

Impact of Public Debt on Infrastructural Development in Nigeria (1986–2022)

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Abstract

Nigeria's persistent infrastructure deficit has remained a major constraint to sustainable development despite rising levels of public borrowing. This study investigates the impact of public debt on infrastructural development in Nigeria from 1986 to 2022. Annual time-series data were analysed using the Autoregressive Distributed Lag (ARDL) bounds-testing approach to examine both the short- and long-run relationships among the variables. The findings reveal that domestic debt and human-capital development exert a positive and significant impact on infrastructural development in the long run, whereas external debt negatively affects infrastructure growth. The estimated error-correction term indicates a rapid speed of adjustment of about 94 percent, confirming long-run equilibrium. The study concludes that judicious use of domestic borrowing and efficient debt management can strengthen infrastructural development. It recommends prioritising debt-financed capital projects with measurable returns, improving transparency in loan utilisation, and fostering sound debt governance to ensure sustainable infrastructure expansion.

Keywords: Public Debt, Infrastructure Development, Domestic Debt, External Debt, ARDL, Nigeria.

1. Introduction

Infrastructure constitutes the backbone of economic transformation, facilitating productivity, competitiveness, and inclusive growth (Srinivasu, & Rao (2013), Lakshmanan, (1989) and Zanfack, (2024)). In Nigeria, inefficient transport systems, poor electricity supply, and inadequate social facilities have continued to undermine industrial performance and

standards of living (Oyedepo, (2012) and Edema, (2019)). To fill this gap, successive administrations have relied heavily on public borrowing both domestic and foreign to finance infrastructure projects. However, concerns are being raised that increasing debt burdens have not translated into commensurate infrastructural accomplishments (Furlong, (2021)).

Public debt can promote development if the funds are channelled to productive capital projects with returns sufficient to service the debt (Hauner, (2009) and Eichengreen, El-Ganainy, Esteves, & Mitchener (2021)). Yet, excessive borrowing for current expenditure or poorly managed projects can lead to a heavy debt burden, which displaces private sector investment and reduces fiscal space (Celestin, (2016)). Nigeria's rising debt stock estimated at ₦49.85 trillion in 2023 creates immediate concerns about debt sustainability and efficiency (Mustapha, & Prizzon, (2015)).

2. Literature Review

Several literatures were reviewed, among which are those that defined the concept of public debt, infrastructure development and those on Public Debt, effect of public debt, instruments of public debt such as Nigeria Treasury Bills, Nigeria Treasury Certificates, Federal Government Bonds etc. Other literature reviewed are on Infrastructure development.

According to the Central Bank of Nigeria (CBN) Public Debt (domestic and external) is a stock of liabilities with different tenure accumulated by government operations in the past and scheduled to be fully repaid by government in the future. It covers only recognized direct financial obligations of government on which government pays interest on redemption. Nigerian Deposit Insurance Corporation (NDIC) 1995, defined debt as an alternative means of raising funds to recapitalize anticipated liquidity short fall in achieving target goals. Public debt is the amount owed by a government to its creditors, including both domestic and foreign investors, as well as international financial institutions such as the International Monetary Fund (IMF). (Carmen Reinhart and Kenneth Rogoff 2010).

Blanchard (2019) argued that the sustainability of public debt depends on the interest rate, the growth rate of the economy, and the primary budget balance (the difference between government revenues and non-interest expenditures). He suggested that a sustainable level of public debt depends on the specific circumstances of each country and cannot be determined by a universal rule. According to Robert Barro (1979), Public debt refers to the accumulated government budget deficits of the past, less any surpluses that have been run in subsequent

periods. According to Oyejide, Soyede and Kayode (1985), Debt is defined as the resource or money in use in an organization which is not contributed by its owner and does not in any way belong to them. It is a liability represented by a financial instrument or other formal equivalent.

Political business cycle theory is used to analyze the political consequences of public borrowing (Barro, 1979). According to hypothesis, government spending rises during election season. With the vote, the government raises public investments but prefers to fund these expenditures with internal borrowing rather than taxes or emissions. Governments who do not wish to appear repulsive to voters in the near- and medium-term pass debt principal and interest payments to the next governments in the long run. This condition exacerbates the debt burden, which in developing nations is frequently exacerbated using debt as a means of debt repayment, Alesina and Ardagna (2005).

The effect of governmental debt on the general level of prices: It is true that borrowing will increase the general level of prices. Only when seen as a bond sale does it have a deflationary effect. As a result, the private sector purchases public bonds with its own funds. Demand, both individual and aggregate, is dwindling. By lowering the overall level of prices, this condition creates deflation. However, the state purchases goods and services using funds raised from the sale of bonds or bills, resulting in an increase in overall demand due to public demand. As a result of the operation of numerous factors, this condition creates inflation by raising the general level of prices, Blanchard, Olivier, and Gali (2019)

The social impact of public borrowing can also be seen in the effect of public debt on income distribution. Alesina, Alberto, and Laurence (2016).

The effect government debt on savings and investments: According to International Monetary Fund (IMF, 2019), National income will rise, and personal income and savings tendencies will rise, as long as the government canalizes savings gathered through internal borrowing into investments. If the government transfers a budget deficit or consumes resources recouped through internal borrowing, it will diminish private sector investment through influencing the total savings volume of the private sector. This is referred to as crowding out. The slowing of national income growth as a result of lower investments reveals the true cost of financing with borrowing rather than taxation on future generations.

Treasury Bills are short-term securities issued at a discount for a tenor ranging from 91 to 364 days, such that the income received is the difference between the purchase price and the

amount received at maturity or prior to the sale. Treasury Bills are short term debt instrument issued by the federal Government through the central Bank to provide short terms funding for the government. They are by nature the most liquid money market securities and are backed by the guarantee of the federal government. They are usually issued for tenors of 9 days, 182 days and 364 days at the primary market auction held forthrightly by the central Bank of Nigeria. The interest rate (spot rate) at the auction is not fixed but fluctuates based on demand and amount offered by the apex Bank.

Treasury bills were first introduced in UK in the days of Walter Bagehot 1877, and as at then they were termed as commercial bills. In Nigeria, Treasury bills came into in effect on the enactment of the Treasury bill act of 1959, No.11 which came into effect on the 19th of March, 1959 and the first public issues of treasury bills in Nigeria was made on April 7, 1960. With the positive outcome achieved with issues of this monetary instrument. Anyafo (1993).

These are similar in all respects to NTBs except that they have maturities of either one or two years. They are no longer being issued. Treasury certificates were introduced in Nigeria in 1968 and are similar to treasury bills in all respects except that the tenure is different. Both instruments are eligible for rediscount t at the secondary market. Treasury certificate is one of Nigeria Domestic debt instruments that have played a major role in the development of money market in Nigeria. The instrument was of a very great assistant to the government in meeting its financial needs, especially during the civil war years and the reconstruction period of the 1970s. Due to excess liquidity in the system occasioned by the Oil Boom, further issues were suspended in 1975. Later in 1976, the treasury certificates were again introduced mainly because of pressure on government finances.

According to Debt Management Office (DMO) (2022), Nigeria's Debt Service Cost is by 23.4% to N3.04 trillion with its current N44.06trillion total debt stock as of September 2022, Nigeria has spent N3.04trillion to service external and domestic debts in nine months of 2022, representing an increase of 23.4 per cent Year-on-Year (YoY) from N2.46 trillion reported in nine months of 2021, the Debt Management Office (DMO) data has revealed.

A breakdown of the N3.04 trillion debt service payments revealed a total N2.15trillion was used by the federal government to service domestic debts in nine months of 2022. The DMO numbers revealed that federal government debt service payments for domestic debts such as Treasury bill, FBN Bond, Green Bond and Sukuk bond borrowings increased by 23.5 per cent

YoY in nine months of 2022 over the need to bridge 2022 budget finance deficit. On the external side, the FG debt service payments with multilateral, bilateral, Eurobond and Diaspora Bond also increased by 23.14 per cent in the period under review.

Analysis of the DMO data revealed that the federal government domestic debt service payments in first quarter of 2022 stood at N668.69 billion but dropped to N664.7billion in Q2 2022. The figure increased to N820.59billion in Q3 2022 as government intensifies selecting N685.61 billion FGN Bond's borrowing. On the flipside, the government service its external debt with N288.5billion or \$694.01million in Q1 2022 and N247.98billion or \$597.95million in Q2 2022, according to DMO report. In Q3 2022, the government debt service payment closed at N346.43billion or \$801.23million.

The government has intensified its external borrowing debt service payment with international agencies such International Development Association (IDA), EXIM Bank of China and Eurobond. It is revealed that the federal government debt service payments with EXIM Bank increased to \$252.07 million in nine months of 2022 from \$207.67million reported by the DMO in corresponding nine months of 2021.

The government had borrowed from these agencies to finance projects such as: Nigeria Railway Modernisation Project (Idu-Kaduna Section), Nigeria Railway Modernisation Project (Lagos – Ibadan Section), Nigeria Abuja Light Rail Project, Nigeria ICT Infrastructure Backbone Project, Nigeria Four Airport Terminals Expansion Project and Nigerian Zungeru Hydroelectric Project. Other projects are: Nigerian Rehabilitation and Upgrading of Abuja-Keffi-Makurdi Road Project, Nigeria Greater Abuja Water Supply Project and Nigeria National ICT Infrastructure Backbone Phase II Project.

Experts have raised concerns as the federal government continues to obtain new loans from both local and external sources, despite growing debt profile and servicing cost. The Director-General, Debt Management Office (DMO), Ms. Patience, recently in Lagos disclosed that the federal government's debt service payments in 2015 and 2021, was between N14.86trillion and revenue generated was at N25.43 trillion.

Infrastructure development is the process of constructing basic foundational services in order to boost economic growth and improve people's quality of life. The majority of modern economies have gone through periods of significant infrastructure construction, which has enhanced regional efficiency and competitiveness.

Nigeria has suffered from poor infrastructure development throughout the years, which has harmed its economic progress. There have been several discussions on infrastructure development and countless presentations of blueprints for big projects by successive governments, but little or no action has been taken in practice. (Fidelis, Jude, Ighata 2014)

Nigeria is still at the heart of Sub-Saharan Africa's development story. The country has abundant natural resources, including one of Africa's largest natural gas and crude oil reserves, over 300,000 square kilometers of arable land, and significant deposits of largely untapped minerals, with a population of over 177 million¹ and an estimated GDP of over US\$587 billion² in 2015. Nigeria's future is also being shaped by strong demographic growth with an improving age mix, greater technology innovation, and rapid urbanization. Diversifying Nigeria's economy will necessitate significant infrastructure investments, which the Nigerian government has prioritized in its 2016 budget, increasing capital expenditure by 223 percent to N1.8 trillion (US\$9.05 billion). This sum amounts for 30% of the overall 2016 budget, compared to 11% (N557 billion) in 2015. Given the current realities and financial situation of the Nigerian government, developing the country's infrastructure will necessitate significant private sector funding, strong collaborations between government and the private sector, and a medium to long-term perspective benefits and economic returns on investments.

According to Fidelis, Jude, Ighata (2014) In Nigeria, there are a few regulatory frameworks for infrastructure development.

The relationship between public debt and infrastructural development is underpinned by the Harrod–Domar model of growth and the Neoclassical model of growth.

In the Harrod–Domar model, investment is believed to be the leading reason for economic growth. Government borrowing to invest in capital such as roads and power generation increases productive capacity and stimulate growth. But wasteful debt leads to future repayments without corresponding returns.

Neoclassical model of growth (Solow, 1956) emphasizes that borrowing can enhance capital formation and productivity levels if investment is efficient. Nevertheless, high debt servicing reduces the amount of funds injected in infrastructure, which leads to diminishing returns. Together, the theories suggest that productivity of debt-financed infrastructure determines whether borrowing has positive or negative long-run effects.

3. Methodology

3.1 Research Design and Data Source

The study utilizes an ex-post facto design using annual time-series data (1986–2022) from the Central Bank of Nigeria Statistical Bulletin and World Development Indicators (WDI).

3.2 Model Specification

To examine the effect of public debt on infrastructural development in Nigeria, infrastructural development (proxied by gross fixed capital formation) depends on public debt which is decomposed in to external debt and domestic debt, real gross domestic product (RGDP) and human capital development (proxied by school enrolment). The functional form of this postulation can be expressed as follows:

$$INFRD = f(EXDB, DMDB, RGDP, HCPD, DBSV) \quad (1)$$

The econometric model is specified as follows:

$$\text{Log } INFRD_t = \beta_0 + \beta_1 \text{logDMDB}_t + \beta_2 \text{logEXDB}_t + \beta_3 \text{logRGDP}_t + \beta_4 \text{logHCPD}_t + \beta_5 \text{logDBSV}_t + et \quad (2)$$

3.3 Apriori expectations

Based on economic theory, it is expected that External debt, domestic debt, human capital development and real gross domestic product, will have positive impact on the economy infrastructural development (proxied by gross fixed capital formation). These implies that:

$$\beta_1, \beta_2, \beta_3, \beta_4, > 0$$

$$INFR_t = f(EXDB_t, DMDB_t, HCDV_t, DBSV_t, RGDP_t) \quad (3)$$

Expressed in an econometric form:

$$INFRD_t = \beta_0 + \beta_1 EXDB_t + \beta_2 DMDB_t + \beta_3 HCDV_t + \beta_4 RGDP_t + \beta_5 DBSV_t + \mu_t \quad (4)$$

Where:

INFRD = Infrastructural Development (proxied by gross fixed capital formation) at time t

HCDV = Human Capital Development (proxied by school enrolment) at time t

RGDP = Real Gross Domestic Product at time t.

EXDB = External Debt at time t

DBSV = Debt Servicing at time t

DMDB = Domestic Debt at time t

e = Error Term.

t = Time Trend.

3.4 ARDL Model Specification

The Autoregressive Distributed Lag (ARDL) model can be expressed as:

$$\Delta \text{INFRD}_t = \alpha_0 + \sum_{i=1}^p \alpha_1^i \Delta \text{INFRD}_{t-i} + \sum_{i=0}^{q_1} \alpha_2^i \Delta \text{EXDB}_{t-i} + \sum_{i=0}^{q_2} \alpha_3^i \Delta \text{DMDB}_{t-i} + \sum_{i=0}^{q_3} \alpha_4^i \Delta \text{HCDV}_{t-i} + \sum_{i=0}^{q_4} \alpha_5^i \Delta \text{RGDP}_{t-i} + \sum_{i=0}^{q_5} \alpha_6^i \Delta \text{DBSV}_{t-i} + \lambda_1 \text{INFRD}_{t-1} + \lambda_2 \text{EXDB}_{t-1} + \lambda_3 \text{DMDB}_{t-1} + \lambda_4 \text{HCDV}_{t-1} + \lambda_5 \text{RGDP}_{t-1} + \lambda_6 \text{DBSV}_{t-1} + \varepsilon_t \quad (5)$$

In the ARDL model (Eqn. (5)), the coefficients denoted by λ at $t-1$ represent the long-run relationship between the dependent variable and its predictors, and form part of the error correction term (ECT). The lag at $t-1$ indicates that the model accounts for deviations from long-run equilibrium in the previous period. These past deviations influence the current period's outcome by ensuring that any short-term disequilibria are corrected over time. In other words, if the dependent variable (infrastructural development) was misaligned with its long-run determinants (e.g., public debt, human capital) in the previous year, the λ term helps adjust the current year's values toward the expected long-run equilibrium. This captures the dynamic adjustment process typical in time-series economic models.

The subscript $t-i$ represents **lagged values** of the dependent and independent variables, where $i = 0, 1, 2, \dots$ denotes the number of periods back. Each lag has its own coefficient ($\alpha_1, \alpha_2, \dots$) capturing the specific effect of that past value on the current outcome. The coefficients themselves are constant over time, but by including multiple lags, the model accounts for both immediate (short-run) effects and past influences on the dependent variable. This structure prevents omitted variable bias and ensures a more accurate estimation of dynamic relationships. For instance, the impact of domestic debt from one year ago on current infrastructural development may differ from the effect of debt two years ago, which is captured through separate coefficients for each lag.

4. Results and Discussion

This section presents the empirical results of the study and provides interpretations in the context of the research objectives. We first examine the unit root tests, cointegration analysis, and ARDL model estimations. The subsequent discussion interprets the long-run and short-run effects of external debt, domestic debt, real GDP, and human capital development on infrastructural development in Nigeria. Tables and figures are employed to support the presentation of results, followed by insights and explanations based on economic theory and prior studies.

The findings confirm the Harrod–Domar model that productive investment—often finance through borrowing can accelerate capital accumulation and infrastructural progress. However, the debt overhang problem is an example where the future repayment obligations push aside investment in critical infrastructure.

These results agree with Fidelis et al. (2014), who found that domestic borrowing enhances infrastructure growth.

4.1 Unit root Tests

The Unit Root test has been carried out to determine the stationarity condition of the series as well as the order of integration. For this purpose, Augmented Dickey Fuller (ADF) test and Phillips-Perron test were conducted, the result is presented in Table 1.

Table 1: Stationarity Test

Variable	Augmented Dickey Fuller Test		Phillips Perron Test	
	ADF Statistic	Level of Integration	PP Statistic	Level of Integration
LNDBSV	-6.0359***	I(0)	-3.95593**	I(0)
LNDMDB	-6.1489***	I(1)	- 6.19461***	I(1)
LNEXDB	-9.0899***	I(1)	- 9.06561***	I(1)
LNHCDV	-4.3257***	I(1)	- 5.92802***	I(1)
LNINFRD	-5.5238***	I(1)	- 4.28736***	I(1)
LNRGDP	2.4257**	I(1)	2.430528**	I(1)

Source: Eviews Computation Output, 2023

***, ** Indicate Significance at 1% and 5% level Respectively

Table 1 presents the results of the unit root test. It was found from ADF test that LNDMDB, LNEXDB, LNHCDV, LNINFRD are integrated of order 1 and statistically significant at 1% level and LNRGDP is also integrated of order 1 and statically significant at 5% level. While LNDBSV is integrated of order 0 and is statistically significant at 1%. Whereas, the PP test showed that LNDMDB, LNEXDB, LNHCDV, LNINFRD are integrated of order 1 and statistically significant at 1% level, and LNRGDP is also integrated of order 1 and statically

significant at 5% level while LNDBSV is stationary at level and statistically significant at 1% level. Thus, the variables are combination of I(0) and I(1). Hence, this provides the basis for conducting ARDL test.

4.2 Estimation Results

4.2.1 ADRL Bounds Test for Cointegration (Model 1)

Table 2 presents the ARDL testing approach to cointegration result.

Table 2: ADRL Bounds Test for Cointegration

Source: Eviews Computation Output, 2023

The ARDL result bounds testing approach to cointegration in Table 2 shows that when Infrastructural Development (INFRD) is the dependent variable, the calculated F-statistic of 9.906733 which falls above any of the upper critical bound of 1%, 5% and 10%. Hence the null hypothesis of no cointegration is rejected.

However, since, we have small sample size, we make use of the critical values provided by Narayan (2005). As n=37, which ranges from 35 to 40, we used 40 as the landmark and k=4. The critical value for the upper bound is 5.06 and for the lower bound 3.74 at 1% level of

ARDL Bounds Test		
F-statistic	9.906733	4
	Critical Value Bounds	
Significance	I (0) Bound	I (1) Bound
10%	2.45	3.52
5%	2.86	4.01
1%	3.74	5.06

significant in Narayan’s table case III: unrestricted intercept and no trend. The f- statistics for this bound test which is 9.906733 is greater than both 5.06 and 3.74 Therefore, the null hypothesis of no long run relationship is strongly rejected at the 1% level of significance. This implies that there exists a presence of cointegration and long run relationship among the variables under investigation in Nigeria over the period of 1986-2022.

4.2.2 ARDL Short run and Long Run Regression Result

Having established the fact that there is a long relationship among the variables using the ARDL bounds testing approach to cointegration. The next step is to estimate the Long-run and

ECM relationship among the cointegrating variables. The table presents the Long-run and the short-run estimates of variables.

Table 3: ARDL Short run and Long Run Model (Model 1)

Dependent Variable: LNINFRD

Variable	Coefficient	Std. Error	t-Statistic	Prob.
Short Run Coefficients				
D(LNEXDB)	0.00752**	0.02534	0.29660	0.7690
D(LNDMDB)	0.100141***	0.02722	3.67881	0.0010
D(LNRGDP)	-0.101788***	0.03245	-3.13680	0.0040
D(LNHCDV)	0.7906520**	0.29448	2.68488	0.0121
ECT (-1)	-0.941624***	0.11900	-7.91270	0.0000
Long Run Coefficients				
LNEXDB	-0.088676**	0.03713	-2.38800	0.0239
LNDMDB	0.106350***	0.03250	3.27272	0.0028
LNRGDP	-0.108098***	0.03313	-3.26310	0.0029
LNHCDV	1.578388***	0.21333	7.39890	0.0000
C	-2.453012	0.59307	-4.13610	0.0003
R ²	0.94203			
Adjusted R ²	0.92753			
F-statistic	64.9965			
P-Value	0.0000			
D-W Statistic	1.82124			

Source: Eviews Computation Output, 2023

***, ** Indicate Significance at 1% and 5% level respectively

$$LNINFRD = -2.4530 - 0.0887 LNEXDB + 0.1063 LNDMDB - 0.1081 LNRGDP + 1.5784 LNHCDV \quad (6)$$

As shown in Table 3, the long-run coefficient of External Debt (LNEXDB) is -0.0887 with a Prob value of 0.0239, indicating it is statistically significant at the 5% level. This implies that a 1-unit increase in external debt leads to approximately an 8.9% decrease in infrastructural development, consistent with the debt overhang hypothesis. The coefficient of Domestic Debt (LNDMDB) is 0.1063 with a Prob value of 0.0028, significant at the 1% level, showing that domestic borrowing contributes positively to infrastructural development, with a 1-unit increase

resulting in roughly a 10.6% increase. Human Capital Development (LNHCDV) has a long-run coefficient of 1.5784 and is highly significant (Prob = 0.0000), suggesting a 1-unit increase in human capital leads to about a 158% increase in infrastructure development. Real GDP (LNRGDP) has a negative coefficient of -0.1081, significant at 1% (Prob = 0.0029), indicating that increases in real GDP over the study period are associated with a 10.8% reduction in infrastructural development in the long run, which may reflect misallocation of resources. In the short run, the coefficients of Domestic Debt (0.1001) and External Debt (0.00752) are positively related to infrastructure, with the latter significant at 5% (Prob = 0.7690), while Human Capital Development (0.7907) is also positive and significant at 5% (Prob = 0.0121). The Error Correction Term (ECT = -0.9416, Prob = 0.0000) indicates a rapid adjustment of 94% towards long-run equilibrium each year.

Also Note: The ‘Prob’ column represents the probability value (p-value) associated with the t-statistic of each coefficient, indicating the statistical significance of the variable at conventional levels (1%, 5%, and 10%)

4.2.3. Consideration of Potential Confounding Variables: For Instance, Debt Servicing (DBSV)

Debt servicing (DBSV) is an important variable in understanding the effect of public debt on infrastructural development. It captures the fiscal burden of debt repayment, which can reduce resources available for productive investment. Including DBSV in the ARDL model ensures that this potential confounding effect is accounted for, providing a more accurate estimation of the effects of domestic and external debt. If DBSV is not included, the model might overestimate the positive impact of debt on infrastructure, as the negative effect of high debt servicing on available funds would be ignored, leading to omitted variable bias. By incorporating DBSV, the model controls this confounding factor, improving the reliability and validity of both short- and long-run coefficient estimates.

4.3 Diagnostic Test

It is appropriate to conduct diagnostic tests to examine if the estimated short-run model as met the assumptions of the Classical Linear Regression Model (CLRM). Table 4 summarizes the diagnostics test carried to see if the model had met the CLRM assumptions.

Table 4: Diagnostic Analysis

Diagnostic test	Statistic	P-Values
χ^2 Normal	8.903196	0.011660
χ^2 Serial	0.24839	0.6222

X^2 ARCH	0.07748	0.7826
X^2 RESET	0.074372	0.9413

Source: Eviews Computation Output, 2023

The normality result shows that with the JB-statistic (X^2) of 8.903196 which is statistically insignificant at 5% level, this implies that we reject the null hypothesis of normality and therefore conclude that the error term is not normally distributed at 5% level of significance.

Also, the result from the Breusch-Godfrey (BG) general test of serial correlation shows that with F-statistics of 0.24839 which is statistically significant at 5%, this implies that we do not reject the null hypothesis of no serial correlation. Hence, we conclude that there is no serial correlation associated in the model.

In addition, the Autoregressive Conditional Heteroskedasticity (ARCH) test to evaluate if the error terms are homoskedastic gave results that showed an F-statistics of 0.07748 which is statistically significant at 5%. This implies that we do not reject the null hypothesis of constant variance of the error term and conclude that there is no presence of Heteroskedasticity in the model.

The test of misspecification using Ramsey RESET tests was also performed to test if the model is correctly specified. From the results given, the F-statistics of 0.074372 which are statistically significant at 5%, this implies that we concluded that there is no specification error. This confirms that the model is well specified.

4.3.1. Addressing Non-Normality of Residuals

All continuous variables were first transformed to their natural logarithm prior to estimation to stabilize variance and reduce skewness, the Jarque-Bera test revealed that the residuals of the ARDL model are not perfectly normally distributed. To ensure robustness, additional diagnostic checks, including the Cumulative Sum of Recursive Residuals. (CUSUM) and Cumulative Sum of Squares of Recursive Residuals (CUSUMsq) tests, were conducted, confirming the stability and reliability of the estimated coefficients. Given the large sample size and the strong model fit, the violation of strict normality does not materially affect the validity of the inference drawn from the model.

4.4 Stability Analysis

The stability test is an important test to check if the ARDL model which is estimated is stable. Stability of the coefficient has done using the cumulative sum of recursive residuals test and cumulative sum of squares.

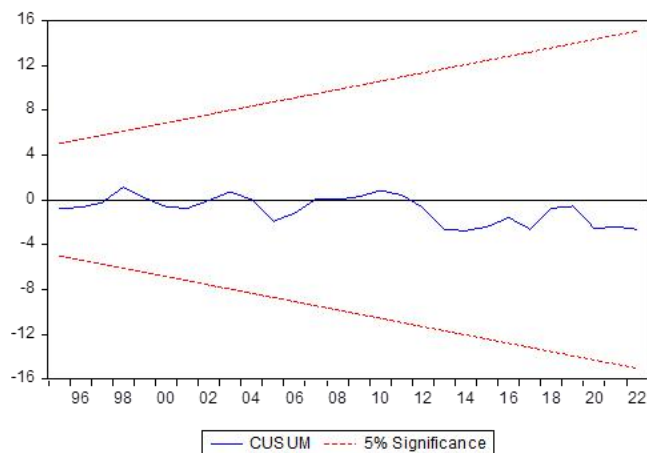


Figure 1a: CUSUM at 5% Significance

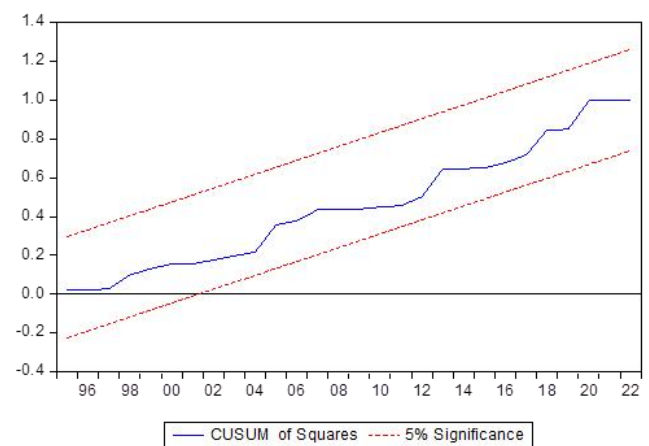


Figure 1b: CUSUMsq at 5% Significance

The stability of the ARDL bounds testing estimates which is investigated using the CUSUM and CUSUMsq tests gave results that are shown in Figs. 1a and 1b. The plots of the CUSUM statistics are well within the critical bounds at 5%. The plots of the CUSUM of squares statistics are within the critical bounds at 5%. This confirms that the ARDL estimates are reliable and consistent. The tests find coefficients to be stable since the cumulative sum (blue lines) does not go outside the area between the two critical bounds (red lines).

4.5 Strengths and Limitations of the Study

This study has the following strengths. First, it uses a long time-series dataset from 1986 to 2022, allowing for robust analysis of both short- and long-run relationships between public debt and infrastructural development. Second, the use of the ARDL bounds-testing approach accommodates variables integrated of different orders (0) and (1) and effectively captures dynamic adjustments. Third, including variables such as domestic debt, external debt, human capital development, and debt servicing (DBSV) ensures a comprehensive assessment of the multiple factors influencing infrastructure growth in Nigeria.

However, the study also has limitations such as data constraints, limiting the inclusion of other potential variables, such as political stability indices or corruption measures, which could influence infrastructure outcomes. Additionally, the study focuses on aggregate national-level data, which may obscure regional variations in infrastructure development and debt management. Finally, the analysis assumes the quality of infrastructure projects is uniform, which may not fully reflect variations in project efficiency or impact.

5 Conclusion and Policy Recommendations

5.1 Conclusion

This study concludes that local debt has been fueling Nigeria's infrastructural development, but foreign borrowing has not been as remunerative owing to inefficient use and management of debt. Investment in human capital and fiscal development is rewarding to infrastructure development.

5.2 Policy Recommendations

The following recommendations are derived from the findings of the research as:

1. **Prioritise Productive Borrowing:** Debt accumulation should be channeled into capital projects with measurable economic returns.
2. **Deepen Domestic Debt Markets:** Expand access to domestic long-term instruments such as infrastructure bonds to reduce dependency on foreign borrowing.
3. **Improve Debt Transparency:** Allow public release of loan agreements, payments, and project performance to enhance accountability.
4. **Improve Debt Utilisation Monitoring:** Establish independent monitoring mechanisms to evaluate the productivity of infrastructure funded through debt.
5. **Human Capital Alignment:** Synchronize infrastructure projects with education and vocational skills development to maximize their contribution in the long run.

5.3. Short-Term Policy Actions

Considering the limited tenures of political actors in Nigeria, it is essential to implement short-term, high-impact measures that can generate observable results within a single political cycle. Such measures include prioritizing debt-financed projects with clearly defined and measurable outcomes, accelerating the completion of ongoing infrastructure initiatives, and strengthening monitoring and evaluation mechanisms to ensure efficient use of resources. Enhancing transparency in procurement and project management, coupled with aligning infrastructure projects with human capital development programs, can maximize immediate socio-economic benefits. These actions help ensure that public borrowing translates into tangible infrastructural improvements even within short political terms, mitigating risks associated with frequent governmental transitions.

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