicing. Thus, a continuous rise in the costs of debt servicing for a nation might further reduce the fiscal environment for infrastructural investment in crucial public infrastructure sectors of the nation.

More so, Regime 2 might also suggests that the public debt incurred by the Nigerian government might not be actually met for infrastructural development (INFRAD) in the country as the 11 observations were within the third, fourth and fifth terms (2008-2018) of successive civilian regime since the emergence of democratic dispensation in the country as the country still witnessed infrastructural deficits amidst several anti-corruption

agencies, policies, initiatives, reforms and programmes established to strengthen institutional quality in the country.

Given the public debt (PD_GDP) threshold level of 62.5% which implies that beyond the estimated threshold (62.5%), public debt would reduce the fiscal space for public infrastructural development (INFRAD) in Nigeria as government would continue to service public debt which would have been used for the development of infrastructures in the country, the study recommends that the government and policy makers should limit public debt accumulation to the specified threshold (62.5%) by practising effective debt management, attracting more foreign direct investment (FDIs), and increasing revenue mobilization in order to reduce the level of debt servicing, thereby boosting infrastructural development in Nigeria.

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