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Optimizing Public Infrastructure Investment: Evaluating Government Expenditure Efficiency and Economic Growth in Nigeria

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Abstract: This study therefore examined the effect of government expenditure on infrastructural development and its influence on economic growth in Nigeria from 1999-2022. Using secondary data obtained from the Central Bank of Nigeria, World Development Indicators, and African Infrastructure Development reports, the paper adopts the Autoregressive Distributed Lag (ARDL) model to investigate short-, mid-, and long-run relationship between public expenditure and gross domestic product (GDP). Augmented Dickey-Fuller (ADF) test results support that the variables are integrated at mixed order of integration, and it validates the use of ARDL framework. The results of the bounds test suggest a strong mutual long-run equilibrium linkage between government spending on infrastructure and economic growth. The empirical findings show that only capital spending is statistically significant and positive for GDP in the short-run but that both health and education recurrent spending are generally either insignificant or negative for growth. The significance and the correct sign of the error correction term is indicating partial speed of adjustment towards long-run equilibrium with 1.5% per annum. Post-estimation diagnostic tests support robustness of the model as no problem in serial correlation, heteroscedasticity and residual normality is indicated. The study concludes that capital spending boosts short-run growth but inefficiency in recurrent outlays restricts its developmental outcomes. Based on the findings, policy recommendations included enhancing the effectiveness and FDI-sectoral composition of government expenditures, mainly through the health and education sector, to promote inclusive and sustainable economic growth. The paper then makes suggestions for further research into disaggregated expenditure analysis and governance and public finance outcomes.

Keywords: *Government Expenditure, Infrastructure Development, Economic Growth, ARDL Model, Nigeria, Public Finance*.

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I. INTRODUCTION

BIt is no new gospel that infrastructure is the hallmark of economic prosperity, particularly in a developing economy as Nigeria. Its potential to stimulate productivity growth, lower transaction costs, and promote economic diversification has been widely recognized. Infrastructure, such as transport networks, energy supply, communications systems, and water and sanitation, are essential for economic activity and promoting welfare (World Bank, 2020).

Though the importance and influence of infrastructure on aggregate demand and supply as a determinant in economic volitional growth equation- are widely recognized, the theoretical and empirical contributions on the efficiency and effectiveness of government expenditure contributing to sustainable growth seems largely underdeveloped in the literature. Most of the works have emphasized more on the expenditure in infrastructure and less on the how efficiently and effectively the expenditure for the infrastructure is made (Akinwale & Dada, 2019). To make the assumption that the boogie man of slippage on poverty alleviation-or-else the wild spending trigger — will induce responsible spending for good economic reasons is to ignore the facing-of-the-wall on public finance cred, and on marginal usefulness of handouts (which can be negative) and capacity to supply infrastructure and monitoring at all.

In reality, infrastructure projects' potential gains are frustrated by such inefficiencies as corruption, projects delay, mismanagement and lack of appropriate planning (Aigbokhan, 2021). Even though the Nigerian government spends large portions of its budget on infrastructure for the stimulation of economic growth and livelihoods (Federal Ministry of Finance, 2019), the outcomes have varied. Many programmes fail to be delivered or completed, many do not achieve the benefits advertised, or even do not make any

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good business case, often raising questions about the efficiency of public expenditure.

Investing in infrastructure are only as good as investments made from the plans, but also in how the funds are disbursed, managed, and tracked. In this regard, the efficiency of government spending is important in order to find whether infrastructure development significantly contributes to sustainable economic development (Obi, 2020). Public expenditure effectiveness does not only involve cost reduction but how to maximize the socio-economic value obtained from investments (Eboh & Eze, 2022). That includes getting projects done on time, under budget and in a way that's consistent with what the population wants, she said.

Infrastructure investment also needs to be evaluated for its capacity to promote inclusive growth, poverty reduction and social equity (Umeh, 2021). Within this collection of studies, some recent work has tried to underline the role not only of the denomination spent on infrastructure but also on the use of public money at each stage of the project cycle—from planning and budgeting to the implementation of the project and, finally, ex-post evaluation (Okonjo-Iweala, 2023).

Therefore, the main objective of the paper is to bridge these gaps by investigating infrastructure development fund and sustainable economic growth in Nigeria. Particular attention is paid to the effectiveness of budget allocation, implementation efficiency, and the socio-economic yield of large infrastructure projects. It is by understanding these aspects that this study seeks to provide policy relevant information that can contribute towards the more efficient use of infrastructure investments and that aligns with Nigeria's driver and development objective (Adedokun & Abiola 2023)

➢ *Research Problem*

The Nigerian government is investing heavily in infrastructure development but the returns (sustainable economic growth) are yet to be realized. Infrastructure and the economy Many studies consider the link between infrastructure and the economy, but with a lack of focus on a key dimension — the efficiency and effectiveness of government spending.

They also argue that the commonly-held notion that more infrastructure spending always tingles the economy short term is a red herring because it glosses over bad budget design, project implementation, and cost control. The net effect of these inefficiencies is project delay, cost overrun, desertion of vital infrastructure, and subpar results that limit the development impact of investments.

This void in literature has serious implications for Nigeria's present infrastructure policies and expenditures. Long term sustainable economies It is difficult to understand if investments like these ever support long term sustainability of economies that excel in the absence of an effective measurement of how well public goods are deployed. Hence, the link between government infrastructure investment and sustainable economic growth, in the sense of efficiency, is of urgent relevance.

This gap is filled by analyzing how much Nigeria has accrued in investment in infrastructure as well as the performance of that investment in the Nigeria economy and weighing the efficiency of the investment. Knowledge generated from this study is important in enhancing optimal allocation of public resources, enhancing transparency and accountability in public finance and strategic infrastructure planning.

Super, 2009 This research assesses the impact of public infrastructure spending on sustainable economic development in Nigeria. These research areas are critical to direct development impacts by advancing mutual vulnerability (i.e., links between parts (or systems) of the economy and the economy (alignment of physical infrastructure - (transport, energy, communication, water, and sewer systems) - with the level of productivity and economic performance enabling (World Bank, 2020).

➢ *Research Questions*

Based on the identified problem, the following research questions guide the study:

- How does government expenditure on infrastructure development contribute to Nigeria's Gross Domestic Product (GDP)?
- To what extent is government expenditure on infrastructure development efficient in driving sustainable economic growth in Nigeria?

➢ *Research Objectives*

The broad objective of this study is to evaluate the efficiency of government expenditure on infrastructure development and its impact on sustainable economic growth in Nigeria.

The specific objectives are to:

- Analyze the contribution of government expenditure on infrastructure development to Nigeria's GDP.
- Evaluate the efficiency of government expenditure on infrastructure development in promoting sustainable economic growth in Nigeria.

➢ *Research Hypotheses*

To address the research objectives and questions, the following null hypotheses are formulated:

- H_{01}: Government expenditure on infrastructure development has no significant contribution to Nigeria's GDP.
- H_{02}: Government expenditure on infrastructure development does not significantly drive sustainable economic growth in Nigeria.

➢ *Scope of the Study*

A time horizon is from 2010 to 2024, in order to give an opportunity to properly assess how the spending is

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progressing through the years, what are the results of the projects implemented, and which impact on the increase indicators. Being specifically the case of Nigeria, where the latter has spent considerable resources on infrastructure over the years with mixed results on economic development and public service delivery. The analysis of this study derives from secondary data extracted from official reports- budget reports (ministry of finance), project completion/record cards (c/o Planning commission), national accounts return (ministry of statistics) and economic performance indicators (Reserve bank of India). It is supported by a review of the academic literature and policy reports where relevant for context and theoretical perspective. We will apply a mixed-method that includes both quantitative (Aigbokhan, 2021), and qualitative (Obi, 2020) analysis to serve as guidance for the assessment of the relationship of-diplomacy and infrastructure investment with economic growth.

Importantly, the investigation is limited to Nigeria's public infrastructure projects, that is, those financed by the government and not by the private sector only or through the private-public partnerships. It is public budget-oriented and well poised to judge if not to good to use public funds. That is from everything relating to an infrastructure project from inception planning and budgeting, implementation, monitoring and post-fulfillment analysis (Eboh & Eze, 2022).

Addressing the twin considerations of the effectiveness and efficiency of intervention in infrastructure and the fiscal, macro and sectoral consequences of public investment, this study has the broader intent of producing useful information on alternative courses of action for policy-makers, project managers and sector experts.

- *Significance of the Study*

This research will provide an important input for the policy debate relating to infrastructure development and Nigeria public financial management It is well documented that infrastructure plays a key role in stimulating economic growth, poverty reduction and quality of life (World Bank, 2020). But its actual impact depends not only on the size of the investment, but also on how well public money is spent.

The focus of the current study addresses this important void by examining not only what government spends on but also how efficiently and effectively government spend and which has often been lacking in the literature (Aigbokhan, 2021). The YESID research offers a fine-grained understanding of how investments can be better geared to public investments and their impact on development pathways, as it relates to infrastructure investments and alternative patterns of sustainable growth.

The results will contribute to policy reforms to enhance fiscal discipline, transparency, and value-for-money considerations in infrastructure projects. This is especially significant in a non cash rich environment as Nigeria where getting the most out of every dollar spent by the public sector is crucial (Obi, 2020).

Moreover, those of this study are findings whose implications are far beyond Nigeria. These problems of how to finance infrastructure, and ZO how to ensure that it contributes to enhancing the living conditions of the population apply to virtually all of the developing economies. Nigeria's situation is also relevant for other countries who strive to maximize the development – effects of an infrastructure strategy (Adedokun & Abiola, 2023).

Academically, this presents another paper that contributes to the evidence base for infrastructure economics, along with the increasing note built up for public sector efficiency and sustainability. It is consistent with recent calls for more robust, holistic evaluations that move beyond traditional resource measures and include considerations of project outcomes, equity, and sustainability (Umeh, 2021).

Finally, the study is useful for policy formulators, development planners, researchers, foreign development partners who believe in infrastructure-led growth in Nigeria and other developing countries

II. LITERATURE REVIEW

- *Conceptual Review*

Government expenditure is the total amount of public funds spent by a government firm on various sectors in the economy for example infrastructure. This includes both capital and recurrent expenditure for social and economic purposes. And when it comes to infrastructure building, Government spending represents that government expending in the construction, repair and improvement of all sorts of physical assets such as roads, bridges, energy infrastructure, and also communication systems (World Bank, 2020) The efficiency and effectiveness of such expenditures are key priorities for assessing the success of a project in infrastructure building and its potential based benefit to economic growth (Eboh & Eze, 2022).

Infrastructure for infrastructure's sake means constructing new buildings and expanding (as well as upgrading and repairing) underlying large physical networks which are necessary to sustaining economic life. That infrastructure ranges from roads and railways to airports (and their electricity grids, renewable energy, water and communication networks) (Akinwale & Dada 2019). Efficient infrastructure contributes to productivity by lowering the cost of doing business and facilitating investment and trade. This is a very significant determinant of sustainable economic growth (Umeh, 2021).

GDP during certain period Gdp function is the total economic value of all the goods and services produced by believers of an individual nation. The economic situation based on this elementary measure method (Federal Ministry of Finance, 2019). The study comprises GDP as the dependent variable in which a proximate quantitative variable is used to measure its expansion through government public infrastructural expenditures.

Goods and services can accumulate over time through sustained investment, and the result is sustainable growth and

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countering the effects of deteriorating conditions when it is not sustainable. A comprehensive balance is unconditionally preferred between the maximization of economic performance, the conservation of the environment and the assurance of equal social circumstances (World Bank, 2020). "Sustainable and stable growth" involve gradual movement of the GDP with the control of inflations base on GDP deflator measures and the unemployment rates of the population remain constant to achieve intergeneration consitency(World Bank, 2021). The quality of infrastructure, particularly energy, transport and communication, is the backbone of economic activities, as it enables increased efficiency and lower costs (OECD, 2020). Investment in sustainable infrastructure for the future (resilience) in mobility (low carbon economy) and supports technological innovation, as well as provides for productivity (Schwab, 2019).

The relationship between the government spending-infrastructure development-income, is a driving force in the economic growth. While this government spends, is expected to enhance infrastructure and hence GDP, some inefficiencies such as corruption, poor planning, mismanagement can limit the expected outcome in the short run (Aigbokhan, 2021).

In this study; government expenditure is an independent variable, GDP is a dependent variable and infrastructure development is a mediating variable. The idea is to compare how effectively public spending gets turned into the concrete infrastructure that has been deemed good policy and how much such infrastructure does or doesn't support economic growth. Drawing on an efficiency lens, the study seeks to explain the conditions of possibility (and impossibility) for the developmental potential of infrastructure investment in Nigeria (Obi, 2020).

- *Theoretical Framework*

The study is underpinned by three theoretical domains; the Public Expenditure Theory, Theories of Sustainable Development and the Models of Economic Growth. These theories inform the nexus between public expenditure, infrastructure provision and development.

- *Public Expenditure Theory*

*T*he economics of public expenditure elucidate what motives and how government expends in areas not offered by private markets, like capital infrastructure (Musgrave & Musgrave, 1989). That means we have to be good with our spending in the public sector in order to maximize welfare and promote growth. Within the Nigerian environment, the public interest theory is applicable in evaluating how efficiently the public money budgeted for infrastructure is applied and used (Eboh & Eze, 2022). The study draws on the theory of public expenditure to examine the ex-post effectiveness of public investment in infrastructure by examining the extent to which actual public infrastructure yield significant impact on GDP growth as a theoretical expectation (Aigbokhan, 2021).

- *Sustainable Development Theories*

Derived from the Brundtland Report (1987), sustainable development theories prioritize fulfilment of the current needs without jeopardising the ability of the future generation to fulfil their own needs. It promotes a form of growth that is socially inclusive, economically viable and environmentally sustainable (Sachs, 2015). The evaluation of infrastructure development in providing growth and sustainable development is guided by the framework explained in this study (Umeh, 2021). It considers social and environmental aspects of infrastructure projects, their ecological footprint, inclusiveness and added value in the future.

- *Economic Growth Models*

Endogenous growth models and Solow-Swan models help us understand variables that affect long-term economic growth. Solow examined the impact of capital accumulation and technological change, while the endogenous models stressed the role of investments in infrastructure and human capital; and R&D (Romer 1990).

These models are the theoretical framework of this study which will be used in analyzing the nexus of governments spending on infrastructure and productivity efficacy in Nigeria (Adedokun & Abiola, 2023). Based on such growth models, infrastructure is presented as a facilitator of growth in gross domestic product (GDP).

- *Empirical Review*

The importance of investment in infrastructure as a linchpin of economic growth is well established. However, empirical research suggests large differences in performance due to efficiency, governance and country-specific environment.

For instance, Adewuyi and Olowookere (2018) found that infrastructure array of investment had a positive but insignificant impact on growth in Nigeria for 2000–2017. Equally, Fasoranti (2019, p.16) noted that in the areas of health, transport and communication, expenditure had not led to a significant improvement in performance of the economy.

At the international level, Zhao and Gao (2019) demonstrated that investment in tourism infrastructure in China [R] was unbalanced by region, with some regions such as the central region receiving too much investment and others such as the coastal and western regions not receiving enough. This legal and spatial [STATUTORY] limitation to budgetary expansion, combined with the Southward direction of the growth potential, required that the territorial distribution of State expenditures also be equitatively [SPATIALLY] balanced. Citing the African Development Bank, AfDB (2021) in Africa pointed out Knowledge gaps of infrastructure outcomes across countries such as governance and implementation issues.

Munnell (2019) demonstrated that investment in infrastructure at the U.S. state level led to a in significant productivity growth in developed economies. But (Bivens 2017) warned that if it is to be reap a benefit and then stop, such inconsistent funding does not allow the money to produce long-term effects, which "suggests a demand for sustained investment from which benefits continue to accrue. For instance, Kraehe (2020) reported that "the Australian economy

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is dependent on infrastructure investment", that there were "reductions in capital investment across most parts of the economy" (esp. in transport and water where investment dropp ed from 5% of GDP in the 1980s to 3.75% in recent years, with consequences on national productivity.

This inefficiency in Nigeria is not peculiar. Misallocation and corruption were cited as major impediments to infrastructure led growth in Africa (Ogun, 2018). Recognize the importance of sustainable finance to prevent potential fiscal imbalances which would undermine growth from infrastructure investments (IMF, 2022). One of the emerging alternatives to fill that efficiency gap are Public-Private Partnerships (PPPs). Rajan and Zingales (2023) had proved that PPP with decent contractual design drastically improved infrastructure delivery in India, may be Nigeria could key into such models.

- *Infrastructure Spending is Also Indicative of Sectoral Trends:*

China's Three-Year Action Plan during 2016–2018 coincided with substantial investment in transport infrastructure, which boosted GDP and led to demand for energy being supplied (particularly in the case of the construction industry) (Ji et al., 2019).

As for the transportation energy use efficiencies the investment on tourism infrastructure has resulted in a joint -soid transportation one (OECD, 2018; L. et al., 2019). 28.5% of the fifth Five-Year Plan in India was dedicated to energy and considered as fundamental element for climate-resilience (Chi, 2023). The service industry received around 23 percent of FDI, followed by telecommunications and construction (Devonshire-Ellis&Associates, 2012).

Public investments, including in electricity generation and grid upgrades, which dominate the energy sector in Nigeria, amount to a large portion of government spending (Edomah & Ndulue, 2020). Nigeria's transportation infrastructure (roads and railways) has been heavily invested in for the purpose of promoting regional trade and industrial development (Adewuyi & Olowookere, 2018). Similarly, there was also a rise in telecommunication investment in 2507.281635); Oyeyemi et al., 2019).

Despite these gains, challenges have impeded the development of the infrastructure and, in turn, impeded the role it plays in the growth of the economy, these include corruption, shortfalls in budgets, and bureaucratic bottlenecks (Nwankwoala, 2021).

- *Infrastructure Investment Key Drivers*

The decision to commit to sustainable infrastructure is deeply complex and goes way beyond mere cost considerations, but stretches to an economic, institutional and technological canvas. One of the notable enablers is the technological innovation that enhance the productivity, resources utilization and effective services delivery across all sectors (Du et al., 2022; Ding et al., 2022). Moreover, it depends upon political stability and policy stability that guarantees a predictable environment and is favorable for long term investment in infrastructure (Henisz, 2002). In light of the monumental impacts of a pandemic upon the world, digitalisation and green investment could now be considered as key cornerstones of recovery strategies to the post-pandemic crisis domestically and internationally and encourage low-carbon growth and resilience, widely acknowledged for the construction industry (Ruddock & Ruddock, 2022). Building a sustainable future depends on more than just infrastructure. Chin et al. (2021) underscore the importance of complementary investments in health, education and export capacity for inclusive development outcomes. Furthermore, co-ordination of infrastructure visions with national development goals not only improves service delivery but also promotes policy coherence on a macro-level (Adshead et al., 2019).

Public–private partnerships (PPPs), and more general mechanisms to leverage private finance, are emerging as potential mechanisms to fill the financing gaps on infrastructure, particularly where domestic resources are limited (Stanley, 2011). Moreover, mainstreaming urban growth and quality service delivery in urban-connected infrastructure in low cost will still represent necessary conditions of inclusive and sustainable economic development (Ng et al., 2019; Proag, 2020). For the transitional economies, smart grid systems and energy infrastructure revival and modernization are slowly also emerging in the lists of sustainable development instruments that provide countries with considerable economic and environmental benefits (Buriak, 2019).

But at its heart it is not about how much money is ploughed into infrastructure that makes it work, but rather institutional structures, innovation ecosystems, long-term planning and inclusive implementation. These complex and contradictory influences provide a challenge and opportunity for Nigeria in using infrastructure as a catalyst for sustainable economic development that are genuinely transforming.

III. METHODOLOGY

- *Model Specification*

This study adopts an econometric approach to evaluate the efficiency of government expenditure on infrastructure development and its impact on sustainable economic growth in Nigeria. Specifically, the model formulation aligns with the second research objective, which assesses the contribution of infrastructure-related government expenditure to Gross Domestic Product (GDP).

The analytical framework adapts the model proposed by Fasoranti (2012), which posits that GDP is a function of government expenditure across key sectors, including education, health, environment and housing, water resources, agriculture, defense and internal security, transportation and communication, and inflation (as a control variable).

$$\mathrm{GDP} = \mathrm{f}\,(\mathrm{EDU}, \mathrm{EEH}, \mathrm{EHS}, \mathrm{EWR}, \mathrm{IFR}, \mathrm{AGR}, \mathrm{SEC}, \mathrm{TC})$$

However, for the purpose of this study, the model is modified to reflect the focus on infrastructure. Expenditure on water resources, agriculture, and security is excluded, and

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infrastructure-related capital and recurrent expenditures are incorporated.

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$$GDP = f(EDU, EEH, EHS, EWR, IFR, AGR, SEC, TC)$$

However, for the purpose of this study, the model is modified to reflect the focus on infrastructure. Expenditure on water resources, agriculture, and security is excluded, and infrastructure-related capital and recurrent expenditures are incorporated.

In its linear form, the model is specified as:

$$GDP_t = \beta_o + \beta_1 GCE_t + \beta_2 RRE_t + \beta_3 CMS_{t+} \beta_4 HI_t + \beta_5 EDE_t + \beta_6 INF_t + \epsilon_t ----- \quad 3.5$$

To accommodate both short-run and long-run dynamics and correct for potential non-stationarity, the Autoregressive Distributed Lag (ARDL) model is employed. The ARDL re-specification is given as:

$$\Delta InGDP_t = \beta_0 + \sum_{i=1}^{n} \beta_{5i} \Delta InGDP_t + \sum_{i=1}^{n} \beta_{2i} \Delta GCE_t + \sum_{i=1}^{n} \beta_{3i} \Delta InRRE_t + \sum_{i=1}^{n} \beta_{4i} \Delta InCMS_t + \sum_{i=1}^{n} \beta_{5i} \Delta InHI_t + \sum_{i=1}^{n} \beta_{6i} \Delta InEDE_t + \sum_{i=1}^{n} \beta_{7i} \Delta InINF_t + \delta_8 InGDP_{t-i} + \delta_9 InGCE_{t-i} + \delta_{10} InRRE_{t-i} + \delta_{11} InCMS_{t-i} + \delta_{12} InHI_{t-i} + \delta_{13} InEDE_{t-i} + \delta_{14} INF_{t-i} + U_t --- - ---------- \quad 3.6$$

Where, Δ = Difference vector, Σ = Summation, In=Logarithm, βo = Constant term, β1…β7 =Short-coefficients, δ_8 ... δ_{14}= Long-run coefficients to be estimated, μ_t represents the error term

This specification enables the estimation of both the short- and long-run effects of government expenditure on infrastructure development and economic growth.

➢ *Sources and Method of Data Collection*

This study relies exclusively on secondary data, drawn from reputable sources. Data were obtained from the Central Bank of Nigeria (CBN) Statistical Bulletin, World Development Indicators (World Bank), and the African Infrastructure Development Reports across multiple editions. The data span a 23-year period (1999–2022), offering a longitudinal view of trends in government expenditure and GDP performance in Nigeria.

- *Variables Collected Include:*

✓ Government capital and recurrent expenditure on infrastructure,
✓ Government spending on health and education,
✓ Inflation rates,
✓ Annual GDP values.
✓ All monetary values were adjusted where necessary to account for inflation and expressed in consistent units.

➢ *Estimation Techniques*

The study applied the following econometric techniques to determine the relationship between public infrastructure expenditure and economic growth:

For this analysis, the researchers employed Augmented Dickey-Fuller (ADF) as the main unit root test.

Before estimation of the models, we performed Unit Root test using Augmented Dickey-Fuller (ADF) methodology, in order to test whether the time-series data became stationary. Stationarity frequently required in time series analysis Stationarity is a common challenge in time series analysis, because lack of it produces spurious results.

Through the unit root of the ADF test, we find whether the statistical properties within the series vary over different spans of time. In stationary series, mean and variance patterns remain constant over time so that these are suitable for modeling and forecasting. This is the augmented Dickey-Fuller test estimated to control for the serial correlation in the residuals by excluding lagged difference terms and increases the robustness of the test (Greene, 2008).

➢ *Autoregressive Distributed Lag (ARDL) Model*

The primary analysis method involved using ARDL because this technique provides flexibility when working with small datasets that contain variables with mixed orders of integration I(0) and I(1). According to Pesaran and Shin (1998) and Pesaran, Shin, and Smith (2001) this methodology represents an efficient method for studying time-series data because it analyzes both short-run and long-run relationships.

ARDL models integrate the delayed measurements of both dependent variables and independent variables. An ARDL approach to determining cointegration allows researchers to examine long-term variable associations without concerning themselves about the I(0) or I(1) characteristics of their elements.

➢ *Post-Estimation Diagnostic Tests*

To ensure the reliability and robustness of the ARDL model results, the following post-estimation diagnostic tests were conducted:

- Jarque-Bera Test – to assess the normality of residuals.
- Breusch-Pagan Test – to test for heteroscedasticity.
- Breusch-Godfrey Serial Correlation LM Test – to check for autocorrelation in residuals.

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These diagnostic checks ensure that the model satisfies classical linear regression assumptions, thereby validating the credibility of the findings.

IV. ANALYSIS AND DISCUSSION OF FINDINGS

The empirical analysis section based on ARDL estimation presents both interpretation and discussion of obtained findings. The research evaluates the connection between public infrastructure spending and economic development in Nigeria. The analysis incorporated time-series methodology which included stationarity tests through the Augmented Dickey-Fuller (ADF) method and long-run relationship identification through the ARDL bounds testing structure together with post-estimation diagnostic checks.

➢ *Stationarity Test (Augmented Dickey-Fuller Test)*

The first step in the time-series analysis involved conducting the ADF test to determine the stationarity of variables. Table 1 summarizes the results.

Table 1 ADF Unit Root Test Results

Variables	Test Statistic	Level	First Difference	Order of Integration
LGDP	-4.4773 (p = 0.0026)	I(0)	N/A	I(0)
LGCE	-0.2533 (p = 0.9173)	-4.1954 (p = 0.0041)	I(1)	
LRRE	-1.9635 (p = 0.2994)	-6.3301 (p = 0.0000)	I(1)	
LEHI	-1.4091 (p = 0.5571)	-6.3310 (p = 0.0000)	I(1)	
LEDE	-0.7843 (p = 0.8039)	-0.6882 (p = 0.0000)	I(1)	
LECS	-1.2681 (p = 0.6252)	-7.1039 (p = 0.0025)	I(1)	
INF	-3.1774 (p = 0.0026)	N/A	I(0)	

Source: Author's Computation using EViews 10, 2024

The results indicate that LGDP and INF are stationary at level [I(0)], while all other variables (LGCE, LRRE, LEHI, LEDE, and LECS) become stationary after first differencing [I(1)]. Given this mixed order of integration, the ARDL technique is appropriate for estimating both short-run and long-run relationships.

➢ *Bounds Testing for Cointegration*

The ARDL bounds test was conducted to examine the existence of a long-run relationship among the variables. The null hypothesis is that no level relationship exists.

Table 2 ARDL Bounds Test

Test Statistic	Value	Critical Values (Bounds)	I(0)	I(1)
F-statistic	17.027	10%	2.12	3.23
		5%	2.45	3.61
		1%	3.15	4.43

Source: Author's Computation using EViews 10, 2024

Since the calculated F-statistic (17.027) exceeds the upper bound of the critical values at all significance levels, we reject the null hypothesis. This confirms the existence of a long-run cointegrating relationship between government expenditure on infrastructure and economic growth.

➢ *Lag Order Selection*

The appropriate lag length for the ARDL model was determined using the Akaike Information Criterion (AIC), which selected a lag length of one.

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Table 3 Lag Length Selection Criteria

Lag	AIC	SC	HQ
0	-0.21109	0.087341	-0.14633
1	-3.15695	-2.80878	-3.08139
2	-3.08328	-2.68536	-2.99692

Source: Author's Computation using EViews 10, 2024

➢ *Long-Run ARDL Results*

The long-run coefficients estimate the impact of government expenditures on economic growth (proxied by LGDP).

Table 4 Long-Run ARDL Results

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LGDP(-1)	-0.015	0.045	-0.34	0.74
LGCE(-1)	0.007	0.021	0.337	0.743
LRRE	0.034	0.021	1.605	0.137
LEHI	-0.049	0.079	-0.619	0.549
LECS(-1)	0.012	0.017	0.728	0.482
LEDE	-0.072	0.072	-0.997	0.34
INF(-1)**	0.007	0.003	2.319	0.041*

Source: Author's Computation using EViews 10, 2024. *Note: * $p < 0.05$

In the long run, only inflation (INF) is statistically significant. Capital and recurrent expenditure, as well as spending on education, health, and community services, have the expected signs but are not statistically significant at the 5% level.

➢ *Short-Run ARDL Results*

Table 5 ARDL Short-Run Coefficients.The Short-Run Dynamics of the Model are Reported Belo

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LGCE)**	0.066	0.017	3.834	0.003*
D(LECS)	-0.016	0.011	-1.51	0.159
D(INF)	0.002	0.001	1.89	0.085
CointEq(-1)**	-0.015	0.001	-12.413	0.000*
Constant	0.597	0.037	15.958	0

$R^2 = 0.908$, Adj. $R^2 = 0.887$, F-Stat = 42.161, Prob = 0.000, DW = 1.670

Source: Author's Computation using EViews 10, 2024

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The short-run model shows that capital expenditure (D(LGCE)) significantly and positively impacts economic growth at the 5% level. The error correction term (CointEq(-1)) is negative and significant, indicating convergence toward the long-run equilibrium at an adjustment speed of 1.5% per annum.

The model explains approximately 90.8% of the variation in LGDP. The F-statistic (42.161) and its p-value (0.000) indicate strong overall significance. The Durbin-Watson statistic of 1.670 suggests no autocorrelation.

➢ *Post-Estimation Diagnostic Tests*

To verify model reliability, the study conducted several diagnostic checks:

Table 6 Post-Estimation Diagnostics

Test	Statistic	Prob.	Decision
Breusch-Godfrey Serial Correlation	0.218	0.4931	No serial correlation
Breusch-Pagan-Godfrey (Heterosced.)	0.58	0.7998	No heteroscedasticity
Jarque-Bera (Normality)	—	0.6162	Residuals are normally distributed

Source: Author's Computation using EViews 10, 2024

These results confirm that the model meets standard regression assumptions, including normality, homoscedasticity, and absence of autocorrelation.

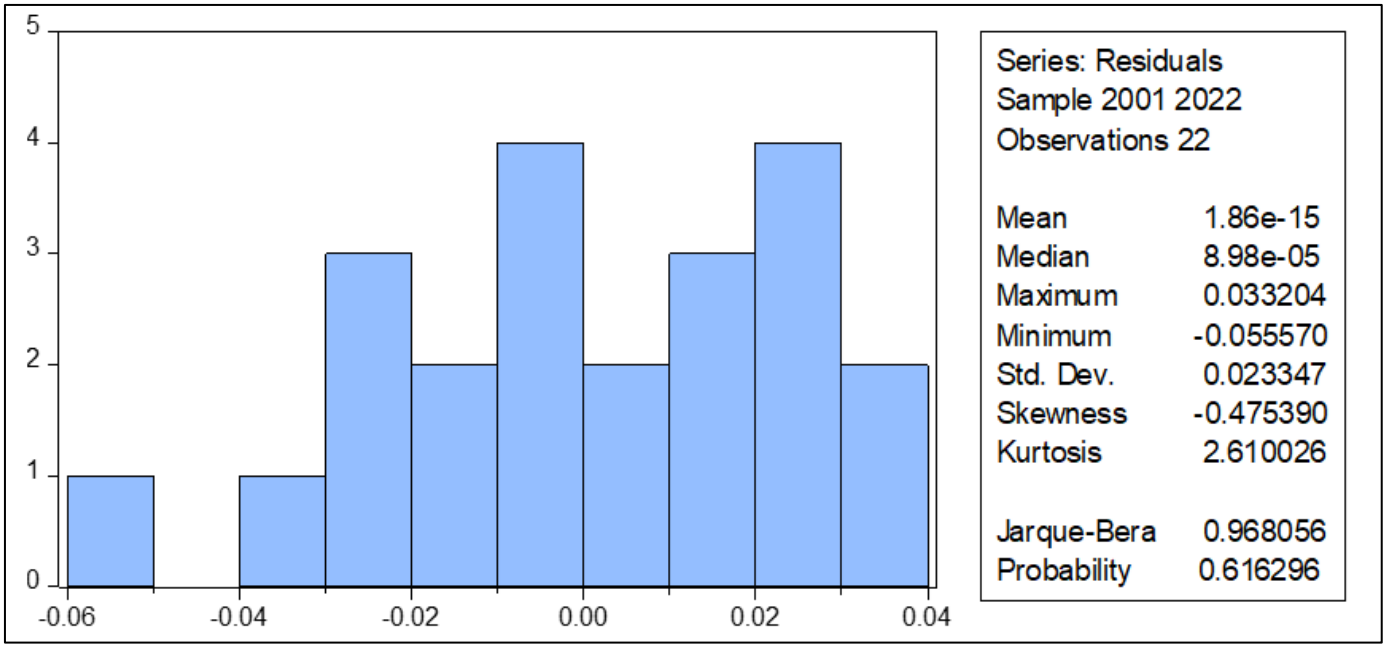

Fig 1 Histogram of Residuals

Source: Author's Computation using Eviews 10, 2024

➢ *Discussion of Findings*

Policy implications Results from this study indicates that government infrastructure spending has a dynamic effect on economic growth in Nigeria in the short run and long run period. The short term direct effect on economic growth comes from the capital spending, but education & health and community services which sector wise end up directing investments too, in the long run do not gain any level of statistical significance, possibly due to poor execution of projects as well as delayed outcome realization.

This may be an area for future research to investigate the intricate relation between macroeconomic stability and investment in infrastructure given that a long run inflation has a strong positive effect on GDP.

The large and appropriately signed error correction term indicates a long run equilibrium relationship, a feature that is confirmed by the diagnostic tests of the ARDL estimations.

V. CONCLUSION AND RECOMMENDATIONS

➢ *Conclusion*

Our results show that government investments imply fundamental growth effects, and that these effects are most

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apparent in the short-run. From the analysis, it can be gleaned that the return on investment in the health and education sector spending in the country is no efficient since their coefficients appear in low and negative form. This implies years of budget ineffectiveness in achieving full value from allocated resources. Public spending shows to be very crucial in the economic development but the effectiveness of resources utilization account for most of the development results. The long-run relationship also highlights the critical role of persistent, strategic public investment. Thus, the quality and efficiency of public spending through better accountability which requires significant institutional reforms in various sectors is as crucial for achieving a stable and long run accelerator of economic growth and development in Nigeria as the magnitude of central government spending.

➢ *Recommendations*

- *Improve Cost-Effectiveness of Public Spending*

For Nigeria, that would mean an absolute focus on enhancing the public expenditure efficiency, especially in these two sectors — health and education. This can be done through tighter planning, monitoring and evaluation frameworks that make sure sizable funds are spent and disbursed toward developmental outcomes.

- *Capex to Boost Economic Infrastructure Development*.

Capital expenditure has a statistically significant effect on national GDP and as such, the government should enhance the proportion of capital projects in the government budget. The focus should be on infrastructure with high economic returns, including transport, energy and digital connectivity.

- *Maintaining Long-Run Infrastructure Investmen*t

And long-term infrastructure development needs to be aligned with the national strategic goal and sustainable development goals. Economies must engage in persistent finance on their frameworks for pragmatic adjustment and comprehensive development.

- *Enhance Design and Facilitation of Policy Implementation and Governance*

Inadequate policy implementation is often followed by delays, cost overruns and even abandonment of projects. Improvement in Role of Institutional Capacity and Enforcing Accountability has a potential to increase on timelines and efficiency of Infrastructure Delivery.

- *Establish Strong Monitoring and Evaluation Systems*

Comprehensive monitoring and evaluation mechanisms will inevitably be a significant step to ensure the performance

➢ *Contributions to Knowledge*

This study offers the following major contributions to the government expenditure, infrastructure development, and economic growth literature:

- *The Lack of Empirical Evidence on Public Spending Efficiency*

It gives me empirical evidence on how effective public spending can be in Nigeria, showing for example that capital expenditure has a bigger economic impact than recurrent spending on health and education.

- *Implementing the ARDL Model in Nigeria*

Moreover, employing the ARDL model in analyzing the dynamic short- and long-run relationships adds a solid methodological dimension to investigating time-series data in developing economies struggling with structural imbalances and data limitations.

- *Sectoral Insights into Expenditure Allocation*

These findings provide a better understanding of sector-specific public expenditures, implying that they belong to a category that challenges the assumption that public spending in all sectors has a positive effect on growth. The study highlights the need for efficiency in the sector.

- *The Short-Run vs. Long-Run Adjustment for Effects*

The study's capabilities to isolate the temporal impacts of government expenditure helps these policymakers as they work to balance their short-term growth objectives with their long-term development objectives.

- *Quick Policy-Relevant Takeaways for Developing Economies*

The practical policy recommendations generated by the study are especially relevant for other developing countries facing resource constraints in optimizing infrastructure spending for sustainable development.

➢ *Recommendations for Future Research*

- *Disaggregated Sectoral Analysis*

Future work should include disaggregated analysis of diffusion of government expenditure (in particular health and education) by specific components of spending (i.e. infrastructure, salary, equipment) to the extent that data becomes available to assess the economic implications.

- *Governance and Institutional Quality*

Showcasing the mediating effect of governance, corruption and bureaucratic efficiency may shed light on the effect of institutional quality on the outcomes of public investments.

- *Similarities and Differences Across Regions and Countries*

Comparative studies, either across Nigeria's regions or between Nigeria and peer developing economies, could enhance understanding of context-specific determinants of expenditure efficiency and improve targeting of resource allocation intervention policies.

- *Studies Looking Long-Term at Infrastructure Projects*

Data on the life cycle and post-completion trajectories of specific infrastructure projects are still scarce; future research could follow these trajectories through time to

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determine the actual impact of completed infrastructure on economic growth.

- *Integration of the New Technologies*

With digital infrastructure and smart technologies now at the heart of modern economies, research should assess how technology can be harnessed to create a more efficient infrastructure and boost economic productivity.

- *Social Effects of Government Investment in Infrastructure*

Future research, in addition to the economic measures, should explore the social benefits of infrastructure investment, such as quality of life, poverty alleviation, and social equity.

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