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Impact of Modes of Transportation Services on the Growth of Small and Medium Enterprises (SMEs) in Nigeria

[1]Ogwah Josephine Aboshio, [2]Aigbedion I. Marvelous, & [3]Ezie Obumneke
[12&3]Department of Economics, Faculty of Social Sciences,
Bingham University Karu, Nasarawa State.

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Abstract

This study examined the impact of transportation services on the growth of Small and Medium Enterprises (SMEs) in Nigeria, considering the contributions of road, rail, and water transport as proxies for transportation services, and SMEs' GDP contribution (percentage) as a measure of SME growth. The study employed an ex-post facto research design and relied on secondary time series data sourced from the Central Bank of Nigeria (CBN), National Bureau of Statistics (NBS), and SMEDAN. The analysis was conducted using the Autoregressive Distributed Lag (ARDL) model, preceded by unit root testing and bounds cointegration procedures. Findings showed that road and rail transport services had significant but negative long-run effects on SME growth, suggesting that despite their prominence, inefficiencies, poor maintenance, and inadequate infrastructure have undermined their contributions to enterprise performance. In contrast, water transport services had a significant and positive impact, highlighting its potential as a cost-effective and underutilized logistics option for SMEs. Based on these findings, the study recommended that the Federal Ministry of Works and Housing, along with FERMA, improve road quality and reduce logistics bottlenecks. The Nigerian Railway Corporation (NRC) and Infrastructure Concession Regulatory Commission (ICRC) were urged to modernize rail networks and enhance connectivity with commercial hubs. Furthermore, the National Inland Waterways Authority (NIWA) and Nigerian Ports Authority (NPA) were advised to invest in water transport infrastructure and safety. It was also recommended that SMEDAN collaborate with these agencies to develop logistics support initiatives tailored to SMEs. These interventions are essential to creating a more efficient transport system that supports sustainable SME growth in Nigeria.

Keywords: *Road transport services, Water transport services, Rail transport services, and SMEs growth*

Corresponding Author: Ogwah Josephine Aboshio

Background to the Study

Transportation serves as the backbone of global economic development, facilitating the movement of goods, services, and people across geographical boundaries. Modern economies rely heavily on efficient transportation networks to support trade, commerce, and business operations. Globally, transportation infrastructure has evolved significantly over centuries, from rudimentary paths to sophisticated multimodal systems incorporating road, rail, water, and air transport services. The World Bank (2022) estimates that the global transportation market reached approximately $6.8 trillion in 2021, with road transportation accounting for about 40% of this value. Transportation services contribute an average of 5-8% to the GDP of developed economies and can account for up to 15% in developing nations where infrastructure development remains a priority (Miapkwap & Adeyi, 2022). The efficiency of transport systems often correlates directly with economic productivity, as businesses can reduce operational costs and expand market reach through reliable logistics networks.

In sub-Saharan Africa, transportation infrastructure presents a mixed picture of development and challenges. The region faces significant transportation constraints, with road density averaging only 204 kilometers per 1,000 square kilometers, compared to the global average of 944 kilometers (African Development Bank, 2021). Rail networks remain underdeveloped, with most systems dating back to colonial periods and covering just 16% of the territory that railways cover in Europe (Nyabadza & Chirwa, 2024). Water transportation, despite the presence of major rivers and extensive coastlines, accounts for less than 7% of freight movement in the region. According to the World Bank (2023), transportation inefficiencies cost African economies between 2-3% of GDP annually and increase the cost of goods by 30-40%. These constraints particularly affect Small and Medium Enterprises (SMEs), which often lack the resources to overcome logistical challenges.

Nigeria, as Africa's largest economy, experiences transportation challenges that mirror the broader regional context but with unique characteristics shaped by its economic structure and historical development. Road transport dominates Nigeria's transportation scope, accounting for approximately 90% of internal freight and passenger movement (National Bureau of Statistics [NBS], 2023). The data provided indicates that road transport services have grown substantially from ₦119.14 billion in 1999 to ₦3,485.82 billion in 2024, demonstrating a nearly 30-fold increase over this period. This growth reflects both expansion in services and inflationary pressures. However, the road network quality remains problematic, with only about 60% of federal roads in good condition (Federal Ministry of Transportation, 2022). Rail transport services, while historically significant during the colonial period, have contributed minimally to Nigeria's GDP, growing from just ₦0.04 billion in 1999 to ₦0.42 billion in 2024. Recent efforts to revitalize the rail sector, including the Lagos-Ibadan standard gauge railway and the Abuja-Kaduna line, represent attempts to diversify the transportation mix. Water transportation remains similarly underutilized despite Nigeria's 853km coastline and extensive inland waterways, contributing between ₦2.13 billion in 1999 and ₦15.14 billion in 2024 to the GDP. According to the Nigerian Maritime Administration and Safety Agency (NIMASA, 2023), water transport currently

handles less than 3% of the country's internal trade volume despite its potential for cost-effective bulk cargo movement.

The transportation scope in Nigeria has shown important patterns over the 25-year period covered by the data. Road transport services have maintained dominance but experienced volatility, particularly during economic downturns, as evidenced by the decline from ₦3,876.25 billion in 2022 to ₦2,904.85 billion in 2023, likely reflecting the economic challenges of that period. Rail transport, while growing gradually, remains the smallest contributor among the transport modes, never exceeding ₦0.42 billion annually. Water transport services show steady but modest growth, increasing from ₦2.13 billion in 1999 to ₦15.14 billion in 2024, representing a seven-fold increase that nonetheless remains small relative to road transport. The data reveals that Nigeria's transportation mix remains heavily imbalanced, with road transport comprising approximately 90% of the transport sector's contribution to GDP throughout the period (CBN, 2024).

Small and Medium Enterprises (SMEs) represent the backbone of the global economy, serving as engines of growth, innovation, and employment. The Organization for Economic Cooperation and Development (OECD, 2023) estimates that SMEs account for approximately 90% of businesses worldwide and contribute between 50-60% of employment in most economies. In developed economies like Germany, SMEs (known as Mittelstand) contribute approximately 55% to GDP and employ about 60% of the workforce (Nwachukwu & Edet, 2023). Similarly, in emerging economies such as India, SMEs contribute nearly 30% to GDP and account for 45% of manufacturing output (Olaniyi & Adeyemi, 2023). The global significance of SMEs extends beyond economic measures to include social stability, wealth distribution, and economic resilience during downturns.

The growth path of SMEs in Nigeria presents a different picture of potential and challenges. Available data shows that SME contribution to Nigeria's GDP fluctuated between 26.01% in 1999 and 50% in 2007 and 2015, but has experienced a concerning downward trend since then, reaching 40% in 2024. This pattern suggests structural challenges facing Nigerian SMEs despite various government initiatives. According to the Small and Medium Enterprises Development Agency of Nigeria (SMEDAN, 2024), SMEs constitute over 96% of Nigerian businesses and account for 84% of employment. However, the sector faces significant constraints, including limited access to finance, inadequate infrastructure, and logistical challenges.

Given that efficient transport systems are essential enablers of business productivity, market access, and cost efficiency, it is imperative to examine how road, rail, and water transport services have influenced the growth of SMEs in Nigeria. Therefore, it is in the interest of this study to conduct an analysis of how modes of transportation services, measured by their contributions to GDP, have impacted the growth of SMEs growth over the period 1999 to 2024.

The study addressed the following questions:

i. What impact does road transport services have on the growth of SMEs in Nigeria?
ii. How has rail transport services impacted the growth of SMEs in Nigeria?
iii. To what extent does water transport services impact the growth of SMEs in Nigeria?

Literature Review

Conceptual Clarifications

Modes of Transportation Services

Transportation services represent a critical component of economic infrastructure that facilitates the movement of people, goods, and services across geographical spaces, thereby supporting trade, commerce, and economic development. According to Adepoju and Salau (2022), transportation services encompass the various systems, operations, and infrastructure that enable mobility and logistics within and between economies. The conceptualization of transportation services has evolved significantly in recent years, moving beyond mere physical movement to incorporate elements of value addition, supply chain integration, and economic transformation. Oyesiku and Adegbite (2023) define transportation services as "structured systems of mobility that create spatial utility through the organized movement of people and goods, generating economic value by overcoming distance friction." In contemporary economic and development literature, transportation services are frequently categorized into road, rail, and water transport, each with unique features, infrastructural demands, and economic implications. These transport modes are not only facilitators of movement but also integral components of economic performance.

Road transport services constitute the most dominant mode of transportation in most developing economies, particularly in Nigeria. Conceptually, Adeniran and Johnson (2021) define road transport services as "the collection of operations, infrastructure, and business activities related to the movement of goods and people via road networks, including commercial trucking, urban transit, intercity passenger services, and logistics support systems that utilize road infrastructure." This definition captures both the infrastructure and operational dimensions of road transportation. Nwaogbe *et al.* (2023) further expand this conceptualization by describing road transport services as "an integrated ecosystem of mobility solutions delivered via road networks, encompassing public transportation, freight haulage, specialized logistics, last-mile delivery, and associated value-added services that facilitate the road-based movement economy." The contribution of road transport services to GDP represents the aggregate value addition generated through these activities within the national economy. According to Oladipo and Iyanda (2022), this contribution encompasses formal and informal transportation activities, vehicle maintenance services, road transport infrastructure operations, and associated business services that facilitate road-based mobility.

Water transport services represent another critical transportation mode, particularly for coastal and riverine communities and for bulk cargo movement. From a conceptual perspective, Olaniyi et al. (2021) define water transport services as "the dynamic of maritime and inland waterway operations that facilitate the movement of passengers and cargo via navigable water bodies, including shipping services, port operations, inland water

transportation, and associated logistics and support services." This definition encompasses both maritime transportation and inland waterway services. Expanding on this conceptualization, Odeleye and Ndikom (2020) describe water transport services as "systematic mobility solutions delivered through maritime and inland waterway channels, comprising shipping operations, port services, ferry systems, and terminal management, which collectively form the blue economy transportation component." In the context of GDP contribution, water transport services incorporate the value addition from formal shipping operations, port services, inland water transport, and associated maritime logistics services. Ibrahim and Musa (2024) note that "the contribution of water transport to GDP represents the aggregated economic output from commercial shipping, port operations, inland water transport, and maritime support services, excluding fishing and resource extraction activities that utilize water channels."

Rail transport services, while historically significant in many economies, have experienced varying levels of development and utilization across different regions. Conceptually, Akintola and Mohammed (2022) define rail transport services as "the systematic mobility solutions delivered through fixed rail infrastructure, encompassing passenger services, freight operations, terminal management, and associated logistics services that utilize rail networks." This definition emphasizes both the infrastructure dependency and service orientation of rail transportation. Elaborating on this concept, Daramola and Ishola (2023) describe rail transport services as "an integrated transportation system based on guided track networks, providing high-capacity, energy-efficient mobility solutions for both passenger and freight movement, including mainline services, urban rail, specialized freight operations, and intermodal terminal services." In terms of GDP contribution, rail transport services represent the value addition from passenger operations, freight services, terminal management, and associated rail-based logistics services. According to Eke et al. (2024), the contribution of rail transport to GDP encompasses "the economic output generated from commercial rail operations, infrastructure management, terminal services, and associated value-added activities that facilitate rail-based mobility."

SMEs Growth

Small and Medium Enterprises (SMEs) represent a vital economic segment characterized by distinctive operational scales, capital requirements, and organizational structures. The conceptualization of SME growth, particularly as measured through their contribution to Gross Domestic Product (GDP), has gained significant attention in recent years. According to Adeyemi and Oluwaseun (2023), SME growth encompasses "the multidimensional expansion of small and medium-sized businesses across various performance indicators including revenue generation, employment creation, productivity enhancement, and market penetration, collectively contributing to increased economic value addition at the national level." This definition highlights the dynamic nature of SME growth beyond mere size expansion to include qualitative dimensions that enhance economic contribution.

Mustapha and Ibrahim (2022) define SME contribution to GDP as "the aggregate value addition generated by small and medium enterprises across all economic sectors,

representing their collective output of goods and services within a specified timeframe." This conceptualization positions SMEs as economic actors whose growth trajectory can be quantified through their expanding share of national output. Elaborating on this concept, Okonkwo and Ajayi (2021) describe SME contribution to GDP as "the measurable economic value created by enterprises operating below defined thresholds of capitalization, employment, and turnover, encompassing both formal and informal business activities that generate quantifiable output within the national accounts framework." This definition acknowledges the distinctive characteristics of SMEs while emphasizing their economic function as value creators.

The conceptualization of SME growth through GDP contribution necessitates understanding the classification parameters that define this business segment. In the Nigerian context, Olugbade and Nwankwo (2024) note that SMEs are typically defined as "enterprises employing between 10 and 199 persons or having assets excluding land and buildings valued between ₦5 million and ₦500 million." This classification framework, established by the Small and Medium Enterprises Development Agency of Nigeria (SMEDAN), provides the operational boundaries for identifying businesses whose collective growth constitutes SME contribution to GDP. According to Babalola and Adejimi (2023), "the measurement of SME contribution to GDP encompasses the aggregate value addition from enterprises that fall within established classification thresholds, capturing their formal and informal economic activities across primary, secondary, and tertiary sectors."

Theoretical Underpinning

The theoretical underpinning for this study is Aschauer's Infrastructure-Led Growth Theory provided by the public economics school of thought on infrastructure development. The infrastructure-Led Growth Theory suggests a direct connection between transportation infrastructure development and economic growth, which stems from the public capital productivity framework. The infrastructure-Led Growth school of thought believes in the existence of a direct relationship between transportation services and SME growth as measured by their contribution to GDP. Aschauer (1989) argues that economists deploy infrastructure development policy to boost the productivity of private sector firms through improved transportation networks, thereby leading to lowered transaction costs and expanded market access.

With enhanced transportation infrastructure, logistics efficiency and market connectivity experience a resultant increase, further spurring increments in the growth potential of SMEs as reflected in their contribution to gross domestic product (GDP). The significance of this theory in the study is in the portrayal of how various modes of transportation services impact aggregate SME performance by enabling more efficient movement of goods, services, and labour. However, Efobi and Asongu (2021) remain unconvinced by the little emphasis by Infrastructure-Led Growth theorists pertaining to the bidirectional nature of the relationship between infrastructure development and economic growth, particularly questioning whether transportation improvements cause SME growth or simply reflect it. This now creates further arguments by spatial economic theories by Krugman and other scholars who advanced the geographical distribution perspective from the market access standpoint.

Empirical Review

The relationship between transportation services and SME growth has attracted significant scholarly attention across diverse geographical contexts. These empirical investigations have employed various methodological approaches to examine how different transportation modes influence SME development. Wang and Chen (2024) investigated how digital transportation platforms affected rural SME integration into national markets across six Chinese provinces from 2018 to 2023. Using instrumental variable approach with data from 1,235 rural enterprises, they examined how traditional transportation infrastructure combined with digital logistics platforms influenced market access. Their findings indicated that while conventional road density showed positive associations with SME market integration, the interaction between road infrastructure and digital transportation platforms demonstrated substantially stronger positive effects, particularly for agricultural product producers and handicraft manufacturers. Water transportation accessibility combined with digital platforms yielded significant benefits for bulk goods producers but showed limited impact for service providers. The researchers' heavy reliance on cross-sectional variation rather than temporal changes in transportation access limits causal inference regarding infrastructure development impacts, while the study's emphasis on digital platform adoption potentially confounds transportation effects with technological literacy and internet connectivity variables that independently influence SME performance.

Eze and Nwokolo (2023) conducted a study titled "Logistics Cost and Transport Mode Choice among SMEs in Nigeria," which explored how different transportation modes affect the operational costs and efficiency of small and medium enterprises across selected Nigerian states. The study focused on a time frame spanning 2010 to 2021, drawing on both firm-level survey data and macroeconomic transport statistics. Using a multivariate regression analysis, the authors examined the relationship between logistics costs, the choice of transport mode (road, rail, and water), and the performance of SMEs, with a focus on cost efficiency, delivery timelines, and market accessibility. Their findings revealed that road transport, while the most widely used mode, is associated with higher logistics costs due to poor infrastructure, congestion, and fuel expenses. Water transport, though less commonly used, was found to be the most cost-effective, especially for SMEs located in riverine or coastal regions. Rail transport had minimal impact on logistics cost due to its limited availability and accessibility. The study highlighted that SMEs are often forced to rely on road transport not by preference but by necessity, given the poor development of alternative transport modes in Nigeria.

A study by Nwachukwu and Edet (2023) assessed the influence of transport infrastructure on SME development in the South-South geopolitical zone from 2000 to 2022. Using a combination of survey data and time-series analysis through Structural Equation Modeling (SEM), the authors evaluated road accessibility, rail connectivity, and proximity to ports. Road infrastructure emerged as the most influential variable, contributing significantly to SME expansion and market reach. Port access via water transport was also positively associated with increased trade and logistics efficiency, particularly for SMEs engaged in import-export activities. However, the study relied on self-reported data from SME operators, which, while rich in perception-based insights, introduced subjectivity and limited the robustness of statistical inference compared to purely objective secondary datasets.

Olaniyi and Adeyemi (2023) examined the impact of transportation infrastructure on SME performance in Ghana, covering the period from 2005 to 2021. Using panel data regression analysis on 345 SMEs across five regions, their study investigated how road, rail, and air transportation accessibility influenced various SME performance indicators. Their findings revealed differentiated impacts across transportation modes, with road transportation demonstrating a statistically significant positive effect on SME productivity and market reach, while rail transportation showed a moderately significant positive relationship with operational efficiency but an insignificant association with revenue growth. Water transportation displayed a significant positive relationship with cost reduction for manufacturing SMEs but had limited impact on service-sector SMEs. The authors' exclusive focus on formal-sector SMEs potentially overlooked the substantial informal economy segment that characterizes many developing regions, while their reliance on self-reported SME performance data rather than objective measurements may have introduced response biases that limit the generalizability of findings.

Miapkwap and Adeyi (2022) investigated the impact of transportation on economic development in Nigeria through a mixed-methods approach combining theoretical models and econometric analysis. Employing secondary data sources, the researchers explored the historical and contemporary perspectives on the transport-development nexus while examining both supply and demand aspects of transportation services. Their findings revealed a statistically significant positive relationship between transportation services and economic development in Nigeria, indicating that transportation investments and improvements contribute meaningfully to development outcomes. The study concluded that transportation serves not merely as a necessary condition but potentially as an instigator of economic growth and development. While the research provides valuable insights into the transportation-development relationship in Nigeria, the authors' reliance on aggregate economic development measures without disaggregating by specific sectors (such as SMEs) limits understanding of the differentiated impacts of transportation across economic segments. Additionally, the study's broad conceptualization of transportation without distinguishing between modes (road, rail, water) restricts insights into how different transportation types might uniquely influence development outcomes. The generalized secondary data approach also misses opportunities to capture regional variations in transportation effects that might emerge from primary data collection across Nigeria's diverse geographical contexts.

In the study on the economic effects of transport infrastructure on SMEs in Ghana, Owusu and Aboagye (2022) analysed data spanning 1998 to 2020 using an Ordinary Least Squares (OLS) regression model. They used road and rail infrastructure investment as independent variables and SME GDP contribution as the dependent variable. The findings revealed that improvements in road infrastructure had a significant positive impact on SME growth, particularly in urban and peri-urban regions. Rail transport had a statistically insignificant effect, largely due to the outdated and fragmented nature of Ghana's railway network. While the study effectively demonstrated the urban benefits of road infrastructure, it failed to account for water transport, despite Ghana's notable inland water bodies that support

regional trade, thereby limiting the completeness of the transportation dimension considered.

Bello and Ikenna (2022) conducted a comparative study of Nigeria and Kenya, evaluating how public expenditure on road, rail, and water transport infrastructure impacted SME performance from 1999 to 2021. Employing a Difference-in-Differences (DiD) estimation strategy, the study assessed SME GDP contributions before and after major transport investments in both countries. In Nigeria, road transport investment had a statistically significant positive effect, while water transport improvements—particularly in the Niger Delta—also showed strong returns in the medium term. Kenya, on the other hand, benefited more from rail infrastructure, notably the Standard Gauge Railway (SGR), which was linked to higher SME logistics efficiency and productivity. Despite its methodological rigor, the study was limited in temporal scope by its focus on major infrastructure projects, potentially overlooking smaller-scale but impactful initiatives.

In the context of East Africa, a study by Muthoni and Kimani (2023) evaluated the impact of transportation infrastructure on the growth of SMEs in Kenya from 1995 to 2021. Employing a vector error correction model (VECM), the study assessed the long-run equilibrium relationships between transport services and SME output. Results suggested that road transport had a short-term positive effect, while rail transport had a stronger long-term impact on SME output growth. Water transport showed a moderate effect, particularly in regions bordering Lake Victoria, where inland ports facilitated trade. One limitation was that the study did not disaggregate SMEs by size or sector, which could have illuminated differences in transport needs between micro-enterprises and medium-sized firms.

In a study conducted by Akinyemi and Adeola (2022), the authors examined the impact of transport infrastructure on sectoral output in Nigeria over the period 1990–2020. Employing an Autoregressive Distributed Lag (ARDL) model, the study analysed the influence of road, rail, and water transport—measured via their contributions to GDP—on manufacturing and SME performance. The results showed that road transport had a statistically significant positive effect on SME growth, while rail and water transport were insignificant, attributed to their underutilization in the Nigerian economy. The study, though comprehensive in its methodological approach, relied heavily on secondary data without capturing informal transport dynamics that often support rural SMEs. Moreover, its sectoral disaggregation of SMEs was limited, which may have limited the variations across industries.

In a cross-country analysis, Chen and Lu (2021) explored the relationship between multimodal transport infrastructure and SME productivity across 15 Asian economies from 2000 to 2018. Using panel data regression and fixed effects models, the study evaluated road density, rail freight volume, and inland water transport capacity as predictors of SME contribution to GDP. Findings indicated that improved rail infrastructure and waterway utilization had a more profound impact on SME performance than road development, particularly in countries like Vietnam and India where industrial clusters are rail-accessible. Road infrastructure, while still significant, exhibited diminishing returns in congested urban

zones. However, the study did not factor in institutional variables such as policy reforms or public-private partnership frameworks that often mediate infrastructure outcomes in developing economies.

From a broader regional perspective, Adegbite and Daramola (2021) conducted a study on West African economies, analysing how transport infrastructure development influenced SME performance between 1990 and 2019. The study utilized a Generalized Method of Moments (GMM) estimation technique to correct for endogeneity and serial correlation issues. It was found that while road transport showed immediate positive effects on SME GDP contribution, the development of water transport infrastructure yielded higher returns over time due to lower freight costs and bulk handling capabilities. Rail transport's impact was found to be inconsistent, primarily due to fragmented rail networks across borders. While the study provided strong regional insights, it relied solely on national-level data, which might obscure intra-country disparities in transport infrastructure and SME development.

Ibrahim *et al.* (2021) conducted research on transportation infrastructure and SME growth in Ethiopia, covering 2012-2020. Through difference-in-differences analysis of 289 manufacturing SMEs affected by the Addis Ababa-Djibouti railway corridor development, they assessed how enhanced rail connectivity influenced business performance measures. Their findings revealed that SMEs gaining rail access experienced statistically significant higher employment growth and productivity improvements compared to the control group, while also demonstrating greater export participation. Road transportation improvements showed more modest but still significant positive effects on SME performance. The authors' reliance on a single infrastructure project as the treatment variable provides limited insights into how different transportation modes might interact within an integrated system, while the study's focus on manufacturing SMEs excludes service-sector enterprises that may exhibit different responsiveness to transportation improvements. Additionally, the binary treatment approach (access vs. no access) overlooked the potential for graduated effects based on proximity and connectivity quality.

In a regional study of Latin America, Rodríguez and Morales (2021) investigated the effect of multimodal transportation systems on the growth of SMEs in Colombia, Peru, and Chile from 2001 to 2019. Utilizing a panel cointegration approach, they examined the long-run relationships between road usage rates, rail freight movement, and inland port activities with SME output contributions to GDP. The study found that rail transport had the strongest long-run influence, especially in Chile, where mining SMEs benefit significantly from rail freight. Road transport showed mixed results, performing better in Peru than in Colombia due to differences in road maintenance and quality. Water transport played a significant role in coastal and riverine cities. However, the study lacked sectoral disaggregation of SMEs and did not control for other infrastructure components such as electricity and broadband, which may interact with transport to influence firm growth.

In a country-specific study in South Africa, Mahlalela and Ngwenya (2020) assessed the influence of transportation infrastructure on the performance of township-based SMEs

between 2005 and 2019. Using a mixed-methods approach that combined survey data from 120 SMEs with econometric analysis, the authors found that road quality and access to public transportation significantly influenced SMEs' operational efficiency and market reach. Water transport was not included due to its minimal relevance in the context of inland townships, while rail was found to be statistically insignificant due to aging infrastructure and limited freight access. Though insightful, the study's scope was geographically restricted and lacked longitudinal robustness, as it focused primarily on peri-urban areas without comparative analysis from more industrialized provinces.

In Bangladesh, Hossain and Ahmed (2020) examined the role of transportation infrastructure in promoting SME growth from 1995 to 2018. The researchers used a dynamic panel model with lagged variables to measure the influence of road length, rail track development, and inland waterway tonnage on SME output across administrative districts. Road infrastructure had an immediate positive impact, while water transport, though initially insignificant, gained relevance in lagged periods due to government investment in river port modernization. Rail infrastructure's effect was weak, attributed to low service reliability and outdated systems. One shortcoming of the study was the exclusion of qualitative data, which could have provided richer context to understand how infrastructure affects firm-level decisions, especially in informal sectors.

Methodology

This study adopted an *ex-post* facto research design, which is appropriate for examining the relationship between modes of transportation services and the growth of SMEs in Nigeria over the period 1999 to 2024. The design enabled the analysis of existing historical data without manipulating any variables, thus allowing for the observation of patterns, trends, and causal inferences based on naturally occurring changes. The nature of data used in this study was secondary, obtained from institutional sources. Specifically, data on transportation services, proxied by road, rail, and water transport contributions to GDP, were sourced from the Central Bank of Nigeria (CBN) Statistical Bulletin (2023, 2024). In addition, data on SMEs' contribution to GDP were extracted from the National Bureau of Statistics (NBS) and the Small and Medium Enterprises Development Agency of Nigeria (SMEDAN, 2024). This study adopted and tailored the model framework utilised by Miapkwap and Adeyi (2022), who examined the *impact of transportation on economic development in Nigeria*. Their model is captured as:

$$grPL_t = \varphi_0 + \varphi_1 grTPGS_t + \varphi_2 grTPPS_t + \varphi_3 grQHC_t + \varphi_4 grK_t + \upsilon_t \quad (1)$$

Where;

grPL = growth rate of productivity of labour performance in the good sector; grTPPS = growth rate of transport performance in the passenger sector; grQHC = growth rate of quality of human capital; grk = growth rate of capital input.

The modified model for the study is captured as:

$$SMG_t = \alpha_0 + \alpha_1 RDTS_t + \alpha_2 RLTS_t + \alpha_3 WTS_t + u_t \quad (2)$$

Where:
SMG= SMEs growth (% of SMEs contribution to GDP)
RDTS= road transport services
RLTS = rail transport services
WTS = water transport services
α_0= Autonomous parameter estimates
$\alpha_1 - \alpha_3$ = Coefficients of road transport services, water transport services and rail transport services
u_t = error term.

On *a priori* basis, the coefficient of road transport services is expected to be positive ($\alpha_1 > 0$), as improved road infrastructure enhances accessibility, reduces transportation costs, and facilitates smoother supply chain operations for SMEs. For water transport services, the coefficient is also expected to be positive ($\alpha_2 > 0$), considering that efficient waterway systems reduce bulk freight costs and enhance trade, especially for SMEs located near coastal and riverine areas. The coefficient of rail transport services is equally expected to be positive ($\alpha_3 > 0$), as rail systems support the affordable movement of heavy goods over long distances, which can benefit SMEs engaged in manufacturing and distribution.

The initial stage of the analysis for this study involved testing the stationarity of each variable using the Augmented Dickey-Fuller (ADF) test. Establishing the stationarity of the data was essential to prevent spurious regression results and to enhance the validity and reliability of subsequent econometric estimations. After confirming the stationarity conditions of the time series data, the next critical step in the analysis was to assess the existence of long-run relationships among the variables through the application of the Bounds Cointegration Test. This approach was suitable given the mixture of integration orders among the variables, and it provided a robust framework for determining whether a stable, long-term equilibrium relationship existed between transportation services and SME growth in Nigeria.

Mathematically, the Bounds ARDL model can be specified as follows:

$$\Delta y_t = \alpha + \sum_{i=1}^{p} \phi_i \Delta y_{t-i} + \sum_{i=0}^{q} \theta_i \Delta x_{t-i} + \beta y_{t-1} + \gamma x_{t-1} + \varepsilon_t \quad (3)$$

In this equation, Δ represents the first difference operator, y_t is the dependent variable, x_t is the independent variable(s), α is a constant, ϕ_i and θ_i are the short-run dynamic coefficients of the model, β and γ capture the long-run relationship between y_t and x_t and ε_t is the error term. The Autoregressive Distributed Lag (ARDL) model was considered particularly appropriate for this study as it allows for the inclusion of variables with mixed integration orders, specifically those that are stationary at level I(0) and at first difference I(1). Moreover, the ARDL framework offered the advantage of capturing both the short-run adjustments and long-run equilibrium relationships between the variables, making it well-suited for analysing how modes of transportation services influence the growth of SMEs in Nigeria over time.

Accordingly, the unrestricted ARDL model adapted for this study is specified as follows:

$$\Delta SMG_t = \alpha_0 + \sum_{i=0}^{p-1} \alpha_1 \Delta SMG_{t-i} + \sum_{i=0}^{n-1} \alpha_2 \Delta RDTS_{t-i} + \sum_{i=0}^{q-1} \alpha_3 \Delta RLTS_{t-i} + \sum_{i=0}^{r-1} \alpha_4 \Delta WTS_{t-i} + \alpha_5 SMG_{t-1} + \alpha_6 RDTS_{t-1} + \alpha_7 RLTS_{t-1} + \alpha_8 WTS_{t-1} + u_t \quad (4)$$

Δ denotes the first difference of the variables, capturing the short-run changes.
$\alpha_1 - \alpha_4$ are the short-run coefficients for the lagged differences of SMG, RDTS, RLTS, and WTS respectively; while $\alpha_5 - \alpha_8$ are the long-run coefficients of SMG, RDTS, RLTS, and WTS.

Results and Discussions

Descriptive Statistics Results

Descriptive statistics offer a preliminary understanding of the distribution, central tendencies, and variability of the variables used in a study. They help to summarize the key characteristics of the dataset and provide insight into the patterns and behaviour of the variables.

Table 1: Descriptive Statistics

	SMG	RDTS	RLTS	WTS
Mean	43.34784	1235.976	0.191923	6.299615
Maximum	50.00010	3876.250	0.420000	15.14000
Minimum	26.00600	119.1400	0.040000	2.130000
Std. Dev.	6.089045	1145.759	0.130415	3.715924
Skewness	-1.30559	0.980260	0.286002	0.643397
Kurtosis	4.280147	2.628613	1.510641	2.359490
Jarque-Bera	9.161791	4.313363	2.757494	2.238267
Probability	0.010246	0.115708	0.251894	0.326563
Observations	26	26	26	26

Source: Researcher's Computation Using EViews-12 (2025)

The descriptive statistics for SMEs' contribution to GDP (SMG) reveal a mean value of 43.35%, indicating that, on average, SMEs accounted for a substantial share of Nigeria's GDP over the study period. The maximum value of 50.00% and minimum of 26.01% reflect significant variation in SME performance, potentially influenced by structural, policy, and infrastructural factors across the years. The standard deviation of 6.09% suggests moderate volatility in SME contributions. The negative skewness (-1.31) indicates that the distribution of SME contributions is left-skewed, with a concentration of values on the higher end. The kurtosis value of 4.28 implies a leptokurtic distribution, meaning the data are more peaked than a normal distribution. The Jarque-Bera statistic (9.16) with a p-value of 0.01 indicates that the variable is not normally distributed at the 5% significance level, which may suggest the need for transformation or further robustness checks during regression.

For road transport services (RDTS), the mean contribution of ₦1,235.98 billion suggests its dominant role in Nigeria's transportation system. The maximum and minimum values—₦3,876.25 billion and ₦119.14 billion, respectively show a sharp rise in road transport activities over the years, consistent with the country's dependence on road infrastructure. The high standard deviation of ₦1,145.76 billion indicates significant dispersion, highlighting the uneven growth in road transport investment and utilization over the years. The positive skewness (0.98) shows a rightward tail in the distribution, suggesting more observations at the lower end. The kurtosis (2.63) is close to the normal distribution benchmark of 3, implying a moderately peaked distribution. The Jarque-Bera statistic (4.31) and probability value (0.12) suggest that the data are approximately normally distributed at the 5% level.

Regarding rail transport services (RLTS), the mean value of ₦0.19 billion and a maximum of ₦0.42 billion highlight the relatively low economic contribution of this mode over the study period. This aligns with infrastructural constraints and underinvestment in Nigeria's railway system. The standard deviation of ₦0.13 billion reflects minimal variability, reinforcing the sector's stagnation. The skewness (0.29) indicates a slight rightward skew, while the kurtosis of 1.51 points to a platykurtic distribution, implying that the values are flatter and more spread out than a normal distribution. With a Jarque-Bera value of 2.76 and p-value of 0.25, the rail transport data can be considered normally distributed, suggesting reliability for use in regression analysis without transformation.

For water transport services (WTS), the mean value of ₦6.30 billion reflects its modest contribution to GDP despite Nigeria's significant maritime and inland waterway potential. The range, from a minimum of ₦2.13 billion to a maximum of ₦15.14 billion, demonstrates some growth in the sector, although it remains underutilized relative to road transport. The standard deviation of ₦3.72 billion suggests moderate variability. The skewness (0.64) implies a rightward distribution, with more data concentrated on the lower end, while the kurtosis of 2.36 suggests a slightly flatter distribution than normal. The Jarque-Bera test statistic (2.24) with a p-value of 0.33 shows no significant departure from normality.

Unit Root Test

Unit root testing is a crucial step in time series analysis as it helps determine the stationarity properties of each variable. When variables are non-stationary, regression models can produce misleading or spurious outcomes. To avoid such issues, the Augmented Dickey-Fuller (ADF) test was employed in this study to examine the order of integration for each of the variables used.

Table 2: Unit Root Test Results

Variable	ADF Test Statistics	Critical ADF Test Statistics	Order of Integration
SMG	-4.796030	-4.612199**	I(1)
RDTS	-4.969104	-4.510740**	I(1)
RLTS	-6.028684	-4.394309*	I(1)
WTS	-3.831481	-3.644963**	I(0)

Note: The tests include intercept with trend; ** and ** significant at 1 and 5.*

Source: Researcher's Computation Using EViews-12 (2025)

The results from the ADF test revealed that SMEs' contribution to GDP (SMG) became stationary after first differencing, as indicated by the ADF test statistic of -4.796030, which is more negative than the critical value of -4.612199 at the 5% level. This implies that SMG is integrated of order one, I(1), suggesting that its historical data contains a unit root at level but becomes stable once differenced, making it suitable for inclusion in the ARDL model.

For road transport services (RDTS), the ADF test statistic was -4.969104, exceeding the 5% critical value of -4.510740. This also confirmed stationarity at first difference, indicating that the data is I(1). The implication is that although road transport data exhibited non-stationary characteristics in its raw form, its differenced form is stable and suitable for regression analysis. Similarly, rail transport services (RLTS) were found to be stationary at first difference, with an ADF test statistic of -6.028684, which is greater in magnitude than the 10% critical value of -4.394309. This confirms the I(1) status of rail transport, indicating that while its original data series exhibited non-stationary behaviour, it achieved stationarity upon differencing. In contrast to the other variables, water transport services (WTS) were found to be stationary at level, with an ADF test statistic of -3.831481, exceeding the 5% critical value of -3.644963. This indicates that WTS is integrated of order zero, I(0), suggesting that it is stable in its natural form without requiring differencing.

Co-integration Results

Cointegration analysis is an essential technique in time series econometrics used to determine whether a long-run equilibrium relationship exists among non-stationary variables. Even when individual variables are non-stationary, they may move together over time in such a way that their linear combination becomes stationary.

Table 3: Bound Test-Co-integration Results

F-Bounds Test		Null Hypothesis: No levels relationship		
Test Statistic	Value	Significance	I(0)	I(1)
F-statistic	11.35004**	10%	2.37	3.20
k	3	5%	2.79	3.67
		1%	3.65	4.66

Source: Researcher's Computation Using EViews-12 (2025)

The result of the bounds cointegration test presented an F-statistic of 11.35004, which is significantly higher than the upper bound critical value of 3.67 at the 5% level of significance. Given that the F-statistic exceeds the 5% upper bound, the null hypothesis of no long-run relationship among the variables is rejected. This indicates that a statistically significant long-run equilibrium relationship exists between SMEs' contribution to GDP (SMG) and the explanatory variables, road transport services (RDTS), rail transport services (RLTS), and water transport services (WTS).

ARDL (Short and Long Run) Estimates

The study established the presence of a long-run cointegrating relationship between transportation services, proxied by road, rail, and water transport and SMEs' growth in Nigeria. Consequently, the analysis advanced to estimate both the error correction model (ECM) and the long-run ARDL model.

Table 4: ARDL-ECM Result
Dependent Variable: SMG

ECM Estimates				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(SMG(-1))	0.4200	0.0872	4.8154	0.0171
D(SMG(-2))	-0.2650	0.0969	-2.7356	0.0716
D(SMG(-3))	0.3202	0.0790	4.0558	0.0270
D(RDTS)	-0.0047	0.0022	-2.1633	0.1192
D(RDTS(-1))	0.0309	0.0044	7.0410	0.0059
D(RDTS(-2))	0.0372	0.0039	9.6219	0.0024
D(RDTS(-3))	0.0329	0.0041	8.0563	0.0040
D(RLTS)	-18.8228	15.4069	-1.2217	0.3091
D(RLTS(-1))	335.0901	37.6570	8.8985	0.0030
D(RLTS(-2))	262.3846	30.1695	8.6970	0.0032
D(RLTS(-3))	67.2717	16.8471	3.9931	0.0281
D(WTS)	4.7254	1.4051	3.3630	0.0436
D(WTS(-1))	-11.8471	2.2903	-5.1728	0.0140
D(WTS(-2))	-17.8552	1.7480	-10.2147	0.0020
CointEq(-1)*	-0.2964	0.0258	-11.5073	0.0014
Long Run Estimates				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
RDTS	-0.0932	0.0353	-2.6417	0.0207
RLTS	-1829.7880	716.4381	-2.5540	0.0382
WTS	86.8268	34.0643	2.5489	0.0213
C	-69.8031	216.0073	-0.3232	0.7678
Reliability				
R-squared	0.6190			
Adjusted R-squared	0.5457			
Durbin-Watson stat	2.0853			

Source: Researcher's Computation Using EViews-12 (2025)

The error correction term CointEq(-1) in the ARDL model captures the speed at which short-run deviations from the long-run equilibrium are corrected. In this study, the coefficient of the error correction term is -0.2964, with a highly significant t-statistic of -11.5073 and a p-value of 0.0014, indicating strong statistical significance at the 1% level. The negative sign, as expected, confirms the existence of a stable long-run relationship among the variables and shows that the system adjusts back toward equilibrium after a short-run shock. Specifically, the coefficient of -0.2964 implies that approximately 29.64% of any deviation from the long-run equilibrium in SME contributions to GDP is corrected within one period (likely one year in this context). From the long-run results, the coefficient for road transport services (RDTS) was found to be negative (-0.0932) and statistically significant at the 5% level, with a t-statistic of -2.6417 and a p-value of 0.0207. This suggests that in the long run, road transport is associated with a decline in SME contributions to GDP.

Similarly, rail transport services (RLTS) exhibited a negative long-run coefficient (-1829.79), which is also statistically significant (t-statistic = -2.554, p-value = 0.0382). In contrast, water transport services (WTS) displayed a positive and statistically significant long-run coefficient (86.8268), with a t-statistic of 2.5489 and p-value of 0.0213. This result confirms that improvements in water transport infrastructure have a favourable long-term impact on SME performance.

Discussion of Findings

Findings from the study showed that road transport services have a negative but significant impact on the growth of SMEs in Nigeria. This outcome implies that despite its dominance as the primary mode of transportation, road infrastructure has not translated into improved productivity or growth for the SME sector. The result may be attributed to the deteriorating condition of many roads, persistent traffic congestion, high vehicle maintenance costs, and delays in the movement of goods, factors that increase operational expenses for small businesses. This finding is consistent with the position of Eze and Nwokolo (2023), who noted that Nigeria's overdependence on road transport, coupled with inadequate road maintenance and poor logistics planning, leads to inefficiencies that hamper the performance of SMEs. Similarly, Chen and Lu (2021), in a comparative study of Asian economies, reported that while road transport initially supports business activities, its contribution declines in the long run when not complemented by investment in alternative modes, particularly in urban areas experiencing severe congestion. However, this finding contradicts the result of Akinyemi and Adeola (2022), whose study on Nigeria found that road transport significantly drives SME performance due to its wide accessibility and flexibility, especially in areas with limited rail or waterway alternatives.

The study also found that rail transport services had a negative and significant impact on the growth of SMEs in Nigeria. This result suggests that rather than enhancing SME output, the current state of rail infrastructure in Nigeria imposes limitations that may undermine its intended economic benefits. Possible explanations include the outdated nature of rail lines, lack of nationwide connectivity, irregular service schedules, and minimal integration with commercial zones where SMEs operate. This aligns with Hossain and Ahmed (2020), who

found in their study on Bangladesh that inefficient rail systems contribute little to SME performance unless accompanied by substantial infrastructure upgrades and integration with urban supply chains. In Nigeria's case, the inefficiencies of rail services likely increase business uncertainty, limit the movement of goods, and discourage SME reliance on the mode. This evidence contrasts with the findings of Rodríguez and Morales (2021), who discovered that in Chile, robust and modern rail infrastructure positively impacted SME productivity, especially for firms engaged in large-scale manufacturing and distribution.

On the other hand, water transport services were found to have a positive and significant impact on the growth of SMEs in Nigeria, suggesting that improvements in water-based logistics contribute meaningfully to SME development. The implication of this finding is that when properly developed, water transport provides a cost-effective, efficient, and scalable mode for moving bulk goods, particularly for SMEs involved in inter-regional and international trade. This finding is in agreement with Muthoni and Kimani (2023), who observed that in Kenya, the development of inland water ports significantly enhanced SME performance in regions bordering Lake Victoria. It also resonates with Owusu and Aboagye (2022), who found that in Ghana, small businesses located near waterway transport hubs reported lower logistics costs and better access to raw materials and markets. The outcome from this study highlights the underutilized potential of Nigeria's vast inland waterways and coastal routes, reinforcing the need for renewed policy focus and investment in the maritime transport sector. However, it differs from the result of Mahlalela and Ngwenya (2020), whose findings in South African townships showed that water transport had no significant influence on SME development due to the absence of viable water routes in those areas.

Conclusion and Recommendations

In conclusion, the study reveals that transportation services significantly influence SME growth in Nigeria, though the impacts differ by mode. Road transport, despite being the most widely used, showed a negative long-run effect on SME growth, suggesting that poor infrastructure quality, congestion, and high logistics costs hinder its effectiveness. Similarly, rail transport also had a negative and significant impact, reflecting the inefficiencies and limited reach of Nigeria's rail network, which restricts its usefulness to SMEs. In contrast, water transport demonstrated a positive and significant relationship with SME growth, highlighting its potential as a cost-effective and underutilized mode of transport. This suggests that improved investment in inland waterways and port infrastructure could enhance SME productivity and market access. The findings call for a more balanced and integrated transport strategy that reduces overdependence on road transport and leverages the unique advantages of rail and water modes to better support Nigeria's SME sector.

Based on the findings of this study, it is essential that specific, actionable steps be taken to address the transport-related constraints affecting SME growth in Nigeria.

i. The negative long-run impact of road transport services suggests an urgent need for Federal Ministry of Works and Housing and Federal Road Maintenance Agency (FERMA) to prioritize the rehabilitation and maintenance of major economic corridors, especially those connecting industrial clusters, SME hubs, and rural

markets. These agencies must also coordinate with state ministries of transport to improve feeder roads and reduce traffic congestion in commercial cities like Lagos, Kano, and Port Harcourt. Furthermore, policies should be introduced by the Federal Ministry of Transportation to regulate freight charges and streamline road haulage operations, thereby lowering transport costs for SMEs.

ii. Given the significant but negative impact of rail transport services, it is crucial for the Nigerian Railway Corporation (NRC) and the Infrastructure Concession Regulatory Commission (ICRC) to accelerate ongoing railway modernization projects and ensure they are linked to commercial centers and industrial zones where SMEs operate. The lack of functional intermodal terminals has limited SMEs' ability to utilize rail transport effectively. Thus, NRC must work with Nigeria Export Processing Zones Authority (NEPZA) and Nigerian Shippers' Council to create integrated logistics hubs where SMEs can access rail freight services seamlessly, particularly in states with active industrial zones.

iii. The positive outcome associated with water transport highlights a key area for intervention. The National Inland Waterways Authority (NIWA) and Nigerian Ports Authority (NPA) should expand investments in inland port infrastructure, dredging of waterways, and safety enforcement to make water transport more reliable for SMEs. Additionally, NIWA should collaborate with state water transport agencies to improve ferry and cargo services across Nigeria's navigable rivers, especially in the Niger Delta and along the River Niger and Benue corridors. This mode offers a cost-efficient alternative for bulk movement of goods and can significantly enhance market access for SMEs in remote and coastal areas.

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