Effect of Debt Burden on Public Infrastructure Investment in Nigeria

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Abstract: The magnitude of debt burden has escalated in Nigeria due to persistently elevated budget deficits, which compromise the capacity of these nations to allocate resources towards infrastructure development. Despite the extensive literature examining the correlation between debt burden and various macroeconomic indicators, scholarly investigation into the impact of national debt burden on public infrastructure investment, particularly in the context of Nigeria, has been notably insufficient. Consequently, this study undertakes an exploration of this relationship by employing the Autoregressive Distributed Lag (ARDL) model utilizing an annual dataset spanning the years 1981 to 2022. In this analysis, external debt and domestic debt are quantified as proportions of GDP, while debt service is articulated as a percentage of government revenue. The results reveal a positive long-term influence of both external and domestic debts on public infrastructure investment, whereas debt service and exchange rate fluctuations exhibit a negative and statistically significant impact on such investments. In the short-term analysis, it was observed that the national debt burden significantly diminishes public investment in infrastructure. For the purposes of policy formulation, the study recommends that the government channel public debts towards economic initiatives aimed at capital formation, as opposed to consumption expenditures. Moreover, it advocates for a strategy of prudent debt management that prioritizes investments in capital projects to bolster production and yield favorable returns.

Keywords*:* debt burden, infrastructure, investment, ARDL, Nigeria

JEL Codes: C22, E62; H63; R51, R58

1. Introduction

The global economic recessions that transpired in the early 1980s precipitated imprudent lending practices, ineffective debt management, and a pervasive debt crisis. Developing nations accrued considerable debt for the purposes of infrastructural development and the maintenance of macroeconomic stability, culminating in challenges related to debt burdens and tax imposition. This situation obstructed economic progress as nations endeavoured to realise long-term goals while simultaneously amassing new debt (Frimpong, Fumey and Nketiah-Amponsah, 2024). Historically, Nigeria has contended with a relentless challenge of rising national debt, which has impeded its economic development. Over the last thirty years, as reported by the International Monetary Fund (IMF, 2023), national debt levels have consistently escalated to what appear to be unmanageable heights, rendering the nation susceptible to financial turmoil, primarily attributable to significant foreign debt, thereby highlighting fiscal inefficiencies, ineffective debt management, and insufficient cash management as principal factors contributing to the economic crisis.

Nigeria's perpetually escalating debt profile is, in itself, a significant cause for concern. It inhibits the potential for the nation's economic resurgence while exacerbating the overall state of infrastructural advancement and intensifying the levels of poverty experienced by its populace. The burden of debt does not merely stem from a nation's financial obligations. It emerges when a sovereign state is unable to fulfil its debt servicing requirements. Debt servicing becomes a crisis when economic growth and development are hindered, resulting in unfavourable balances of payments and discrepancies in external financial transactions (Onyele, Ikwuagwu and Opara, 2023). The public debt of Nigeria is substantial. The ramifications of this debt burden for the nation, therefore, cannot be underestimated. These ramifications encompass the escalating debt issues, the gradual depletion of credit facilities as the comprehensive consequences of the debt burden become increasingly apparent, the lack of medium- to long-term financing for certain indebted states, which has impeded the completion of various infrastructural initiatives, along with the absence of short-term financial cover that further depletes foreign exchange reserves by obstructing the country's conventional means of financing imports.

The aggregate debt incurred by the Nigerian government in 2022 reached ₦40,912.62 billion, exceeding the debt levels of preceding years, with approximately 44.94% of governmental revenue earmarked for debt servicing (CBN, 2022). The burgeoning debt, coupled with prohibitively high servicing costs, presents

a significant risk to the national economy. A considerable fraction of government revenue designated for debt repayment exacerbates the existing infrastructure deficit and renders the economy more vulnerable to external shocks. The totality of debt, categorised into domestic and external components, reflects a recent trend, with over 50% classified as domestic in 2020. Nigeria's overall debt encompasses both domestic and international obligations (Osadume, University and Ikubor, 2022). Historically, elevated government borrowing resulted in a substantial portion being foreign debt prior to a notable decline in 2004. Recently, the ratio of external debt has diminished, with a greater segment of public debt being classified as domestic following the debt relief extended to Nigeria in 2006 by the Paris Club. During this timeframe, domestic debt has experienced a more rapid increase in comparison to external debt, as evidenced by data from the CBN. Nigeria's national debt is considerable relative to its substantial economic scale and the imperative for public investment in infrastructural initiatives. Despite an uptick in debt accumulation from 1981 to 2022, public investments have remained remarkably inadequate throughout this duration.

The phenomenon of debt burden has escalated to a crisis level in Nigeria. The gravity of the debt crisis is exacerbated by Nigeria's unfortunate status as one of the most impoverished nations globally (Onyele and Nwokoacha, 2016a). Consequently, the matter of debt has emerged as a pivotal concern in contemporary Nigeria, warranting serious attention. It is abundantly clear that the debt burden has precipitated significant ramifications within Nigeria. The obligations of debt and its servicing are syphoning resources that could otherwise be allocated for infrastructural development (Saka, 2024). A few years subsequent to Nigeria's reprieve from the historical debt burden accumulated by successive administrations, a new wave of debt has begun to emerge, characterised by renewed and questionable borrowings that have been deemed dubious, unethical, and corrupt. The peril associated with escalating debt levels has been correlated with the financial challenges currently faced by several states within the country, with cautionary statements suggesting that Nigeria may follow a similar trajectory if the prevailing policy of accruing debt through borrowing is not amended. Over the years, the burden of debt has constituted a significant impediment to socio-economic and infrastructural advancement in Nigeria. In spite of the substantial revenue generated from the export of petroleum products, the nation continues to rank as one of the most impoverished globally, plagued by inadequate infrastructure to support its economy, with approximately 60

percent of its population subsisting on less than one dollar per day (Onyele and Nwokocha, 2016b).

Government expenditures directed towards infrastructure are regarded as paramount for achieving economic sustainability, with the potential to yield fiscal multiplier effects (Uremadu and Onyele, 2019). Variations in the debt-to-GDP ratio are contingent upon the fiscal multiplier and the elasticity of income relative to output. The generation of revenue is impeded by inadequate domestic savings, an ineffective tax regime, and political hesitance towards incurring debt. Notably, public infrastructure initiatives frequently depend on debt financing owing to their substantial scope and extended duration. In light of these challenges, Nigeria is confronted with a deficit in infrastructure investment (Ozue and Okenwa, 2021). Conversely, public investment in infrastructure is perceived as vital for the creation of employment opportunities and the alleviation of poverty; yet, Nigeria's susceptibility to macroeconomic instabilities, including public debt, constrains infrastructure expenditure in both qualitative and quantitative aspects. Nigeria exhibits a lower standard of infrastructure in comparison to other developing countries, which significantly obstructs economic advancement (Awa and Alo, 2022). The historical economic initiatives of the 1960s established a groundwork for growth; nonetheless, the enduring levels of debt that have escalated in recent years, threatening to surpass sustainable thresholds, present a substantial concern for policymakers. Existing literature has predominantly indicated the adverse impact of public debt on public infrastructure investment. However, the precise dynamics between government debt and infrastructure investment within the Nigerian context have not garnered substantial scholarly focus, thereby necessitating the documentation of empirical findings in the present study.

The outcomes of this investigation will contribute to the discourse surrounding the sustainability of national debt and public investment, particularly in the realm of infrastructure such as transportation networks, rail systems, water supply, and wastewater treatment facilities. Moreover, it enhances the comprehension of the principal determinants influencing public infrastructure investment in Nigeria and offers strategic insights for the effective management of infrastructure projects funded through borrowing. The remainder of the study is systematically arranged into four sections: the first section encompasses the introduction, the second section presents a review of the literature, the third section elucidates the methodology, while the fourth section articulates the empirical findings along with their discussions, and the concluding section provides policy recommendations.

2. Literature Review

Although it has been extensively acknowledged that borrowing serves as a significant driver for economic development, external loans facilitate the transfer of tangible resources to developing nations, thereby assisting in the alleviation of several constraints such as savings, foreign exchange, and technology that impede progress in Nigeria (Saka, 2024). Furthermore, it is evident from the preceding discussion that external debt exerts a detrimental impact on national income, per capita income, and the advancement of public infrastructure (Awa and Alo, 2022). Additionally, the elevated levels of external debt have resulted in the depreciation of the national currency, an increase in workforce retrenchments, persistent industrial strikes, as well as a deteriorating educational system and infrastructural decline across various states in the country (Onyele and Ariwa, 2020). In light of this context, the present study is fundamentally grounded in the debt overhang theory.

2.1. Stylized facts: National debt and public investment in Nigeria

National debt burden and public investment trends are considered. The national debt burden was essentially grouped into three: external debt, domestic debt, and debt service. In Figure 1 and Table 1, national debt components are shown alongside public investment between 1981 and 2022 (on average of 3 years).

Table 1: National debt burden and public investment (%)

Year	Public investment (PBI) %	External debt (EXD) %	Domestic debt (DMD) %	Debt service (DBS) %
1981-1983	1.51	4.80	10.81	9.17
1984-1986	1.51	13.15	15.05	11.53
1987-1989	1.14	47.66	13.90	24.53
1990-1992	1.14	59.29	18.97	20.21
1993-1995	1.29	37.09	20.28	25.88
1996-1998	0.81	14.06	11.21	11.29
1999-2001	1.39	43.59	13.32	5.70
2002-2004	1.79	31.73	9.26	11.11
2005-2007	4.85	4.85	6.27	5.00
2008-2010	6.84	1.32	7.24	5.24
2011-2013	6.20	1.53	8.98	6.53
2014-2016	4.78	2.50	9.72	16.69
2017-2019	3.95	5.81	10.32	24.05
2020-2022	4.59	8.95	10.92	41.29

The trend of external debt (EXD), domestic debt (DMD), and debt service (DBS) was higher than the trend of public investment (PBI). EXD was 4.80%, DMD was 10.81%, and DBS was 9.17%, while PBI was 1.51%, indicating the national debt burden must have crowded out domestic investment due to the collapse of oil revenues following the glut in the international oil market in the early 1980s (Ogbe, 1992). This is evident in the high rate of debt accumulation through external and domestic sources coupled with the amount of public revenue committed to debt servicing. This situation probably led to the adoption of the structural adjustment program (SAP) in 1986. In the period that followed (1984-1986) that marked the era of financial liberalisation in 1986 when the Structural Adjustment Programme (SAP) was adopted in Nigeria, EXD, DMD, and DBS increased to 13.25%, 15.05%, and 11.53%, respectively, while public investment remained stagnant at 1.51%, which implied that the risen national debt burden was not committed to public investment. As such, it can be said that public investment did not progress with national debt burden between 1984 and 1986.

For the period 1987 to 1989, SAP had taken full effect. During this period, EXD rose astronomically to 47.66%, DMD declined slightly to 13.90%, and DBS rose to 24.53% as public investment declined to 1.14%. This shows that public investment was not prioritised due to excessive funds committed to debt service amidst a high level of indebtedness. Clearly, at this stage, the national debt burden was outrageous, which explains the downward trend of public investment. The period 1990-1992 witnessed rising EXD and DMD to 59.29% and 18.97%, respectively, but a decreased DBS to 20.21% while public investment remained at 1.14% as the previous period, meaning that the national debt burden had persisted and there was probably a shortfall in revenue generation as debt service reduced even as EXD and DMD rose higher. This could mean that the introduction of SAP had not caused desired change in the public sector of Nigeria.

The period 1993-1995 was marred by political crisis following the annulment of the June 12 general election, the removal of the interim government through a palace coup, and the reign of the military dictatorship afterwards. In this period, the military head of state adopted the austerity measure aimed at increasing revenue and reducing expenditure, which probably explains the fall in EXD to 37.09%, a slight increase in DMD to 20.28%, and 25.88% for DBS with public investment increase to 1.29%. This means that the government paid more attention to public investment. In the era of 1996-1998, public investment declined to
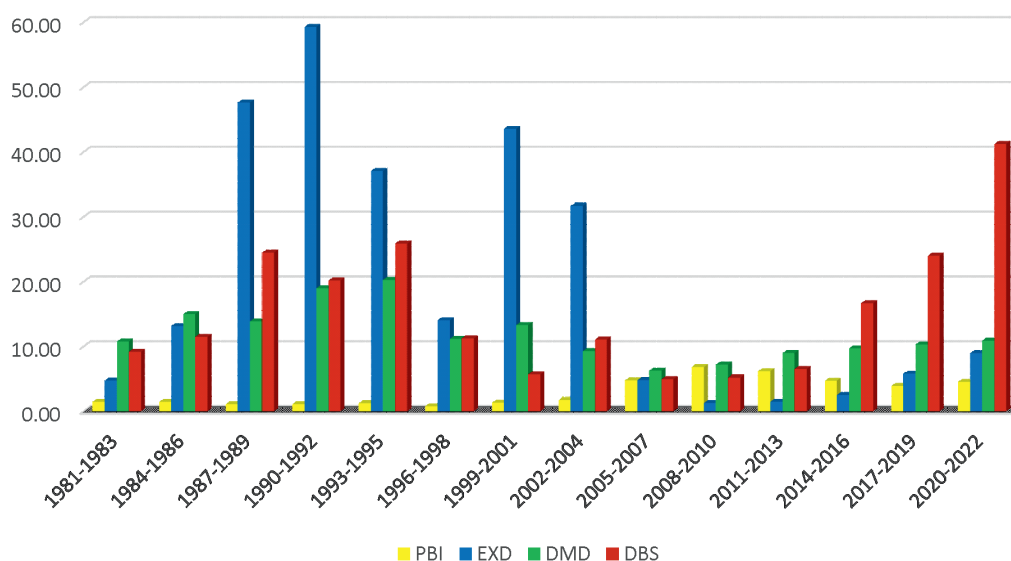
Figure 1: Co-movement between national (% of GDP) and public investment (% of GDP)

0.81% alongside EXD, DMD, and DBS, which declined to 14.06%, 11.21%, and 11.29%, respectively. With this scenario, it can be said that the government eased its borrowings, which eventually reduced its ability to fund public investment amidst revenue shortfalls and the death of the then military head of state, which led to the emergence of General Abdulsalam Abubakar in 1998, who handed over the civilian regime in 1999.

The period that followed was 1999-2001, when the new democratic dispensation began. At this time, EXD increased to 43.59% and DMD rose to 13.32%, while DBS fell to 5.70% and public investment rose to 1.39 percent. This indicates that amidst the rising debt profile of Nigeria, public investment increased compared to the previous period, but the fall in DBS could be due to low revenue generation or the concentration of government expenditure on public investment. With the rising debt profile and inability to service those debts, the government began to take steps towards securing debt forgiveness from the Paris Club. For the period of 2002-2004, it was realised that EXD dropped to 31.73%, DMD rose to 9.26%, and DBS rose to 11.11%, while public investment increased to 1.79%. The increase in public debt can be linked to the low debt accumulation as reflected in the fall of EXD and DMD as well as the fall in DBS. This shows better economic performance and revenue generation, which was probably used to fund

public investment alongside public debt. Still, in the quest to deliver Nigeria from the shackles of debt burden, the government kept pushing for debt pardon, which was eventually secured in 2005.

Having secured debt forgiveness in 2005 from the Paris club, three-year average EXD and DBS within the period of 2005–2007 reduced drastically to 4.85% and 5.00%, respectively, while DMD reduced to 6.27%, with public investment rising to 4.85%. By obtaining debt pardon, the amount for debt service was challenged to public investment, which explains the increase to 4.85%. This further reduced the pressure on public revenue. Unfortunately, the global financial crisis of 2008 caused revenue shortfalls, which led to further public debt. The period covered for 2008-2010 was marred by the global financial crisis of 2008. During this period, Nigeria could not secure external debt but rather secured domestic debt. This mirrors the shrink in EXD to 1.32% and DMD increasing to 7.24% with DBS of 5.24%. Within this period, public investment rose to 6.84%. This may imply that Nigeria largely financed its public projects with domestic debt due to the crisis that undermined the global economy at that time.

Looking at the period 2011-2013, it was realised that public investment reduced slightly to 6.20%, with EXD increasing marginally to 1.53% and DMD leapfrogging to 8.98%. Also, DBS rose slightly to 6.53%. Again, the government continued to rely on domestic debt to finance its activities, committing more of its revenue to servicing more of the outstanding domestic debt. The use of domestic debt appears to be favourable because it does not entangle with the exchange rate as the transactions involve the domestic currency. However, the subsequent period shows that heightened domestic debt may have crowded out domestic public investment. In the period covered by 2014-2016, denote a decrease in public investment to 4.78% while EXD and DMD increased to 2.50% and 9.72%, respectively. The period also witnessed a sharp rise in DBS to 16.69%, indicating a higher commitment to debt servicing. This shows that borrowings crowded out public investment, probably due to the economic recession witnessed in 2016. Again, this might be due to the late implementation of the 2016 budget and the appointment of cabinet members by the Buhari-led government.

The 2017-2019 period further witnessed a decline in public investment to 3.95% while national debt burden skyrocketed, as evident in the surges in EXD to 5.81%, DMD to 10.32%, and DBS to 24.05. This shows that the increased borrowings were not committed to public investment. There was also the problem

of free movement of funds due to the introduction of the Treasury single account (TSA). Unfortunately, the debt burden was further heightened by the COVID-19 pandemic that erupted in 2020. Within the period of 2020-2022, public investment reduced slightly to 4.59%, with EXD rising to 8.95%, DMD increasing to 10.92%, and DBS increasing to 41.29%. The astronomical rise in debt and debt service was due to a revenue shortfall due to the drastic fall in crude oil price and the devastating economic effect of the COVID-19 pandemic. This situation brought about a heightened level of national debt burden that triggered low income/revenue generation, which further weakened the Nigerian economy.

2.2. Theoretical Underpinning

This research is fundamentally based on the principles of the debt overhang theory, as well as the liquidity constraints and dual gap hypotheses. Myers (1977) was the pioneer in articulating the debt overhang theory, which posits that a nation's debt reaches a threshold whereby it inhibits subsequent investment in public infrastructure, thereby hindering the nation's economic advancement. Bao, Wang and Wu (2024) assert that the debt burden escalates to such an extent that a significant portion of the nation's revenue is allocated to servicing debt obligations rather than investing in critical areas such as new infrastructure. Consequently, sovereign entities are adversely impacted by debt, where the term denotes a scenario in which a nation's indebtedness exceeds its anticipated revenue streams. This phenomenon may arise from the economy's incapacity to fill available employment positions or a persistent demand for additional credit to mitigate a production shortfall (Uremadu, Umezurike and Onyele, 2024). An excessive debt load may constrain economic expansion and diminish living standards by reallocating resources from essential services, including healthcare, education, and infrastructure.

The liquidity constraint hypothesis articulates that imperfections within capital markets impose limitations on the amount of capital an individual can procure or the interest rates they are willing to accept. The concept of liquidity constraints implies that the obligation to repay debt may deplete resources that would otherwise be allocated to economically advantageous initiatives. The suboptimal investment levels observed in high-debt developing countries are attributed to liquidity constraints rather than debt overhang (Hoffman and Reisen, 1991). This perspective is further emphasised by advocating for the legal enforcement of a debt liquidity limit, as the servicing of interest and principal diminishes the available capital for investment

purposes. In the absence of access to international financial markets, nations face a liquidity constraint that hampers their ability to compensate for deficits in private fiscal resources and foreign currency revenues (Serieux and Yiagadeesen, 2001). Given that a substantial proportion of loans in African nations are sourced from foreign governments, assessing the efficacy of their public debt, particularly external debt, frequently represents a significant challenge.

The dual-gap hypothesis posits that a developing nation may anticipate fulfilling its economic growth aspirations through a specified amount of borrowing. According to Panizza and Presbitero (2014), this hypothesis regards investment as intrinsically linked to savings, indicating that both the capital-output ratio and the rate of savings are crucial determinants of economic growth. However, it is critical to note that external assistance and domestic savings cannot serve as substitutes; thus, even if savings are elevated to facilitate the desired investment, the requisite importation of capital goods to enhance productivity remains essential. Consequently, a deficit in foreign currency required to procure capital goods cannot be rectified merely by increasing savings. This predicament creates a disparity between foreign exchange and savings necessary to attain targeted growth rates. Developing nations are disproportionately impacted by this deficiency as they struggle to augment export levels. Therefore, the two-gap hypothesis elucidates the non-interchangeability of savings and foreign currency, indicating that the absence of local savings or access to foreign capital constitutes a significant obstacle for developing countries (Onyele, Onyele-Onyekachi and Ikwuagwu, 2024). External funding sources are indispensable for financing the infrastructural demands critical to fostering growth and compensating for the inadequate levels of domestic savings.

2.3. Empirical Review

On the empirical dimension, targeted investigations that have explored the nexus between governmental indebtedness and investment encompass the work of Frimpong, Fumey and Nketiah-Amponsah (2024), which scrutinised the Ghanaian context from 1983 to 2020. Employing a Non-linear Autoregressive Distributed Lagged (NARDL) model, the research elucidated a positive association between governmental and infrastructural investment within Ghana. Onyele, Ikwuagwu and Opara (2023) conducted an analysis utilising data spanning from 1981 to 2020 with the threshold autoregressive regression (TAR) methodology, revealing a non-linear interrelationship between debt service relative to revenue

and total debt stock in relation to GDP, as they pertain to public, private, and foreign direct investments amidst fluctuations in macroeconomic indicators such as exchange rate, inflation rate, and monetary policy rate. Chukwu, Ogbonnaya-Udo and Ubah (2021) employed data ranging from 1985 to 2018 alongside the Auto-Regressive Distributed Lag (ARDL) model to assess the ramifications of public debt on public investments, concluding that, in the Nigerian context, public indebtedness exhibited no substantial influence on public investment. Utilising a fixed-effects model, Kengdo, Nchofoung, and Ntang (2020) determined that the repercussions of external debt on the infrastructural landscape in Africa are predominantly negative; however, a sustainable debt threshold approximating 99% reveals a positive correlation between debt and infrastructure.

In light of the challenges associated with funding renewable energy initiatives in sub-Saharan Africa, Onuoha, Dimnwobi, Okere and Chukwunonso (2023a) investigate the moderating influence of governance quality on the relationship between public debt and renewable energy consumption (REC) in the region, utilising the Feasible Generalised Least Squares methodology. The research established that public debt exerts a positive effect on REC; however, the interactive dynamics between governance quality and public debt serve to hinder REC. Hence, there exists an imperative to address the funding obstacles pertinent to the transition towards a sustainable energy future within sub-Saharan Africa by emphasising the pivotal role of governance. In a closely related inquiry entitled 'Sustainability burden or boost? Analysing the impact of public debt on renewable energy consumption in sub-Saharan Africa (SSA), Onuoha, Dimnwobi Okere and Chukwunonso (2023b) posited that while renewable energy exerts a minimal effect on environmental degradation, developing regions such as sub-Saharan Africa (SSA) encounter constraints due to the capital-intensive investment necessities inherent in the expanding renewable energy market. Consequently, to investigate the relevance of existing funding sources on renewable energy advancement in the region, their study examines the impact of public debt on renewable energy consumption (REC) across a panel of 29 SSA nations, categorised both holistically and by sub-regions. The analysis employed both the instrumental variable generalised method of moments (IV-GMM) approach and two-stage least squares estimators to scrutinise the data. Overall, the findings indicate that public debt, carbon emissions, financial development, and economic growth exert negative and significant influences on renewable energy, whereas urbanisation demonstrates a positive and significant effect.

Okere, Dimnwobi, Ekesiobi and Onuoha (2023), in their research aimed at elucidating the relationship between public debt and energy poverty across 30 sub-Saharan African nations during the period from 2007 to 2018, constructed a composite energy poverty index through the application of principal component analysis. The principal outcome of this study indicated that public debt exerts a positive and statistically significant linear impact on the energy poverty index, national electricity access, urban electrification, rural electrification, and availability of clean cooking fuels, while concurrently diminishing the production and utilisation of renewable energy. Al-Dughme (2019) explored the ramifications of governmental borrowing and expenditure within the context of Jordan spanning from 1990 to 2017 through the utilisation of multiple linear regression analysis. The investigation established an inverse correlation between governmental debt and expenditures. Sanchez-Juarez and Garcıa-Almada (2016) conducted an analysis of public debt, public investment, and economic development within the Mexican state governments from 1993 to 2012. They employed dynamic panel data models alongside the generalised method of moments (GMM), taking into account variables such as total population, GDP, GDP per capita, public investment, debt, government expenditure, FDI, and educational attainment. The results indicated that elevated national debts are associated with a rise in government expenditures, tax revenues, and economic growth, thereby signifying Mexico's strategic utilisation of public debt to foster growth and investments.

Alaeddine (2022) employed panel data encompassing 19 Arab nations from 2000 to 2020 to investigate the influence of public debt on infrastructure development. The generalised least squares regression method, with the Hausman test implemented to ascertain the appropriateness of a random effect versus a fixed effect model, was utilised subsequent to the ordinary least squares regression. The findings demonstrated that the debt-to-GDP ratio adversely affected the infrastructure index. Ncanywa and Masoga (2018) examined the influence of South Africa's public debt on public investment and its consequential effects on economic growth from 1995 to 2016. They utilised autoregressive distributive lag modelling, Granger causality analysis, impulse response functions, and variance decomposition methodologies. The study unveiled a long-term inverse association between public debt and investment. Oke and Sulaiman (2012) applied multiple linear regression analysis to explore the interrelationship between Nigeria's foreign debt, investment, and GDP growth from 1980 to 2008. The results revealed that augmentations

in government expenditure significantly facilitate both economic growth and the escalation of national debt. A higher level of external debt and trade openness was found to correlate positively with private investment, though the inverse relationship was also evidenced. Kamundia (2015) investigated the implications of Kenya's public external debt on private investment and GDP growth, assessing various determinants from 1980 to 2013, including economic growth, trade openness, real interest rates, inflation, public debt, debt servicing, investment, human capital, and population growth. The study concluded that public debt has a significant impact on GDP growth, albeit a comparatively lesser influence on private investment.

Awa and Alo (2022) conducted an evaluation of the influence exerted by external public debt on infrastructural development within Nigeria during the timeframe spanning from 2008 to 2021. The hypotheses formulated were tested utilizing multiple regressions grounded in the ordinary least squares (OLS) methodology, with a significance level set at 5%. The results of the study indicated that the utilization of public external debt did not yield favorable outcomes for the Nigerian economy. Ogunjimi (2019) employed the Autoregressive Distributed Lag (ARDL) technique to examine both the long- and short-term impacts of various components of Nigeria's state debt on investment behavior from 1981 to 2016, taking into account both domestic and international investment dynamics. Analyzing private capital, public capital, and FDI separately was necessitated by their inherent distinct characteristics. Furthermore, considerations were given to GDP and interest rates. The findings of the study revealed that, notwithstanding its positive implications for public and private investment, domestic debt exerted a negative influence on FDI. The overarching conclusion drawn posited that any type of government debt, irrespective of its duration, imposes detrimental effects on investment. Picarelli, Vanlaer and Marneffe (2019) investigated the crowding-out effect of public debt on public investment across 26 European nations, utilizing the Generalized Method of Moments (GMM) approach. In alignment with the debt overhang hypothesis, their findings indicated that a 1% increment in EU public debt corresponded with a 3% reduction in public infrastructure investment.

2.4. Gap in Empirical Literature

The extant literature clearly illustrates that the majority of studies predominantly concentrate on the ramifications of national debt on infrastructure investment, alongside investigations in other nations, while exhibiting insufficient focus on the

nexus between the national debt burden and investments directed toward public investment in infrastructure in Nigeria. Additional research has also correlated national debt with issues pertaining to renewable energy investment in Sub-Saharan Africa (SSA) by employing panel data analysis methodologies. Consequently, this study aims to scrutinise the manner in which Nigeria's escalating national debt burden influences its capacity to allocate investments toward both existing and prospective public infrastructure projects, employing the ARDL technique for estimation purposes.

3. Methodology

3.1. Empirical Method

The study engaged secondary key data sourced from the CBN statistical bulletin between 1981 and 2022. Modifying the model of Osadume, University and Ikubor (2017) this study used public investment in place of real GDP because this study looks at the impact of national debt burden on public investment. On the other hand, inflation was replaced with exchange rate because a large proportion of national debt in Nigeria is external; hence, exchange rate was introduced in the model as a control variable. The variables considered include public investment in infrastructure (PBI), external debt (EXD), domestic debt (DMD), debt service (DBS), and exchange rate (EXR), as depicted in equation (I).

$$PBI = \beta_0 + \beta_1 EXD + \beta_2 DMD + \beta_3 DBS + \beta_4 EXR + \mu \qquad \text{(I)}$$

The estimation of data was done using the multiple regression analysis based on the autoregressive distributed lag (ARDL) model. For the ARDL, the bounds test was used to determine the long-run relationship between the regressand and the regressors following the Pesaran, Shin and Smith (2001) criteria of bound limits. One of the merits of the bound test is that it accommodates possible structural breaks that might have adverse implications for the existence of a long-run association between the explained and explanatory variables. Under ARDL, long-run and short-run coefficients were estimated simultaneously and utilised for the cointegration test even if the variables are of a mixed level of integration, that is, I(1) and I(0). In other words, the underlying assumption is that the variables could be of mixed integration (I(1) and I(0), but none are integrated at second differencing (I(2). Hence, the ARDL model is developed when these conditions are met. The ARDL bounds test for cointegration is expressed in equation (II).

$$\Delta PBI_t = \delta_0 + \sum_{i=1}^{P} \delta_1 \Delta PBI_{t-i} + \sum_{i=1}^{P} \delta_2 \Delta EXD_{t-i} + \sum_{i=1}^{P} \delta_3 \Delta DMD_{t-i} + \sum_{i=1}^{P} \delta_4 \Delta DBS_{t-i} + \sum_{i=1}^{P} \delta_5 \Delta EXR_{t-i}$$
$$+ \beta_1 PBI_{t-1} + \beta_2 EXD_{t-1} + \beta_3 DMD_{t-1} + \beta_4 DBS_{t-1} + \beta_5 EXR_{t-1} + \mu_t$$

(II)

Once cointegration was established, the long-run relationship is estimated using the conditional ARDL model as depicted in equation (III):

$$\Delta PBI_t = \delta_0 + \beta_1 PBI_{t-1} + \beta_2 EXD_{t-1} + \beta_3 DMD_{t-1} + \beta_4 DBS_{t-1} + \beta_5 EXR_{t-1} + \mu_t \quad \text{(III)}$$

The short-run dynamic relationship was estimated using the error correction mechanism (ECM) as specified in equation (IV):

$$\Delta PBI_t = \delta_0 + \sum_{i=1}^{P} \delta_1 \Delta PBI_{t-i} + \sum_{i=0}^{P} \delta_2 \Delta EXD_{t-i} + \sum_{i=0}^{P} \delta_3 \Delta DMD_{t-i} + \sum_{i=0}^{P} \delta_4 \Delta DBS_{t-i}$$
$$+ \sum_{i=0}^{P} \delta_5 \Delta EXR_{t-i} + \theta ECM_{t-i}$$

(IV)

Where,

PBI = public investment in infrastructure

EXD = external debt

DMD = domestic debt

DBS = debt servicing

EXR = Exchange rate

δ_0 = constant

$\delta_1 - \delta_5$ = short-run elasticities (coefficients of the first-differenced explanatory variables)

$\beta_1 - \beta_5$ = long-run elasticity (coefficients of the explanatory variables)

θ = speed of adjustment

ecm_{t-i} = error correction term lagged for one period

Δ = first difference operator

p = lag length

The time series data was examined for stationarity prior to ARDL estimation. The Augmented Dickey-Fuller (ADF) unit root test will be used to determine whether the

data are stationary. This specific step is crucial since the majority of macroeconomic time series have unit roots, and non-stationary series regressions nearly invariably yield significant relationships even in the absence of a relationship between the variables. Equation (V) represents the generic model for the ADF unit root test.

$$\Delta y_t = \beta_0 + \beta_1 t + \beta\lambda y_{t-1} + \Sigma_{j-1}^p \delta_j \Delta y_{t-j} + \mu_t \tag{V}$$

Where,

y_{t-1} = Lagged value of y_t at first difference

Δy_{t-j} = A change in lagged value

δ = Measure of lag length

Δy_t = First difference of y_t

μ_t = Error term

3.2. Description of Model Variables

Debt service was stated as a ratio of revenue, and the combined amount of domestic and external debt was expressed as a ratio of GDP to determine the burden of national debt. This illustrates how the production of goods and services contributes to the level of income generated by public external and domestic debt. Conversely, the debt service to revenue ratio assesses whether government revenue is enough to cover the whole amount of debt incurred. Due to the fact that debt payment costs are mostly expressed in US dollars, changes in the real effective exchange rate would result in increased costs. Table 2 provides an overview of the model variables.

Table 2: Measurement of model variables

Variable	Measurement	Expected sign
Public investment (PBI)	Government gross fixed capital formation (%GDP)	
External debt (EXD)	External debt expressed as a ratio of GDP	Positive
Domestic debt (DMD)	Domestic debt expressed as a ration of GDP	Positive
Debt service (DBS)	Total debt service expressed as a ratio of revenue	Negative
Exchange rate	Naira – dollar exchange rate	Uncertain

4. Data Analysis and Results

4.1. Unit Root Test

The unit root test serves to ascertain the characteristics of the data utilised in order to avert the occurrence of spurious results, and it will facilitate the identification of

the most suitable analytical technique. The findings of the unit root test presented in Table 4 demonstrate that all variables are integrated of the first order, denoted as I(1), at a 5% critical significance level. The variable PBI exhibits stationarity with an intercept, albeit lacking a trend. The Augmented Dickey-Fuller (ADF) test was applied in this research to ascertain the order of integration of the time series data. The results from the Schwarz Information Criterion (SC) unit root analysis indicated that EXD, DMD, DBS, and EXR are all non-stationary at their levels; however, upon first differencing, these variables attain stationarity at the first difference, I(I), and none of the variables are integrated at the second order, I(2). Therefore, the Auto-Regressive Distributed Lag (ARDL) model is considered optimal for the estimation of cointegration, given the presence of a combination of I(0) and I(1) variables across both sets of results.

Table 3: Results of the ADF Stationarity Test

Variable	Level		First difference		Order of integration
	T-statistics	*5% critical value*	*T-statistics*	*5% critical value*	
PBI	-3.888265	0.0224**	-	-	I(0)
EXD	-1.382570	0.8509	-3.686564	0.0350**	I(1)
DMD	-2.477332	0.6528	-3.934873	0.0198**	I(1)
DBS	-1.877070	0.6481	-5.900874	0.0001***	I(1)
EXR	-2.102379	0.7359	-5.839198	0.0001***	I(1)

Note: Null hypothesis (H0): has a unit root (non-stationary); Alternate Hypothesis (H1): no unit root (stationary). Rejecting the null hypothesis at 1 and 5%, respectively.

4.2. ARDL Bounds for Cointegration

Table 4 displays the outcome of the bound test. At a 5% level of significance, the F-statistics value of 4.248930 is greater than the I(I) result of 3.49. This suggests that the alternative hypothesis, which asserts that there is a long-term relationship between the variables, was accepted and the null hypothesis, which states that there

Table 4: Bounds F-test results for the model

F-Bounds Test		Null Hypothesis: No levels relationship		
Test Statistic	Value	Signif.	I(0)	I(1)
F-statistic	4.248930	10%	2.2	3.09
k	4	5%	2.56	3.49
		2.5%	2.88	3.87
		1%	3.29	4.37

is no long-term relationship among the variables, was rejected. This implies that the variables in the model have cointegration, which demonstrates the existence of long-term relationships between the variables.

4.3. Long-run Estimates

Estimating the long-term relationships between the variables in the model is necessary because of their cointegration. The long-run estimation results of the model are shown in Table 5. According to the long-run coefficient, PBI is positively and significantly impacted by both DMD and EXD. This means that for every unit increase in domestic and foreign debt, PBI will rise by 0.75 and 0.30 units, respectively. It also indicates that there is a positive and substantial relationship between DBS, EXR, and PBI, meaning that a unit increase in one of these variables will result in a unit decrease in PBI. The long-run estimation's conclusion indicates that while debt service and exchange rates decreased public investment over time, external and domestic debt increased it.

Table 5: Long-run Estimates

Variable	Coefficient	Std. Error	t-Statistic	Prob.	
EXD	0.304120	0.104958	2.897539	0.0094	***
DMD	0.752412	0.250287	3.006197	0.0007	***
DBS	0.699790	0.240352	2.911521	0.0073	***
EXR	-0.596719	0.226637	-2.632928	0.0178	**
C	23.51185	3.140596	7.486428	0.0000	***

Note: *** and ** stands for 1% and 5% levels of significance, respectively

4.4. Error Correction Mechanism (ECM) and Short-run Coefficients

The findings presented in Table 6 elucidate the results of co-integration analysis. The calculated coefficient of the error correction model (ECM) at lag -1 was -0.219882. The ECM serves as an estimation for the short-run dynamics and reflects negative adjustments that facilitate the correction of deviations from equilibrium at an approximate annual rate of 22%. This indicates that the discrepancies, quantified at 22%, between the long-run equilibrium value and the actual observed value of the dependent variable (PBI) have been rectified. Furthermore, the negative coefficient suggests the presence of co-integration amongst the examined variables.

The Durbin-Watson statistic of 2.12 indicates an absence of significant serial autocorrelation among the independent variables incorporated in the model. The

R-squared statistic, which gauges the goodness of fit, reveals that nearly 85% of the variance in the dependent variable can be accounted for by the independent variable, leaving a residual 15% unexplained. Additionally, the adjusted R-squared suggests that the inclusion of an additional independent variable would still allow for approximately 80% of the variation in the dependent variable to be elucidated. The F-statistic, calculated at 10.94737 and exceeding its associated probability value (0.000034) at a 5% significance level, indicates that the linear correlation between the independent and dependent variables is statistically significant.

The coefficient for the short-run dynamics further indicates that PBI(-1) exerts a negative and statistically insignificant influence on PBI, suggesting that an increase in PBI(-1) results in a decrement of approximately 0.22 units in the current year's PBI. In contrast, in the short-run context, EXD demonstrates a negative and statistically significant effect on PBI, implying that a unitary increase in EXD will correspond to a 0.88 unit increase in INFRA. FDI, conversely, displays a negative yet statistically insignificant impact on INFRA, indicating that a percentage increase in FDI will yield a 0.19 unit increase in PBI. Analogously, DMD was found to have a negative and statistically significant effect, denoting that a unit increase in domestic debt results in an approximate 0.12 unit reduction in PBI within the short-run framework. Moreover, DBS exhibits a negative and statistically significant influence on PBI, suggesting that a unitary rise in debt service will precipitate a decline in public investment by roughly 0.24 units. Lastly, EXR is associated with a negative

Table 6: Error Correction Mechanism

Variable	Coefficient	Std. Error	t-Statistic	Prob.	
D(PBI(-1))	-0.224279	0.087357	-2.567738	0.0174	**
D(PBI(-2))	-0.190608	0.070799	-2.692260	0.0122	**
D(PBI(-3))	0.438162	0.063549	6.894910	0.0000	***
D(EXD)	-0.190608	0.079291	-2.403904	0.0236	**
D(DMD)	-0.124139	0.027280	-4.550598	0.0001	***
D(DBS)	-0.239028	0.077579	-3.081092	0.0005	***
D(EXR)	-0.418634	0.198621	-2.107700	0.0449	**
D(EXR(-1))	-0.854637	0.186616	-4.579646	0.0001	***
ECM(-1)	-0.219882	0.039882	-5.513274	0.0000	***
R-squared	0.853775	F-statistic		10.94737	
Adjusted R-squared	0.806118	Prob.(F-statistic)		0.000034	***
Durbin-Watson stat	2.116081				

Note: *** and ** stands for 1% and 5% levels of significance, respectively

and significant effect on PBI, implying that a unit increase in EXR will lead to a 0.42 unit decrease in PBI, thus indicating that an escalation in the exchange rate is responsible for an approximate 0.42 unit decline in public investment.

4.5. Diagnostic Tests

The diagnostic assessments conducted encompassed the serial correlation, heteroscedasticity, and Jarque-Bera normality tests. The graphical representations of the cumulative sum (CUSUM) and cumulative sum of squares (CUSUMSQ) reaffirmed the stability of the model, as the plotted figures resided within the bounds of the 5% significance level, as illustrated in Figure 2.

Table 7: Residual Diagnostic Tests

| Breusch-Godfrey Serial Correlation LM Test:			
F-statistic	0.312435	Prob. F(2,24)	0.7346
Obs*R-squared	0.964271	Prob. Chi-Square(2)	0.6175
Heteroskedasticity Test: Breusch-Pagan-Godfrey			
F-statistic	1.056257	Prob. F(11,26)	0.4303
Obs*R-squared	11.73656	Prob. Chi-Square(11)	0.3838
Scaled explained SS	4.364231	Prob. Chi-Square(11)	0.9580
Test of normal distribution			
Jarque-Bera	0.629022		0.7031
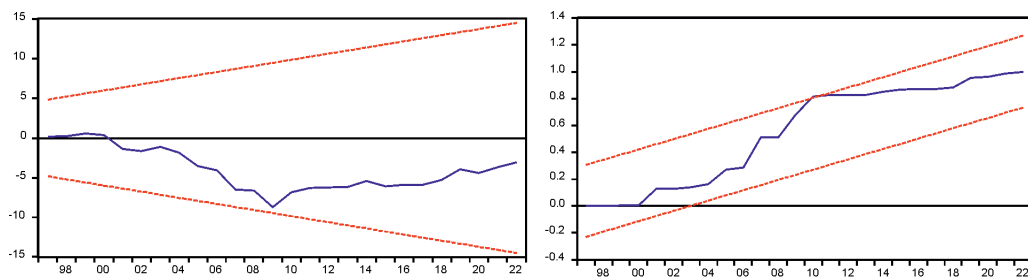
Figure 2: CUSUM and CUSUMSQ tests

The findings presented in Table 7 suggested that the autoregressive distributed lag (ARDL) model is devoid of issues related to serial correlation, heteroscedasticity, and deviations from normality in the distribution of residuals. This signifies that the outcomes derived from the ARDL estimation possess robustness and can be deemed reliable for the purpose of inference.

4.6. Discussion of Findings

The findings derived from the long-run public investment equation indicated that the variables, including external debt, domestic debt, debt service, and exchange rate, possess statistical significance. Specifically, both external debt and domestic debt demonstrated a positive influence on public investment. Furthermore, public investment exhibited a negative sensitivity to increases in debt service and exchange rate over the long term. This implies that an escalation in national debt exerts a more pronounced effect on public investment in the long run, whereas debt service and exchange rate substantially detract from public investment. Such a conclusion aligns with the research conducted by Osadume et al. (2022); Onyele and Nwadike (2021); Ozue and Okenwa (2021), which explored the implications of public debt on economic stability within Nigeria. The work of Ariyibi et al. (2023) further substantiates this conclusion. Additionally, it concurs with the findings of Sanchez-Juarez and Garcıa-Almada (2016) regarding the ramifications of public debt on public investment and economic development in Mexico. This is also consistent with the research by Frimpong et al. (2024) concerning the impact of debt on infrastructure investment in Ghana. Conversely, this finding stands in opposition to the study conducted by Awa and Alo (2022) regarding the influence of debt on infrastructure development in Nigeria.

The short-run evidence derived from various studies reveals a negative and statistically significant correlation between the national debt burden and public investment. Consequently, at the 5% level of significance, public investment diminishes for each percentage point increase in the independent variables. The long-run model corroborates the short-run outcome that associates the national debt burden with expenditures on public investment. This relationship was corroborated by Alaeddine (2021) in their examination of selected Arab nations. In a similar vein, Kengdo et al. (2020) resonate with these findings in their investigation of selected African countries.

5.   Conclusion

In this research endeavor, an effort is undertaken to examine the implications of the national debt burden on public investment in Nigeria. The analysis employs annual data spanning the years 1981 to 2022. Consequently, the investigation was executed utilizing the Autoregressive Distributed Lag (ARDL) estimation methodology. This approach is preferred over the traditional Ordinary Least Squares (OLS) method due

to its capacity to accommodate the mixed levels of integration that may be present within a time series. Furthermore, the study emphasizes trend analysis among flow variables, specifically focusing on the indices of national debt and public investment. The outcomes derived from this investigation are credible. Initially, the relationship between external debt, domestic debt, and public investment was determined to be both positive and statistically significant in the long-term, whereas a notable inverse effect of external and domestic debt was identified in the short-term. Additionally, it was observed that debt service obligations and exchange rate fluctuations exert a negative and statistically significant impact on public investment in both the long and short run.

With respect to the national debt incurred from external and domestic sources, the evidence substantiates a growth-enhancing effect on public investment. Consequently, the magnitude of external and domestic debt is ascertained to influence the upward trajectory observed in public investment. Despite the observation that debt service funded by government revenue and exchange rate dynamics induces a declining trend in public investment, it is subsequently advised that the government should prioritize policies that facilitate improvements in public investment through self-financing debt mechanisms.

In light of the debt burden and substantial infrastructural deficits confronting Nigeria, alongside the challenges faced by the Federal Government due to diminishing oil revenues and other related issues, it has become critical to formulate recommendations that would optimize the utilization of debt for infrastructural investments. Primarily, effective debt management is paramount for advancing infrastructural development. In instances where infrastructure is deficient or insufficient, the structural obstacles afflicting the Nigerian economy may not be surmounted, thereby rendering the attainment of sustainable growth and development, essential for future generations of Nigerians, an elusive goal. The government should intensify competition and enhance efficiency within infrastructural sectors, particularly in electricity, thereby facilitating an indirect contribution to overall development. Moreover, it is vital for both state and federal governments to reduce governmental expenditures with the objective of restructuring loan repayments and servicing. Furthermore, the Nigerian government ought to rely more heavily on internally generated revenue for financing infrastructural projects until all debts are settled. Ultimately, there exists an urgent necessity for the government to diversify the economy. The current condition, where the

economy remains predominantly mono-cultural, should be actively discouraged, given that numerous sectors within the economy require development to generate sufficient revenue to sustain economic viability, instead of depending on external and domestic loans for infrastructural financing, a situation that has exacerbated Nigeria's debt burden. All these measures are imperative to avert a developmental crisis within the nation.

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