

Financing Transportation Infrastructure for Sustainable Development: Evidence from Emerging Economies in Africa

Zubaida Abubakar¹, Mohammed Rabi Musa, PhD^{1*}, Khalil Nasiru Wada, PhD², Yusuf Abubakar¹, Abdullahi Zakari Abdulhamid¹, Abdullahi Zakari Aliyu¹

¹Department of Logistics and Maritime Economics, Faculty of Transportation Management, Federal University of Transportation Daura, Katsina State, Nigeria

²Capital City University, Kano Nigeria

DOI: <https://doi.org/10.36348/sjef.2026.v10i09.002>

| Received: 18.07.2026 | Accepted: 12.09.2026 | Published: 16.09.2026

*Corresponding author: Mohammed Rabi Musa, PhD

Department of Logistics and Maritime Economics, Faculty of Transportation Management, Federal University of Transportation Daura, Katsina State, Nigeria

Abstract

Transportation infrastructure is critical to economic transformation and sustainable development in emerging African economies, yet inadequate financing continues to constrain the development and efficiency of transport systems. This study examines the effect of transportation infrastructure financing on sustainable development, using economic growth as the principal indicator, with particular attention to public-private partnerships (PPPs), public investment, infrastructure bonds, concessional loans, and sovereign funds. The study adopted a quantitative survey design and analysed 2,836 valid responses obtained from transportation and logistics organisations. Least square regression was employed to examine the relationships between the financing mechanisms and sustainable development, while logistic regression was used as a robustness check. The results reveal positive and statistically significant relationships across all five financing mechanisms. Infrastructure bonds recorded the strongest estimated relationship (3.231), followed by public investment (2.841), sovereign funds (2.767), PPPs (2.764), and concessional loans (2.667), all significant at the 1% level. The robustness analysis further supports the consistency of the findings. The study concludes that diversified and effectively managed transportation infrastructure financing can contribute significantly to sustainable development in emerging African economies. It recommends stronger institutional capacity, improved governance, and strategic diversification of public and private financing sources.

Keywords: Transportation Infrastructure; Infrastructure Financing; Sustainable Development; Public-Private Partnerships (PPPs); Public Investment; Infrastructure Bonds.

Copyright © 2026 The Author(s): This is an open-access article distributed under the terms of the Creative Commons Attribution 4.0 International License (CC BY-NC 4.0) which permits unrestricted use, distribution, and reproduction in any medium for non-commercial use provided the original author and source are credited.

1.1 INTRODUCTION

Transportation infrastructure is widely recognized as a fundamental catalyst for sustainable development and economic transformation. In addition to facilitating the flow of people, products, and services, efficient transportation systems also increase market accessibility, lower logistical costs, promote trade, draw in investment, and strengthen regional integration. Reliable transportation infrastructure is now essential for boosting productivity, fortifying supply chains, and fostering equitable economic growth as economies become more interconnected (Bassem, 2026; Sajjad & Soriya, 2025). As a result, governments, development organizations, and private investors looking to hasten sustainable development continue to prioritize investing in transportation infrastructure.

The supply of sufficient transportation infrastructure is still hampered by large funding gaps, especially in emerging economies, despite its strategic significance. The need for contemporary highways, railroads, airports, seaports, and urban transit systems has significantly expanded due to rapid urbanization, population growth, rising trade volumes, and industrial expansion. However, governments' ability to finance the infrastructure needed to sustain long-term economic development has been hampered by a lack of public resources, growing public debt, conflicting developmental agendas, and insufficient institutional capacity (Anago, 2024; Bolomope *et al.*, 2021). The necessity for diverse and innovative financing methods that might supplement conventional public funding has grown as a result of this circumstance.

The mobilization and distribution of financial resources for the design, development, operation, upkeep, and upgrading of transportation infrastructure is referred to as transportation infrastructure funding. In order to finance transportation projects, governments, private investors, financial institutions, and development partners work together through a variety of funding methods. In addition to ensuring the long-term sustainability, operational effectiveness, and contribution to national development goals of transportation infrastructure, effective funding is crucial for its expansion (Kumar & Soriya, 2026; Ren *et al.*, 2025).

Public-Private Partnerships (PPPs), public investment, infrastructure bonds, concessional loans, and sovereign funds are some of the most popular ways to finance transportation infrastructure. In order to overcome infrastructure shortages, public-private partnerships which combine public oversight with private sector knowledge, technology, creativity, and financial resources have grown in importance. Research indicates that PPPs can support the development of sustainable infrastructure, but their efficacy is contingent upon suitable institutional arrangements, risk allocation, finance structures, and governance (Akomea-Frimpong *et al.*, 2023; Anago, 2022). In a similar vein, public investment continues to be a vital source of funding for the direct allocation of budgetary resources by governments to the development of key transportation infrastructure that supports social welfare and national economic interests (Aawaar & Abendin, 2025).

Another significant tool for raising long-term local and foreign funding for infrastructure development is infrastructure bonds. Large-scale infrastructure projects can benefit from these funding options, which also lessen reliance on yearly government budgetary allotments (Ke & Liu, 2023; Weinreich, 2021). Similarly, in developing economies where domestic financing capacity may be limited, concessional loans from bilateral and multilateral development partners can offer reasonably priced long-term financing for infrastructure projects (Elsner & Kreibich, 2025). Furthermore, although institutional governance and prudent investment management play a major role in their efficacy, sovereign funds can act as channels for directing national financial resources toward strategic and profitable initiatives.

The efficiency, accessibility, and quality of transportation infrastructure are all greatly impacted by the availability of sustainable funding options, which in turn promotes sustainable development. Achieving economic growth while guaranteeing the effective use of resources and generating opportunity for both current and future generations is known as sustainable development. Among its many facets, economic growth continues to be one of the key markers of sustainable development since it reflects higher living standards,

enhanced productivity, employment creation, income growth, and industrial development. Infrastructure development can boost economic growth by enhancing connectivity, attracting investment, and fostering profitable economic activity, according to data from developing and emerging economies (Bassem, 2026; Sajjad & Soriya, 2025).

The Sustainable Development Goals (SDGs) of the United Nations further support the role that financing for transportation infrastructure plays in sustainable development. SDG 9 (Industry, Innovation and Infrastructure) places a strong emphasis on the creation of resilient and sustainable infrastructure, while SDG 8 (Decent Work and Economic Growth) is closely linked to transportation infrastructure investment due to its contribution to employment and productive economic activities. Additionally, SDG 17 (Partnerships for the Goals) emphasizes the significance of collaborations between international organizations, governments, private investors, and development finance institutions. Thus, a key avenue for advancing sustainable development goals is the increasing use of public-private investment and creative financing methods (Ren *et al.*, 2025; Tabash *et al.*, 2024).

Although, many studies such as Weinreich (2021), Vardar *et al.*, (2025) and Musa *et al.*, (2026) have looked at economic performance, transportation development, and infrastructure investment, most of the literature that is now available focuses more on the results of infrastructure than on the funding sources that make infrastructure delivery possible. Additionally, prior research of Montesinos-Sansaloni *et al.*, (2025) has frequently looked at individual financing strategies in isolation, paying relatively little attention to how public-private partnerships, public investment, infrastructure bonds, concessional loans, and sovereign funds all contribute to sustainable development in emerging economies. This necessitates a more comprehensive understanding of the ways in which various finance strategies for transportation infrastructure might support economic expansion and more general sustainable development results.

Using public-private partnerships (PPPs), public investment, infrastructure bonds, concessional loans, and sovereign funds as important financing mechanisms and economic growth as the primary indicator of sustainable development, this paper investigates the role of transportation infrastructure financing in fostering sustainable development. The study offers policy insights into how creative and varied financing structures might improve transportation infrastructure, boost economic growth, and support sustainable development in emerging economies by combining recent theoretical and empirical data.

1.2 Statement of the Problem

Transportation infrastructure is one of the primary drivers of sustainable development since it enables commerce, improves mobility, decreases logistics costs, enhances productivity, and encourages economic growth. However, many emerging economies continue to have severe transportation infrastructure deficits due to inadequate and unsustainable financing. These shortfalls have resulted in bad road networks, underdeveloped railway systems, congested seaports, inefficient airports, and weak urban transport systems, which impede economic activity and undermine national competitiveness (Bassem, 2026; Sajjad & Soriya, 2025).

Public-Private Partnerships (PPPs) have become a significant source of funding for transportation infrastructure, but their application has been hampered in many developing nations by inadequate institutional frameworks, unclear regulations, drawn-out procurement procedures, inadequate risk allocation, and low investor confidence. As a result, PPP projects' ability to contribute to infrastructure development may be limited by delays, cost overruns, renegotiations, or challenges in reaching financial close (Akomea-Frimpong *et al.*, 2023; Bolomope *et al.*, 2021; Nguyen *et al.*, 2024).

Similar to this, public investment which is still a significant source of funding for transportation infrastructure in many developing nations has grown more insufficient as a result of budgetary restrictions, growing public debt, conflicting development goals, and low government revenue. Significant infrastructure finance needs may not be met by available public money, which could lead to project implementation delays, poor maintenance, and growing infrastructure gaps (Aawaar & Abendin, 2025; Anago, 2024).

Additionally, immature capital markets, low investor engagement, macroeconomic instability, and inadequate financing methods have continued to limit the usage of infrastructure bonds in many emerging economies. These difficulties may make it more difficult for governments to raise long-term funding for significant transportation infrastructure projects and increasing reliance on traditional public funding (Ke & Liu, 2023; Weinreich, 2021).

Similarly, although infrastructure development can be supported by concessional loans from bilateral partners and international development organizations, eligibility restrictions, approval processes, and financing conditions may limit access to such funding. Additionally, an over-reliance on borrowing from outside sources might raise questions about long-term fiscal stability and debt sustainability, especially in developing nations (Elsner & Kreibich, 2025).

Furthermore, even while sovereign funds can offer strategic sources of long-term infrastructure

funding, their impact may be constrained in situations where funds lack sufficient capital or where governance and investment frameworks are deficient. Therefore, good institutional frameworks, open governance, and suitable investment strategies are necessary for the effective use of such resources (Mehar, 2024).

When taken as a whole, these funding issues can hinder the growth of transportation infrastructure, lower transportation efficiency, raise the cost of transactions and logistics, deter private investment, and limit commerce and industrial production. As a result, transportation infrastructure's ability to promote sustainable development especially economic growth which may be seriously compromised. Market access, labor mobility, regional integration, and the competitiveness of emerging economies can all be hampered by poor transportation connections (Bassem, 2026; Layaoen *et al.*, 2023).

Many studies have looked at the connection between economic growth and transportation infrastructure, most of the literature that is currently available has concentrated on infrastructure results rather than the financial processes that affect infrastructure delivery. Furthermore, prior research has typically looked at public-private partnerships, public investment, infrastructure bonds, concessional loans, and sovereign funds separately, with little attempt to provide an integrated understanding of how these financing mechanisms all work together to promote sustainable development through economic growth. This disjointed approach leaves a significant knowledge gap, especially in emerging economies where funding infrastructure continues to be a major problem.

In light of this, this study uses economic growth as the primary indicator to investigate how public-private partnerships (PPPs), public investment, infrastructure bonds, concessional loans, and sovereign funds all important financing mechanisms for transportation infrastructure contribute to sustainable development. In order to increase finance for transportation infrastructure and foster long-term economic growth in emerging nations, the study aims to offer evidence-based insights to policymakers, infrastructure investors, and development partners.

1.3 Objectives of the Study

The main objective of this study is to examine the effect of transportation infrastructure financing on sustainable development, using economic growth as a proxy for sustainable development. The specific objectives are to:

1. Examine the effect of Public-Private Partnerships (PPPs) on economic growth.
2. Assess the effect of public investment on economic growth.
3. Determine the effect of infrastructure bonds on economic growth.

4. Examine the effect of concessional loans on economic growth.
5. Evaluate the effect of sovereign funds on economic growth.

1.4 Research Questions

The following research questions will guide the study:

1. What is the effect of Public-Private Partnerships (PPPs) on economic growth?
2. To what extent does public investment influence economic growth?
3. What effect do infrastructure bonds have on economic growth?
4. How do concessional loans affect economic growth?
5. What is the effect of sovereign funds on economic growth?

2.0 LITERATURE REVIEW

2.1 Transportation Infrastructure Financing

The mobilization, distribution, and management of financial resources necessary for the design, construction, operation, maintenance, and growth of transportation infrastructure, such as roads, railroads, airports, seaports, inland waterways, and urban transit systems, is referred to as transportation infrastructure financing. According to Bassem (2026) and Sajjad & Soriya (2025), it is one of the key factors influencing the development of transportation systems because sufficient funding makes it possible to create safe, dependable, effective, and sustainable transportation networks that boost economic activity and boost national competitiveness. By utilizing creative financing methods that can handle growing infrastructure investment needs in the face of tight public budgets, transportation infrastructure finance goes beyond conventional government spending (Anago, 2024; Kumar & Soriya, 2026).

In order to support expanding populations, urbanization, industrialization, and international trade, transportation infrastructure needs significant and ongoing investment on a global scale. However, due to poor institutional frameworks, growing public debt, insufficient private sector participation, and limited fiscal capacity, many developing and emerging economies still face large infrastructure financing shortages. According to Anago (2024) and Bolomope *et al.*, (2021), these financial limitations might hinder sustainable economic development, create maintenance backlogs, postpone the supply of infrastructure, and lower transportation efficiency.

Diverse financing methods are crucial for enhancing infrastructure investment results and guaranteeing the long-term viability of transportation networks, according to recent research. Alternative financing tools like Public-Private Partnerships (PPPs), infrastructure bonds, concessional financing, sovereign wealth and infrastructure funds, multilateral

development aid, and blended finance are being used by governments to supplement traditional public spending. In addition to easing risk sharing, enhancing project execution, and drawing private investment into infrastructure development, these methods can mobilize extra resources (Akomea-Frimpong *et al.*, 2023; Elsner & Kreibich, 2025; Kumar & Soriya, 2026).

The Sustainable Development Goals (SDGs) of the United Nations, specifically SDG 8 (Decent Work and Economic Growth), SDG 9 (Industry, Innovation and Infrastructure), SDG 11 (Sustainable Cities and Communities), and SDG 17 (Partnerships for the Goals), further highlight the significance of financing transportation infrastructure. Sufficient funding facilitates the construction of robust transportation infrastructure, encourages inclusive mobility, improves regional connectivity, boosts trade and industrialization, generates job opportunities, and supports environmentally sustainable transportation systems (Ren *et al.*, 2025; Tabash *et al.*, 2024). As a result, governments looking to boost national and regional competitiveness and drive sustainable development have made financing transportation infrastructure a key policy priority.

2.1.1 Public-Private Partnerships (PPPs)

Long-term contractual agreements between governmental and private sector entities for the funding, development, management, and upkeep of public infrastructure and services are known as public-private partnerships, or PPPs. Because they combine governmental oversight with private sector funding, experience, technology, and administrative skills, PPPs have become a significant infrastructure financing tool in the transportation industry (Akomea-Frimpong *et al.*, 2023; Kumar & Soriya, 2026). PPP agreements enhance project delivery and operational performance by distributing risks, responsibilities, and rewards among public and private partners based on their individual competencies (Anago, 2022; Nguyen *et al.*, 2024).

Increasing infrastructure finance requirements, financial restrictions, and the need to enhance service quality without unduly straining government budgets have all contributed to the increased acceptance of PPPs. By merging public and private resources, PPP agreements can promote infrastructure development and encourage private investment. Additionally, evidence indicates that suitable funding structures, governance arrangements, risk allocation, and project-specific variables all affect PPP effectiveness (Kumar & Soriya, 2026; Ren *et al.*, 2025).

Despite these benefits, PPPs require robust institutional frameworks, open procurement procedures, stable macroeconomic conditions, competent regulatory frameworks, and efficient risk allocation to be successful. PPP implementation can be hampered in many developing nations by institutional flaws, project

governance issues, and restricted access to local funding (Bolomope *et al.*, 2021; Akomea-Frimpong *et al.*, 2023). However, PPPs can be a significant source of funding for the construction of transportation infrastructure and support sustainable economic growth if they are well planned and run (Ren *et al.*, 2025).

2.1.2 Public Investment

Planning, building, renovating, expanding, and maintaining transportation infrastructure through national budgets, capital expenditure programs, and public development projects is referred to as public investment. Because transportation infrastructure promotes social participation, national growth, and economic change, public investment has historically remained a significant source of infrastructure finance in many nations (Aawaar & Abendin, 2025; Anago, 2024). Public spending on roads, railroads, ports, airports, bridges, and urban transportation systems can boost industrial development, increase labor mobility, facilitate commerce, lower logistical costs, and improve connectivity. By increasing market accessibility and infrastructure availability, well-targeted public investment can also foster complementary private investment (Sajjad & Soriya, 2025; Bassem, 2026).

However, governments' ability to finance transportation infrastructure solely through public resources has been limited by growing infrastructure demands, fiscal deficits, debt-servicing obligations, and competing public expenditure priorities. Evidence from Africa indicates that public investment can have significant implications for sustainable development, though its effectiveness may depend on investment levels and prevailing institutional and economic conditions (Aawaar & Abendin, 2025). These challenges have prompted governments to adopt complementary financing mechanisms while increasing expenditure efficiency, transparency, and project prioritization in order to maximize the developmental impact of public investment (Anago, 2024).

2.1.3 Infrastructure Bonds

Infrastructure bonds are long-term financial instruments that corporations, governments, and development finance organizations issue to raise money especially for infrastructure projects. In order to draw in institutional investors, such as pension funds, insurance firms, sovereign wealth funds, and asset managers looking for reliable long-term investment prospects, they offer an alternative financing source (Ke & Liu, 2023; Weinreich, 2021).

Because transportation infrastructure projects need large sums of money with lengthy repayment terms that frequently surpass traditional commercial lending horizons, infrastructure bonds have grown in significance. Governments can spread infrastructure financing costs across the economic life of infrastructure assets, diversify funding sources, and lessen reliance on

yearly budgetary allotments by using bond financing. (Smith, 2023; Ke & Liu, 2023).

Strong financial institutions, open regulatory frameworks, reliable project pipelines, and stable macroeconomic conditions are necessary for infrastructure bond markets to be successful. The broader use of infrastructure bonds in emerging nations may be hampered by weak capital markets, currency risks, low investor trust, and regulatory uncertainty. However, bolstering domestic bond markets continues to be a key tactic for raising long-term funding for environmentally friendly transportation infrastructure (Ke & Liu, 2023; Weinreich, 2021).

2.1.4 Concessional Loans

Concessional loans are development-focused financing options offered by international financial institutions, bilateral development agencies, and multilateral development banks under advantageous lending terms like longer grace periods, lower interest rates, and longer repayment terms. Large-scale transportation infrastructure projects that might not otherwise be financially feasible can be undertaken by governments, especially in developing nations, thanks to these funding arrangements. Therefore, in situations when fiscal capacity is constrained, concessional finance can assist infrastructure development and supplement domestic resources (Anago, 2024; Elsner & Kreibich, 2025).

In order to improve regional connectivity, trade facilitation, rural accessibility, and economic integration, organizations like the World Bank, the African Development Bank, the Asian Development Bank, and other international development partners have provided concessional financing for transportation infrastructure projects. Concessional loans may improve implementation quality and long-term sustainability by incorporating technical assistance, institutional capacity building, environmental safeguards, and project oversight in addition to financial support (Anago, 2024; Elsner & Kreibich, 2025).

Concessional loans offer inexpensive financing, but if projects do not produce enough economic returns, an over-reliance on external borrowing could raise sovereign debt exposure and put long-term fiscal strain on the government. Therefore, in order to improve the developmental results of transportation infrastructure investment, governments must combine concessional finance with solid project evaluation, effective implementation, and complementing domestic financing solutions (Mehar, 2024; Elsner & Kreibich, 2025).

2.1.5 Sovereign Funds

Sovereign funds are government-owned investment vehicles designed to promote long-term national development goals and finance key infrastructure projects. They include sovereign wealth

funds and specific national infrastructure funds. These funds can lessen reliance on traditional public financing by offering steady, long-term capital for infrastructure investments. Their involvement is especially important when governments want to diversify their funding sources and mobilize domestic resources for infrastructure that is economically viable (Mehar, 2024; Anago, 2024).

Highways, railroads, airports, seaports, urban transit systems, and logistics infrastructure that promote economic diversity, regional integration, and national competitiveness can all be financed by sovereign funds in the transportation sector. These funds can supplement governmental spending and open doors for private sector involvement in infrastructure development by offering longer-term investment money. (Luu *et al.*, 2025; Kumar & Soriya, 2026).

Strong governance frameworks, open investment guidelines, expert fund management, accountability systems, and well-chosen projects are all necessary for sovereign funds to function well. Financial hazards and decreased developmental effectiveness might result from poor governance and improper use of sovereign resources (Mehar, 2024). As a result, well-managed sovereign funds can support sustainable economic growth, solve long-term transportation infrastructure financing needs, and supplement existing infrastructure financing options.

2.2 Sustainable Development

A pattern of development that meets the requirements of the current generation without jeopardizing the capacity of future generations to meet their own needs is known as sustainable development. Through the Brundtland Report, the World Commission on Environment and Development (WCED, 1987) formally presented the idea, which has since grown to be a key tenet directing international development strategies. In order to ensure that development is inclusive, equitable, and environmentally responsible, sustainable development aims to create a balanced integration of economic prosperity, social well-being, and environmental protection. It acknowledges that resilient infrastructure, social inclusion, efficient governance, and sustainable use of natural resources are necessary for long-term economic success (United Nations, 2015; Arzova & Şahin, 2024).

Following the adoption of the United Nations 2030 Agenda for Sustainable Development, which consists of 17 Sustainable Development Goals (SDGs) targeted at eliminating poverty, fostering inclusive economic growth, safeguarding the environment, and fortifying international partnerships, sustainable development has become more prominent in recent years. The provision of effective, accessible, resilient, and ecologically sustainable transportation infrastructure that may promote trade, industrialization, regional

integration, and enhanced quality of life is directly linked to sustainable development in the transportation sector. In addition to facilitating economic activity, sustainable transportation systems improve social inclusion, lessen environmental degradation, and boost national competitiveness (Layaoen *et al.*, 2023; Bassem, 2026).

Scholarly interest in the connection between financing for transportation infrastructure and sustainable development has grown. Governments can create and maintain transportation infrastructure that boosts mobility, lowers logistics costs, increases connectivity, encourages investment, and promotes long-term economic development with the help of adequate funding. Additionally, research indicates that when supported by suitable institutional and financial conditions, public-private investment and creative financing arrangements can contribute to more comprehensive sustainable development results (Tabash *et al.*, 2024; Ren *et al.*, 2025). Additionally, SDG 8 (Decent Work and Economic Growth), SDG 9 (Industry, Innovation and Infrastructure), SDG 11 (Sustainable Cities and Communities), and SDG 13 (Climate Action) are all aided by sustainable infrastructure financing.

Economic growth is used in this study to operationalize sustainable development, reflecting the degree to which financing for transportation infrastructure boosts productivity, creates jobs, expands investment, facilitates trade, and enhances overall national economic performance. Infrastructure development and financing can have significant effects on economic growth, especially through increased connectivity, investment, and productive capacity, according to evidence from emerging economies (Sajjad & Soriya, 2025; Bassem, 2026).

2.2.1 Economic Growth

The steady rise in an economy's output of goods and services over time is referred to as economic growth, and it is commonly gaged by changes in GDP or GNI. It shows increases in industrial output, investment, employment prospects, income generation, productive capacity, and general economic welfare. Economic growth is often regarded as a key indicator of national development since it raises living standards, eliminates poverty, increases fiscal capacity, and promotes long-term socioeconomic transformation (Sajjad & Soriya, 2025).

By facilitating better cross-regional mobility of people, products, and services, transportation infrastructure is essential to fostering economic growth. Effective transportation networks save travel times, cut down on logistics and transaction costs, promote both domestic and international trade, enhance market accessibility, and boost corporate productivity. In addition to promoting private investment, industrialization, regional integration, and supply chain efficiency, well-developed transportation infrastructure

also boosts economic growth and creates job possibilities (Lieske *et al.*, 2021; Bassem, 2026).

The contribution of transportation infrastructure to economic growth is heavily influenced by the availability of sufficient and sustainable infrastructure financing. Public-Private Partnerships (PPPs), infrastructure bonds, concessional loans, public investment, and sovereign infrastructure funds are examples of financing structures that allow governments to create, update, and maintain transportation networks that may sustain long-term economic growth. While PPP agreements can help deliver infrastructure by mobilizing additional financial and technical resources, empirical data suggests that public investment can affect economic development results (Aawaar & Abendin, 2025; Akomea-Frimpong *et al.*, 2023). On the other hand, insufficient funding could lead to inadequate infrastructure, poor upkeep, traffic jams, higher transportation costs, and lower economic output.

The infrastructure-Led Growth Theory, which contends that investments in core infrastructure boost productivity, lower production costs, increase market access, and encourage public and private investment, can be used to explain the connection between financing for transportation infrastructure and economic growth. Transportation infrastructure can boost economic growth through increased connectivity and investment flows, according to data from emerging economies (Bassem, 2026). Since economic growth directly relates to SDGs 8 (Decent Work and Economic Growth) and 9 (Industry, Innovation and Infrastructure), it is a suitable proxy for sustainable development in this study.

2.3 Theoretical Framework

The Endogenous Growth Theory and the Infrastructure-Led Growth Theory (ILGT) serve as the study's main pillars. These theories offer a solid basis for understanding how funding for transportation infrastructure promotes sustainable development by boosting economic growth.

2.3.1 Infrastructure-Led Growth Theory

According to the Infrastructure-Led Growth Theory, infrastructure spending is a key factor in economic growth since it boosts private sector investment, increases market accessibility, lowers production and transaction costs, increases productivity, and facilitates trade. According to the theory, sufficient infrastructure acts as productive capital that boosts the effectiveness of all economic sectors, hastening long-term economic growth and enhancing societal welfare. By lowering logistics costs, boosting connectivity, and facilitating the flow of products, services, labor, and information, infrastructure including roads, railroads, ports, airports, and urban transportation systems fosters a business-friendly environment.

The process by which governments and private investors mobilize financial resources for infrastructure development is known as transportation infrastructure finance in the context of this study. The money needed to create and maintain effective transportation infrastructure is provided via financing tools like Public-Private Partnerships (PPPs), public investment, infrastructure bonds, concessional loans, and sovereign funds. As a result, improved transportation infrastructure boosts trade efficiency, draws in investment, generates job opportunities, encourages industrialization, and fosters long-term economic growth. According to the hypothesis, nations that are able to raise sufficient and sustainable funding for infrastructure are more likely to attain greater levels of long-term sustainability and economic development.

In emerging economies, where infrastructure deficiencies continue to be a significant barrier to economic change, the infrastructure-Led Growth Theory is especially pertinent. Governments can advance the Sustainable Development Goals (SDGs), especially SDG 8 (Decent Work and Economic Growth) and SDG 9 (Industry, Innovation and Infrastructure), by strengthening supply chain performance, improving regional integration, and increasing national competitiveness through the expansion of transport infrastructure through efficient financing mechanisms.

2.3.2 Endogenous Growth Theory

Long-term economic growth is produced by internal variables such investment in physical capital, technical innovation, human capital development, institutional quality, and infrastructure, according to the Endogenous Growth Theory, which was primarily created by Romer (1986, 1990) and Lucas (1988). The theory contends that thoughtful investment choices and sensible public policies have long-term effects on economic growth via boosting productivity and creativity, in contrast to exogenous growth models.

According to the theory, transportation infrastructure is a significant type of productive public capital that promotes private investment, enables the spread of information, enhances labor mobility, improves resource allocation, and supports technological innovation. Therefore, by lowering transportation costs, improving production efficiency, opening up new markets, and boosting economic activity, adequate financing of transportation infrastructure has multiple effects across the economy. Long-term development and steady economic growth are directly impacted by financing systems that guaranty ongoing investment in transport infrastructure.

The infrastructure-Led Growth Theory is complemented by the Endogenous Growth Theory, which explains that financing for transportation infrastructure not only increases physical infrastructure but also boosts economic productivity through increased

investment, efficiency, and innovation. As a result, sustainable financing methods become crucial tools for attaining equitable and long-term economic growth.

Relevance of the Theories to the Study

This study's theoretical foundation is provided by the infrastructure-Led Growth Theory and the Endogenous Growth Theory, which explain how financing for transportation infrastructure promotes sustainable growth. According to the theories, public-private partnerships (PPPs), public investment, infrastructure bonds, concessional loans, and sovereign funds are some of the financing mechanisms that make it possible to develop and maintain effective transportation infrastructure, which in turn boosts productivity, facilitates trade, encourages investment, creates jobs, and supports sustainable economic growth. As a result, these theories lend credence to the idea that sustainable development in emerging nations is largely dependent on efficient financing for transportation infrastructure.

3.0 METHODOLOGY

This study utilized a quantitative survey research design grounded in the positivist research paradigm, which emphasizes objectivity, empirical observation, and statistical analysis of observable events. Because it makes it easier to gather objective data and test correlations between variables using quantitative methods, the positivist approach was deemed suitable.

17,082 workers from ten significant transportation and logistics organizations in Nigeria, such as the Nigerian Institute of Transport Technology (NITT), the National Automotive Design and Development Council (NADDC), and the Nigerian Shippers' Council (NSC), made up the study population. A target sample of 2,899 respondents was obtained by estimating the sample size using Taro Yamane's (1967) formula for finite populations at a 95% confidence level and 5% margin of error. Purposive sampling was used to choose information-rich respondents after the sample size was determined, especially mid- and senior-level employees directly involved in technology transfer, policy creation, operational operations, and green logistics projects.

A standardized questionnaire that was distributed both in-person and electronically (using Google Forms) was used to gather primary data between May and August of 2026. A five-point Likert scale, with 1 representing "strongly disagree" and 5 representing "strongly agree," was used in the questionnaire. 2,836 valid questionnaires remained for the final analysis after 63 of the 2,899 received questionnaires were eliminated during data screening due to excessive missing data, multivariate outliers, and response bias.

Pilot research was carried out in the last quarter of 2025 to guaranty the instrument's quality, and the questionnaire's content validity was established by

specialists in business and logistics management. All measuring scales exceeded the suggested threshold of 0.60 (Kyokutamba, 2011; Sabana, 2014), suggesting excellent reliability when internal consistency reliability was evaluated using Cronbach's Alpha in SPSS.

In order to investigate the relationships between the study variables in the context of Nigerian transport and logistics agencies, the analytical framework was modified from the empirical models of Bhatti and Qureshi (2007), Balouch and Hassan (2014), Inuwa (2016), Alromaihi *et al.*, (2017), and Razak *et al.*, (2018).

4.0 FINDINGS AND DISCUSSIONS

4.1 Least Square Regression Result of Transportation Infrastructure Financing and Sustainable Development

Across the five funding mechanisms analyzed, the regression results show a positive and statistically significant association between financing for transportation infrastructure and sustainable development. The calculated coefficients, which are significant at the 1% level, are 2.764 for public-private partnerships (PPPs), 2.841 for public investment, 3.231 for infrastructure bonds, 2.667 for concessional loans, and 2.767 for sovereign funds. The results indicate that increasing financing for transportation infrastructure is connected with improved sustainable development outcomes in the chosen emerging economies in Africa. Concessional loans had the lowest coefficient, but still having a positive and significant impact, while infrastructure bonds had the highest coefficient, indicating the strongest estimated association.

The variations in the coefficients' magnitudes imply that the form and structure of finance methods affect how much they contribute to sustainable development. While the notable coefficient for public investment emphasizes the ongoing significance of government financing, the relatively substantial coefficient for infrastructure bonds may represent their ability to mobilize long-term resources for significant infrastructure projects. The favorable outcomes for PPPs, sovereign funds, and concessional loans further show that, with proper mobilization and management, both local and foreign funding sources may support the development of transportation infrastructure. Therefore, rather than relying solely on one source of infrastructure finance, these findings advocate a diversified financing strategy.

The results of the control variables are inconsistent. In general, gender is not statistically significant, meaning that there is little difference in the estimated association between male and female respondents. However, age is significant in some conditions, especially among respondents between the ages of 30 and 40. This suggests that, in some situations, age differences may affect how people view finance for transportation infrastructure and sustainable

development. However, compared to the findings for the primary finance variables, these demographic effects are less stable.

The Fisher test probability value of 0.000, which shows that the explanatory variables are jointly significant, validates the models' statistical soundness. The models account for around 55.3% and 56.0% of the variation in the dependent variable, respectively, according to the corrected R-squared values of 0.553 and 0.560. Other economic, institutional, governance, and infrastructure-related elements not covered by the models could be linked to the remaining variation.

Overall, the findings show that funding for transportation infrastructure plays a significant role in sustainable growth in developing African countries. The results specifically highlight public investment and infrastructure bonds as potentially significant financing tools, and the advantages of PPPs, sovereign funds, and concessional loans support the benefits of integrating several funding sources. This implies that in order to achieve sustainable transportation development, more funding is needed in addition to efficient resource allocation, robust institutional capability, sound governance, and effective infrastructure project implementation.

Table 1: Least Square Regression Result of Transportation Infrastructure Financing and Sustainable Development: Evidence from Emerging Economies in Africa

Variables	Dependent Variable Measure: Economic Growth	
	1	2
Transportation Infrastructure Financing	0.810*** (0.033)	0.771*** (0.036)
Gender: Male		-0.039*** (0.010)
Age: 30–40 years		0.044*** (0.016)
Above 40 years		0.038** (0.019)
Education qualification: B.Sc.		0.017* (0.009)
Working experience: 1–5 years		0.046 (0.035)
Above 5 years		0.034 (0.036)
Constant	0.898*** (0.160)	1.024*** (0.172)
Adj. R-squared	0.553	0.560
Fishers Test	600.45	150.41
Probability (Fisher Test)	0.000	0.000
Observations	2,836	2,836

Note: Standard errors (robust) are reported in parentheses; *, **, *** signify significance levels of 10%, 5%, and 1% respectively.

Source: Author's computation from Field Survey (2026).

Age and gender were included as control factors to account for potential variations in respondents' evaluations of sustainable development and financing for transportation infrastructure. The reference categories chosen were female respondents and those under the age of thirty. Gender does not significantly change the calculated association, as the coefficient for male respondents is negative in some conditions but is generally not statistically significant. Respondents between the ages of 30 and 40 exhibit positive and statistically significant effects in some models, especially under public investment, whereas the coefficients for respondents over 40 are positive in some specifications but are not consistently significant. This implies that, although these impacts are secondary to the primary funding variables, views of transportation

infrastructure financing may differ among age groups in particular financing circumstances.

All five of the financing options have a positive and substantial relationship with sustainable development, according to the primary regression results. All coefficients are significant at the 1% level, with infrastructure bonds having the highest coefficient (3.231), followed by public investment (2.841), sovereign funds (2.767), PPPs (2.764), and concessional loans (2.667). The findings imply that sustainable development can be significantly aided by the availability and efficient mobilization of financial resources for transportation infrastructure. The substantial impact of public investment supports the government's ongoing role in funding strategic

transportation infrastructure, while the relatively higher coefficient for infrastructure bonds indicates their capacity to mobilize long-term resources.

The models' statistical performance provides additional evidence of the estimations' dependability. The joint significance of the explanatory factors is indicated by the Fisher test probability of 0.000. Furthermore, the models account for roughly 55.3% and 56.0% of the variation in sustainable development, respectively, according to the modified R-squared values of 0.553 and 0.560. The residual variation implies that additional institutional, policy, and economic elements that are not included in the calculated models may also have an impact on sustainable development.

When considered collectively, the data indicates that suitable and varied financing arrangements are necessary for the development of sustainable transportation in developing African countries. The benefits of integrating public resources with private and alternative sources of long-term financing are highlighted by the results, which do not suggest that any one financing option is adequate. However, efficient resource allocation, institutional capability, good governance, and the successful execution of transportation infrastructure projects are all necessary for converting funding into sustainable development outcomes.

Table 2: Logistic Regression Result of Transportation Infrastructure Financing and Sustainable Development Measures: Evidence from Emerging Economies in Africa

Variables	Dependent Variable Measure: Economic Growth				
	Public-Private Partnerships	Public Investment	Infrastructure Bonds	Concessional Loans	Sovereign Funds
	1	2	3	4	5
Transportation Infrastructure Financing	2.764*** (0.322)	2.841*** (0.311)	3.231*** (0.358)	2.667*** (0.248)	2.767*** (0.285)
Gender: Male	0.164 (0.445)	0.257 (0.438)	-0.407 (0.367)	0.092 (0.315)	0.074 (0.364)
Age: 30–40 years	-0.451 (0.682)	1.853*** (0.718)	0.053 (0.478)	0.920* (0.533)	0.076 (0.546)
Above 40 years	-0.220 (0.751)	1.170 (0.755)	-0.214 (0.534)	0.993 (0.685)	-0.683 (0.559)
Education qualification: B.Sc.	1.182* (0.637)	0.821 (0.626)	0.633 (0.482)	0.254 (0.385)	-0.412 (0.399)
Working experience: 1–5 years	0.974 (0.648)	1.410** (0.561)	0.915 (0.622)	0.820 (0.563)	2.028*** (0.628)
Above 5 years	1.211* (0.713)	0.574 (0.697)	0.620 (0.575)	-0.098 (0.684)	1.362** (0.546)
Constant	-8.910*** (1.385)	-10.192*** (1.443)	-11.049*** (1.581)	-9.086*** (1.173)	-9.473*** (1.316)
Wald Chi-Square	110.82***	122.37***	107.68***	143.39***	130.86***
Pseudo R ²	0.305	0.385	0.377	0.262	0.312
Log likelihood	-115.67	-113.36	-161.71	-200.35	-161.73
Observations	2,836	2,836	2,836	2,836	2,836

Note: Standard errors (robust) are reported in parentheses; *, **, *** signify significance levels of 10%, 5%, and 1% respectively.

Source: Author's computation from Field Survey (2026).

The logistic regression results examining the relationship between transportation infrastructure financing and the five financing mechanisms public-private partnerships (PPPs), public investment, infrastructure bonds, concessional loans, and sovereign funds in the emerging economies of Africa are shown in Table 2 to evaluate the robustness of the primary empirical findings. The statistical significance at the 1%, 5%, and 10% levels, as well as the estimated coefficients and standard errors in parenthesis, are presented. The findings from the primary regression analysis are supported by the results, which offer additional proof of a favorable and statistically significant association

between financing for transportation infrastructure and the corresponding finance mechanisms.

PPPs have an estimated coefficient of 2.764, public investment is 2.841, infrastructure bonds are 3.231, concessional loans are 2.667, and sovereign funds are 2.767. Stronger use of these finance mechanisms is linked to improvements in transportation infrastructure financing, according to the positive coefficients. Infrastructure bonds have the strongest association, according to the estimates' magnitude, followed by public investment, sovereign funds, PPPs, and concessional loans. This pattern supports the previous

conclusion that public investment and infrastructure bonds may be especially crucial in raising funds for the construction of transportation infrastructure.

The given pseudo R-squared values show that the explanatory variables have significant explanatory power, and the Wald Chi-square statistics validate the overall importance of the calculated models. When combined, the robustness results increase confidence in the primary findings by showing that, even when different model specifications are taken into account, there is still a favorable association between finance for transportation infrastructure and sustainable development. The findings thus offer more evidence of the significance of expanding the financing of transportation infrastructure in growing African countries through public, private, and alternative long-term financing sources.

5.0 CONCLUSION

This study examined the contribution of transportation infrastructure financing to sustainable development in emerging economies in Africa, focusing on PPPs, public investment, infrastructure bonds, concessional loans, and sovereign funds. The empirical evidence demonstrates that all five financing mechanisms have a positive and statistically significant relationship with sustainable development, indicating that adequate access to and effective mobilisation of infrastructure finance can support improved economic outcomes.

Among the financing mechanisms, infrastructure bonds recorded the strongest estimated relationship, followed by public investment, sovereign funds, PPPs, and concessional loans. This variation suggests that the structure and capacity of different financing instruments matter in determining their contribution to transportation infrastructure development. The findings also indicate that reliance on a single financing source may be inadequate, particularly in emerging economies where public resources are constrained. A diversified financing approach that combines government resources, private-sector participation, capital-market instruments and development financing is therefore more appropriate.

The robustness analysis further strengthens confidence in the principal findings, as the alternative logistic regression specification produces results consistent with the main analysis. The statistically significant Wald Chi-square statistics and meaningful Pseudo R-squared values provide additional support for the empirical relationships identified.

The study concludes that transportation infrastructure financing is an important enabler of sustainable development in emerging African economies. However, financing alone does not guarantee development outcomes. Its effectiveness depends on

transparent resource allocation, institutional capacity, sound governance, appropriate project selection, effective implementation, and proper maintenance of infrastructure. Strengthening these conditions while diversifying financing sources can enhance the capacity of transportation infrastructure to promote economic growth, improve connectivity, facilitate trade, attract investment, and support long-term sustainable development.

REFERENCES

- Aawaar, G., & Abendin, S. (2025). The non-linear threshold effects of public investment on sustainable trade development in Africa: a panel smooth transition regression approach. *African Journal of Economic and Management Studies*. <https://doi.org/10.1108/AJEMS-08-2024-0486>
- Akomea-Frimpong, I., Jin, X., Osei-Kyei, R., & Kukah, A. S. (2023). Public-private partnerships for sustainable infrastructure development in Ghana: a systematic review and recommendations. *Smart and Sustainable Built Environment*, 12(2), 237-257. <https://doi.org/10.1108/SASBE-07-2021-0111>
- Anago, J. C. (2024). Sustainable infrastructure development in sub-nations of Nigeria: what alternative financing options are open amidst constrained budget?. *Sustainability Accounting, Management and Policy Journal*, 15(6), 1378-1407. <https://doi.org/10.1108/SAMPJ-02-2023-0054>
- Anago, J. C. (2022). How do adoption choices influence public private partnership outcomes? Lessons from Spain and Portugal transport infrastructure. *International Journal of Managing Projects in Business*, 15(3), 469-493. <https://doi.org/10.1108/IJMPB-03-2021-0077>
- Arzova, S. B., & Şahin, B. Ş. (2024). Macroeconomic and financial determinants of green growth: an empirical investigation on BRICS-T countries. *Management of environmental quality: an international journal*, 35(3), 506-524. <https://doi.org/10.1108/MEQ-07-2023-0210>
- Bassem, B. S. (2026). Transport infrastructure–FDI–economic growth nexus: evidence from the MENA region. *Journal of Economic and Administrative Sciences*, 1-29. <https://doi.org/10.1108/SEF-09-2020-0381>
- Bolomope, M. T., Baffour Awuah, K. G., Amidu, A. R., & Filippova, O. (2021). The challenges of access to local finance for PPP infrastructure project delivery in Nigeria. *Journal of Financial Management of property and Construction*, 26(1), 63-86. <https://doi.org/10.1108/JFMPC-10-2019-0078>
- Bueno-Ferrer, Á., de Pablo Valenciano, J., & de Burgos Jiménez, J. (2026). Capital Structure Dynamics and Their Impact on Financial Performance in SMEs of the Road Transportation Sector. *Sage Open*, 16(1), 21582440261417595. <https://doi.org/10.1177/21582440261417595>

- Chen, F., Law, S. H., Wong, Z. W. V., & Azman-Saini, W. N. W. (2022). The role of institutions in private investment: panel data evidence. *Studies in Economics and Finance*, 39(4), 630-643.
- Das, L., & Mishra, S. (2026). Green financing infrastructure and its determinants towards sustainable development of steel industries of India. *Sustainable Finance Review*, 1(2), 101-120. <https://doi.org/10.1108/SFR-05-2025-0010>
- Elsner, C., & Kreibich, N. (2025). Financing industry decarbonization in developing and emerging countries: assessing the impetus for innovative financial mechanisms promoted by the climate club. *International Journal of Climate Change Strategies and Management*, 17(1), 1203-1222. <https://doi.org/10.1108/IJCCSM-04-2025-0082>
- Ke, L., & Liu, S. (2023). Local governments' adoption of innovative infrastructure finance tool: Evidence from Pennsylvania municipalities. *Public Finance Review*, 51(4), 513-567. <https://doi.org/10.1177/10911421231153787>
- Kumar, A., & Soriya, S. (2026). Financing transport sector through public-private partnerships
- (PPPs): a macroeconomic, governance and project-specific perspective. *Transforming Government: People, Process and Policy*, 20(3), 636-652. <https://doi.org/10.1108/TG-04-2025-0108>
- Layaoen, H. D. Z., Abareshi, A., Abdulrahman, M. D. A., & Abbasi, B. (2023). Sustainability of transport and logistics companies: an empirical evidence from a developing country. *International Journal of Operations & Production Management*, 43(7), 1040-1067. <https://doi.org/10.1108/IJOPM-12-2021-0799>
- Lieske, S. N., van den Nouwelant, R., Han, J. H., & Pettit, C. (2021). A novel hedonic price modelling approach for estimating the impact of transportation infrastructure on property prices. *Urban studies*, 58(1), 182-202. <https://doi.org/10.1177/0042098019879382>
- Luu, H. N., Nguyen, L. Q. T., & Nguyen, L. T. M. (2025). The impact of foreign direct investment on infrastructure development. *Journal of Economic Studies*, 52(7), 1226-1243. <https://doi.org/10.1108/JES-12-2023-0688>
- Mehar, M. A. (2024). Global financial connectivity and ineffectiveness of sovereign debt: implications for business activities in South Asia. *Asian Journal of Economics and Banking*, 8(2), 219-239. <https://doi.org/10.1108/AJEB-03-2023-0015>
- Montesinos-Sansaloni, E. X., Ribeiro-Soriano, D., & Botella-Carrubi, D. (2025). Innovation dynamics in public funding: a comparative analysis of social economy and capitalist organisations in public-private partnerships. *European Journal of Innovation Management*, 28(10), 5255-5276. <https://doi.org/10.1108/EJIM-02-2025-0166>
- Musa, M. R., Abubakar, Z., Elatikpo, I. S., Yusuf, K. M., & Halliru, K. I. (2026). Effect of Port Congestion on Maritime Trade Performance in Nigeria: Evidence from The Nigerian Ports Authority. *Journal of Management Research and Review*, 2(07), 552-560. <https://doi.org/10.65150/EP-jmrr/V2E7/2026-10>
- Musa MR, Wada KN, Sagir B, Elatikpo IS, Yusuf KM, Jediel BV, (2026). Reward System and Employee Productivity in Nigeria's Transport and Logistics Regulatory Bodies: A Catalyst for Green Logistics and Sustainable Performance. *Sinergi International Journal of Logistics*. 4 (1), <https://doi.org/10.61194/ijl.v4i1.962>
- Musa, M. R., Wada, K. N., Elatikpo, I. S., Yusuf, K. M., Sagir, B., & Jediel, B. V. (2025). Technology Transfer and Green Logistics Integration: A Policy-Oriented Framework for Sustainable Logistics Firms in Nigeria. *Journal of Science Innovation and Technology Research*. <https://doi.org/10.70382/ajsitr.v10i9.077>
- Musa, M. R., Yusuf, K. M., & Elatikpo, I. S. (2025). Entrepreneurial Orientation in Transport and Logistics Sector in the Last Decade: A Systematic Review. *Sinergi International Journal of Logistics*, 3(4), 190-212. <https://doi.org/10.61194/sijl.v3i3.900>
- Musa, M. R., Elatikpo, I. S., & Yusuf, K. M. (2025). A Blueprint for Achieving Technological Literacy in Nigeria's Transport and Logistics Sector. *Journal of Science Innovation and Technology Research*, 9(9). <https://doi.org/10.70382/ajsitr.v9i9.034>
- Nguyen, T., Hallo, L., & Gunawan, I. (2024). Investigating risk of public-private partnerships (PPPs) for smart transportation infrastructure project development. *Built Environment Project and Asset Management*, 14(1), 74-91. <https://doi.org/10.1108/QRFM-07-2020-0130>
- Nguyen, V. C. T., & Le, H. Q. (2024). The impact of ICT infrastructure, technological innovation, renewable energy consumption and financial development on carbon dioxide emission in emerging economies: new evidence from Vietnam. *Management of Environmental Quality: An International Journal*, 35(6), 1233-1253. <https://doi.org/10.1108/MEQ-09-2023-0325>
- Oliver-Espinoza, R., & Stezano, F. (2022). Effect of private and public investment in R&D on innovation in Mexico's biotechnology firms. *Journal of Science and Technology Policy Management*, 13(4), 746-764. <https://doi.org/10.1108/JSTPM-10-2020-0156>
- Rabiu, M. M., Adewale, B. A., Lamino, A. H., Olalekan, A. J., & Oluseun, O. O. (2024). Employee job satisfaction and employee productivity in Nigeria's federal civil service: An empirical examination of communication as metric for job satisfaction. *International Journal of Professional*

- Business Review: Int. J. Prof. Bus. Rev., 9(3), 6. <https://doi.org/10.26668/businessreview/2024.v9i3.4328>
- Ren, F., Huang, Y., Xia, Z., Xu, X., Li, X., Chi, J., ... & Song, J. (2025). Do public-private partnerships (PPPs) promote the sustainable development of infrastructure (SDI)? Evidence from China. *Engineering, Construction and Architectural Management*, 32(11), 7587-7621. <https://doi.org/10.1108/ECAM-12-2023-1267>
- Sajjad, S., & Dar, K. H. (2025). Economic infrastructure and its impact on economic growth: a case study of 7 sister states. *Journal of Financial Management of Property and Construction*, 30(3), 357-376. <https://doi.org/10.1108/BL-04-2022-0070>
- Silva, J. P. N., de Oliveira, C. C., Pedrosa, G., & Grutzmann, A. (2023). The effects of technological leapfrogging in transportation technologies in BRICS and G7 countries. *The Bottom Line*, 36(1), 52-76. <https://doi.org/10.1108/BL-04-2022-0070>
- Smith, M. (2023). Financing cleaner transportation: understanding changing trends in capturing developer contributions towards sustainable transport infrastructure. *Planning Practice & Research*, 38(2), 218-235. <https://doi.org/10.1080/02697459.2022.2138148>
- Tabash, M. I., Farooq, U., Anagreh, S., & Al-Faryan, M. A. S. (2024). Contributing to sustainable development goals (SDGs) in environmental sustainability through public-private investment in energy: empirical evidence from EAGLE economies. *International Journal of Innovation Science*, 16(5), 838-854. <https://doi.org/10.1108/IJIS-09-2022-0178>
- Vardar, G., Aydoğan, B., & Gürel, B. (2025). Investigating the ecological footprint and green finance: evidence from emerging economies. *Journal of Economic and Administrative Sciences*, 41(5), 1821-1843. <https://doi.org/10.1108/JEAS-05-2023-0124>
- Weinreich, D. (2021). Bridging the gap: A national study analyzing the process of toll road governance, finance and revenue allocation. *Transportation Research Record*, 2675(12), 130-141. <https://doi.org/10.1177/03611981211028597>
- Xu, L., Liu, F., & Chu, X. (2021). The credit analysis of transportation capacity supply chain finance based on core enterprise credit radiation. *Journal of Intelligent & Fuzzy Systems*, 40(6), 10811-10824. <https://doi.org/10.3233/JIFS-201818>
- Zhang, K., Shaheen, Q. H., & Cui, Q. (2026). Understanding structured project finance for US transportation public-private partnerships: what maximizes financing capacity?. *Built Environment Project and Asset Management*, 1-18. <https://doi.org/10.1108/BEPAM-07-2025-0217>
- Zhao, R., Wu, J., & Sun, J. (2024). Does digital finance drive the green level of transportation companies? Coordination effects of governmental digital preference. *Journal of Management Science and Engineering*, 9(3), 376-389. <https://doi.org/10.1016/j.jmse.2024.05.004>