

Public debt and infrastructural Development in Nigeria

Abstract

The objective is to examine the differential effects of composition of public debt on infrastructural development in Nigeria from 1986 to 2021 using Autoregressive Distributed Lag Model (ARDL) and Error Correction Model as the major econometrics' techniques of analysis. The Keynesian Growth theory was employed and the sample period covered 36 years with data obtained from World Bank Indicators (WDI) database and Nigerian Central Bank Statistics Bulletin undated to 2024. From the findings, the CointEq(-1) has 94% speed of adjustment to the long run or equilibrium value. The short-run findings show that external debt, debt servicing and exchange rate are statistically significant with negative influence Access to Electricity as a proxy to infrastructural development, while only domestic debt exhibits positive impact in the short run. In the long run, both domestic and external debt have positive long-run impact on AE. But, Debt servicing, inflation rate and interest rate have negative impact on AE in the long run. The study concluded that external debt has not been impactful to infrastructural development in Nigeria. It recommended that Nigeria government should cut down excessive external borrowings in order to keep down the negative impact of debt servicing and also recommend an adoption of economic policy that will ensure macroeconomic stability such as price stability, job creation, increased output, political stability.

Key words: External Debt, Domestic debt, Infrastructure, Development, Debt servicing.

1.0 Introduction

Public debt and infrastructural development in Nigeria have become critical topics due to the country's rising debt levels and the need to address infrastructure gaps. The increasing public debt in Nigeria has raised concerns about its impact on economic growth, investment, and the ability to finance critical infrastructure like electricity, education, and healthcare. Nigeria's public debt reached \$108.3 billion in 2023, marking a significant increase of 123% since 2012, far outpacing the country's GDP growth rate.

The rise in debt is attributed to various factors, including the COVID-19 pandemic and global economic pressures, leading to challenges in servicing the debt and hindering development efforts. The composition of Nigeria's debt has shifted towards more external borrowing, with external debt accounting for a larger share of the total debt from 14% in 2012 to 40% in 2022.

Infrastructural development refers to a general condition of advancement of the basic organizational and physical structures and facilities, such as buildings, roads, and electrical power that are required for the operation of a society or industry. Given the extent of government's constant demand for loans and inability to generate sufficient revenue to cover her recurrent budgetary expenses over the past five years have raised serious concerns and queries about the long-term implications of debt accumulation. For instance, in Q4 2022, Debt Management Office (DMO) (2022) reported that Nigeria now owes N46.25 trillion or USD 103.11 billion in national debt, which represents 14.46% rise over the N39.56 trillion or USD95.77 billion values recorded as at December 31, 2021.

This raise serious concern to investors because investors are also worried about high debt-to-GDP ratios since they may hinder a country's stride for economic development (Saungweme and Odhiambo, 2019). Ekperiware and Oladeji (2012) also asserted that decision-makers and

multilateral lenders can gain trustworthy insight and understanding about a nation's capacity to pay back its obligations by analyzing the ratio of public debt to GDP of the nation. However, even while public debt could stimulate the economy, it can also result in debt distress when it becomes unmanageable (IMF 2020). Debt defaults can also result in market access losses, increased borrowing costs, and the loss of a valuable asset to the lender (UNCTAD, 2017). For example, in December 2017 China take-over the management of Hambantota Port from Sri Lanka's for 99 years due to \$8 billion debt (Benabdallah, 2018). Similarly, the higher debt payment may be over-bearing, adversely affecting efforts to achieve targeted economic development policy objectives (Johnny & Johnnywalker, 2018).

Of course, Nigeria's successive governments have claimed and maintained that the country has made great strides in the provision of critical infrastructure and basic needs, but the reality is that, Nigerians are worse-off on international development metrics like Global Infrastructure Outlook. According to the Global Infrastructure Hub's (2017) forecast, between 2016 and 2040, the global economy would invest roughly \$3.7 trillion annually to boost infrastructure, which is 20% greater than the trend in GDP. The finance gap will also quadruple when the additional investment needed to achieve SDGs, targets is taken into account (Alaeddine, 2022). Despite the Federal Government's assertion that it has borrowed money to build infrastructure, the World Bank (2021) rated Nigeria's infrastructure quality low. World Bank (2021) argued that Nigeria's gap in infrastructural development in 30 years to come will probably approach \$3 trillion. It states, "Nigeria is ranked 132 in the 2018 by Global Competitive Index out of 137 nations for infrastructure index, demonstrating the poor level and quality of the nation's infrastructure". It concluded that Nigeria infrastructural development is among the worst in the world, which suggested a need for significant public spending.

According to a World Bank survey (2017), one of the most important infrastructures in Nigeria is energy access, which also seems to be one of the main problems facing Nigerian businesses. According to a survey of 1,891 businesses, there were typically 27 power outages per month, which is more above the global and regional averages. Also, Energy Progress Report (2022) stated that Nigerians electricity access low in the world, with 92 million of its 200 million residents living without electricity access. According to Ogundipe et al., (2015), the lack of power has been a serious issue in Nigeria. Adesoji, (2009) also buttress this assertion, "The main infrastructure difficulty that Nigeria is currently facing is the investment in power supply", even though all vital infrastructures are necessary to guide economic development.

Also, Odili, 2022, asserts debt service to income ratio is over 60% in Nigeria, meaning that for every N100 earned, it spends N60 on debt servicing, which is far above World Bank recommendation of 22.5%.

Finally, Several empirical studies (Mbah, Umunna & Agu, 2016; Onwuka, C. E. (2021). Udofia & Akpanah, 2016; Ugwuegbe, Okafor & Azino, 2016; Ndubuisi, 2017; Elwasila, 2018; Matuka & Asafo, 2018; Matandare & Tito, 2018; Said & Yusuf, 2018; have examined the relationship between public debt and infrastructural development using input variables, such as government capital expenditure, capital expenditure, etc., which according to economic standards can only result in economic growth. Unlike previous studies, since the focus of this study is on development, emphasis on infrastructural development will be shifted to output indicator, represented by Access to Electricity (AE) as percentage of population.

2.0 Literature review

This covers theoretical and empirical literature on public debt and infrastructure

2.1.1 Theoretical literature: Three theories are considered suitable for this study:

2.1.1 Keynesian theory of public debt

John Maynard Keynes developed the public debt theory in 1935 and argued that debt does not obstruct an economy's growth and development but rather raises the value of that growth and development. He continued by saying that this value may be reached if the debt taken on was used to finance profitable and beneficial capital projects. According to the argument, borrowing must be necessary for economic development and growth in developing nations. Therefore, capital projects must be the focus of the money. The country will undoubtedly fall into debt traps if this money is not used into capital development. According to Keynes' public debt theory, debt accumulation through capital accumulation is an important aspect to take into account when evaluating the overall rate of economic growth. In support of this claim, Habib and Zurawicki (2002) contend that domestic income, foreign aid, and direct foreign investment can all be used to increase capital formation that will lead to economic growth. This does not signify that significant borrowing leads directly to economic growth. However, how loans are used is important, as is the political resolve to wisely use the money that has been secured.

2.1.2 Dual gap model

The concept, which is an expansion of the Harrod-Domar growth model, was put forth by Chenery in 1966. While the Model is relevant in an open economy, the Harrod-Domar model deals with closed economies. The two gap model postulates existence of two gaps:

- 1) The expansion of less developed nations is hampered by an imbalance between national savings and investment, where domestic savings are not enough to support the rate of development.
- 2) The foreign exchange gap, which happens when capital transfers plus import value are not enough to support the rate of growth in imports. This model is commonly employed to investigate the necessity of borrowing foreign capital or receiving foreign aid in order

to bridge the two disparities that exist in developing and less developed countries. According to Rostow's thesis, "Stages of Economic development," it will be simpler for economics to advance to the take-off stage if the gap is closed.

2.1.3 The debt overhang hypothesis

The notion of the debt overhang contends that excessive borrowing causes high debt that may lead to debt traps and consequently hamper economic development. The debt overhang hypothesis states that anticipated debt servicing costs may deter further domestic and international investment if there is a chance that the government debt may grow in the future beyond the country's ability to pay back. Prospective investors may be deterred by the notion that as production rises, governments would tax them more harshly in order to pay off the public debt, resulting in an avoidance of current investment costs in order to raise output in the future (Gordon & Cosimo, 2018).

2.2 Empirical Review

This subsection covers a few empirical researches from Nigeria and other countries that look at the connection between Public debt and infrastructural development.

2.2.1 Public Debt and Infrastructural Development

Amaefule and Ernest (2016) assessed how borrowing by the government affects infrastructure development as measured by capital expenditures made by the Nigerian federal government between 1986 and 2015. The OLS Regression technique was utilized to ascertain the relationships between the variables. The findings indicated a transient relationship between the variables. The analysis also revealed that there was no relationship between capital spending and foreign debt, but a positive correlation between capital spending and domestic debt for the federal government.

Aladejana et al., (2021) examined Nigeria's debt load and its effects on the country's infrastructure development from 1986 to 2019. The study used Fully Modified Ordinary Least Squares (FMOLS) estimation techniques on yearly time-series data. The findings demonstrated that, while the relationship between external debt and infrastructure development is negative and not statistically significant during the study period, the relationship between domestic debt and infrastructure development exhibited a positive and statistically significant relationship.

Using annual data from 1978 to 2015, Thilanka and Ranjith (2018) investigated how Sri Lanka's public debt affects private investment. The study used a few econometric techniques, including the unit root test, the Johansen co-integration test, and lastly the Vector Error Correction Model (VECM), to determine the long-term effect. Our study's empirical results demonstrated that public debt has a long-term crowding-in effect on private investment, indicating that the government has redirected borrowing money to support the private sector. Additionally, real GDP influences private investment favorably, indicating that the economy will inevitably continue to grow.

Ogunjimi (2019), using an ARDL approach, looked at the effects of the public debt stock's composition on various kinds of investment in Nigeria from 1981 to 2016. The findings showed that internal borrowing encourages investment by the public and private sectors. While external debt deterred private investment over the long term, domestic debt discouraged investment by the public as well. Kehinde et al. (2015) used the Vector Error Correction Model (VECM), the Johansen Cointegration test, and the Auto-Regressive Distributed Lag (ARDL) to investigate the impact of Nigeria's public debt on private investment. Their long-run and short-run findings indicated that internal loans discouraged domestic investment, which is in stark contrast to

Ogunjimi's (2019) findings. The outcome, however, shows that over time, external debt drove out domestic investment.

However, some others contended that debt-driven infrastructure improvements have no beneficial effect on the overall economic performance of a country (Soludo, 2004; Mojekwu and Ogege, 2012; Essien, Ngozi, Michael, and Ogochukwu, 2016; Isibor, Babajide, Akinjare, Oladeji, and Osuma, 2018). The lack of general agreement on the issue has made it necessary to look into the relationship between public debt and infrastructure development.

3.0 Research methodology

To achieve the differential impact of domestic and external debt on infrastructural development, the study makes use of Autoregressive Distribution Lag (ARDL) and Vector Error Correction Model (ECM) to capture the degree of impact in the short run and long run period of study.

3.1 Sources of data

The UNDP Official Website Database up to 2022, the World Development Indicators (WDI, 2022) Database, and the Central Bank Statistic Bulletins (2022) each provide valuable information on diverse variables. UNDP's database predominantly focuses on human development indicators, encompassing variables like the Human Development Index (HDI), life expectancy, literacy rates, and per capita income. These variables are often expressed as indices or percentages and serve as metrics for evaluating progress toward global development goals.

The World Development Indicators (WDI) Database maintained by the World Bank encompasses a wide spectrum of economic, social, and environmental variables. It includes data on exchange rates, inflation rates, poverty ratios, education access, and more. These variables are measured using standardized methodologies, enabling cross-country comparisons and trend analyses.

Central Bank Statistic Bulletins, published by Nigeria's central banks, primarily provide financial and monetary variables. These variables encompass domestic debts, external debts, interest rates, money supply, exchange rates, inflation rates, balance of payments, and banking sector statistics. Data in these bulletins is sourced from the central banks themselves and is essential for monitoring a country's economic stability and monetary policy effectiveness.

3.2 Model specification

The differential impact of Domestic debt, external debt and other control variables on Infrastructural Development Index (IFD)

$$IFD_t = b_{10} + \sum_{i=1}^p a_{1i} IFD_{t-1} + \sum_{i=1}^p a_{2i} D.DEBT_{t-1} + \sum_{i=1}^p a_{3i} E.DEBT_{t-1} + \sum_{i=1}^p a_{4i} \ln AGG.EX_{t-1} + \sum_{i=1}^p a_{5i} DEBT-SER_{t-1} + \sum_{i=1}^p a_{6i} EXC.RATE_{t-1} + \sum_{i=1}^p a_{7i} INF.RATE_{t-1} + U_{it}$$

Where,

b_{10} = intercept in the models

p = lag of both dependent and independent variables

a_{j1} = coefficient of the independent variables (where $j = 1, 2, 3, 4, 5, 6, 7$)

U_{it} = vector of error terms

Definition of Terms

IFD = Infrastructural development refers to the creation and improvement of foundational products and services aimed at enhancing the quality of life and fostering long-term economic growth. Represented by access to electricity.

D.DEBT = Domestic Debt (DD): Internal debt or domestic debt is the component of the total government debt in a country that is owed to lenders within the country.

E. DEBT = External Debt (EXD): External debt is the portion of a country's debt that is borrowed from foreign lenders, including commercial banks, governments, or international financial institutions. (Kenton, 2021).

AGG.EX = Aggregation of total government spending from current and capital expenditure.

DEBT.SER = Debt Servicing refers to the money required to cover the payment of interest and principal on a loan or other debt for a particular time period. The term can apply both to individual debts and government debt such as business loans and debt-based securities such as bonds.

EXC.RAT = An *exchange rate* is a relative price of one currency expressed in terms of another currency

INF.RAT = *Inflation (INF)*: When the general price level rises, each unit of currency buys fewer goods and services; consequently, inflation corresponds to a reduction in the purchasing power of money (Walgenbach, Dittrich, & Hanson, 1973)

4.0 EMPIRICAL RESULTS

It is important to run descriptive summary of all variables and other diagnostic before starting the estimating technique. Table 1 below shows the descriptive statistics and properties of the variables.

Table 1 Descriptive Statistic of Variables

	AE	D_DEBT	E_DEBT	AGG_EXP	INF_CP	DEBT_SEREXC_RATE	
Mean	44.84533	3871.372	2166.179	2668.858	19.44256	2.542914	122.9967
Median	46.49368	1350.005	806.8600	1344.044	12.70720	1.933496	123.1931
Maximum	59.30000	15121.61	7945.430	11667.62	72.83550	6.521339	401.1520
Minimum	25.30000	28.44000	41.45000	16.22370	5.388008	0.100218	1.754523
Std. Dev.	9.897696	4801.974	2335.226	3071.509	17.57477	2.065407	109.2979
Skewness	-0.568622	1.123782	1.150676	1.330236	1.737863	0.523826	0.861062
Kurtosis	2.259490	2.782641	3.064042	4.067682	4.700181	1.919113	3.019887
Jarque-Bera	2.762520	7.648189	7.950486	12.32709	22.45693	3.398834	4.449157
Probability	0.251262	0.021838	0.018775	0.002105	0.000013	0.182790	0.108113
Sum	1614.432	139369.4	77982.43	96078.87	699.9322	91.54489	4427.882
Sum Sq. Dev.	3428.753	8.07E+08	1.91E+08	3.30E+08	10810.54	149.3067	418111.2
Observations	36	36	36	36	36	36	36

Author's computation

Table 1 above shows the descriptive statistics as provided in the raw data of the variables used in this study. It is evidence that both mean and median values of each variable fall within their corresponding maximum and minimum values, which is an indication of high level of consistency. The Access to Electricity (AE) and Debt Services appeared to maintain low standard deviation values, implying low level of changes over the years under consideration, while domestic debt, external debt, Aggregate expenditure and exchange rate maintain relatively high volatility.

Table.2 Correlation Matrix

Variables	AE	D_DEBT	E_DEBT	AG_EXP	INF_CP	DT_SER	EX_Rt	RINT
AE	1.000000							
D_DEBT	0.753474	1.000000						
E_DEBT	0.595236	0.746996	1.000000					
AGG_EXP	0.758753	0.961584	0.755527	1.000000				
INF_CP	-0.425317	-0.293922	-0.238688	-0.325593	1.000000			
DEBT_SER	-0.757204	-0.570107	-0.339388	-0.584766	0.578398	1.000000		
EXC_RATE	0.833820	0.941198	0.848073	0.953768	-0.378140	-0.622451	1.000000	

Note: AE :Access to Electricity, D-DEBT: Domestic debt, E_DEBT: External debt, AGG_EXP : Government Aggregate expenditure, DEBT_SER : Debt Services, EXC_RATE : Exchange rate, INFCP: Inflation as percentage of Consumer Price and RINT : Real interest rate.

Source: Author's Computation, 2024.

From the table 2, while D. DEBT, E_DEBT, AGG_EXP, and EXC_RATE have positive relationship with AE, DEBT_SER and INF-CP have a negative relationship. It can also be

observed from the table that correlation coefficients above the threshold of 0.8, indicating the tendency for presence of multicollinearity in the model surfaced only in the control variables, especially in Government Aggregate expenditure and exchange rate. Hence, the little concern about multicollinearity.

4.1. Unit Root Test

It is important to carry out unit-root test to determine the stationarity of each of the variable series so as to justify the model's estimation techniques employed in this study and also to avoid spurious regression. This study employs Augmented Dickey-Fuller (ADF) and Phillips-Peron (PP) test and the test was conducted using the available roots (with constant, with constant and trends and without constant and trend). The results of the unit root test are shown mixture of I (1) and I (0) in the table.3 below.

Table 3: The Results Summary of Augmented Dickey-Fuller and Phillips-Perron Tests

Phillips-Perron (PP)				Augmented Dickey-Fuller (ADF)		
Variable	Level	First Difference	Order of Integration	Level	First difference	Order of Integration
AE	0.12	0.00***	I (1)	0.00***		I (0)
LD_DT	0.07	0.00***	I (1)	0.52	0.04**	I (1)
LE_DT	0.21	0.00***	I (1)	0.45	0.01***	I (1)
LAGEX	0.01***		I (0)	0.04**		I (0)
LEX_RT	0.03**		I (0)	0.06	0.00***	I (1)
DT_SER	0.37	0.00***	I (1)	0.33	0.00***	I (1)
INF_CP	0.54	0.00***	I (1)	0.00***		I (0)

Note: (***) and (**) indicate 1 percent and 5 percent levels of significance.

Source: Author's Computation, 2023.

4.2 Cointegration Test

The Result of Bound Test and Pesaran et al (2001) Critical Value in the model

ARDL Bounds Test
Sample: 1988 2021
Included observations: 34
Null Hypothesis: No long-run relationships exist

Test Statistic	Value	K
F-statistic	6.754739	7

Critical Value Bounds

Significance	I0 Bound	I1 Bound
10%	2.03	3.13
5%	2.32	3.5
2.5%	2.6	3.84
1%	2.96	4.26

Source: Author's Computation, 2024.

Table.1 shows the bound test for the model. The comparison of F-statistics value (6.75) from the bound test to the critical values of lower bound (2.32) and upper bound (3.5), exceed their corresponding lower and upper bounds at 5 percent level of significance which imply that the null hypotheses of no long-run relationship among the variables for each of the models be rejected. Therefore, there is long run relationship between the dependent variable and the independent variables.

4.3.1 Hypothesis 1

H0: No significant relationship between Public debt and Nigeria infrastructural development in the short run

H1: Significant relationship existbetween Public debt and Nigeria infrastructural development in the short run

4.3.2 Hypothesis 2

H0: No significant relationship between Public debt and Nigeria infrastructural development in the long run

H1: Significant relationship exist between Public debt and Nigeria infrastructural development in the long run

4.4. Estimating ARDL ECM Result of Hypothesis 1

The short-run analysis results of the differential impacts of domestic and external debt on infrastructural development proxy by Access to Electricity, show that domestic debt, debt servicing and exchange rate are statistically significant. Domestic debt had a positive impact, while external debt, debt servicing, aggregate expenditure, inflation, exchange rate and real interest rate had negative impact in the short run. The result is in agreement with Abula and Ben (2016) position that foreign loans and their servicing had an adverse effect on Economic development in short run.

Table.4ARDL ECM Result of Model

Dependent Variable: LAE

Selected Model: ARDL(1, 2, 1, 0, 2, 2, 1, 1)

Sample: 1986 2021

Included observations: 34

Cointegrating Form				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LD_DEBT)	0.164011	0.058264	2.814949	0.0125
D(LD_DEBT(-1))	0.147372	0.073408	2.007578	0.0619
D(LE_DEBT)	-0.024015	0.037667	-0.637562	0.5328
D(LAGG_EXP)	-0.019608	0.058207	-0.336871	0.7406
D(LDEBT_SER)	-0.063494	0.023417	-2.711422	0.0154

D(LDEBT_SER(-1))	-0.039577	0.014837	-2.667486	0.0169
D(LEXC_RATE)	0.079927	0.058797	1.359378	0.1929
D(LEXC_RATE(-1))	-0.082129	0.034989	-2.347268	0.0321
D(INF_CP)	-0.001402	0.001043	-1.345269	0.1973
D(RINT)	-0.001508	0.001860	-0.810781	0.4294
CointEq(-2)	-0.941637	0.158483	-5.941574	0.0000

$$\text{Cointeq} = \text{LAE} - (0.1102 \cdot \text{LD_DEBT} + 0.0856 \cdot \text{LE_DEBT} - 0.0208$$

$$\cdot \text{LAGG_EXP} - 0.0524 \cdot \text{LDEBT_SER} - 0.0476 \cdot \text{LEXC_RATE} - 0.0039$$

$$\cdot \text{INF_CP} - 0.0059 \cdot \text{RINT} + 2.8306)$$

Source: Author's Computation, 2023.

Also, the coefficient shows 94% speed of adjustment to long run if there arise a distortion in the short run. The model R-squared is 0.83 denoting that 83% variation in infrastructural development (FD) is explained by the explanatory variables (domestic and external debt) and the other control variables (debt service, aggregate expenditure, exchange rate, inflation rate and real interest rate) in the short run.

4.5 Long Run ARDL Result of Hypothesis 2

From table 6, domestic debt, external debt, debt service, inflation rate and interest rate were significant and had a long run impact on Access to Electricity. Both domestic and external debt have positive long-run impact on AE. A 1% increase in domestic and external debt the long run, will lead to 0.11 and 0.08 increase in AE respectively. Debt servicing, inflation rate and interest rate have negative impact on AE. 1% increase in debt service, will lead to 0.05 reduction in AE, while a 1% increase in inflation rate and interest rate will lead 10% falls in AE. Though aggregate expenditure and exchange rate are insignificant, yet they have negative impact on AE in the long run.

Table 5 Long Run ARDL Coefficients of Model 2

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LD_DEBT	0.110205	0.043419	2.538147	0.0219
LE_DEBT	0.085586	0.032784	2.610600	0.0189
LAGG_EXP	-0.020823	0.062594	-0.332676	0.7437
LDEBT_SER	-0.052410	0.024715	-2.120582	0.0499
LEXC_RATE	-0.047554	0.057266	-0.830412	0.4185
INF_CP	-0.003892	0.001548	-2.514963	0.0230
RINT	-0.005878	0.002567	-2.290066	0.0359
C	2.830613	0.147675	19.167890	0.0000

Source: Author's Computation, 2023.

4.6 Conclusion

The study concluded that both domestic and external debt have positive long run impact on Access to Electricity (AE), but in the short run only domestic debt exerts positive influence on AE. Debt service, inflation rate and interest rate also erode the potentials of Nigerians to AE in the long run.

4.8 Policy Recommendations

The following recommendations are provided to achieve substantial improvement and significant increase in AE level in Nigeria;

1. since domestic and external debts have not impacted infrastructural development significantly despite their surge in the recent years, there is need for Nigerian government to review how the borrowed funds were spent and redirect the use of public fund to more profitable venture while preventing linkages.
2. this study also recommends a massive investment in Nigeria power sector to boost generation and distribution.

3. the government must also put in place adequate measure to reduce cost of debt servicing in order to have more income that will be channeled to improve health condition, education and poverty and put the economy on the part of development.
4. inflation and interest were also established as impediment to infrastructural development. Government must embark on aggressive policies aimed at boosting foods supply and reduction in cost of borrowing.
5. Lastly, debt servicing was completely seen as impediment to infrastructural development, proactive policy should be put in place to reduce the percentage of Nigeria revenue that are used to service debt.

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