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# Effects of Public Sector Investment in Transportation Infrastructure on Economic Growth in Nigeria

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**KEYWORDS:** Transportation infrastructure, public investment, economic growth, capital expenditure, ARDL, Nigeria.

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**ABSTRACT**

This study investigates the effects of public investment in transportation infrastructure on economic growth in Nigeria over the period 2000–2024. The dataset is sourced from the Central Bank of Nigeria (CBN) Statistical Bulletin, National Bureau of Statistics (NBS), and the World Development Indicators (WDI, World Bank) Real Gross Domestic Product (RGDP) is employed as the dependent variable, while public investment in transportation infrastructure (PITI), road construction expenditure (RCE), total capital expenditure (TCE), and inflation (INF) serve as the explanatory variables. Anchored on the Keynesian multiplier theory, the study adopts the Autoregressive Distributed Lag (ARDL) model, following preliminary descriptive, correlation, and unit root tests. The empirical findings reveal that public investment in transportation infrastructure has a positive and statistically significant long-run effect on economic growth, while road construction expenditure and total capital expenditure exert positive but statistically insignificant effects. Inflation shows a negative but insignificant relationship with growth. The short-run results indicate delayed adjustment effects, with the error-correction term confirming a stable convergence to long-run equilibrium. Diagnostic tests show no evidence of serial correlation, heteroskedasticity, misspecification, or model instability. The study concludes that sustained and efficient investment in transportation infrastructure is crucial for long-term economic growth in Nigeria. It recommends improved project execution, macroeconomic stability, diversification of transport infrastructure, and stronger governance mechanisms to enhance the growth impact of public spending.

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## 1.0 INTRODUCTION

### 1.1 Background to the Study

Transportation infrastructure, encompassing roads, railways, ports, and airports, serves as the backbone of economic activity by facilitating the movement of goods, services, labour and ideas, reducing transaction costs and stimulating both local and international commerce. Countries at various stages of development recognize transport infrastructure investment as a key component of long-run growth strategies, with public investment often acting as a catalyst for private sector engagement. In developing economies, public investment in such infrastructure is often pivotal for unlocking growth potential, as private sector participation may be limited by high risks and long gestation periods (Foster, Gorgulu, Straub and Vagliasindi, 2023).

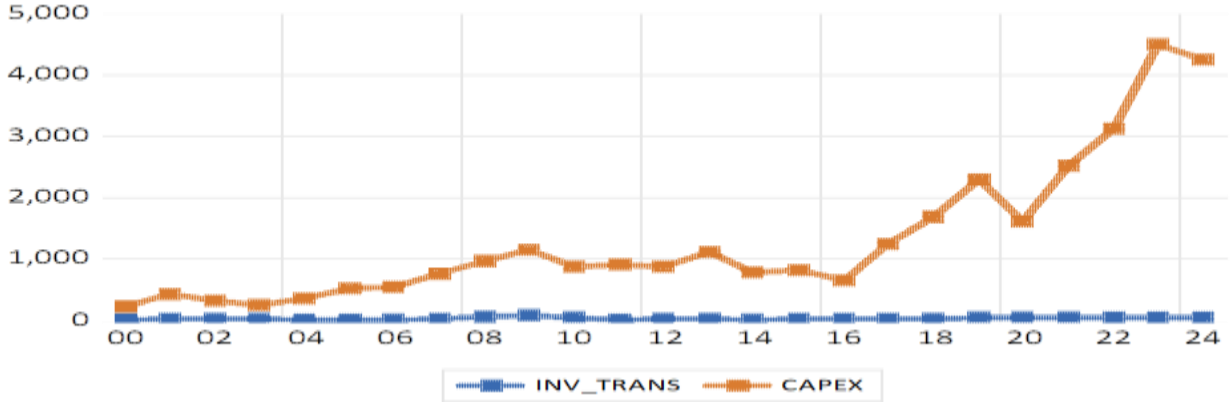
In the case of Nigeria, the importance of the transport sector is magnified by the country's size, population and aspirations for diversification away from oil. Transportation infrastructure in Nigeria constitutes a significant component of public capital outlay, covering roads, railways, ports, airports, and inland waterways but sadly, has long been a critical bottleneck to sustainable development. Despite being among the world's ten largest oil producers, Nigeria grapples with dilapidated road networks, underutilized rail systems, and congested ports, which inflate logistics costs to 40% of goods' value - far exceeding the global average of 10-15% (Damilola, Pedro-Itota and Olufemi, 2023). These deficiencies exacerbate regional disparities, hinder non-oil sector diversification, and contribute to persistent poverty affecting over 40% of the population. For instance, the Nigerian Institution of Highway and Transportation Engineers (NIHTE, 2025) has reported that Nigeria's infrastructure capital stock currently amounts to only about 30 % of GDP, far below the 70 % benchmark recommended for middle-income countries. The state of transport infrastructure has direct implications for Nigeria's economic performance. As one of Africa's largest economies and most populous nation, Nigeria relies heavily on the efficient movement of crude oil, agricultural produce, manufactured goods, and labor across different regions. Inefficiencies in transportation have contributed to rising production costs, reduced competitiveness, regional inequality, and low foreign investment in key sectors. The link between transport infrastructure and economic growth therefore becomes a critical policy issue, especially as Nigeria continues to pursue economic diversification away from oil dependence.

The transport sector in Nigeria is critical for several reasons: First, it carries the lion's share of passenger and freight movements, especially in the road sub-sector which handles over 80-90 % of movements in many estimates. This makes the state of road infrastructure pivotal for economic activity (NIHTE, 2025). Second, it forms the logistical backbone for other sectors: agriculture, manufacturing, trade, services. For example, rural roads enable access to markets, reduce post-harvest losses, and support farm incomes. A recent project announcement by the World Bank under Nigeria's Rural Access Agricultural Marketing Project – Scale Up (RAAMP-SU) aims to rehabilitate/upgrade 6,500 km of rural roads to benefit 4 million rural residents (World Bank, 2024). In Nigeria, the policy context highlights the urgency of efficient and expanded transport infrastructure. The nation has announced major projects including rail modernization, coastal highways, seaport expansions, rural accessibility programmes aimed at overcoming the bottlenecks. For example, the country has secured international funding for rail-links, and loans to shore up roads. These show commitment, but empirical assessment lags behind. In view of limited fiscal space, high public debt burden and competing demands on public funds (education, health, security), it becomes imperative to examine whether the public investments in transport infrastructure over the years yield commensurate economic growth.

### 1.2 Statement of the Problem

Despite the recognition of transportation infrastructure as a critical driver of economic growth, the economy of Nigeria continues to experience sub-optimal performance of real gross domestic product (RGDP) growth, even as public investment and other relevant macroeconomic variables evolve.

**Figure 1: Historical Trend and Movement of Public Investment in Transportation Infrastructure Vs. Total Capital Expenditure (2000-2024)**




***Source: Researcher's computation (2025)***

In particular, the period from 2000 to 2024 has been characterized by the following troubling trends:

1. Infrastructure investment gaps and low returns: Although the government has increased public investment in transportation infrastructure (roads, rail, ports, airports) and overall capital expenditure, the infrastructure stock remains inadequate and often in poor condition. For example, one report notes that Nigeria's infrastructure investment has failed to keep pace with its population growth of around 2.5 % per annum. The result is persistent bottlenecks in logistics, high vehicle operating costs, delays in goods movement, and lower productivity (Nairametrics, 2024; World Bank, 2025). Thus, while public investment in transportation infrastructure has increased in absolute terms, the effectiveness of that investment in translating into higher RGDP remains doubtfully small or inadequately measured.

2. Mismatch between expenditure and economic growth: Total capital expenditure - including investments in transportation - has at times been cut or underspent, and often fails to meet benchmark levels that developing economies require for sustained growth. For example, infrastructure funding in Nigeria has been far below the recommended 70 % of GDP needed to maintain growth-enhancing infrastructure (Punchng.com, 2024). Accordingly, it is unclear whether increases in public investment in transportation infrastructure (and road construction expenditure specifically) are yielding commensurate increases in RGDP during the 2000-2024 period.

3. Inflation and macro-economic instability undermining returns: Inflation in Nigeria has often been high and volatile, which can erode the real value of public investment spending, increase maintenance and construction costs, and reduce the real productivity gains from transport infrastructure. High inflation can also raise borrowing costs, reduce private investment, and divert public funds to recurrent expenditures rather than productive capital outlay.

Given Nigeria's constrained fiscal space, high public debt, and competing demands from health, education, security and other sectors, it is crucial to establish whether public investment in transportation infrastructure yields significant growth benefits after accounting for inflation and in the context of total capital expenditure. If the marginal returns are low or uncertain, policy makers may need to reconsider the allocation, mode (roads vs rail vs ports), and financing (public vs public-private partnership) of infrastructure investments.

Hence, the primary problem this study addresses is: Why does the substantial public investment in transportation infrastructure (including specific road construction expenditure and total capital expenditure) in Nigeria not appear to translate fully into robust RGDP growth when inflation is significant and persistent? In other words, what is the empirical impact of public investment in transportation infrastructure, road construction expenditure, total capital expenditure and inflation on Nigeria's RGDP over 2000-2024, and why might growth be constrained despite investment?

In essence, given the pivotal role of transport infrastructure in enabling growth, and Nigeria's existing infrastructure challenges and heavy reliance on public investment in this sector, this research aligns closely with both theoretical expectations and policy imperatives. The findings are expected to support evidence-based policymaking toward sustainable economic growth through strategic transport infrastructure investment in Nigeria.

### 1.3 Objectives of the Study

The main Objective is to examine the effect of public investment in transportation infrastructure on economic growth in Nigeria between 2000 and 2024. The specific objectives are:

1. To determine the impact of public investment in transportation infrastructure on economic growth in Nigeria.
2. To assess the effect of road construction expenditure on economic growth in Nigeria.
3. To evaluate the relationship between total capital expenditure and economic growth in Nigeria.
4. To examine the effect of inflation on economic growth in Nigeria.

### 1.4 Research Questions

The research is guided by the following questions:

1. What is the effect of public investment in transportation infrastructure on economic growth in Nigeria?
2. How does road construction expenditure influence economic growth in Nigeria?
3. What is the relationship between total capital expenditure and economic growth in Nigeria?
4. To what extent does inflation affect economic growth in Nigeria?

### 1.5 Research Hypotheses

The research hypotheses are to be tested in their null form ($H_0$)

$H_{01}$: Public investment in transportation infrastructure has no significant effect on economic growth in Nigeria.

$H_{02}$: Road construction expenditure has no significant effect on economic growth in Nigeria.

$H_{03}$ Total capital expenditure has no significant relationship with economic growth in Nigeria.

$H_{04}$ Inflation has no significant effect on economic growth in Nigeria.

### 1.6 Significance of the Study

This study is important because it provides empirical evidence on whether Nigeria's public investment in transportation infrastructure has significantly contributed to economic growth over the last two decades, offering insight that can guide policymakers, development agencies, and investors in making informed decisions about capital allocation. By examining the separate effects of transport investment, road construction expenditure, total capital expenditure, and inflation on real GDP, the study fills a gap in existing literature, especially with updated data up to 2024, a period marked by economic shocks such as recession, COVID-19, and subsidy reforms. The findings will contribute to academic knowledge, support national planning, and help evaluate whether government spending in the transport sector is yielding productive economic returns.

### 1.7 Scope of the Study

The study focuses on Nigeria and covers the period 2000–2024, examining the relationship between real GDP and key explanatory variables: public investment in transportation infrastructure, road construction expenditure, total capital expenditure, and inflation. It is limited to government-funded transport infrastructure, with primary emphasis on road-related expenditure due to available data, and adopts a macroeconomic, national-level perspective rather than a sectoral or state-level analysis. The study employs time series econometric methods to assess both the short- and long-run effects of the variables, and relies on secondary data sourced from institutions such as the CBN, NBS, and World Bank.

## 2.0 LITERATURE REVIEW

### 2.1 Conceptual Review

#### 2.1.2 Public Investment in Transportation Infrastructure in Nigeria

Public investment in transportation infrastructure refers to government capital outlays on physical transport assets such as roads, railways, ports, airports and inland waterways. The literature treats public investment in transportation infrastructure (PITI) as a form of public capital that enters the production function and raises the productivity of private capital and labour. Improved transport infrastructure lowers transaction and logistics costs, shortens travel times, and increases market access. Public investment in transportation infrastructure in Nigeria has been a critical focal area for promoting economic growth, regional trade facilitation, and improving connectivity across urban and rural areas over the past two decades (African Development Bank, 2019; African Infrastructure reports). The Nigerian government has made strides in infrastructure renewals by reviving stalled projects and deepening public-private partnerships (PPPs) to mobilize sustainable financing (Olaniwun, 2025). Nevertheless, bottlenecks persist, including regulatory hurdles, funding gaps, and maintenance deficits that limit the pace and quality of infrastructure delivery. Poor infrastructure has also been linked to increased logistics costs, which undermine competitiveness in regional and international trade (Nigerian Economic Summit Group, 2024; Umoh and Effiong, 2024).

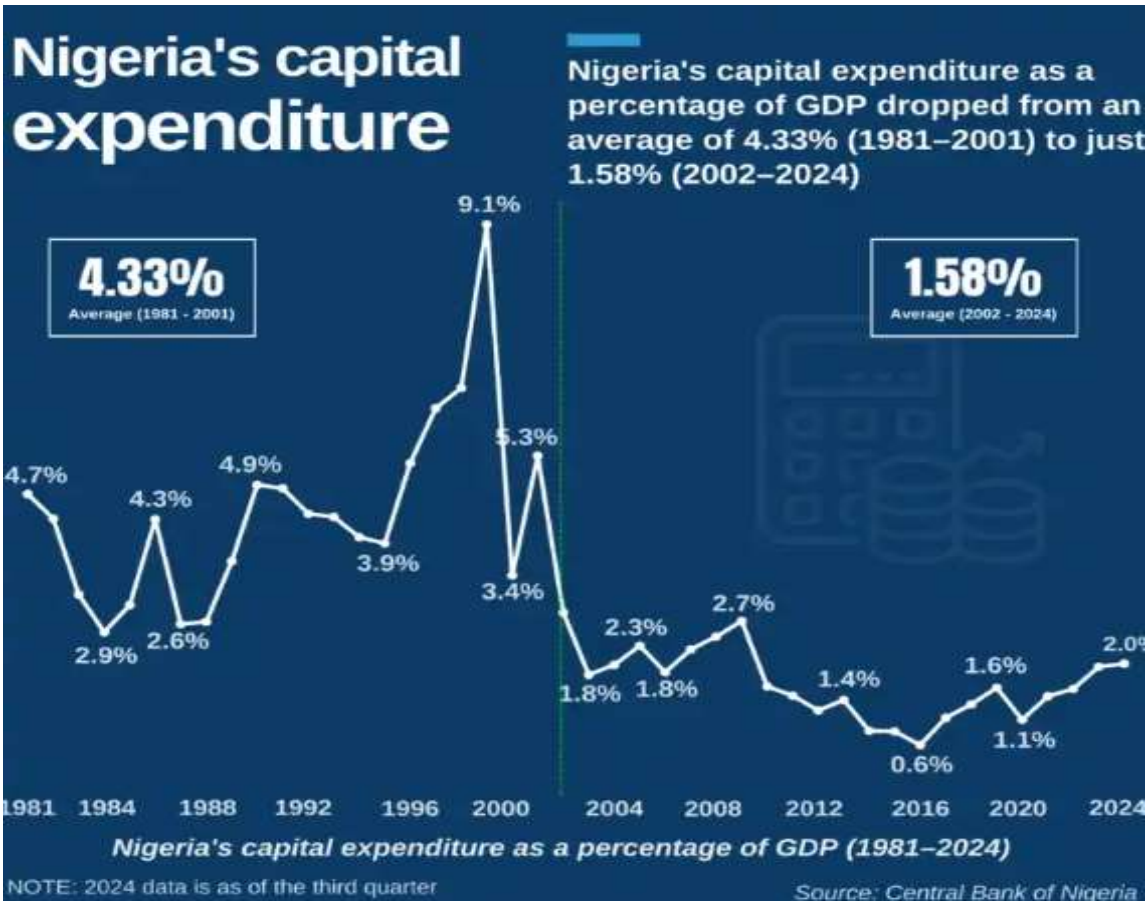
#### 2.1.3 Road Construction Expenditure

Roads are typically the dominant transport mode for both freight and passenger movements in Nigeria; therefore, road construction expenditure is often the most visible and measurable component of public investment in transportation infrastructure. Road investments can have direct effect (jobs during construction, demand for inputs) and indirect effect (reduced vehicle operating costs, improved supply-chain reliability, market expansion for agricultural and manufactured goods). In the 2024 fiscal year, the Nigerian government allocated approximately ₦548.6 billion (about $922 million) towards road construction projects, targeting the rehabilitation and expansion of over 1,900 roads nationwide. Additionally, around ₦288.44 billion was spent on modernizing roads and bridges in 2023, bringing combined expenditure for roads and bridges in these two years above ₦837 billion (Punch news report, 2023). Empirical studies on Nigeria show that road infrastructure improvements are strongly linked to regional economic activity and reductions in logistics costs, although the magnitude of effect varies by study and depends on maintenance and complementary investments (Idiong and Essien, 2023).

#### 2.1.4 Total Capital Expenditure

Total capital expenditure represents the aggregate government investment spending across sectors (not only transportation). Total capital expenditure is relevant because transport investment occurs within broader public investment decisions; crowding-in (or crowding-out) effects and complementarities mean that the growth impact of transport spending can depend on the level and composition of overall capital spending. Nigeria's capital expenditure as a percentage of GDP dropped sharply from an average of about 4.33% during 1981–2001 to just around 1.58% in the period of 2002–2024. After peaking at 9.1% in 1999, capital spending nosedived and has rarely surpassed 2% of GDP in the last two decades, reflecting a shift towards prioritizing recurrent expenditure like salaries and operating costs (CBN, 2025).

**Figure 2.1: Nigeria's capital expenditure as a percentage of GDP (1981-2024)**




***Source: Central Bank of Nigeria (2025)***

In summary, from 2000 to 2024, Nigeria experienced a declining trend in capital expenditure as a share of GDP despite increases in nominal expenditure values, with ongoing challenges in balancing capital and recurrent spending within the government budget framework (Punch news report, 2025).

### 2.1.5 Inflation

Inflation alters the real value of public investments, construction costs, and the price competitiveness of goods and services. High and volatile inflation can erode the purchasing power of budget allocations to infrastructure, raise project costs, and discourage private investment that might otherwise respond to improved infrastructure. Inflation in Nigeria has been characterized by significant fluctuations with an overall rising trend, especially pronounced in recent years. In summary, Nigeria's inflation rate from 2000 to 2024 shows a pattern of moderate to high inflation, with recent years reflecting significant inflationary pressures that have impacted cost of living and economic planning. Stabilizing inflation remains a key macroeconomic policy goal amid external shocks and domestic economic vulnerabilities. This inflationary backdrop also critically influences government spending decisions, capital project costs, and overall economic growth dynamics over the period (CBN, 2025; Statista, 2024).

### 2.1.6 Real Gross Domestic Product (RGDP)

Real GDP (RGDP) measures the total value of goods and services produced in an economy adjusted for price changes (inflation) and is the standard indicator of economic performance and growth. RGDP is the dependent variable in this study because it captures real output changes over time and allows assessment of whether public investments translate into higher productive activity and national income (i.e., real growth).

### 2.1.7 Transmission Channels

In practical terms, transport investments affect output through (i) supply-side productivity gains (lower input and distribution costs), (ii) demand stimulation during construction (fiscal multiplier), (iii) induced private investment and FDI (better infrastructure encourages firm expansion), and (iv) distributional and regional effects (improved accessibility for underserved areas). When inflation is high or public maintenance is poor, these channels weaken or reverse. Recent empirical and policy literature on Nigeria consistently highlights the importance of transport infrastructure for growth but also emphasizes mixed effectiveness driven by maintenance deficits, financing constraints and macro volatility. Sectoral and regional studies show clear benefits of road improvements for agricultural incomes, local GDP and market integration, but also document that poor

maintenance and high logistics costs continue to limit the full growth potential of investments. This mixed evidence motivates the study's focus on both the level and composition of public capital spending and on inflation as a moderator of real outcomes.

## 2.2 Theoretical Review

### 2.2.1 The Keynesian Multiplier

The Keynesian multiplier is a foundational concept in Keynesian economics which asserts that an initial increase in autonomous spending (such as government expenditure) can generate a greater than one-for-one increase in aggregate output because of successive rounds of induced consumption (Keynes, 1936). In its simplest form, the multiplier is expressed as:

$$Multiplier = \frac{1}{1 - MPC}$$

When applied to the context of transportation infrastructure in Nigeria, the multiplier idea can help explain how public investment in transport, road construction expenditure, and total capital expenditure may influence real GDP (RGDP). First, on the demand side, expenditure on road/rail/port construction immediately injects funds into the economy: contractors pay wages, purchase raw materials, hire services — these generate incomes for households which then spend, stimulating further rounds of spending. Second, on the supply side, once the infrastructure becomes operational, it lowers logistics and transaction costs, improves accessibility, expands markets and enhances productivity of private capital and labour. These supply-side improvements raise the economy's output potential, producing long-run multipliers beyond the initial fiscal stimulus (Barro, 1990; Aschauer, 1989). In Nigeria's case, several factors suggest that the multiplier effect of transportation infrastructure investment could be particularly significant. The country has one of the largest infrastructure deficits in Africa, especially in transport (Olaniyi, Tella and Onanuga, 2024). When government invests in major transport projects (roads, rail, airports), there is substantial unused capacity and high room for improvements in productivity; in such contexts the fiscal multiplier tends to be higher because the induced consumption and productivity gains are strong. For instance, large road works will draw on domestic labour and materials—amplifying the demand stimulus—and once completed, they reduce vehicle operating costs and expand market reach for agricultural and manufactured goods.

However, the effectiveness of the multiplier in Nigeria is conditioned by certain macroeconomic and structural factors. High and volatile inflation, for example, can erode the real value of government investment, increase project costs, reduce real incomes from induced spending, and thus dampen the multiplier effect. Empirical studies in Nigeria have shown that inflation exerts a negative relationship with economic growth when public capital expenditure is accounted for (Saidu and Ibrahim, 2022). Furthermore, inefficient implementation, poor maintenance, weak institutional quality, or mismatch in spending composition reduce the productivity gains from infrastructure — so the supply-side multiplier may be muted despite large nominal investments (Ohalete, Anyanwu and Azuka, 2023).

## 2.3 Empirical Review

Dimnwobi, Nwokoye, Ekesiobi and Igboanugo (2017) investigated the empirical link between transportation infrastructure and diversification of the Nigerian economy. Descriptive demonstrations are adopted to provide a situational focus to the study, while a generalized method of moment (GMM) model is specified and estimated. Findings reveal that economic diversification is a negative function of transportation concentration ratio. In the same vein, the result suggests that transportation infrastructure is a significant factor in diversifying the sectoral output share of the country and the export base of the economy from oil sector to non-oil sector. To address this, the study put forward policy suggestions to improve the effectiveness and efficiency of transportation infrastructure geared for rapid diversification of the economy.

Enya and Ezeali (2021) examined Public Investment in Infrastructure and the Economic Growth of Nigeria. The study adopted Econometric analysis using E-View. The stationarity test carried out in the study showed that all the variables were all stationary at first difference,1(1). The study had it that Public Investment in Technology, Educational infrastructure and Power all have positive relationship with the Economy whereas Transport has negative relationship with the Economy. The study went further to conclude that Public Investment plays important roles in stimulation the Nigerian Economy especially in this era of democracy.

Damilola, Pedro-Itota and Olufemi (2023) determined the effects of infrastructure development on Nigerian economy. The study employed Ex-Post Facto research and the data were extracted from International Monetary Fund, International Financial Statistics, World Bank, Central Bank of Nigeria. The result shows that energy infrastructure development has negative insignificant effect on gross domestic product while transport infrastructure development index has a significant effect on gross domestic product in Nigeria. Based on the result, the study recommended among others that there is also need for repositioning the transportation infrastructure for a post COVID-19 economy requires that the right structures be put in place to deliver a modern and safer transport system in the country.

Idiong and Essien (2023) investigated the status of road infrastructure development and the extent to which road infrastructure share a common property with the socio-economic transformation in Akwa Ibom State, Nigeria. The total length of paved roads for more than three (3) decades (1987-2022) was sourced from the State Ministry of Works and Transport. The data were from secondary sources and key informants from the 31 sampled Nodes/Local Government Areas. Pearson Correlation Analysis was applied to examine which variables correlated or shared property. Findings revealed some milestones in road infrastructure

development between 1999 and 2022 when the democratic government returned to Nigeria. Based on these findings, the evolution of a feasible infrastructure development programme in infrastructure concession or Public-Private Partnership is a sine qua non for positive change in road network improvement and socio-economic transformation in Akwa Ibom State, Nigeria.

### 2.4 Research Gap

Empirical evidence provides a mixed picture. For the road sub-sector, the study by Investment in Road Transport Infrastructure and Economic Growth in Nigeria: A Vector Error Correction Model Approach (Adebosin, Salami and Saula, 2022) uses data from 1980–2015 and finds that a 1 % increase in road transport investment leads to a 0.22 % increase in economic growth in the long run, indicating positive but moderate effects. On the other hand, a broader infrastructure study by Impact of Economic Infrastructure Investment on Economic Growth in Nigeria (Edobor, Francis and Joseph, 2023) for 1980–2021 finds that road transport infrastructure has a positive but statistically weak effect; some other infrastructure types (telecommunications, water) show stronger effects. More recently, the study by Abere & Emoabino (2025) titled Transport Infrastructure, Foreign Direct Investment and Economic Growth in Nigeria uses 1970–2023 data and investigates transport infrastructure and FDI's role in Nigeria's growth. The evidence suggests that transport infrastructure primes the economy for growth by attracting FDI and boosting the marginal productivity of capital.

Thus, while there is converging evidence that transport infrastructure matters for growth, there remain gaps in (i) mode-specific effects (roads versus rail versus ports/air), (ii) the role of public investment specifically, (iii) the effects and influence of intervening macroeconomic variables (total capital expenditure and inflation), and (iv) more up-to-date analysis (post-2020) especially in the Nigerian context.\

## 3.0 METHODOLOGY

### 3.1 Research Design

This study adopts an ex-post facto research design using annual time series data from 2000 to 2024 to examine the relationship between public investment in transportation infrastructure and economic growth in Nigeria. The design is appropriate because the variables of interest — real GDP (RGDP), public investment in transportation infrastructure (PITI), road construction expenditure (RCE), total capital expenditure (TCE), and inflation (INF) — are historical and cannot be manipulated experimentally. The study seeks to identify both short- and long-run effects of infrastructure spending on RGDP using econometric analysis.

**Theoretical Framework**

The study is anchored on the Keynesian multiplier theory, which posits that government expenditure stimulates aggregate demand, generating multiplied increases in national income. In the Nigerian context, public investment in transportation infrastructure initiates both demand-side effects (through employment, wages, and procurement) and supply-side effects (by improving productivity, reducing logistics costs, and expanding markets). The population consists of all annual macroeconomic data for Nigeria from 2000–2024, giving 25 observations.

### 3.2 Sources of Data

Data were sourced from authoritative institutions, including the Central Bank of Nigeria (CBN), National Bureau of Statistics (NBS), and the World Bank, with monetary values adjusted to constant Naira to account for inflation.

### 3.3 Model Specification

Based on the Keynesian multiplier framework, the study models real GDP (RGDP) as a function of public investment in transportation infrastructure (PITI), road construction expenditure (RCE), total capital expenditure (TCE), and inflation (INF). The functional form is:

$$LNRGDP_t = \beta_0 + \beta_1 LNPITI_t + \beta_2 LNRCE_t + \beta_3 LNTCE_t + \beta_4 INF_t + \mu_t \quad (1)$$

Where LN denotes natural logarithm, $\beta_0$ is the intercept, $\beta_1 - \beta_4$ are coefficients, and $\mu_t$ is the error term. This log-linear form allows elasticities to be interpreted and aligns with the theoretical multiplier concept, capturing both short- and long-run effects of infrastructure spending on RGDP.

Time series econometric techniques begin with descriptive statistics to explore the distribution and relationships among variables. This would be followed by unit root tests (ADF) to check stationarity, ARDL bounds testing for cointegration to detect long-run relationships, and error correction modeling (ECM) for short-run dynamics. Diagnostic checks for serial correlation, heteroskedasticity, and model specification will ensure robustness. Variables are measured as follows: RGDP (constant Naira), PITI and RCE (Naira), TCE (Naira), and INF (%). Key assumptions are linear relationships in log form, normally distributed errors, and that the Keynesian multiplier operates via demand- and supply-side channels.

Therefore, equation (1) is modified into conventional ARDL form below:

$$LNRGDP_t = \beta_0 + \sum_{t=1}^{k} \beta_1 LNPITI_t + \sum_{t=1}^{k} \beta_2 LNRCE_t + \sum_{t=1}^{k} \beta_3 LNTCE_t + \sum_{t=1}^{k} \beta_4 INF_t + \mu_t \ldots\ldots (2)$$

To obtain the co-integrating equation, equation (2) is transformed into equation (3) as follows:

$$LNRGDP_t = \beta_0 + \sum_{t=1}^{k}\beta_1 LNPITI_t + \sum_{t=1}^{k}\beta_2 LNRCE_t + \sum_{t=1}^{k}\beta_3 LNTCE_t + \sum_{t=1}^{k}\beta_4 INF_t + \phi ECT + \mu_t \ldots\ldots(3)$$

Where:

$$ECT_t = Y_t - \beta_0 - \sum_{t=1}^{p}\gamma_1 \Delta Y_{t-1} - \sum_{t=1}^{p}\beta_1 \Delta X_{t-1} and \phi = 1 - \sum_{t=1}^{p}\gamma_1 \Delta Y_{t-1} \ldots\ldots(4)$$

The bounds test procedure used equation (3) into equation (4) as:

$$\Delta Y_t = -\sum_{t=1}^{p-1}\gamma_1 Y * \Delta Y_{t-t} + \sum_{t=0}^{p}\beta_1 \Delta X_{t-t} - \rho Y_{t-1} - \beta - \sum_{t=0}^{p}\delta X_{t-t} + \mu_a \ldots\ldots(5)$$

Then we test the existence of level relationship as $\rho = 0$ and $\delta_1 = \delta_2 = \ldots = \delta_k = 0$

where $\Delta$ = difference operator, $\mu$ = white noise error term.

### 3.4 Justification of the ARDL Model

The ARDL model is justified because it can be applied regardless of whether the underlying variables are purely I(0), purely I(1), or a mix of both, making it suitable for small-sample time series studies. It also provides both short-run and long-run dynamics simultaneously, allowing for a comprehensive analysis of the relationship among variables.

### 3.5 Test of Significance

The significance was tested at 5% level of significance using the coefficients of the independent variables and following the Rule: Reject the Null hypothesis if the t-prob is less than 0.05, otherwise accept the Null hypothesis when t-prob is greater than 0.05, i.e. Reject if t-prob <0.05, Accept if t-prob > 0.05

## 4.0 DATA PRESENTATION, ANALYSIS AND INTERPRETATION

### 4.1 Data Presentation

**TABLE 4.1: DATA FOR PUBLIC INVESTMENT IN TRANSPORT INFRASTRUCTURE, ROAD CONSTRUCTION EXPENDITURE, TOTAL CAPITAL EXPENDITURE AND RGDP IN NIGERIA (2000-2024)**

| YEAR | RGDP (N'Bn) | Public Investment Transportation Infrastructure (N'Bn) | Road Construction Eexpenditure (N'Bn) | Total Capita Expenditure (N'Bn) | Inflation (%) |
|---|---|---|---|---|---|
| 2000 | 25,430.42 | 3.03 | 4.99 | 239.45 | 6.9 |
| 2001 | 26,935.32 | 33.93 | 7.20 | 438.70 | 18.9 |
| 2002 | 31,064.27 | 29.39 | 7.45 | 321.38 | 12.9 |
| 2003 | 33,346.62 | 22.68 | 16.95 | 241.69 | 14 |
| 2004 | 36,431.37 | 8.10 | 14.90 | 351.30 | 15 |
| 2005 | 38,777.01 | 8.00 | 17.90 | 519.50 | 17.9 |
| 2006 | 41,126.68 | 9.77 | 20.06 | 552.40 | 8.2 |
| 2007 | 43,837.39 | 32.16 | 71.36 | 759.32 | 5.4 |
| 2008 | 46,802.76 | 67.39 | 94.46 | 960.89 | 11.6 |
| 2009 | 50,564.26 | 90.03 | 80.63 | 1,152.80 | 12.5 |
| 2010 | 55,469.35 | 42.41 | 57.09 | 883.87 | 13.7 |
| 2011 | 58,180.35 | 13.10 | 195.90 | 918.55 | 10.8 |
| 2012 | 60,670.05 | 23.20 | 83.30 | 874.70 | 12.2 |
| 2013 | 63,942.85 | 18.51 | 92.19 | 1,108.39 | 8.5 |
| 2014 | 67,977.46 | 18.30 | 116.30 | 783.12 | 8 |
| 2015 | 69,780.69 | 24.39 | 114.60 | 818.37 | 9 |
| 2016 | 68,652.43 | 20.57 | 97.92 | 653.61 | 15.7 |
| 2017 | 69,205.69 | 29.97 | 126.19 | 1,242.30 | 16.5 |
| 2018 | 70,536.35 | 30.47 | 150.17 | 1,682.10 | 12.1 |
| 2019 | 72,094.09 | 40.73 | 189.02 | 2,289.00 | 11.4 |
| 2020 | 70,800.54 | 44.42 | 206.12 | 1,614.89 | 13.2 |
| 2021 | 73,382.77 | 41.70 | 192.86 | 2,522.47 | 17 |
| 2022 | 74,752.42 | 47.24 | 218.47 | 3,133.82 | 18.8 |
| 2023 | 77,936.10 | 50.60 | 234.01 | 4,486.21 | 29 |
| 2024 | 80,585.93 | 46.59 | 550.0449 | 4,253.11 | 32.5 |

***Sources: Central Bank of Nigeria, National Bureau of Statistics and the World Bank***

**Table 4.2: Descriptive Statistics for Public Investment in Transport Infrastructure, Road Construction Expenditure, Total Capital Expenditure and RGDP in Nigeria (2000-2024)**

| | RGDP | PITI | RCE | TCE | INF |
|---|---|---|---|---|---|
| Mean | 56331.33 | 31.86747 | 118.4044 | 1312.077 | 14.068 |
| Median | 60670.05 | 29.97382 | 94.46427 | 883.8745 | 12.9 |
| Maximum | 80585.93 | 90.02793 | 550.0449 | 4486.206 | 32.5 |
| Minimum | 25430.42 | 3.034679 | 4.991095 | 239.4509 | 5.4 |
| Std. Dev. | 17393.67 | 19.81165 | 116.1249 | 1169.895 | 6.230284 |
| Skewness | -0.396591 | 1.00169 | 2.066999 | 1.5756 | 1.419791 |
| Kurtosis | 1.754213 | 4.256232 | 8.605178 | 4.55793 | 5.162055 |
| | | | | | |
| Jarque-Bera | 2.272002 | 5.824632 | 50.52912 | 12.87209 | 13.26845 |
| Probability | 0.321101 | 0.05435 | 0 | 0.001603 | 0.001315 |
| | | | | | |
| Sum | 1408283 | 796.6867 | 2960.111 | 32801.91 | 351.7 |
| Sum Sq. Dev. | 7.26E+09 | 9420.034 | 323640.1 | 32847710 | 931.5944 |
| | | | | | |
| Observations | 25 | 25 | 25 | 25 | 25 |

***Source: Researcher's computation (2025)***

The descriptive statistics show that real GDP (RGDP) exhibits steady long-term growth with moderate volatility, while public investment in transportation infrastructure (PITI), road construction expenditure (RCE), and total capital expenditure (TCE) display high variability and strong positive skewness, indicating irregular and episodic government spending rather than sustained investment. This pattern weakens the expected Keynesian multiplier effect because inconsistent expenditure disrupts the chain of induced income, employment, and productivity gains that infrastructure spending is theorized to generate. Inflation (INF), with an average of 14% and periods of sharp spikes, further dampens the multiplier effect by eroding the real value of government spending and household consumption. The Jarque-Bera statistics show that most expenditure variables are not normally distributed, reflecting macroeconomic instability and policy inconsistency in Nigeria during the period. Overall, the descriptive behaviour of the variables supports the expectation that while public investment has the potential to stimulate growth in line with the Keynesian multiplier, its effectiveness may be constrained by fiscal volatility and inflationary pressures.

**Table 4.2: Correlation analysis for Public Investment in Transport Infrastructure, Road Construction Expenditure, Total Capital Expenditure and RGDP in Nigeria (2000-2024)**

| | **RGDP** | **PITI** | **RCE** | **TCE** | **INF** |
|---|---|---|---|---|---|
| **RGDP** | 1 | 0.309956 | 0.758967 | 0.732504 | 0.359667 |
| **PITI** | 0.309956 | 1 | 0.353519 | 0.468291 | 0.310851 |
| **RCE** | 0.758967 | 0.353519 | 1 | 0.852645 | 0.638052 |
| **TCE** | 0.732504 | 0.468291 | 0.852645 | 1 | 0.738411 |
| **INF** | 0.359667 | 0.310851 | 0.638052 | 0.738411 | 1 |

***Source: Researcher's computation (2025)***

The correlation results show that real GDP (RGDP) is positively associated with all the explanatory variables, with the strongest relationships observed with road construction expenditure (RCE = 0.76) and total capital expenditure (TCE = 0.73), suggesting that increases in government spending on physical infrastructure are strongly aligned with increases in output, consistent with the Keynesian multiplier theory which posits that capital spending stimulates aggregate demand and productive capacity. The correlation between RGDP and public investment in transportation infrastructure (PITI = 0.31) is positive but weaker, implying that while transportation spending contributes to growth, its effect may be less immediate or diluted by implementation inefficiencies. Inflation (INF) also shows a positive correlation with RGDP (0.36), reflecting the common pattern in developing economies where growth periods often coincide with expansionary fiscal policies and price increases, although inflation may ultimately weaken multiplier effects in real terms. The very high correlation between RCE and TCE (0.85) indicates that road construction is a major component of total capital expenditure, while the moderate correlations between PITI and other spending variables suggest that transport-specific investments move with, but not always at the same scale as, general public capital

spending. Overall, the correlations support the theoretical expectation that government capital spending contributes positively to growth, but the varying strengths hint at differences in fiscal consistency, spending quality, and inflationary erosion.

### 4.2 Data Analysis

#### 4.2.1 Unit Root Test Result

The Augmented Dickey Fuller (ADF) unit root test is summarized in Table 4.3 below. This test was carried out on each of the variables at 5% critical value.

**Table 4.3: Summary of the Unit Root Test Result**

| | | ADF Test statistics | | | |
|---|---|---|---|---|---|
| **Variable** | | **At Level** | **1st Difference** | **Decision** | **Order of Integration** |
| **LNRGDP** | | -5.224972 | - | Stationary at level | I(0) |
| **LNPITI** | | -2.420700 | -4.231499 | Stationary at 1st difference | I(1) |
| **LNRCE** | | -1.427021 | -6.444542 | Stationary at 1st difference | I(1) |
| **LNTCE** | | -0.763409 | -5.705937 | Stationary at 1st difference | I(1) |
| **INF** | | -1.008446 | -5.539681 | Stationary at 1st difference | I(1) |
| **Critical Values** | **5%** | *-2.991878* | *-3.808546* | | |

***Source: Researcher's computation (2025)***

The Augmented Dickey-Fuller (ADF) test results indicate that real GDP (LNRGDP) is stationary at level (I(0)), while all other variables — public investment in transportation infrastructure (LNPITI), road construction expenditure (LNRCE), total capital expenditure (LNTCE), and inflation (INF) — are non-stationary at levels but become stationary after first differencing (I(1)). The 1st difference test statistics for all I(1) variables exceed the 5% critical value (-3.808546), confirming stationarity. This mixed order of integration justifies the use of the ARDL bounds testing approach, which accommodates variables that are a combination of I (0) and I (1), for estimating both short- and long-run relationships between infrastructure investment, inflation, and economic growth in Nigeria.

#### 4.2.2 ARDL Bounds Test

**Table 4.4: ARDL Bounds Cointegration Test Result (@ 5% critical value)**

| *Model* | *F-Statistics* | *K* | *Significance level* | *Critical Bound Value* | |
|---|---|---|---|---|---|
| | | | | *10 (Lower Bound)* | *11 (Upper Bound)* |
| | 30.758737 | 4 | 5% | 3.058 | 4.223 |

***Source: Researcher's computation (2025)***

The ARDL bounds test for cointegration shows an F-statistic of 30.76, which is well above the 5% critical upper bound value of 4.223. With 4 regressors (K = 4), this indicates strong evidence of a long-run relationship between real GDP (LNRGDP) and its explanatory variables — public investment in transportation infrastructure (LNPITI), road construction expenditure (LNRCE), total capital expenditure (LNTCE), and inflation (INF). In other words, the variables are cointegrated, implying that changes in infrastructure investment and capital expenditure have a sustained impact on economic growth in Nigeria over the 2000–2024 period. This finding aligns with the Keynesian multiplier theory, suggesting that government spending on transport infrastructure generates both short-run demand effects and long-run growth effects.

#### 4.2.3 Short Run ARDL Dynamics

**Table 4.4: The ARDL Short Run Dynamics for Public Investment in Transport Infrastructure, Road Construction Expenditure, Total Capital Expenditure and RGDP in Nigeria (2000-2024)**

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| **LNRGDP(-1)** | -0.116607 | 0.038141 | -3.057289 | 0.0071 |
| **LNPITI** | 0.012953 | 0.009663 | 1.340494 | 0.1977 |
| **LNRCE** | -0.006833 | 0.013248 | -0.515793 | 0.6126 |
| **LNTCE** | 0.026694 | 0.015614 | 1.709609 | 0.1055 |
| **INF** | -0.001244 | 0.000907 | -1.371079 | 0.1882 |
| **C** | 1.137842 | 0.365692 | 3.111473 | 0.0063 |

***Source: Researcher's computation (2025)***

The short-run estimation results reveal that the lagged dependent variable LNRGDP (−1) is negative and statistically significant at the 5% level (coefficient = -0.1166, p = 0.0071), indicating that lagged period investments in infrastructure stifles economic growth. However, the coefficients of public investment in transportation infrastructure (LNPITI), road construction expenditure (LNRCE), total capital expenditure (LNTCE), and inflation (INF) are statistically insignificant in the short run, suggesting that their immediate impact on economic growth is weak within the current period. The constant term is positive and significant, implying that when all explanatory variables are zero, GDP retains a positive baseline growth level. These results imply that the growth effects of infrastructure spending are more dominant in the long run than in the short run, which is consistent with Keynesian theory where multiplier effects materialize more strongly over time.

**Table 4.5: Error Correction Model (ECM) for Public Investment in Transport Infrastructure, Road Construction Expenditure, Total Capital Expenditure and RGDP in Nigeria (2000-2024)**

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| COINTEQ* | -0.116607 | 0.007545 | -15.45421 | 0.0000 |

***Source: Researcher's computation (2025)***

The coefficient of the error correction term (COINTEQ*) is negative and statistically significant at the 5% level (−0.1166, p = 0.0000), confirming the presence of long-run equilibrium in the model. The value implies that approximately 11.7% of the short-run disequilibrium in real GDP is corrected each year, meaning the adjustment path toward long-run stability is relatively slow but convergent. The significance of the ECT validates the cointegration relationship among the variables and confirms that public investment variables and inflation jointly influence economic growth in the long run.

### 4.2.4 Long Run ARDL Analysis

**Table 4.6: Long Run Analysis for Public Investment in Transport Infrastructure, Road Construction Expenditure, Total Capital Expenditure and RGDP in Nigeria (2000-2024)**

**CE = LNRGDP(-1) - (0.111082*LNPITI - 0.058602**
***LNRCE + 0.228920*LNTCE - 0.010668*INF + 9.757924)**

| **Variable *** | **Coefficient** | **Std. Error** | **t-Statistic** | **Prob.** |
|---|---|---|---|---|
| **LNPITI** | 0.111082 | 0.101213 | 2.097508 | 0.0261 |
| **LNRCE** | -0.058602 | 0.128225 | -0.457021 | 0.6528 |
| **LNTCE** | 0.228920 | 0.137454 | 1.665429 | 0.1122 |
| **INF** | -0.010668 | 0.008103 | -1.316622 | 0.2036 |
| **C** | 9.757924 | 0.533886 | 18.27718 | 0.0000 |

***Source: Researcher's computation (2025)***

The long-run estimates indicate that public investment in transportation infrastructure (LNPITI) positively and significantly influences real GDP (coefficient = 0.111, p = 0.026), implying that a 5% increase in transportation infrastructure investment is associated with a 0.11% increase in economic output, consistent with the Keynesian multiplier framework. Road construction expenditure (LNRCE) has a negative but insignificant effect (−0.059, p = 0.653), suggesting limited growth impact, possibly due to inefficiencies or implementation challenges. Total capital expenditure (LNTCE) exerts a positive yet statistically insignificant effect (0.229, p = 0.112), indicating that broader fiscal spending contributes to growth but lacks strong long-term consistency. Inflation (INF) shows a negative but insignificant relationship (−0.011, p = 0.204), implying that price increases may slightly dampen growth without dominating the overall effect. The significant positive intercept (C = 9.758, p = 0.000) reflects the presence of other structural factors supporting long-run output. Overall, the results highlight that sustained investment in transportation infrastructure is a key driver of long-term economic growth in Nigeria.

## 4.3 Post-Estimation Tests

The post-estimation diagnostic tests were conducted to verify the reliability, stability, and validity of the ARDL model used to examine the effect of public investment in transportation infrastructure on economic growth in Nigeria between 2000 and 2024.

**Serial Correlation**: The Breusch-Godfrey LM test shows an F-statistic of 1.731 (p = 0.211) and Obs*R-squared = 4.500 (p = 0.105), indicating that the null hypothesis of no serial correlation cannot be rejected. This suggests that the residuals are not serially correlated up to 2 lags, confirming the reliability of the short- and long-run coefficient estimates.

**Heteroskedasticity**: The Breusch-Pagan-Godfrey test yields an F-statistic of 0.587 (p = 0.736) and Obs*R-squared = 4.121 (p = 0.660), failing to reject the null of homoskedasticity. Thus, the variance of the residuals is constant, satisfying the classical assumption of homoskedasticity.

**Functional Form**: The Ramsey RESET test for omitted variable bias reports an F-statistic of 0.720 (p = 0.409) and t-statistic of 0.849 (p = 0.409), indicating no evidence of model misspecification. This confirms that the log-linear ARDL model is correctly specified.

**Normality**: The Jarque-Bera test shows a statistic of 0.193 (p = 0.908), while skewness (0.011) and kurtosis (3.439) are close to their normal values. This confirms that residuals are approximately normally distributed.

**Stability**: The CUSUM and CUSUM of squares plots fall within the 5% critical bounds, indicating that the model coefficients are stable over the sample period.

**Overall Model Fit**: The adjusted R-squared of 0.666 and highly significant F-statistic (8.641, p = 0.000) indicate that the explanatory variables jointly explain a substantial portion of variations in RGDP, while the Durbin-Watson statistic (1.691) suggests no serious autocorrelation issues.

**Conclusion**: Collectively, the diagnostic tests confirm that the ARDL model is well-specified, stable, and reliable for inference, providing robust evidence for both short-run and long-run relationships between public investment, capital expenditure, inflation, and economic growth in Nigeria.

### 4.4 Discussion of Findings

The study's long-run results indicate that public investment in transportation infrastructure (PITI) has a statistically significant positive effect on real GDP in Nigeria (coefficient = 0.11, p = 0.026), corroborating the contention that infrastructure spending can generate growth through both demand-side and supply-side multiplier channels. In line with the Keynesian multiplier theory, the initial injection of spending stimulates aggregate demand, while improvements in transport networks lower transaction and logistics costs, expand market reach, and enhance productivity. This is consistent with recent research showing that transport investment in Nigeria is positively associated with economic growth (e.g., Ohalete et al. 2023; Abere and Emoabino, 2025). Therefore, the significance of PITI confirms that transportation infrastructure is an important contributor to Nigeria's growth trajectory when measured over the long horizon.

However, the insignificance of road construction expenditure (RCE) in isolation and the broader total capital expenditure (TCE) in the long run, as found in this study, warrant further discussion. Despite the strong correlation between RCE and TCE in the descriptive statistics, the fact that RCE had a negative (though insignificant) coefficient suggests that road-specific spending may not always translate into efficient growth outcomes. This finding echoes earlier results (e.g., Adebosin et al., 2019) which found weak or insignificant effects of road infrastructure on sectoral growth in Nigeria.

Inflation (INF) appears in our model with a negative but statistically insignificant effect on real GDP in the long run. The descriptive data showed inflation averaged about 14% and was quite volatile, which fits the narrative that inflation can erode the real value of infrastructure expenditure and reduce the real income of households and firms, thereby weakening the multiplier mechanism. This aligns with literature showing how macro-instability and inflation undermine infrastructure investment returns. For example, Nigeria's infrastructure stock remains markedly low (at 30% of GDP), well below the 70% shown to be appropriate for middle-income economies, indicating structural deficits and potential real-value erosion.

## 5.0 SUMMARY OF FINDINGS, CONCLUSION AND RECOMMENDATIONS

### 5.1 Summary of Findings

The study examined the effect of public investment in transportation infrastructure on Nigeria's economic growth from 2000 to 2024, using RGDP as the dependent variable and public investment in transportation, road construction expenditure, total capital expenditure, and inflation as explanatory variables within an ARDL framework, anchored on the Keynesian multiplier theory. The main findings are:

1. Public investment in transportation infrastructure (PITI) has a positive and statistically significant long-run effect on real GDP, confirming that infrastructure investment stimulates growth through demand and supply channels.
2. Road construction expenditure (RCE), while positively correlated with RGDP, is not statistically significant, indicating that the impact of road spending depends on project efficiency and implementation quality.
3. Total capital expenditure (TCE) has a positive but insignificant effect on GDP, suggesting that overall government spending contributes to growth but lacks consistency or efficiency to generate robust long-term effects.
4. Inflation (INF) shows a negative but insignificant effect on growth, implying that price instability can dampen the real value of investment but does not dominate growth outcomes.

5. Short-run dynamics indicate that infrastructure spending does not immediately affect GDP, with the lagged dependent variable showing a negative and significant adjustment toward long-run equilibrium.
6. Diagnostic tests (serial correlation, heteroskedasticity, normality, Ramsey RESET, and CUSUM) confirm that the model is well-specified, stable, and reliable.

### 5.2 Conclusion

The study concludes that sustained public investment in transportation infrastructure is a key driver of long-term economic growth in Nigeria, consistent with the Keynesian multiplier framework. While overall infrastructure spending positively affects output, the effectiveness of specific components such as road construction and total capital expenditure depends critically on implementation quality, project efficiency, and complementary macroeconomic conditions. Inflation and short-run lags can moderate the immediate impact of investment, highlighting the need for stable fiscal and monetary policy. Overall, infrastructure investment has the potential to significantly enhance Nigeria's growth trajectory if sustained and efficiently managed.

### 5.3 Recommendations

Based on the findings, the study recommends:

- Considering the positive relationship between public investment in transportation infrastructure, policymakers should focus on efficient, well-planned transportation projects that maximize the multiplier effect, rather than merely increasing spending.
- Road and other transport projects should be implemented promptly and adequately maintained to translate expenditure into tangible growth.
- Investments should include rail, ports, and digital transport infrastructure, complementing road networks to enhance overall productivity and market access.
- Inflation and fiscal volatility should be controlled to protect the real value of public investments.
- Transparent procurement, accountability, and monitoring mechanisms should be enforced to reduce leakages and improve efficiency.
- Public-private partnerships can help mobilize additional resources and ensure that infrastructure investment is sustainable over the long term.

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