ALTERNATIVE INFRASTRUCTURE FUNDING MODELS: A COMPARATIVE STUDY OF GHANA AND NIGERIA

by

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Alternative Infrastructure Funding Models: A Comparative Study of Ghana and Nigeria

I declare that the above thesis is my own work and that all the sources that I have used or quoted have been indicated and acknowledged by means of complete references.

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Abstract

This work examined the role of alternative funding models in addressing the substantial infrastructure shortfall in Ghana and Nigeria, specifically focusing on road development. The primary objective of the research was to assess how alternative models, such as public-private partnerships, crowdfunding, green finance, project finance, and asset securitisation, could address the infrastructure funding deficit in Ghana and Nigeria. Using 20-year secondary data from 2003 to 2023, the study employed multiple regression and Autoregressive Distributed Lag (ARDL) econometric models to investigate the correlation between alternative funding models and key development indicators. This was augmented by Granger-causality analyses to assess the directional impact of critical infrastructure variables on GDP growth. Through a comparative analysis, the study further examined the factors that influenced the successful adoption of these models in each country. The key findings of this research indicate that, while traditional funding models remain essential, alternative models, particularly public-private partnerships and green finance, offer considerable potential for bridging the infrastructure funding deficit. Additionally, the research identified key drivers of infrastructure development, such as per capita income, employment rates, poverty reduction, and access to electricity, which emerged as significant predictors of infrastructure success in both countries. Thus, the study emphasises that the effective execution of these alternative models could foster sustained economic growth, social inclusiveness, and environmental resilience. The study proposes a decision-making framework to assist policymakers in the effective selection and execution of various funding models. This framework highlights the need to balance financial sustainability, social equality, and environmental responsibility, offering a strategic guide for Ghana and Nigeria to achieve their infrastructure objectives in line with global development frameworks. This study makes a substantial contribution to the field by integrating alternative funding models with the Sustainable Development Goals (SDGs). It offers a clear pathway for African countries to meet their infrastructure targets under the SDGs and AU Agenda 2063, while fostering long-term economic growth, social inclusion, and environmental stewardship.

Keywords: *Alternative Infrastructure Funding, Public-Private Partnerships (PPPs), Green Finance, Sustainable Development Goals (SDGs), AU Agenda 2063, Road Infrastructure, Environmental Sustainability, Comparative Study, Ghana, Nigeria*.

Okucashuniwe

Lolu cwaningo luhlose ukuhlola iqhaza elibanjwe yizindlela ezahlukahlukene zoxhasomali lokuxazulula ukwentuleka kwengqalasizinda e*Ghana* nase*Nigeria*, ikakhulu ekuphuculeni imigwaqo. Inhloso enkulu yocwaningo ukuhlola ukuthi izindlela ezahlukene, okubalwa kuzo izivumelwano zokusebenzisa kwezinhlaka zikahulumeni nezizimele (ama*PPP*), abezokuxhasa ngemali ngokuhlanganyela, ezezimali yokuvikelwa kwemvelo, ezezimali yemiklamo nokuvikeleka kwempahla yokusebenza, zingasiza kanjani ukunciphisa ukungalingani kwemali yokuxhasa izingqalasizinda e*Ghana* nase*Nigeria*. Lapha kusetshenziswe imininingo eyisibili yeminyaka engama-20 – kusukela ngonyaka wezi-2003 kuya kowezi-2023 – izindlela zokubala ukwehla kokuphindaphinda kanye nendlela ye-*Autoregressive Distributed Lag* (*ARDL*) ukuze kuhlolwe ubudlelwano phakathi kwezindlela ezahlukahlukene zoxhasomali nezinkomba ezisemqoka zendlela yokuthuthukisa. Lokhu kwenziwe ngohlelo lokuhlolwa kwesimo se*Granger* ukuze kuqinisekiswe umthelela oyinkombandlela phakathi kweminxa yengqalasizinda emqoka kanye nokukhula komnotho. Ngokokuqhathaniswa kocwaningo, lolu cwaningo luphinde lwahlaziya imithelela ethinta impumelelo ngokwamukelwa kwalezi zindlela ezweni ngalinye. Imiphumela ikhombisa ukuthi, nakuba zibalulekile izindlela zoxhaso ezijwayelekile, nalezi ezinye izindlela ezahlukahlukene, ikakhulu ama*PPP* nezezimali yokuvikelwa kwemvelo nazo zinamandla okuvala igebe elikhona ngokuntuleka kwezimali zokwakha ingqalasizinda. Ngaphezu kwalokho, iminxa emqoka ekuthuthukiseni ingqalasizinda, okubalwa kuyo imali yokuqalisa umsebenzi, izinga lomsebenzi, ukulwa nobubha nokufinyelela ekuhlomuleni ugesi, kuye kwahlonzwa njengezinye zezinkomba ezimqoka ekuzuzeni ingqalasizinda encono kulawa mazwe womabili. Lolu cwaningo luphinde luveze ukuthi ukusetshenziswa ngokufanele kwalezi zindlela ezahlukene zoxhasomali kungagcina kahle ukukhula komnotho, ukubandakanywa komphakathi kanye nozinzo kwezemvelo. Lolu cwaningo luphakamisa ukusebenza kohlaka lokuthathwa kwezinqumo ukuze kusizakale abasunguli bezinqubomgomo ekukhetheni nasekusebenziseni ngendlela efanele izindlela ezahlukene zoxhasomali. Lolu hlaka lugcizelela isidingo sokulingana kokusebenza kwemali, ukulingana komphakathi nokusebenza kwemvelo, futhi luhlinzeka ngomhlahlandlela wokusebenza e*Ghana* nase*Nigeria* ukuze kufezeke izinhloso zokusebenza kwengqalasizinda ngokuhambisana nezindlela zokusebenza ekuthuthukiseni umhlaba jikelele.

Lolu cwaningo lufaka isandla kakhulu emkhakheni weZezimali Zentuthuko ngokuhlanganisa izindlela ezahlukahlukene zoxhasomali nezinhlelo zeMigomo Yokugcina Kahle Intuthuko (ama*SDG*). Luhlinzeka ngendlela ecacile ngokuthi amazwe ase-Afrika angazifeza kanjani izinhloso zawo zokuba nengqalasizinda ngokwama*SDG* ne-*AU Agenda 2063*, aphinde akhuthaze ukukhula komnotho kwesikhathi eside, ukuhlanganyela komphakathi kanye nokuzibophezela kwezemvelo.

Amagama amqoka: Uxhasomali Lwezindlela Ezihlukahlukene Zengqalasizinda, Izivumelwano Zokusebenzisa Kwezinhlaka Zikahulumeni Nezizimele (ama*PPP*), Izimali Zokuvikelwa Kwemvelo, Izinhlelo Zemigomo Yokugcina Kahle Intuthuko (ama*SDG*), i-*AU Agenda 2063*, Ingqalasizinda Yomgwaqo, Ukugcinwa Kwemvelo, Ucwaningo Oluqhathanisayo, i*Ghana*, i*Nigeria*.

Mohopolo

Thuto ena e hlahlobile karolo ya mekgwa e meng ya ditjhelete ya ho rarolla mabapi le kgaello ho mafaratlhatlha bakeng sa ditlhoko tsa baahi ho Ghana le Nigeria, mme tsepamiso maikutlo e le ho ntshetsopele ya mebila. Sepheo se ka sehloohong sa dipatlisiso e ne e le ho lekola hore metjha e meng, e jwalo ka balekani ba setjhaba–poraevete (PPPs), bongata ba ditjhelete, ditjhelete tse mabapi le diprojeke tseo tikoloho e unang molemo ho tsona, ditjhelete tsa projeke le polokeho ya thepa, di ka thusa jwang ho hlola dikgaello tsa ditjhelete tsa mafaratlhatlha ho Ghana le Nigeria. Ka tshebediso ya tlhahisoleseding ya bobedi ka ho pharalla ha lemo tse 20 – ho tloha ho 2003 ho ya ho 2023 –multiple regression and Autoregressive Distributed Lag (ARDL) metjha ya dipalopalo e tla batlisisang kamano pakeng tsa metjha ya ditjhelete e meng le matshwao a bohlokwa a ntshetsopele. Sena se ile sa hodiswa ke diteko tsa Granger causality ho netefatsa ho ameha ho mahareng ha dintha tse ka fetohang tse bohlokwa tsa mafaratlhatlha le kgolo ya moruo. Ka tlhatlhobo e ka bapiswang, thuto e tswella ho hlahloba dintlha tse amang kamohelo ya metjha ena ho naha ka nngwe.Tse fumanweng tse bohlokwa di bontsha hore, ha metjha ya ditjhelete ya setso e dula e ntse e le ya bohlokwa, metjha e meng, haholoholo ditjhelete tsa PPPs le tse mabapi le ho una molemo ha tikoloho, di nehelana ka bokgoni bo nahanwang bo ka rarollang kapa bo ka kwalang dikgaello tsa ditjhelete tsa mafaratlhatlha. Ha ho tlatsetswa, dintho tse bohlokwa ho ntshetsopele ya mafaratlhatlha, jwalo ka lekeno la motho ka mong ho naha kapa lebatowa, dikgahla tsa mosebetsi, ho fokotseha ha bofuma le ho fihlella motlakase, di ile tsa fumanwa e le tsa bohlokwa ho katleho ya mafaratlhatlha ho dinaha ka bobedi. Thuto e hlakisa phethahatso e sebetsang hantle ya metjha ena e meng ya ditjhelete mme e ka kgothalletsa kgolo e tsitsitseng ya moruo, ho kenyelletswa ha setjhaba le mamello ya tikoloho. Thuto e hlahisa moralo wa ho nka qeto ho thusa baetsi ba maano ka ho kgetha ka tsela e sebetsang le ho tswedisa pele metjha e fapaneng ya ditjhelete. Moralo ona o hatella tlhokeho ya ho tsitsa ha ditjhelete, ho lekalekana ha setjhaba le maikarabelo a tikoloho, e nehelanang ka maano a tataiso bakeng sa Ghana le Nigeria ho fihlella dipheo tsa mafaratlhatlha ho ya ka meralo ya ntshetsopele ya lefatshe.

Dipatlisiso tsena di etsa tlatsetso e tsitsitseng ho lekala la Ntshetsopele ya Ditjhelete ka ho kopanya metjha ya ditjhelete e meng le Dipheo tsa Ntshetsopele e Titsitseng (SDGs). E nehelana ka tsela e hlakileng bakeng sa dinaha tsa Afrika ho fihlella dipheo tsa mafaratlhatlha tlasa Lenane-tsamaiso la SDGs le AU 2063, ha e ntse e phahamisa kgolo ya nako e telele ya moruo, kenyeletso ya setjhaba le tsamaiso ya tikoloho.

Mantswe a bohlokwa: Ditjhelete tse ding tsa mafaratlhatlha, Balekani ba Setjhaba–Poraevete (PPPs), Ditjhelete tseo tikoloho e unang molemo ho tsona, Dipheo tsa Ntshetsopele tse Tsitsitseng (SDGs), Lenane-tsamaiso la AU 2063, Mafaratlhatlha a Mebila, Botsitso ba Tikoloho, Thuto e ka Bapiswang, Ghana, Nigeria.

Dedication

I dedicate this thesis to my beloved wife, Abigail Esi Aidoo, whose unwavering love, support, and encouragement have been my strength throughout this journey. To my wonderful children, Kukua Amoa Aidoo, Ewurabena Bonney Aidoo, and Adjoa (AJ) Nyarkoa Aidoo, your smiles and boundless energy have been a constant source of inspiration. This work is as much yours as it is mine, and I am eternally grateful for your presence in my life.

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I am deeply grateful to everyone who made a significant and small contribution to my journey.

List of Acronyms

Acronym	Definition
AfDB	African Development Bank
AHC	Access to Health Care
AU	African Union
BOOT	Build-Own-Operate-Transfer
BOT	Build-Operate-Transfer
BTO	Build-Transfer-Operate
CEI	Percentage Change in Employment Rate
CPR	Percentage Change in Poverty Rate
CEPA	Centre for Policy Analysis
CSFs	Critical Success Factors
DBFM	Design-Build-Finance-Maintain
DBFO	Design-Build-Finance-Operate
DFID	Department for International Development
ECOWAS	Economic Community of West African States
FDX	Financial Market Development Index
GIP	Ghana Infrastructure Plan
GIX	Governance Index
GDP	Gross Domestic Product
HDMI	Highway Development and Management Initiative
ICRC	Infrastructure Concession Regulatory Commission
ICT	Information Communication Technology
IEA	Improvement in Educational Attainment
IFS	Innovative Financing Strategy
LR	Length of Roads Built
MDGs	Millennium Development Goals
NHE	Number of Households with Access to Electricity
ODA	Official Development Assistance
OECD	Organisation for Economic Co-operation and Development
PCI	Per Capita Income
PIDA	Programme for Infrastructure Development in Africa

PPPs	Public-Private Partnerships
PPP-ABS	Public-Private Partnership - Asset-Backed Securities
RGDPG	Real Growth of National Income
RIDRITCS	Road Infrastructure Development and Refurbishment Investment Tax Credit Scheme
RFI	Resource-Financed Infrastructure
SDGs	Sustainable Development Goals
SPV	Special Purpose Vehicle
TISM	Total Interpretive Structural Modelling
MICMAC	Matriced' Impacts Croises Appliquee Aaun Classement
UN ESCAP	United Nations Economic and Social Commission for Asia and the Pacific
UNEP	United Nations Environment Programme
UNIDO	United Nations Industrial Development Organisation
VECM	Vector Error Correction Model

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Chapter One
Introduction and Background

1.1 Background to the Study

The 21st century poses distinctive challenges for humanity (Desa, 2019). In the face of fast population growth, urbanisation, and climate change, it has become crucial to achieve sustainable development on a global scale (Rozenberg, 2017). The foundation of these efforts is adequate infrastructure, the essential component of strong economies and equitable societies (World Bank, 2016).

Building upon these pressing challenges, the pursuit of sustainable infrastructure development is a priority for the world (Marozva & Makoni, 2018). In response to this, the United Nations initiated the Millennium Development Goals (MDGs) in 2000. This significant framework established eight essential objectives for addressing poverty, education, health, and environmental sustainability (Fukuda-Parr, 2004). Although the MDGs made notable advancements, disparities and emerging obstacles persisted. In 2015, the United Nations introduced the Sustainable Development Goals (SDGs) with the aim of significantly transforming the world by 2030.

The United Nations established seventeen (17) Sustainable Development Goals (SDGs) to be achieved by 2030, representing a global commitment to socio-economic growth, environmental sustainability, and overall human well-being (United Nations Development Programme, 2015). SDG 9 focuses in particular on fostering innovation, inclusive and sustainable industrialisation, and the promotion of resilient infrastructure (United Nations Environment Programme, 2023). The objective is to create top-notch, dependable, long-lasting, and resilient infrastructure, including regional and transnational infrastructure, to support economic growth and people's well-being, with an emphasis on equitable and affordable access for everyone. Additionally, it aims to modernise infrastructure and transform industries into sustainable ones through increased resource efficiency and increased adoption of green, eco-friendly industrial techniques.

Continuing the momentum towards sustainable development, the African Union (AU) has put forward Agenda 2063, a strategic framework that aims to accelerate Africa's

political, social, and economic development (African Union, n.d.). The AU Agenda sets out seven aspirations, two of which are directly relevant to infrastructure development. This connection is illustrated in Table 1, which highlights the linkage between the AU Agenda 2063 and the SDGs. Aspiration 1 seeks to transform economies through industrialisation, value addition, and the promotion of environmentally sustainable and resilient economies and communities. Its specific goals include creating a prosperous Africa based on inclusive growth and sustainable development (African Union n.d.). Meanwhile, Aspiration 2 emphasises the creation of an integrated and politically united continent, with a particular goal to develop world-class infrastructure across Africa (African Union, n.d.).

Table 1: Agenda 2063 and the SDGs Linkage

AU Agenda 2063 Goals			**UN Sustainable Development Goals**	
Goal Number	Goal	Priority Areas	Goal Number	UN Sustainable Dev. Goals
4	Transformed economies	Economic diversification and resilience	9	Increase innovation, encourage inclusive and sustainable industrialisation, and build resilient infrastructure.
10	Africa has extensive world-class infrastructure.	connectivity of the infrastructure and communications.	9	Increase innovation, encourage inclusive and sustainable industrialisation, and build resilient infrastructure.

Source: Author's own conceptualisation from (African Union n.d.)

The African Union's Aspiration 2, which aims to develop world-class infrastructure across Africa, build resilient infrastructure, advance inclusive and sustainable industrialisation, and foster innovation, is the three main objectives of the ninth (9th) Sustainable Development Goal (SDG) of the United Nations. Under the African Union's Agenda 2063 is PIDA, which stands for Programme for Infrastructure Development in Africa. PIDA is a strategic continental initiative that aims to mobilise funding to transform Africa by creating innovative and integrated infrastructure projects in the fields of transport, energy, transboundary water resources, and ICT. (African Union, n.d.) It seeks to encourage and promote regional economic integration, and it is part of the continent's Agenda 2063 framework, developed by the African Union. The connection between Aspiration 2 and SDG 9 lies in their shared focus on infrastructure development and its role in driving sustainable development. Both initiatives recognise that reliable and efficient infrastructure is crucial for economic growth, social inclusion, and environmental sustainability. By investing in high-quality infrastructure, African countries can create a solid foundation for industrialisation, innovation, job creation, and improved access to essential services. This foundational framework is visually represented in Figure 1, which provides a schematic presentation of the pillars supporting Agenda 2063.

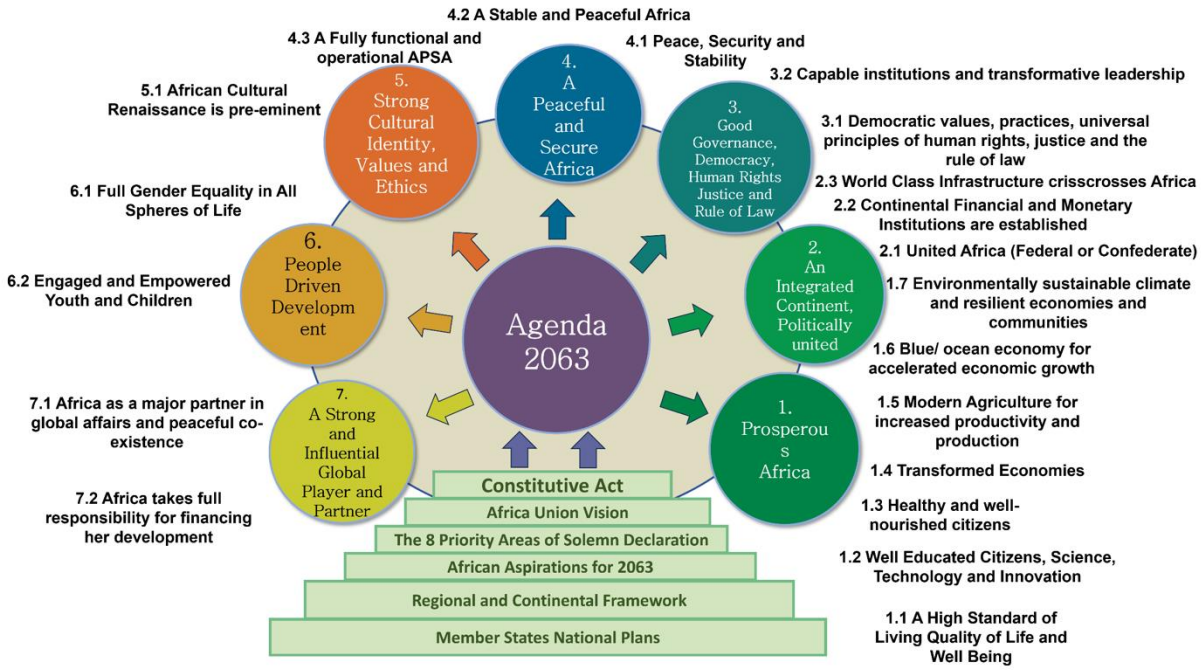

Figure 1: Schematic Presentation of the Foundation of Agenda 2063

Source: (Africa Union, 2015)

Building upon the continental aspirations enshrined in Agenda 2063, West Africa presents a microcosm of both immense potential and persistent challenges related to infrastructure development. The region, which has a population of over 350 million, exhibits significant economic growth potential but encounters intricate infrastructure challenges (World Bank, 2022). Progress is hindered by fragile states, conflict, and resource limitations, emphasising the necessity for inventive and situation-specific solutions (World Bank, 2022). In response to these difficulties, the Economic Community of West African States (ECOWAS) formulated the Vision 2020 development strategy, with a focus on key sectors such as energy, transportation, and water, in order to attain regional integration and collective prosperity (ECOWAS, 2020).

Within this dynamic West African landscape, Ghana and Nigeria emerge as compelling case studies. Nigeria, the nation with the highest population in Africa, has a rapidly growing economy and ambitious plans for developing its infrastructure (AfDB, 2023). Ghana has emerged as a prominent figure in democratic governance and economic stability within the region, according to the World Bank (2023). However, both nations encounter substantial deficiencies in their infrastructure, impeding their individual paths of development (AfDB, 2023; World Bank, 2023). The study examined their respective alternative infrastructure models and provided a valuable case study for comprehending the difficulties and possibilities linked to implementing the Sustainable Development Goals (SDGs) and Agenda 2063 in various West African settings.

These aspirations present a crucial obstacle: traditional funding models such as taxation and government budgets face difficulties keeping up with the magnitude of infrastructure requirements. This study explored alternative models of funding infrastructure as drivers for achieving the goals outlined in Agenda 2063. Alternative infrastructure funding models encompass a variety of strategies that seek to generate extra resources, alleviate the strain on public finances, and encourage greater involvement of the private sector in infrastructure development (AfDB, 2022; UNIDO, 2021; World Bank, 2023). These models deviate from traditional approaches by their

capacity to access alternative funding sources, implement inventive risk-sharing mechanisms, and promote collaboration among a wide range of stakeholders.

Africa's widespread lack of infrastructure has led to the emergence of several alternative funding models that could potentially drive development. This study examined the capabilities of Public-Private Partnerships (PPPs) in different forms, such as conventional concession agreements, lease-operate-transfer (BOT) models, build-operate-transfer (BOOT) models, and design-build-finance-operate (DBFO) models. In addition, the study investigated the function of progressive channels such as green finance, which facilitates the flow of funds towards environmentally sustainable infrastructure projects, and crowdfunding, which involves the participation of individual investors in financing projects. In addition, the study assessed the capacity of infrastructure bonds, which are issued by both governmental and private organisations, to direct resources towards crucial infrastructure development and, finally, asset securitisation. Asset securitisation refers to the process of using already established infrastructure assets to obtain funding for new projects (World Bank, 2023). Through the careful examination of these various models, this study's objective was to evaluate their effectiveness in closing the financial deficit and advancing Africa towards its goals of widespread economic expansion and enduring development (Aspiration 1). Furthermore, this study examined the capacity of these models to enhance continental integration and interconnectedness, thereby strengthening regional cooperation and advancing collective prosperity (Aspiration 2).

The following chapters explore each of these models in greater detail, offering a comprehensive comprehension of their advantages, constraints, and appropriateness for particular situations within Ghana and Nigeria. Traditional funding models for infrastructure have limitations in addressing the significant infrastructure deficit described in the AU Agenda 2063 (DeGhetto, Grey, & Kiggundu, 2016). Akomea-Frimpong, Jin, Osei-Kyei and Kukah (2023) argue that PPPs can significantly impact infrastructure development and therefore propose a critical learning approach. Consistent with the opinions presented, Schwerhoff and Sy (2017) present a convincing portrayal of renewable energy infrastructure as a powerful and versatile solution. Allocating resources to this industry not only directly supports Sustainable Development Goal 7 (ensuring affordable and clean energy) but also stimulates

economic expansion, generates employment opportunities, and enhances health outcomes, all fundamental components of Aspiration 2.

In the examination of alternative infrastructure funding models, it becomes apparent that traditional models of funding infrastructure frequently prove inadequate, facing difficulties in closing the substantial funding gap required to achieve the ambitious objectives established by the international community (Calderón & Chong, 2013; Machete & Marques, 2021). In the new global economy, infrastructure has become a central issue for countries. The growth and operation of societies depend heavily on infrastructure.

The term infrastructure is multifaceted and often defined contextually, encompassing a broad spectrum of structures and systems (Boyer, 2016). Infrastructure includes both physical and digital public infrastructure, such as telecommunications, energy grids, water supply systems, transportation networks, and social infrastructure like hospitals and schools (Ruiters & Amadi-Echendu, 2023). Infrastructure also refers to the actual buildings, systems, and facilities that support economic and social activities (Kharlamov & Aref'ev, 2022). Even when such structures and systems are numerous or invisible, one typically associates the term infrastructure with large, long-lasting works of material artifice like bridges, dams, highways, and grids (Boyer, 2016). As suggested by Miller (2021), the function that infrastructure serves in the economy should be considered in its definition, essentially providing vital capacity for systems related to transportation, communications, electricity, and water, among other things (Joshi & Aldrich 2022). Infrastructure includes physical structures such as roads, bridges, airports, telecommunications networks, water supply systems, power plants, and facilities for disposing of garbage (Moteff & Parfomak, 2004). In some instances, the term infrastructure has been used to describe expenditure on transportation, particularly roads and highways, water projects, environmental improvements, energy, broadband, public lands, and public housing (Miller, 2021).

Walsh et al. (2022) extend the definition of infrastructure to include a whole system approach. They argue that infrastructure is a business model. How infrastructure systems produce, deliver, and capture economic, social, and environmental values throughout the entire infrastructure life cycle is described as an infrastructure business

model. This concept is encapsulated in Figure 2, which presents a framework for the infrastructure business model.

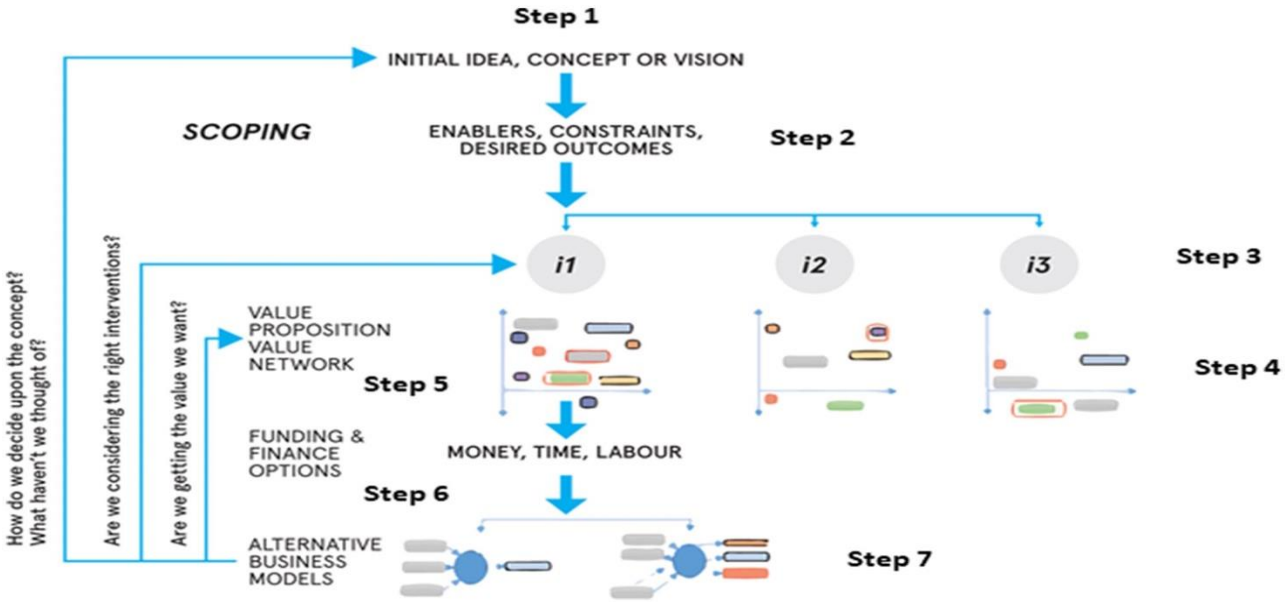

Figure 2: Framework for Infrastructure Business Model

Source: (Walsh et al., 2022)

By bringing together actors from various infrastructure sectors to recognise cross-sectoral connections and dependencies, co-risks, and to capitalise on both short- and long-term values, these experiments and testing, and ultimately their use in practice, can encompass broader perspectives and priorities.

Baldwin and Dixon (2008) classify infrastructure into four categories of: transportation, communication, water and sewage, and electricity, occasionally extending to hospitals and schools. Building upon this framework, Roy (2012) provides a broader perspective, classifying infrastructure as including telecommunications, irrigation, water supply, sanitation, storage, roads, bridges, railroads, ports, and airports. Further nuanced perspectives are provided by Beeferman and Wain (2016), who define infrastructure from a human-centric lens, viewing infrastructure as facilities and assets vitally important to individuals' capabilities to thrive socially, economically, and politically. Miller (2021) echoes this focus on human well-being, aligning his definition with Baldwin and Dixon (2008) by including facilities for water, waste management, health, and energy, alongside communication and transportation systems.

Complementing these definitions, the World Bank (1994) introduced the concept of "Social Overhead Capital," encompassing public infrastructure, transportation sectors, and public utility services. This framework distinguishes between social infrastructure, which includes educational institutions and medical facilities, and economic infrastructure, which comprises transportation networks and essential utilities like electricity and telecommunications. Highlighting the significance of this distinction, Snieška and Šimkūnaitė (2009) underscore the intimate link between infrastructure and societal well-being, emphasising its role in preserving humanity. Furthermore, Kaur and Kaur (2018) emphasise the crucial contribution of energy, as an essential resource, to the overall economic infrastructure. Additionally, they highlight the interconnected roles played by transportation, irrigation systems, and social infrastructure in national development.

Offering an alternative perspective, the distinction between social and economic infrastructure provides a nuanced lens for understanding the complexities of infrastructure investment. Drawing attention to the disparities between these categories, Fransen, Bufalo, and Reviglio (2018) point out the relative ease with which financial analysis can be applied to economic infrastructure, due to its readily measurable cash flows. In contrast, social infrastructure presents challenges in quantifying its returns, despite its multifaceted benefits for both individuals and governments. Expanding this perspective further, O'Brien and Pike (2017) and Bird, Liem, and Thorp (2014) encourage viewing infrastructure not only as physical structures but also as financial assets, acknowledging its potential for participation in markets.

Gaining a comprehensive understanding of these intricate aspects is crucial to fully grasping the multifaceted role of infrastructure in promoting economic and societal progress (Brueckner, 2021). Again, research has established a positive correlation between infrastructure investment and economic growth, as evidenced by studies conducted by Aschauer (1989), Munnell (1992), and the World Bank (2015). Equipped with this knowledge, policymakers can effectively direct resources and implement strategies for infrastructure improvement, ultimately contributing to a more prosperous and sustainable future.

This research acknowledges the limitations of relying solely on definitions to establish a causal relationship between infrastructure investment and economic growth. However, it specifically focuses on analysing alternative infrastructure funding models in Ghana and Nigeria. Through a comparative analysis of the models utilised in these two nations, our objective is to acquire a comprehensive comprehension of the variables that impact their acceptance and efficacy in promoting infrastructure growth, economic advancement, and societal well-being. This methodology enables us to transcend the oversimplified assumption of a straightforward connection and instead, explore the intricate interaction among funding models, implementation strategies, and particular contextual factors within each nation.

This research is consistent with previous studies that highlight the significance of the institutional, political, and economic context when evaluating the effects of infrastructure investment (Calderón & Chong, 2013; Rodrik, 2008). By examining the decisions and execution of alternative funding models in Ghana and Nigeria, it can enhance the ongoing discussion by offering valuable perspectives on the circumstances in which these models can promote sustainable and fair economic development.

The infrastructure deficit in Africa, which hinders economic progress and development, is characterised by insufficient transportation networks, energy infrastructure, and limited access to clean water and sanitation (World Bank, 2023). The deficit acts as an obstacle to economic growth by obstructing the smooth flow of goods and services, raising transaction expenses, and restricting the availability of vital services (Ajakaiye & Ncube, 2010). To address this deficiency in infrastructure, numerous African nations are adopting Public-Private Partnerships (PPPs) as a viable strategy for infrastructure development.

Public-Private Partnerships (PPPs) are contractual agreements between the public and private sectors to deliver public services or infrastructure (World Bank, 2023). These collaborations provide a distinct chance to utilise the specialised knowledge, funding, and risk mitigation abilities of the private sector in order to expedite infrastructure advancement (African Development Bank, 2022). Governments can

derive advantages from Public-Private Partnerships (PPPs) by obtaining access to the resources and specialised knowledge of the private sector, while private companies secure enduring contracts and sources of income. External investment, which includes foreign governments, private investors, and international organisations, is vital for funding infrastructure development in Africa (African Development Bank, 2022). External investment has the potential to expedite infrastructure development, but it also gives rise to apprehensions regarding the accumulation of debt and the possibility of relinquishing control over national resources (Arezki & Sy, 2016). Hence, it is imperative for governments to meticulously weigh the advantages and drawbacks of foreign investment, guaranteeing its alignment with domestic development objectives and avoiding any compromise to economic autonomy (Arimoro, 2019). Achieving this equilibrium necessitates rigorous supervision, transparent funding mechanisms, and efficient risk mitigation strategies. Governments must establish unambiguous guidelines and regulations regarding external investment. These measures should aim to structure Public-Private Partnership (PPP) contracts in a manner that safeguards the public interest and fosters sustainable development (World Bank, 2024). The complex correlation between infrastructure and economic growth has been extensively discussed by scholars and policymakers (Marozva & Makoni, 2018; Zhang, Zhang, Xu, Wang & Shi, 2021).

Conversely, a significant issue prevalent among African countries is the existence of an infrastructure funding gap on the continent. Funding gap can be defined as the difference between the actual financial commitments made in a given year and the required financing needed to deliver a basic level of service to the African population (The Infrastructure Consortium for Africa, 2023). This gap, which represents the disparity in funding, poses a challenge to achieving the African Development Bank's (AfDB) target of provision of basic infrastructure services by 2025 (The Infrastructure Consortium for Africa, 2023) which by extension stifles the progress of the AU's Agenda 2063.

In 2019, the funding gap for African infrastructure reached its lowest point, mainly because resources were redistributed to meet the demands of the COVID-19 pandemic which affected the efforts in closing the infrastructure gap. Consequently, the rating downgrades, made it more difficult for many nations and financial institutions

to obtain funding, and so infrastructure projects in Africa suffered. Some of the projects that halted were Mombasa-Nairobi Expressway, Lagos-Kano High-Speed Rail and Medupi and Kusile coal-fired power plants. In comparison to the global average of 31.8% and the averages for other continents, which are 45% in the Americas, 28% in Asia, and 9% in Europe, respectively; 56% of rated African countries were downgraded (The Infrastructure Consortium for Africa, 2023). However, in the subsequent year of 2020, this gap widened, amounting to an estimated range of $59 billion to $96 billion. Consequently, this setback further delayed the attainment of the continent's infrastructure goals (The Infrastructure Consortium for Africa, 2023). Moreover, the effect of the COVID-19 pandemic continues to hinder the recovery of most African countries, with a notable adverse effect on infrastructure investment. As a result, the efforts to bridge the annual funding deficit for Africa's infrastructure have been significantly impeded (The Infrastructure Consortium for Africa, 2023).

Furthermore, it is important to note that over time, the sources of funding for infrastructure in Africa have largely remained the same. Members of the International Group of Seven (G7), which consists of Canada, France, Germany, Italy, Japan, the United Kingdom, and the United States, are among the major financiers for the Infrastructure Consortium for Africa. Additionally, other contributors encompass various multilateral and bilateral institutions, African national governments, and the private sector (The Infrastructure Consortium for Africa, 2023). As shown in Table 2 and Figure 3, these sources have contributed significantly to infrastructure financing, with total commitments and average financing detailed for the period 2018–2020.

Table 2: Total Commitments and Average Financing by Source (billion US$), 2018-2020

Source	**2018**	**2019**	**2020**
Total ICA Members	20.20	26.90	18.10
Other Multilateral/Bilateral	31.20	12.50	10.40
Private Sector	11.80	10.80	19.00
Total African National Governments	37.50	34.90	33.40
Total	**100.70**	**85.10**	**80.90**

Source: Author's conceptualisation from The Infrastructure Consortium for Africa (2023)

Among the infrastructural needs, transportation received the most funding in 2020 due to its importance to the African continent, yet there remains a significant funding gap (Arimoro, 2021).

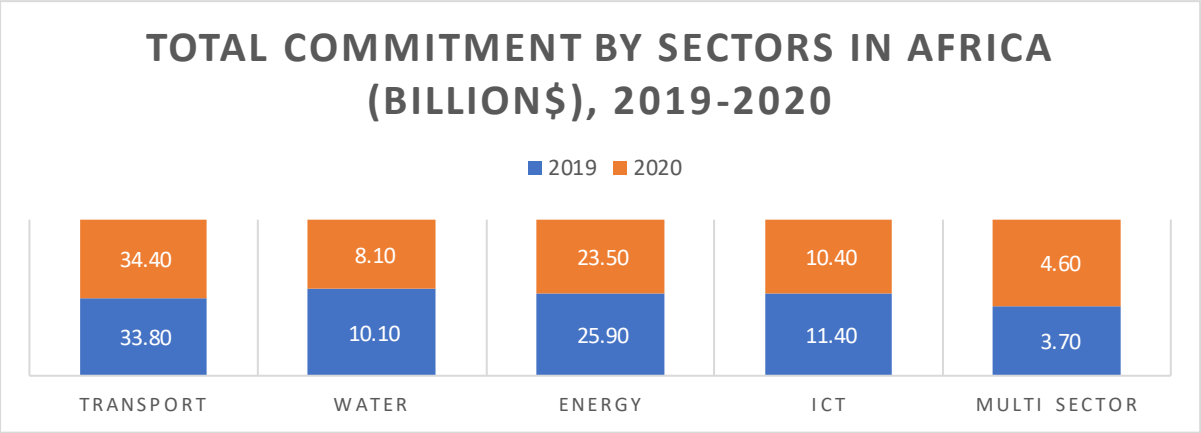

Figure 3: Total Commitment by Sectors in Africa (Billion US$), 2019-2020
Source: Author's own conceptualisation from The Infrastructure Consortium for Africa (2023)

Developing and expanding economies, notably West African countries, have struggled to fund infrastructure projects over the years (Lakmeeharan, Manji, Nyairo & Poeltner, 2020). Resource scarcity frequently poses a challenge for governments, especially in developing countries, impeding their ability to effectively address extensive infrastructure initiatives (Suttmeier, 2021). The existing fiscal vulnerability is worsened by burdensome levels of debt, rendering them susceptible to the unpredictable nature of volatile financial markets (Özker, 2022).

Conventional approaches are hindered by insufficient allocation of resources and bureaucratic inefficiencies that afflict public procurement processes, resulting in prolonged delays and excessive costs (Israel, 2023). In addition, governments bear exclusive responsibility for risk, making them vulnerable to unforeseen circumstances such as project delays, cost increases, and technical malfunctions (Sukhova, 2022). This exacerbates the fiscal strain even more, putting crucial public services at risk. Furthermore, due to their lengthy approval processes, the slow pace and lack of adaptability inherent in conventional approaches impede the prompt commencement of projects and the ability to respond to changing requirements (Powl & Skitmore, 2005). Moreover, the perception of infrastructure projects as having a high-risk, low-

return nature frequently discourages private investors, thereby further restricting the inflow of resources (Onischuk, 2022). Conventional approaches not only impede the gathering of resources, but also disrupt public finances, which could jeopardise essential social services such as healthcare and education (Vickerman, 2018). For example, Ghana's persistent focus on developing infrastructure at the expense of generating revenue has led to an unmanageable debt burden and insufficient investment in critical sectors. This could hinder economic advancement and societal welfare. Nevertheless, alternative approaches such as Public-Private Partnerships (PPPs), although appealing due to their ability to tap into private knowledge and resources, are not devoid of their own obstacles. Potential conflicts of interest, inflated costs, and long-term contractual obligations pose a significant risk to the long-term viability of infrastructure projects (Nasios & Foradoula, 2021).

Infrastructure financing is critical for such countries' medium to long-term development. A more nuanced strategy for infrastructure development is required, one that takes into account the complexity of the problems that various regions face (Dimitriou, 2019). A lack of transport infrastructure in West Africa is affecting economic activities. Inadequate transport infrastructure affects the movement of goods and persons within the West Africa sub-region. Focusing on West Africa, this study narrows its scope to two countries: Ghana and Nigeria. These countries, though economically vibrant, face significant infrastructure challenges. The Ghana Infrastructure Plan (GIP), which prioritises investment in transport, energy, water and sanitation, and information and communication technology, contains the infrastructure goals set forth by the National Development Planning Commission of Ghana (National Development Planning Commission, 2019). Similarly, infrastructure development is listed as a strategic goal in Nigeria's Economic Recovery and Growth Plan (ERGP) to encourage economic growth and social inclusion (Africa Development Bank, 2013). The ERGP addresses the SDGs' three elements of economic, social, and environmental sustainability challenges (Africa Development Bank, 2013). In addition, the National Integrated Infrastructure Master Plan for Nigeria, is the government's strategic plan for developing infrastructure. It was first created in 2012 to direct infrastructure investment, boost the country's economy, and, in particular, increase private sector involvement in infrastructure development. These national plans aim to

enhance sustainable and inclusive economic growth, infrastructure development, and industrialisation which are key elements of Agenda 2063 and SDG 9.

Road infrastructure is a key component of the infrastructure development plans of both Ghana and Nigeria. As a result, the study focused on road infrastructure in Ghana and Nigeria. Limiting the scope to road infrastructure in Ghana and Nigeria is justified due to several compelling reasons, although the definition of infrastructure covers a wide range of sectors. The African Development Bank (AfDB, 2023) has highlighted the crucial role of road infrastructure in economic development. It enables the smooth transportation of goods and services, lowers transportation expenses, and improves connectivity between markets and production hubs. The presence of well-developed road infrastructure in Ghana and Nigeria plays a vital role in linking agricultural areas with urban hubs, facilitating the movement of goods to markets, and promoting trade and economic expansion (Calderón & Servén, 2010). Moreover, a well-established network of roads has a direct influence on alleviating poverty by enhancing accessibility to vital services such as healthcare, education, and employment prospects (UNECA, 2021).

The World Bank (2023) highlights that in Ghana and Nigeria, where poverty rates are still significant, road infrastructure development can play a crucial role in linking rural communities to vital services, enhancing people's quality of life, and supporting poverty reduction efforts. Road infrastructure plays a crucial role in fostering social inclusion and equity as it ensures that all citizens, irrespective of their geographical location or socioeconomic status, have equal access to essential services and opportunities (World Bank, 2023). In Ghana and Nigeria, enhancing road connectivity can serve as a means to narrow the disparity between urban and rural regions, guaranteeing equitable access for all citizens to vital services and prospects for economic advancement (AfDB, 2022).

Road infrastructure plays a significant role in attaining various Sustainable Development Goals (SDGs), such as Goal 9 (Industry, Innovation, and Infrastructure), Goal 8 (Decent Work and Economic Growth), and Goal 10 (Reduced Inequalities) (Thacker et al., 2019). According to UNECA (2021), focusing on road infrastructure in Ghana and Nigeria can contribute to the achievement of the Sustainable Development

Goals (SDGs) and facilitate sustainable development. Road infrastructure is essential for promoting trade and regional economic integration. Yet, these countries' road infrastructure faces numerous challenges, including insufficient funding, poor maintenance, and weak institutional capacity. About 23% of Ghana's road network is paved, leaving the other 77% unpaved (National Development Planning Commission, 2019). The country is projected to have a US$17 billion infrastructure deficit, with the road and railway sectors suffering the most. Out of this, the gap in road infrastructure alone amounts to over US$7 billion(Business and Financial Times, 2021).

In the rural regions of Nigeria, where more than 70% of the country's current roads are unpaved and frequently in appalling states, rendering them impassable, the road network is considerably worse (Government of Nigeria, 2020). The Nigerian government has shown its dedication to finishing important highways by putting into place, laws that promote private sector involvement in road construction all across the nation. Public-private partnership (PPP) initiatives and the introduction of infrastructure bonds are examples of this effort (Government of Nigeria, 2020). Numerous road projects were started between 2014 and 2020, some of which were backed by budgetary provisions and funded through Public-Private Partnership (PPP) agreements. To finance important road infrastructure projects, the government has used a variety of financing methods, including Sovereign Sukuk Bonds, the Presidential Infrastructure Development Fund (PIDF), and the Road Infrastructure Development and Refurbishment Investment Tax Credit Scheme (RIDRITCS). According to estimates, 27% of the Federal Road network is in good shape but needs regular maintenance, 30% is in medium condition and needs periodic repair, and 40% of the network is in poor condition and needs rehabilitation. Unpaved trunk roads that need to be paved make up the final 3%. Only 22% of State highways are in fair to good condition, and 78% of State roads are in bad shape (Government of Nigeria, 2020).

The challenges discussed above underscore the need for alternative funding models and robust institutional frameworks to support road infrastructure development in Ghana and Nigeria. This research thus seeks to examine the various alternative funding models used in Ghana and Nigeria using a comparative analysis approach. This study will also give a thorough assessment of the sub-region's funding gaps and

the solutions that can be used to close them. This knowledge is essential for creating sustainable plans for providing these nations with the infrastructure they require to support their economic development.

1.2 Research Problem

Alternative infrastructure approaches that can deliver equitable, sustainable, and cost-effective infrastructure development are increasingly needed in Ghana and Nigeria. There is, however, little study evaluating the efficacy of various strategies throughout the region's nations (Arimoro, 2022). The Infrastructure Consortium for Africa (2023), has indicated that in Africa, the transport industry is aiming for a preservation ratio of 80% and development of 20%, respectively. This offers a plan that prioritises maintaining the existing transport infrastructure while simultaneously funding the development of new initiatives. Basic requirements are predicted to cost the transportation sector US$36 to US$48 billion annually. Over the last three years, the actual contribution to this industry has averaged US$33 billion. However, research has consistently shown that these commitments are not enough to close Africa's infrastructure gap (The Infrastructure Consortium for Africa, 2023). There is still a US$3 to US$15 billion funding deficit despite a large cash commitment (The Infrastructure Consortium for Africa, 2023). This implies that additional funds or a higher level of commitment are needed to address the financial shortfall and accomplish the goals set for the transportation sector. What is not yet clear is how this funding gap would be closed. This funding gap has a direct impact on limiting the growth of the economy, because infrastructure investment is associated empirically with increased Real GDP (RGDP) via increased productivity, facilitation of trade, and employment (Brueckner, 2021).To fill this gap, alternative funding models are needed that can raise capital effectively, but also guarantee sustainable returns to investors and long-term increases in real GDP for national economies.

The stark reality of the state of the roads is the problem. Nigeria, the most populated country in Africa, has a significant infrastructure gap that needs to be filled. There are about 200,000 kilometres of roads in the nation, but only about 35% of them can be driven on due to poor maintenance, making them more like death traps than useful routes. Nigeria's road infrastructure remains in a terrible state despite efforts to

address the problem, including a 3 trillion Nigerian Naira infrastructure gap intervention, the Sukuk funding for road construction, and budgetary allocations (BusinessDay, 2021). This is because of high construction and maintenance costs, insufficient funding, and a lack of commitment to maintenance. However, only 23% of Ghana's network of maintainable roads are paved (National Development Planning Commission, 2019), despite efforts to find additional funding sources to fill the infrastructure gap (United Nations, 2021). The estimated cost of Ghana's infrastructure needs over the next ten (10) years is US$4 billion (Owusu-Manu, Mankata, Debrah, Edwards & Martek, 2021). Considering the costs associated with building and maintaining roads, the problem becomes more serious. Compared to other African nations, the cost of building or maintaining a kilometre of road in Nigeria is extremely high, and budgetary allocations have not been adequate to meet the needs (BusinessDay, 2021).

This holds true for Ghana as well, where traditional funding models such as government funding have not been successful in filling the infrastructure financing gap. The failure of traditional models to fulfil the demand for infrastructure has smothered economic possibilities. It has been found that a 1% investment in infrastructure translates to a 0.5%-1% increase in RGDP growth in developing economies, demonstrating the priority of alternative infrastructure funding methods (Brueckner, 2021). To expand the length of the current road network in Ghana to the long-term goal of building 253,000 kilometres by 2047, an investment of US$271.7 billion is required (National Development Planning Commission, 2019). Thus, it is the responsibility of the state authorities in Ghana and Nigeria to open up domestic funding for private sector investments in financing infrastructure (Arimoro, 2019). There are several issues with this situation. It primarily has a detrimental effect on the transport sector, which causes underperformance and a downward trend in its contribution to the GDP (BusinessDay, 2021). Additionally, due to traffic congestion and increased security risks like armed robberies and kidnapping, the condition of the roads has reduced worker productivity (BusinessDay, 2021). The issue is especially important to the governments, decision-makers, and general public of these nations because they depend on these road networks for their daily activities. Investors and companies that rely on efficient transportation systems for their operations are also concerned. Regarding the temporal aspect, the issue persists and needs immediate attention

because any further delays will only exacerbate the detrimental effects on societal welfare and economic growth. The consequence of this economic impact is that transport inefficiencies will increase in the short term. Poor infrastructure investment contributes to a cycle of underdevelopment: bad road infrastructure heightens logistical expenses, deters foreign direct investment (FDI), and lowers the contribution of a sector to RGDP (Munatsi, 2021).The alternative models need to, therefore, cater to funding gaps and growth multipliers.

A thorough analysis of alternative infrastructure funding models is required due to the critical state of road infrastructure financing in Ghana and Nigeria. Although there is widespread recognition of the necessity for innovative funding models for infrastructure in Africa (Machete & Marques, 2021), there is still a lack of comprehensive knowledge regarding the constraints and efficacy of current alternative funding models. The lack of knowledge in this area presents a major obstacle to effectively implementing alternative models, especially in countries such as Ghana and Nigeria that have limited financial resources and significant infrastructure deficiencies. This position is corroborated by Evans (2020), who advocates for more research into novel funding approaches, and best and sustainable practices in development funding leading to policy formulation and implementation. Understanding alternative funding models, their advantages, and disadvantages is crucial going forward (Machete & Marques, 2021). This position is further strengthened by Singla, Shumberger and Swindell (2021), who further averred that tackling infrastructure demands may call for other funding models in addition to traditional ones, such as domestic resource mobilisation, development assistance and multilateral and bilateral loans. Finding solutions that not only deal with the issues at hand but also open the door for future sustainable development is therefore crucial. By conducting a comparative analysis of alternative infrastructure funding models in Ghana and Nigeria, this research aims to contribute to this urgent issue by offering insightful analysis and suggestions for policymakers and relevant stakeholders. Both Ghana and Nigeria are key economies in Africa, and improving the infrastructure would enhance their ability to harness increased foreign investment. The comparison of Ghana and Nigeria provides key insights since both countries are similar in their infrastructure problems, yet different in economic structures, use different policies and

funding systems, which makes it possible to understand how different funding models operate in these countries.

This study explored alternative approaches to infrastructure funding, recognising the shortcomings of traditional models that struggle to address the extensive requirements of developing countries (Merna & Njiru, 2017). The focus is specifically on Ghana and Nigeria. Although the importance of innovative models is widely acknowledged (Machete & Marques, 2021), existing research frequently lacks the detailed analysis and context-specific considerations required to effectively guide their implementation. The objective of this research is to close this gap and provide valuable perspectives to policymakers and stakeholders.

Beyond the sole study of Public-Private Partnerships (PPPs), as advocated by Udeagha and Muchapondwa (2023), this study investigates a wide range of alternative models that have significant potential for infrastructure funding. This encompasses the implementation of targeted user fees and community-based initiatives (Machete & Marques, 2021), harnessing individual involvement through crowdfunding (World Bank, 2023), and employing financial mechanisms that promote environmental sustainability for projects (UNIDO, 2021). Through a comparative analysis, this study aims to evaluate the effectiveness of these models in Ghana and Nigeria, considering their distinct economic, political, and social contexts.

The study goes beyond merely recognising the limitations of conventional approaches (Merna & Njiru, 2017). This study provides a nuanced viewpoint that surpasses the promotion of any specific model, instead offering a comprehensive understanding of the pros and cons linked to each alternative. This comprehensive examination, in accordance with the demand for a thorough investigation of optimal methods (Evans, 2020), provides policymakers with the essential understanding to choose and execute models that most effectively fit their particular requirements and difficulties, maximising the allocation of resources and the results of projects.

Furthermore, this study acknowledges the significance of conducting an analysis that takes into account the specific context, as the distinct challenges and opportunities encountered by Ghana and Nigeria influence the suitability of various models. This is

consistent with the demand for research that is customised to meet the specific requirements of each country (Arimoro, 2022). Through a comparative study in these two different settings, our goal is to enhance the overall comprehension of these models and their applicability in various regions, providing valuable insights that go beyond the specific case studies.

Although various decision-making frameworks for infrastructure funding exist, most are designed for contexts distinct from Ghana and Nigeria. Frameworks like those by Camane (2013) and Henn (2015), while insightful, may not sufficiently address the regulatory constraints, funding challenges, and socio-political risks inherent in West African infrastructure development. In addition, such frameworks tend to be rigid to the changing financial conditions in these countries. Therefore, this study identifies a gap in existing literature regarding context-specific frameworks that address the unique challenges of infrastructure funding in Ghana and Nigeria. Section 4.15, Proposal of Decision-making Framework, contained under the research methodology chapter, provides a detailed analysis of the existing global frameworks, further highlighting the need for a context-specific framework for effective decision-making.

It is anticipated that the results of this study will not only provide valuable insights for policy development in Ghana and Nigeria but also contribute to the advancement of infrastructure financing on a larger scale for developing economies. The aim of the study is to identify viable and enduring funding strategies to support the attainment of the AU Agenda 2063 and the UN Sustainable Development Goals. This will ultimately foster a more prosperous future for African nations and their inhabitants.

1.3 Research Objectives and Questions

This study seeks to compare alternative infrastructure funding models in two selected West African nations, namely, Ghana and Nigeria, as its main goal. The study's research objectives are thus:

1. To assess the various alternative infrastructure funding models currently employed in Ghana and Nigeria, respectively.
2. To analyse the determinant factors that influence Ghana and Nigeria's acceptance and use of new alternative infrastructure funding models.

3. To examine the cointegrating and causal relationships between the alternative infrastructure funding models and infrastructure development, economic expansion, and the social welfare agenda, respectively.
4. To propose a suitable decision-making framework for efficient and sustainable infrastructure funding in Ghana and Nigeria.

1.4 Research Questions

1. What alternative infrastructure funding models are employed in Ghana and Nigeria, respectively?
2. What factors determine Ghana and Nigeria's acceptance and use of alternative infrastructure funding models?
3. What cointegrating and causal relationships exist between the alternative infrastructure funding models and infrastructure development, economic expansion, and the social welfare agenda, respectively?
4. What decision-making framework would best suit the fostering of efficient and long-lasting infrastructure funding in Ghana and Nigeria?

1.5 Scope of the study (delimitations)

This research will concentrate on road infrastructure in Ghana and Nigeria. The emphasis has shifted to private sector funding of infrastructure due to the vast financial requirements of the industry. Matching the excess savings and investments advantages beyond national boundaries would create opportunities for all (African Development Bank, 2018). Previous research has highlighted the potential advantages of alternative funding models to address these issues. The specific West African nations of Ghana and Nigeria were chosen for the analysis for a number of reasons. Firstly, as two of the biggest economies with similar economic structures (Nchor, Adamec & Kolman, 2016), Ghana and Nigeria serve as crucial case studies for comprehending infrastructure funding models in the region. Their experiences can offer insightful guidance for other West African nations dealing with comparable issues. Secondly, both Ghana and Nigeria have shown that they take different approaches to funding and developing infrastructure. Ghana has been more organised and innovative in the approach to infrastructure financing. It relies on public-private partnerships (PPPs), capital market finance and support from development finance institutions. This has been supported with sound governance and policies (Asumadu

et al., 2023). On the other hand, Nigeria has had a hard time accessing private sector investment because of bureaucratic inefficiencies, inadequate institutional frameworks, and too much reliance on public spending, especially from oil revenues (Okegbemi, 2024). These distinct approaches provide a basis to compare both countries. This allows the study to explore choices, institutional capacity and governance structures. This enables a more thorough understanding of the advantages, disadvantages, and lessons learned from the experiences of each nation by allowing for a comparative analysis of their alternative infrastructure funding models.

This study will take into account a specific number of years for data analysis and collection to ensure the inclusion of current trends and advancements. This period was chosen based on the accessibility and dependability of the data sources. To gather the most pertinent data on the application and effects of alternative funding models in the road infrastructure sector, it is crucial to consider recent times and economic events. As such, for the purposes of this study, the focus will cover the period 2003 to 2023. The period is considered adequate as it covers twenty (20) years, which were significant enough to exert some influence on the topic at hand. This research aims to provide a focused and in-depth analysis of alternative funding models within these particular contexts by focusing on the road infrastructure sector in Ghana and Nigeria, respectively. This study will add to the body of knowledge already in the field and enable an in-depth comprehension of the difficulties, opportunities, and successes related to alternative infrastructure funding in these nations, to inform macroeconomic policy formulation.

1.6 Contribution to Knowledge

Existing literature has argued for greater study into creative funding models, sustainable funding models, and the creation and application of policies (Idaeho & Adeshina, 2021). Many regions, including West Africa, face significant road infrastructure gaps due to limited financial resources and traditional funding mechanisms falling short of meeting the demand for road development (AfDB, 2018). Road infrastructure development in West Africa faces numerous challenges, including inadequate funding from government budgets and international loans (Cateia, Bittencourt, Carvalho & Savard, 2023). The traditional approach of relying solely on

public funding is often insufficient to meet the substantial investment requirements of road infrastructure projects (Kravchenko, 2018). As a result, alternative infrastructure funding models have gained prominence as viable solutions to bridge the funding gap and expedite road infrastructure development (Abiru, 2023). One effective alternative funding model is Public-Private Partnerships (PPPs). It enables public and private sector collaboration, combining their strengths to deliver road infrastructure projects (Chilunjika, 2023). Private entities bring expertise, technical know-how, and efficiency in project delivery, while the public sector provides regulatory frameworks, oversight, and access to public land (Moszoro, 2017). This collaboration promotes the effective distribution of resources, fosters innovation, and accelerates the implementation of road infrastructure projects (Buyvis, Novichikhin & Kaledin, 2018; Buyvis, Yu Yuryeva & Novichikhin, 2019; Kalu & Rugami, 2021).

By comparing alternative infrastructure funding models in Ghana and Nigeria, this study will support the governments of Ghana and Nigeria in their ongoing efforts to address the problems with infrastructure bottlenecks, particularly those that plague each country's road networks. This study provides policymakers with valuable insights by closely examining various funding models. These insights allow for well-informed decisions regarding the allocation of resources and the attraction of investment for road construction initiatives. As a result, this research has the potential to speed up road infrastructure development, which will ultimately benefit society and the economy.

This study's findings will likely serve as a roadmap for governments as they deal with potential financiers of road construction projects. The insights this study offers will undoubtedly be valuable to investors, particularly those with a close eye on infrastructure development. This study provides investors with an understanding of the risks and rewards associated with various approaches through a comparative analysis of different funding models. In turn, this encourages the formation of public-private partnerships by enabling investors to make wise investment choices. Such partnerships play a key role in luring private investment, which is essential for addressing the grave road infrastructure deficits in both Ghana and Nigeria.

Additionally, financial asset managers looking to diversify into infrastructure assets can benefit from this research. Infrastructure investments come with special risks, despite the benefits of diversification that they provide. The results of this study shed light on how various funding models affect risk and return profiles. Financial asset managers can use these insights to inform their investment choices and help to promote ethical and successful asset management procedures. The overall landscape of infrastructure investment is improved due to this win-win situation, which benefits investors and the larger financial ecosystem.

On a personal level, the accomplishment of this study's successful conclusion marks a significant academic turning point and the achievement of the highest level of academic qualification. Beyond personal development, this achievement serves as a motivating model for other academics and students. It acts as a lighthouse, inspiring and enticing upcoming researchers to explore the area of alternative infrastructure funding models. In doing so, this research advances academic understanding while fostering a community dedicated to tackling the urgent problems with infrastructure development in West Africa and elsewhere, ushering in constructive societal change.

1.7 The Organisation of the Study

This chapter introduced the study by outlining its background. The problem statement, thesis objectives, and research questions were explicitly articulated. Chapter Two offers a comprehensive introduction to the theoretical framework that forms the foundation of infrastructure funding. The chapter provides an overview of the core theories that shape our comprehension of the connection between infrastructure development and economic growth. Chapter Three provides a comprehensive overview of the overall alternative infrastructure funding landscape, examines the alternative infrastructure models in Ghana and Nigeria, and presents a preliminary conceptual framework. Subsequently, Chapter Four elaborates on the underlying methodology. The chapter also offers a rationale for the choice of variables and the duration of the sample period. The same chapter will address the estimation techniques, explicitly explaining the reasoning behind the selection of the models employed. Chapters Five and Six primarily focus on data analysis and a consideration of the key findings for Ghana and Nigeria, respectively. Chapter Seven undertakes a comparison of the key drivers that determine alternative funding models in Ghana and

Nigeria. The study concludes in Chapter Eight, providing a comprehensive summary of the entire thesis, underpinning the contribution to knowledge made by the study. It also emphasises policy recommendations and the study's implications for future research.

Chapter Two
Theoretical and Conceptual Literature Review

2.1 Introduction

This section offers a comprehensive introduction to the theoretical framework that forms the foundation of infrastructure funding. This chapter provides an overview of the core theories that shape our comprehension of the connection between infrastructure development and economic growth. It lays the groundwork for thoroughly examining the scholarly principles underpinning alternative models for funding infrastructure.

2.2 Relevant Infrastructure Funding Theories to the Study

Expanding on the introduction section, this subsection explores the theories that influence our understanding of infrastructure funding. This section examines established economic theories and models, explaining how a well-developed infrastructure system stimulates economic progress. It provides a solid theoretical framework for the subsequent analysis of alternative funding models in the comparative study of Ghana and Nigeria.

2.2.1 Wagner's Law of Increasing State Activity

In 1877, Adolf Wagner, a political economist from Germany, developed an empirical law to consider and explain the rise in public spending. According to Wagner, an industrialising economy's private sector expansion and its proportional growth have a functional cause-and-effect relationship (Peters, 2002). According to Wagner's Law, industrialising economies are characterised by a related increase in the public sector. Wagner's study of industrialising countries, including the United States, France, Germany, Japan, and Great Britain, provided evidence to support this claim. He concluded from his research that the public sector's economic contribution increases proportionally as per capita income and output increase in industrialising nations (Lamartina & Zaghini, 2011). Wagner postulated a causal link between industrialisation and the relative importance of public sector participation. He then set out to prove his theory by examining the industrialisation processes in several

European nations and Japan. The results of his research led to the development of Wagner's Law of Increasing State Activity (Yamamura, 2021).

With a focus on Germany specifically, Wagner, in 1877, carried out a methodical analysis of historical data on the expanding expenditure activities of public bodies. Through his well-known "Law of Increasing State Activities," he sought to explain why public spending was increasing. Wagner asserts that there are natural tendencies for different governmental levels, including the federal and state governments, to experience both intensive and significant increases in their activity. Wagner contends that thorough comparisons of various nations and eras demonstrate that progressive individuals regularly see an increase in both the central government's and local governments' activity (Kónya & Abdullaev, 2018). This growth is significant. The national and local governments constantly take on new duties while carrying out both old and new duties more fully and effectively. Wagner's Law of rising state activity has gained widespread acceptance. Expanding government operations and rising public spending are indisputable indicators of a country's economic growth (Lamartina & Zaghini, 2011). The premise of an ongoing upward trend in government activity is supported by empirical data (Magazzino, 2010).

According to Tarschys (1975), Wagner's Law is true not only for governments that are quite similar to one another, but also for those that are very different from one another. Tarschys (1975) avers that governments of all forms demonstrate comparable inclinations to increase public spending, regardless of their levels (such as central, state, or municipal), objectives (peaceful or warlike), or size. Wagner's Law, which was based on historical data, primarily concerns modern progressive governments attempting to expand the size of the public sector of the economy. Tarschys (1975) further argued that Wagner saw a steadfast tendency towards an "extensive" and "intensive" expansion of the state's functions. While "extensive increase" refers to the adoption of new welfare functions, "intensive increase" refers to the significant extension of established state functions (Musgrave, 2020). Wagner's Law states that there are three main reasons why public authorities' spending shows a consistent upward tendency.

Firstly, conventional roles like defence, judicial administration, upkeep of law and order, and the provision of social overheads are expanding. The scope and range of these functions have gradually expanded throughout time. Defence spending has rapidly increased as a result of the advancement of military arts and sciences, which was sparked by the transition from straightforward aggression to attack prevention and the deployment of cutting-edge weaponry (Magazzino, 2010). Defence spending has correspondingly increased for personnel, resources, and maintenance. Similarly, as administrative territories have expanded and become expensive, highly specialised government apparatus has been built, the prices of internal protection and administrations have gone up.

Secondly, the state's activities have widened their scope beyond their original purposes. As a result of governments realising their social responsibilities, they have become more involved in a range of welfare programmes meant to enhance the quality of life for the populace and provide social security (Magazzino, 2012). As a result, the government has had to spend more money on public health, affordable housing, food subsidies, agricultural support, pensions, and sickness benefits.

Thirdly, the realm of public goods is expanding. Governments in contemporary democracies are becoming more aware of the necessity of expanding and providing public goods. The state wants to devote a larger portion of the GDP to public goods, which will increase state spending on things like irrigation and flood control projects, the construction and upkeep of public parks, the provision of healthcare and educational facilities, and the development of economic infrastructure. It takes significant expenditures in public enterprises to provide these merit-based public goods (Wahab, 2004). Wagner also examined and clarified the forces at play on the supply and demand sides of the operations of the public sector. Social organisations have different effects on changes in the production and marketing arrangements of public sector activities (Wahab, 2004).

Both the demand for and the supply of public expenditure activities are influenced by several factors. Firstly, variables like affluence and per capita income have a beneficial influence on both the demand for government services and the expenditures involved in supplying them. The population growth rate and density also impact the demand for

public goods like healthcare, transportation, and communication as well as the cost of providing these services (Afonso & Alves, 2017).

Secondly, urbanisation, industrialisation, and the makeup and composition of the population are the main elements influencing the demand side of public expenditure activities. The demand for educational facilities, pensions for the elderly, and other services relating to the needs of the population, are determined by these elements. The quality of production, changes in scale of production in government operations, and grants from other governments are all significant determinants on the supply side of public expenditure activities. These elements have an impact on the availability and effectiveness of public sector operations. Adolf Wagner thought that rising public spending was a logical result of economic expansion and the constant drive for social advancement. According to Wagner, government spending tends to grow faster than per capita income because it has a higher income elasticity than unity (Kolluri et al., 2000).

Over the years, the literature on Wagner's Law of Increasing State Activity has received many criticisms. First of all, Wagner's Law is believed to suffer from the issue of endogeneity and Inverse Causation. According to critics, Wagner's Law is said to have problems with reverse causality and endogeneity (Arestis, Şen, & Kaya, 2021). A clear correlation between economic growth and the expansion of the public sector is challenging to establish. Increased economic activity may lead to a rise in demand for public services, but increased government involvement may also be to blame. Causality's direction is not always obvious (Leeper, 1991).

The significance of institutional and political factors in determining the scope and expansion of the public sector is another issue Wagner's Law is criticised for not fully taking into account many factors such as political ideology, popular preferences, and institutional restraints, which are not taken into account in Wagner's theory, affect the size of the government (Besley & Case, 1995). Buchanan and Wagner (1977) further argue that Wagner's Law disregards the function of fiscal illusion and hidden costs. The primary factor influencing the public sector's growth is thought to be the demand for public goods and services. The public sector may, however, become more expansive than is economically necessary due to political pressures and budgetary

illusions. Governments may use public spending to increase their popularity or provide advantages in a certain way, which is not considered economically efficient.

Additionally, there is the concern over the evolving nature of public goods. According to critics, Wagner's Law fails to effectively consider how public goods and services are evolving. Wagner notes that the provision of public goods may change over time, and technological developments may change the ideal size and composition of the public sector (Tanzi, 2000).

Critics also point out that there is variation between nations. Wagner's Law is frequently criticised for having limited applicability in many circumstances and nations. Due to variations in institutions, cultures, and phases of development, there are significant regional differences in the relationship between economic growth and the size of the public sector. Wagner's Law may not apply to all countries; hence it must be carefully considered when applying (Hansen & King, 1996).

The theory is relevant to the work as the Law of Increasing State Activity by Wagner provides a critical background that might be used in studying the relationship between economic growth and investment in infrastructure by the state. This theory proposes that economic growth results in high demand for public goods like infrastructure, and therefore necessitates more government intervention. The reason why Ghana and Nigeria require additional infrastructure can be attributed to the Wagner Law. The two economies have posted dramatic increases in their respective GDPs in the past 2 decades. As an illustration, the GDP of Ghana has increased by approximately 6 percent annually since 2000 due to industrialisation, as well as urbanisation and population growth (World Bank, 2023). The country with the largest economy in Africa, Nigeria, has also experienced a high level of urbanisation as well as increased middle-income brackets, which have also culminated in increased demands for roads, energy, and other goods provided by the government. However, both countries have struggled to fulfil this requirement using traditional funding sources such as taxes and borrowed funds due to weak fiscal capacities and other demands. This follows Wagner's point that as economies expand, the demand for public goods frequently exceeds the capacity of a government to finance the goods; hence, alternatives have to be sought.

2.2.2 Innovation Diffusion Theory

The Innovation Diffusion Theory was first proposed by Ryan and Gross in 1943, and later refined by Rogers in 2003 (Ryan & Gross, 1943; Rogers, 2003). This theory has arisen in the field of innovation adoption, providing a structured perspective to understand how new ideas, like alternative infrastructure funding models, are introduced, accepted, and spread within a complex social system.

The Innovation Diffusion Theory, first proposed by Ryan and Gross in 1943, asserts that the adoption of innovations does not occur randomly, but rather follows a predictable pattern. This pattern consists of several stages that individuals and social systems go through. In 2003, Rogers made significant contributions to this theory by enhancing its conceptual framework and broadening its applicability to various contexts. In the innovation diffusion theory, Rogers (2003) delineated five distinct stages in the process of adopting innovation. The stages encompassed in this process are as follows: Knowledge, which denotes the initial stage where an individual becomes cognisant of innovation and acquires a basic understanding of how it functions. Persuasion refers to the process by which an individual develops a favourable or unfavourable perspective towards innovation. Decision, on the other hand, involves the individual's actions that ultimately result in either adopting or rejecting the innovation. The stage of implementation involves putting the innovation into practice. On the other hand, confirmation means seeking validation for the decision to adopt the innovation. However, encountering conflicting information about the innovation could reverse this decision.

The relevance of the Innovation Diffusion Theory to this study of alternative infrastructure funding models lies in its capacity to clarify the complex processes by which these innovative funding approaches are introduced, embraced, and incorporated into the practices of governments, private sectors, and communities within the specific socio-economic contexts of Ghana and Nigeria (Rogers, 2003). This research seeks to explore the intricacies of how information about alternative funding models is spread, how opinions and attitudes are formed, and how choices are made regarding their acceptance and execution, by utilising this well-established theory.

The Innovation Diffusion Theory offers a comprehensive and methodical basis for studying the acceptance and spread of alternative models of funding infrastructure. It provides a structured framework for analysing the dynamics of innovation in the field of infrastructure development (Kaur & Kaur, 2010). This theoretical framework enhances the research by offering a detailed comprehension of the different phases implicated in the process of adoption, providing valuable insights to the wider discussion on sustainable development in the context of Ghana and Nigeria.

Rogers' (2003) conceptual framework identifies and systematically categorises crucial stages in the diffusion process, clearly outlining the path from knowledge to confirmation (Bhattacharya, 2015). The stages of knowledge, persuasion, decision, implementation, and confirmation provide a systematic and analytical framework that is essential for studying the complete lifecycle of adopting and spreading alternative infrastructure funding models (Rogers, 2003). The knowledge phase, which is essential in this framework, explores how stakeholders in Ghana and Nigeria are exposed to and gain awareness of these innovative funding models. This phase focuses on how stakeholders understand the potential advantages of these innovative funding methods, setting the foundation for future stages.

The persuasion phase is a crucial component of the Innovation Diffusion Theory, occurring alongside the knowledge phase. This facet examines the impact of communication channels and influential individuals on the formation of perceptions and attitudes towards different infrastructure funding models (Rogers, 2003). Gaining a comprehensive understanding of the mechanics of persuasion is crucial for deciphering the intricate interaction of factors that impact stakeholders' initial responses to these novel funding methods. The knowledge and persuasion phases establish the foundation for the subsequent decision-making processes in the infrastructure funding landscape of both Ghana and Nigeria.

The decision-making processes are inherently subjective and can be influenced by various factors, such as perceived advantages and compatibility, as suggested by Rogers (2003). The conceptual framework acknowledges the complex nature of innovation adoption when examining these decision-making processes. It recognises that the subjective assessment of benefits and compatibility greatly influences the

adoption path of different models for funding infrastructure. This phase establishes the overall atmosphere for the following stages of implementation and verification, during which the practical aspects and results of the chosen models are thoroughly examined.

Following that, the implementation phase of the framework evaluates the tactics utilised to execute the new funding models, scrutinising their integration into pre-existing infrastructure development frameworks (Rogers, 2003). This phase is crucial for comprehending the practical consequences and difficulties linked to the implementation of alternative funding models, providing valuable understanding into the practical use of theoretical ideas. The confirmation phase rigorously assesses the results of the implemented models, gauging their effectiveness and the degree to which they achieve their intended objectives. This stage concludes the diffusion process, offering a comprehensive perspective on the adoption trajectory and its influence on sustainable development.

The Innovation Diffusion Theory offers a robust and methodical foundation for thoroughly examining the adoption and spread of alternative infrastructure funding models in the socio-economic settings of Ghana and Nigeria (Ryan & Gross, 1943; Rogers, 2003). The intricate methodology of this theory seeks to decipher the intricate dynamics of innovation diffusion, providing valuable insights into the comprehension of adoption processes and their consequences for sustainable development. The theory thoroughly examines the complex process of adopting alternative infrastructure funding models in Ghana and Nigeria by analysing each stage, from acquiring knowledge to confirming outcomes.

The Innovation Diffusion Theory is applicable in this study because it engulfs a structured route in learning how to adapt and use other approaches of infrastructure funding models in Ghana and Nigeria. This study considers Rogers' (2003) five-stage model, namely knowledge, persuasion, decision, implementation, and confirmation, to help stakeholders in the two countries become aware of innovative approaches to funded programmes, develop their attitude to those approaches, and take a position between adopting a new approach and rejecting it. For example, in the case of Ghana, the successful implementation of the PPP arrangement to construct the Accra-Tema

Motorway expansion started with the level of awareness, passing through the negotiation stage and finishing with the confirmation. In contrast, Nigeria's challenges with PPPs, such as delays in the Lagos-Ibadan Expressway project, highlight barriers at various stages, particularly in decision-making and implementation. This theory, therefore, offers valuable insights into the factors that influence the adoption of alternative funding models, helping to explain why some approaches succeed while others encounter bottlenecks. Applying the Innovation Diffusion Theory, this study contributes to a deeper understanding of how alternative funding models can be effectively introduced and scaled in developing economies like Ghana and Nigeria.

2.2.3 Financial Theories

Financial Theory is a core field in finance that influences decision-making in infrastructure funding. The incorporation of Financial Theory into this research seeks to establish a strong analytical basis for comprehending the intricacies of different infrastructure funding models and their implementation in the unique socio-economic environments of Ghana and Nigeria.

Financial Theory, when applied to infrastructure funding, is essential for understanding the complexities of funding models. Financial Theory fundamentally offers a structured framework for assessing investment choices, mitigating risks, and determining the most efficient distribution of financial assets. The importance of the Financial Theory is evident in its role in guiding the creation and execution of funding strategies that align with economic sustainability and societal well-being (Kutsenko & Lepokhin, 2022).

The fundamental principles in Financial Theory, including the concept of the time value of money, the relationship between risk and return, and the determination of the cost of capital, serve as the underlying framework for making financial decisions in infrastructure projects. The concept of the time value of money acknowledges that cash flows have a temporal aspect, which affects the assessment of project value and investment evaluation (Velez-Pareja & Tham, 2010). Comprehending the interplay between risk and return is essential for evaluating the feasibility of infrastructure

investments, while the cost of capital establishes the minimum necessary rate of return (Zhang & Li, 2021).

Financial Theory provides valuable insights into determining the most advantageous capital structure for infrastructure projects, taking into account the dynamic relationship between debt and equity. The investigation of this aspect examines the influence of financing decisions on the project's long-term viability, ability to withstand economic fluctuations, and capacity to attract a wide range of funding sources (Zhang & Chen, 2017).

Applying Financial Theory to infrastructure financing entails utilising investment appraisal techniques. These methods encompass discounted cash flow analysis, net present value, and internal rate of return. These tools aid in assessing the financial viability of different funding models and contribute to well-informed decision-making (Sun, 2022).

Infrastructure projects are inherently susceptible to a range of risks, encompassing financial, operational, and geopolitical factors. Financial Theory offers a systematic method for managing risk by helping to identify, evaluate, and reduce risks related to different funding models (Calugareanu, 2020). The discussion encompasses the impact of risk considerations on financial decisions and project outcomes.

Financial Theory is utilised to analyse Public-Private Partnerships (PPPs) in infrastructure funding. This entails examining the financial organisation of Public-Private Partnerships (PPPs), the distribution of risks between public and private entities, and the influence of financial incentives in promoting cooperation (Nwangwu, 2021).

The realm of Financial Theory encompasses the creation of novel financial instruments and methodologies for funding infrastructure projects. This section examines the role of financial innovation in the development of funding models, which enhances the ability to adjust to changing economic environments (AfDB, 2019). The global context of infrastructure financing is used to analyse the applicability of Financial Theory. This analysis examines the adaptation and implementation of

financial principles in different socio-economic settings, highlighting the potential variations in the application of Financial Theory to the specific contexts of Ghana and Nigeria (Kapesa, Mugano & Fourie, 2022).

An essential aspect for thoroughly comprehending the dynamics of alternative infrastructure funding models being examined is the incorporation of Financial Theory. This section explores the relationship between financial principles and the design, implementation, and success of alternative models. It highlights the importance of financial considerations in influencing the effectiveness and long-term viability of these models (Kurakova, 2018).

The Financial Theory focuses on financial principles and their impact on alternative infrastructure funding models, which is important in the study because it will provide a foundation on which the financial dynamics of alternative infrastructure funding models in Nigeria and Ghana will be understood. This study examines the evaluation and application of funding models by different stakeholders in different countries using concepts like time value of money, cost of capital and risk-return trade-offs. For instance, Ghana's issuance of bonds is evidence of the successful application of Financial Theory in the field of capital acquisition and risk management. This situation in Nigeria, where oil is the dominant source of revenue, explains the challenges of achieving adequate capital structure when economic conditions are unstable. The Financial Theory offers critical knowledge towards addressing risk management and evaluation of Public-Private Partnerships (PPP), which is crucial in addressing the infrastructure deficit in Ghana and Nigeria. This study contributed to the more profound knowledge on how financial principles can be applied to design and implement a sustainable infrastructure funding model in emerging economies, having incorporated the Financial Theory.

2.3 Alternative Infrastructure Funding Models

Within the domain of alternative infrastructure funding, the term "model" is closely associated with a unique framework or approach for funding infrastructure projects, which differs from traditional funding methods such as government budgets and taxation. This concept often entails partnerships between the public and private sectors, utilising creative financial tools to obtain funding from various sources, as

articulated by Ruiters and Matji (2016). These alternative infrastructure funding models encompass a wide range of financing approaches, such as Public-Private Partnerships (PPPs), user fees, land value capture mechanisms, crowd-funding, and green finance. Expanding on this comprehension, Beecher (2021) characterises Alternative Infrastructure Funding Models as innovative approaches for funding infrastructure projects that diverge from conventional funding sources. Chen (2016) earlier provided a more comprehensive definition, describing these models as a broad term that includes any approach that involves new ways of obtaining funds, innovative methods of financing, and unique financial agreements in infrastructure development. These models specifically aim to overcome the challenges related to the traditional lack of funding and provide long-lasting solutions for funding infrastructure. This aligns with the findings presented by the World Bank in 2015.

The discussion surrounding alternative approaches for funding infrastructure projects showcases contrasting viewpoints that can be broadly classified as either supportive or sceptical.

Advocates, such as Nafziger and Koo (2015), argue that alternative infrastructure funding models offer numerous benefits. Their ability to draw in private sector investments, exceeding government allocations, is highlighted, with Public-Private Partnerships (PPPs) serving as an illustrative model where private entities collaborate with the government for extensive project development and operation (Nguyen, Hallo & Gunawan, 2023). Others argue that these models improve efficiency, promote innovation, and accelerate project implementation, ultimately leading to improved infrastructure quality and service delivery.

On the other hand, critics, as highlighted by Nguyen, Hallo and Gunawan (2023), express concerns about possible dangers and difficulties associated with alternative funding models. Their main focus revolves around the profit motive of private entities involved, suggesting that financial gains may take precedence over public welfare, resulting in higher costs for end-users and limited accessibility in essential services such as water and transportation. These sceptics also express reservations regarding the complex arrangement of agreements, possible conflicts of interest, and the crucial

requirement for rigorous regulation to protect public interests, echoing the views of Hall (2015).

Essentially, the academic definition of alternative infrastructure funding models refers to creative financing methods that differ from the conventional government funding (Badu, Edwards, Owusu-Manu & Brown, 2012). The subsequent discussion demonstrates an exchange of ideas, with advocates emphasising the possible advantages in terms of effectiveness and novelty (Hall, 2015), while critics emphasise the related dangers and difficulties associated with private sector participation in vital public services (Hall, 2015).

2.3.1 Private Public Partnerships (PPP) Financing Model

A Private Public Partnership (PPP) is a funding model that entails public and private sector cooperation in the planning and management of infrastructure developments (Boyfield, 1992). It also refers to a cooperative agreement between the public sector, in this case the government, and private entities that typically involve shared investment, risk, and management responsibilities in infrastructure projects (Xiong, Cheng, Guo & Zhao, 2022). To overcome the difficulties of financing and completing major infrastructure projects, this concept has attracted substantial interest and popularity on a global scale. This scholarly overview will go through the background, advocates, and characteristics of PPPs.

PPPs have existed since the nineteenth century, when the private sector first started to participate in the construction and management of public infrastructure, such as utilities and railroads (Hatem, 2022). Contrarily, the current concept of PPPs was only widely accepted in the 1980s and 1990s, in part because of the need to find innovative ways of funding the growth of public infrastructure in the face of budgetary constraints and increasing infrastructure needs (Merna & Njiru, 2017). PPPs were established as a feasible funding option during this time due to the wave of privatisation and the transition to market-oriented policies.

PPPs involve a contract between the public and private sectors. These contracts are typically formulated as a management contract. In a PPP, the public-sector partner

maintains authority and oversight while the private sector partner is responsible for the asset's design, building, financing, operation, and maintenance (Delmon, 2013). The contractual terms specify the risk distribution, revenue-sharing formulas, performance standards, and dispute resolution procedures. PPPs can take many different shapes depending on the project's nature and the extent of private sector involvement. Some of these examples of standard PPP models include the Build-Operate-Transfer (BOT), Build-Own-Operate-Transfer (BOOT), Design-Build-Finance-Operate (DBFO), and Design-Build-Finance-Maintain (DBFM) models (Delmon, 2013). These models enable more flexible structuring of financial arrangements and risk allocation between the public and private sectors.

Build-Operate-Transfer (BOT): Under the BOT model, a private sector organisation plans, finances, develops, and manages an infrastructure project for a predetermined time period (Feng, Zhang, & Gao, 2015). The project is returned to the public sector after the conclusion of the concession period. Through project income, this paradigm enables the private sector to recuperate its investment (UN ESCAP, 2012). BOT is commonly employed to construct a specific asset rather than an entire network, and is typically completely new or in the early stages of development (although renovation may be required). In a BOT (Build-Operate-Transfer) transaction, the project company or operator typically generates its income by imposing a fee on the utility or government, rather than collecting tariffs from consumers. In jurisdictions that follow the common law system, various initiatives are referred to as concessions, including toll road projects. These projects involve constructing new infrastructure and share several similarities with build-operate-transfer (BOT) arrangements (World Bank, 2022).

Even though BOT is the most common form of this model, other variants of this model exist such as Build-own-operate-transfer (BOOT), Build-Own-Operate (BOO), Build-lease-operate-transfer (BLOT), among others (Turina & Car-Pusic, 2006). In the BOO model, the infrastructure project is financed, designed, built, and operated by the private sector. Throughout the duration of the concession, the private business maintains ownership of the asset and is in charge of its management and upkeep (Bernstein et al., 2016). The BLOT variant ensures a facility is designed, financed, and built on leased public land by a private sector partner. The private-sector partner is in

charge of managing the facility for the duration of the land lease (Kingsley-Omoyibo, 2021). After the lease expires, assets are transferred to the public-sector partner. In the BOOT variant, an infrastructure component may be given to a private company to finance, design, build, and operate (along with the ability to charge users fees) for a predetermined amount of time before being given back to the public-sector partner.

Design-Build-Finance-Maintain (DBFM): The DBFM approach entrusts the private sector with the planning, development, funding, and ongoing maintenance of the infrastructure project. Throughout the concession time, the asset must be maintained by the private enterprise (AfDB, 2017).

Design-Build-Finance-Operate (DBFO): This model involves the private sector taking charge of the infrastructure project's design, construction, financing, and operation. A concession is awarded to the private business so that it may manage the asset and recoup its investment through project profits (Wu & Zhang, 2013).

Build-Transfer-Operate (BTO): In the BTO model, when the infrastructure project is built, the private sector turns over ownership to the public sector. However, a concession agreement requires the private firm to keep the asset operational and maintained for a defined amount of time (UN ESCAP, 2012).

Public-Private Partnerships (PPPs) in Nigeria are now seen as a crucial approach for addressing the infrastructure gap and improving service provision in several industries. PPPs seek to overcome the constraints of public sector funding and management by utilising the efficiency, technological know-how, and financial resources of the private sector. In Nigeria, Public-Private Partnership (PPP) activities encompass several projects, such as transportation infrastructure, power generation, healthcare facilities, and educational institutions. The Nigerian government has implemented comprehensive regulatory structures to supervise PPP deals and guarantee openness and accountability. Significant legislation comprises the Infrastructure Concession Regulatory Commission (ICRC) Act of 2005, which established the ICRC to oversee PPP procedures, and the Public Procurement Act of 2007, which offers directives for the procurement process in PPP projects.

Table 3 below presents a detailed summary of the construction and maintenance of 12 highway corridors as part of the Highway Development and Management Initiative (HDMI) in Nigeria. Every project is funded using a Public-Private Partnership (PPP) framework, with specific information regarding the dates of approval, lengths of concessions, concessionaires, current status, and costs of the projects (ICRC, 2024).

Table 3: Road projects Financed through PPPs in Nigeria

Project Name & Description / Current Status	Funding Model	Approval Date/Duration of Concession	Concessionaire	Status	Value of Concession /Project cost
The Construction & Maintenance of 12 corridors under a highway development and management initiative (HDMI): Route 1: Benin-Asaba 125 km road	PPP	FEC approval on January 19, 2023 for a 25-year Concession Period	Africa Plus consortium	Commercial Close achieved	NGN 87,258,586,463 (US$189,692,579)
The Construction & Maintenance of 12 corridors under a highway development and management initiative (HDMI): Route 2: Abuja - lokoja 195km road	PPP	FEC approval on January 19, 2023 for a 25-year Concession Period	Avia Infrastructure Services Limited AISL	Commercial Close achieved	NGN 134,006,560,000 (US$291,318,609)
The Construction & Maintenance of 12 corridors under a highway development and management initiative (HDMI): Route 4: Onitsha - Owerri - Aba 161.2 km road	PPP	FEC approval on January 19, 2023 for a 25-year Concession Period	Eyimba Economic City Consortium	Commercial Close achieved	NGN 104,410,351,000 (US$226,979,023)

The Construction & Maintenance of 12 corridors under a highway development and management initiative (HDMI): Route 5: Shagamu - Benin 258km road	PPP	FEC approval on January 19, 2023 for a 25-year Concession Period	AFC/Mota Engil Consortium	Commercial Close achieved	NGN 122,271,257,000 (US$265,807,080)
The Construction & Maintenance of 12 corridors under a highway development and management initiative (HDMI): Route 6: Abuja-keffi-Akwanga 175.9km road	PPP	EC approval on January 19, 2023 for a 25-year Concession Period	China Harbour Engineering Company ltd CHEC	Commercial Close achieved	NGN 3,028,612,000 (US$6,583,939)
The Construction & Maintenance of 12 corridors under a highway development and management initiative (HDMI): Route 7A: Kano – Shuari 100km road	PPP	EC approval on January 19, 2023 for a 27-year Concession Period	Dafac Consortium	Commercial Close achieved	NGN 39,135,027,712 (US$85,076,147)
The Construction & Maintenance of 12 corridors under a highway development and management initiative (HDMI): Route 9: Enugu – Port Harcourt 200km road	PPP	FEC approval on January 19, 2023 for a 25-year Concession Period	Eyimba Economic City Consortium	Commercial Close achieved	NGN 157,967,789,000 (US$343,408,237)

The Construction & Maintenance of 12 corridors under a highway development and management initiative (HDMI): Route 11: Lagos – Ota – Abeokuta 80km road	PPP	FEC approval on January 19, 2023 for a 25-year Concession Period	Africa Plus consortium	Commercial Close achieved	NGN 84,456,920,908 (US$183,602,002)
The Construction & Maintenance of 12 corridors under a highway development and management initiative (HDMI): Route 12: Lagos – Badagry – Seme Border 79km road	PPP	FEC approval on January 19, 2023 for a 25-year Concession Period	AFC/Mota Engil Consortium	Commercial Close achieved	NGN 54,175,434,000 (US$117,772,683)

Source: Author's own conceptualisation using data from the ICRC database (2024)

The Benin-Asaba 125 km road (Route 1) has been authorised for a 25-year concession period. The concession has been issued to the Africa Plus consortium, and a commercial closure has been reached. The project is estimated to cost NGN 87,258,586,463 (about US$189,692,579). The Abuja-Lokoja 195 km road (Route 2) is likewise under the management of Avia Infrastructure Services Limited (AISL), which has been approved for a 25-year period. The project cost for this road is NGN 134,006,560,000 (roughly US$291,318,609), according to the ICRC (2024).

Additional notable projects consist of the Onitsha-Owerri-Aba 161.2 km road (Route 4) executed by the Eyimba Economic City Consortium, with a value of NGN 104,410,351,000 (approximately US$226,979,023), and the Shagamu-Benin 258 km road (Route 5) undertaken by the AFC/Mota Engil Consortium, with a cost of NGN 122,271,257,000 (approximately US$265,807,080). The table provides information on the concession specifics and expenses for more routes, including Abuja-Keffi-Akwanga, Kano-Shuari, Enugu-Port Harcourt, Lagos-Ota-Abeokuta, and Lagos-

Badagry-Seme Border. These routes are managed by different consortia, each with their own individual commercial near successes (ICRC, 2024).

Nigeria's utilisation of Public-Private Partnerships (PPPs) in these projects showcases a deliberate approach to bolster infrastructure development, with the goal of enhancing transit networks and fostering economic expansion.

In relation to Ghana, the Public Private Partnership Act 2020 (Act 1039), sometimes referred to as the 'PPP Act', was passed on December 29, 2020. This legislation establishes a systematic framework for agreements between government contracting agencies and private corporations, guaranteeing the delivery of public infrastructure and services. The PPP Act mandates the incorporation of domestic content and the encouragement of technology transfer in applicable projects, thus facilitating the advancement of the nation. Furthermore, it outlines specific protocols for obtaining partnership arrangements and formalising partnership agreements, both of which must adhere to Ghanaian law. Ghana's Ministry of Finance is responsible for implementing this Act (Ghana Ministry of Finance, 2020).

As shown in Table 4, several road infrastructure projects in Ghana have been financed through PPPs, highlighting the practical application of this framework. These projects span various sectors and demonstrate the diversity of PPP models being implemented in the country.

Table 4: Road Infrastructure Projects Financed through PPP in Ghana

Project	Estimated cost	Sector	Type of PPI	Reference
Accra-Takoradi Highway Dualisation	US$600m	Roads	Concession	DFID (2015)
Boankra Inland Port / Eastern Railway Line project	US$900m - 1.5bn	Rail / Inland port	Concession	DFID (2015)
Accra-Tema Motorway Expansion	US$200-350m	Roads	Concession	DFID (2015)

Accra-Kumasi Motorway expansion	US$400m	Roads	Concession	Arterial Toll Roads Company (2015)
Ghana LNG Import Terminal	US$500m	Transport	Greenfield	CEPA (2015)
Volta Lake Transport Corridor Project	N/A	Transport	Other	CEPA (2015)

Source: Author's own conceptualisation from various sources

The table above provides a snapshot of significant Public-Private Infrastructure (PPI) initiatives in Ghana, highlighting their estimated costs, sectors, types of PPI, and references. The Accra-Takoradi Highway Dualisation project, with an estimated cost of US$600 million, and the Accra-Tema Motorway Expansion, valued between US$200-350 million, both fall under the roads sector and are structured as concession agreements, as cited by DFID (2015). Similarly, the Accra-Kumasi Motorway Expansion, a US$400 million project, is also a road concession but referenced by the Arterial Toll Roads Company (2015).

In the rail and inland port sector, the Boankra Inland Port / Eastern Railway Line project stands out with an estimated cost ranging from US$900 million to US$1.5 billion, indicating a substantial investment in multimodal transport infrastructure, as documented by DFID (2015). Additionally, the Ghana LNG Import Terminal, a US$500 million greenfield project in the transport sector, and the Volta Lake Transport Corridor Project, categorised under 'Other,' reflect the diversification of Ghana's infrastructure development initiatives. These projects, referenced by CEPA (2015), underscore the strategic use of various PPI models to address infrastructural needs across different sectors, fostering economic growth and enhancing connectivity within the region.

2.3.2 Crowdfunding

Crowdfunding has emerged as a transformative and revolutionary force in redefining the landscape of project funding, surpassing the limitations of traditional financial structures (Mollick, 2014). Crowdfunding was originally designed to collect small

amounts of money from a large group of people. However, it has evolved significantly and now has various models that can be used in different industries, ranging from the creative arts to infrastructure development (Belleflamme, Lambert, & Schwienbacher, 2019). Crowdfunding is a financing method that involves acquiring modest amounts of money from multiple individuals or organisations (Wati & Winarno, 2018). The inherent appeal of crowdfunding lies in its distinctive ability to democratise the financial realm, allowing a diverse and inclusive group of contributors to actively engage in supporting and bringing various projects to fruition. Crowdfunding's transformative impact not only challenges traditional funding norms but also redefines the fundamental concept of financial participation, promoting a more accessible and participatory approach to supporting projects. Crowdfunding is a complex phenomenon that includes different models, each with its own distinct characteristics and mechanisms (Agrawal, Catalini & Goldfarb, 2015). Out of these models, reward-based crowdfunding is notable for its involvement of contributors who receive non-financial incentives or rewards in return for their support. This model prioritises the exchange of value that goes beyond financial profits, promoting a sense of community and active involvement among supporters. Equity-based crowdfunding, in contrast, provides contributors with a share of ownership in the project, thereby aligning their interests with the project's success and financial results (Agrawal et al., 2015). This model not only portrays backers as individuals who provide financial support but also as individuals who have a personal stake in the project's progress.

Debt-based crowdfunding incorporates a lending aspect into the crowdfunding industry, enabling contributors to offer financial assistance in return for future profits. In this model, backers function as creditors, providing funds with the anticipation of receiving reimbursements within a predetermined timeframe (Ordanini, Miceli, Pizzetti, & Parasuraman, 2011). This financial arrangement presents a methodical form of assistance that fills the space between traditional financing and innovative crowdfunding mechanisms. On the other hand, donation-based crowdfunding relies on selfless contributions from participants motivated by a sense of altruism or a desire to support a particular cause (Ordanini et al., 2011). Donation-based crowdfunding, in contrast to other models, does not entail a monetary gain or ownership share. Instead, a willingness to support a cause they believe in drives participants. The selection of a crowdfunding model is a pivotal choice that is shaped by the characteristics of the

infrastructure project and the anticipated preferences of potential supporters (Gupta, Li, Kärkkäinen & Mukkamala, 2023). Project organisers meticulously evaluate the attributes and objectives of their initiative in order to choose the most appropriate crowdfunding model, ensuring that the project's framework aligns with the preferences and motivations of their target audience (Gupta et al., 2023). Having a sophisticated comprehension of various crowdfunding models and their consequences is crucial for making well-informed choices that increase the likelihood of successfully funding and executing a project.

The crowdfunding industry is significantly influenced by well-known platforms, namely Kickstarter, Indiegogo, and Crowdcube, which are recognised as influential participants (Simons, Kaiser & Vom Brocke, 2019). These platforms have gained significant recognition for their ability to transform the dynamics of fundraising. They provide project creators with user-friendly interfaces to present their proposals and establish connections with potential backers (Simons et al., 2019). Gaining a comprehensive understanding of the complexities of these platforms is crucial, as they play a vital role in driving the crowdfunding ecosystem, especially in the context of infrastructure development. Kickstarter, a leading crowdfunding platform, has gained recognition for its wide array of projects, encompassing both creative endeavours and groundbreaking infrastructure initiatives (Protas & Samsonova, 2022). The interface offers project creators a comprehensive set of tools to clearly express their proposals, integrate multimedia elements, and interact with a worldwide audience. Indiegogo, a notable platform, has positioned itself as a versatile and easily accessible environment for project financing. Indiegogo, with its worldwide influence, allows creators to access a wide network of potential supporters, making it easier for projects that might encounter difficulties in obtaining funding through conventional channels to come to fruition.

Crowdcube has revolutionised the field of crowdfunding by enabling supporters to become shareholders in the projects they back, with a specific emphasis on equity-based crowdfunding. This crowdfunding shift introduces a distinct aspect by aligning the financial interests of backers with the success of infrastructure projects (Du, Bartholomae & Stumpfegger, 2022). Gaining a comprehensive understanding of the unique characteristics and capabilities of these platforms is crucial, as it provides

valuable information to both project creators and backers regarding the various options for involvement and assistance.

Examining the functionality, accessibility, and reputation of these crowdfunding platforms greatly enhances our understanding of how crowdfunding operates in the context of infrastructure development. Every platform has its own distinct advantages, challenges, and user demographics, which impact the strategies used by project organisers to effectively showcase their initiatives and attract the appropriate supporters. With the ongoing evolution of crowdfunding, it is crucial to have a detailed understanding of the role that these platforms play in the crowdfunding ecosystem.

Examining successful examples and detailed analyses of crowdfunding for infrastructure projects reveals captivating stories that emphasise the effectiveness and potential influence of this model. The High Line Park in New York City and the Solar Roadways project are two prominent examples that demonstrate the significant impact crowdfunding can have on infrastructure development (Burtch, Ghose & Wattal, 2013).

The High Line Park serves as a testament to the efficacy of community-led endeavours. The project was originally a raised railway track and was subsequently transformed into a lively urban park with the help of financial contributions obtained through crowdfunding (Falah, 2018). The triumph of the High Line Park campaign highlighted the community's dedication to converting abandoned areas into valuable public resources. The utilisation of effective communication strategies was pivotal in obtaining support, as supporters were motivated by a vision that corresponded with their principles: the establishment of an environmentally friendly sanctuary in the centre of the urban area (Falah, 2018). The transparent allocation of funds further strengthened trust, guaranteeing that supporters were fully informed of how their donations directly contributed to the park's progress.

The Solar Roadways project exemplifies the power of crowdfunding in promoting cutting-edge and environmentally friendly infrastructure solutions. The objective of this initiative was to substitute conventional road surfaces with solar panels that have the ability to produce sustainable energy. Supporters were attracted to the project's dedication to sustainability and its capacity to tackle energy difficulties. The triumph of the Solar Roadways campaign showcases the significance of infrastructure initiatives

that coincide with supporters' principles and contribute to wider societal and environmental objectives.

In 2017, a consortium of Nigerian individuals successfully mobilised a substantial sum of US$1.2 million to finance the construction of a solar-powered water pump in a remote rural community within the borders of Nigeria. The project received financial backing via the crowdfunding platform, Crowdfund.ng. In 2018, a collective of Nigerian individuals successfully gathered a sum of US$200,000 for the purpose of constructing a communal library in Lagos. The project was financed via the crowdfunding platform, GoFundMe. In 2019, a consortium of Nigerian individuals successfully gathered a sum of US$500,000 to construct a communal recreational area in Abuja. The project received financial support via the crowdfunding platform, Fundly (Ogun, 2023). Cofundie, a crowdfunding platform in Ghana, has recently initiated its inaugural project. The project involves crowdfunding for the initial stage of a housing development consisting of 20 units. This endeavour is being carried out in collaboration with Appolonia City, which is Ghana's leading urban developer. The fund is also aiming to construct 100 residential units, consisting of one, two, and three bedrooms, using polystyrene panels for the construction. These dwellings are priced at a range of between US$21,000 and US$45,000, which is 20% lower than similar units constructed with conventional materials (Jackson, 2021).

Examining these instances of success uncovers shared elements that enhance the efficacy of fundraising efforts for infrastructure. Effective communication is crucial, as it engages supporters by expressing a shared vision through clear and captivating storytelling. Ensuring complete transparency in the utilisation of funds is of utmost importance, as it promotes trust and accountability. Furthermore, when projects are in line with the values of their supporters, it cultivates a sense of common purpose, promoting a community-oriented mindset.

Although these success stories offer valuable insights, it is important to recognise that the suitability of crowdfunding models may differ in various socio-economic and cultural contexts. The outcomes can be influenced by various factors, including the characteristics of the infrastructure project, the regulatory environment at the local level, and the extent of community engagement. An extensive analysis of success stories and case studies not only provides inspiration but also helps to comprehend

the intricate dynamics that contribute to the success of crowdfunding in infrastructure development.

Although crowdfunding has its advantages, it is not exempt from challenges that require careful attention (Ordanini et al., 2011). Although crowdfunding has the potential to revolutionise financial support and facilitate a wide variety of projects, it is crucial to recognise and resolve the significant challenges that could hinder its smooth integration into the development of infrastructure.

An important obstacle related to crowdfunding for infrastructure projects pertains to matters of accountability (Babayoff & Shehory, 2022). Crowdfunding differs from traditional funding models by involving a diverse group of contributors rather than relying on centralised financial accountability. Establishing and maintaining accountability mechanisms in a decentralised funding environment raises questions about how to effectively manage funds transparently and efficiently. This challenge highlights the importance of strong governance systems and effective communication strategies to build trust among supporters regarding the responsible utilisation of funds.

Risk is a notable issue in crowdfunding for infrastructure initiatives (Babayoff & Shehory, 2022). Crowdfunding, with its decentralised nature, introduces a distinct dynamic compared to traditional funding models that typically involve thorough risk assessments and management strategies. Contributors may encounter uncertainties pertaining to the project's viability, punctual finalisation, or unanticipated hindrances. Project organisers must effectively communicate risk mitigation strategies and inspire confidence in backers. Gaining a comprehensive understanding of the distinct risk environment associated with crowdfunding in the realm of infrastructure development is crucial for establishing confidence and promoting long-term project backing.

The inclusion of concerns related to project completion introduces an additional level of intricacy to the process of crowdfunding for infrastructure projects (Jovanović, Mosurović & Berić, 2020). Under traditional funding models, stakeholders commonly conduct thorough due diligence prior to investing funds, ensuring that their expectations are in line with established project timelines. When participating in a crowdfunding campaign, it is essential to ensure that backers with different levels of

expertise are well-informed about potential challenges and milestones. Navigating the delicate balance between transparency and preserving backer confidence amidst project uncertainties necessitates cautious manoeuvring.

The decentralised nature of crowdfunding presents intricacies that are approached differently by traditional funding models (Babayoff & Shehory, 2022). Decentralised crowdfunding involves the distribution of decision-making, communication, and risk-sharing among a diverse set of backers. The shift away from centralised decision-making structures may result in difficulties in coordinating actions, aligning goals, and managing conflicting interests. Recognising and managing these intricacies is essential for capitalising on the advantages of crowdfunding while minimising its inherent difficulties.

Although crowdfunding has the potential to greatly change how infrastructure projects are funded, it is important to recognise and tackle challenges related to accountability, risk, and project completion. This is necessary to ensure that crowdfunding is effectively and sustainably integrated into the larger context of infrastructure development. This acknowledgement creates opportunities for formulating strategies, governance frameworks, and communication approaches specifically designed to address the distinct dynamics of crowdfunding in the context of infrastructure projects.

Mastering the legal terrain is crucial for achieving success in crowdfunding. Diverse regulatory frameworks in various jurisdictions have an impact on crowdfunding (Dushnitsky & Zunino, 2019). Comprehending the intricate legal subtleties in Ghana and Nigeria is essential for assessing the viability of utilising crowdfunding for road infrastructure projects.

An in-depth analysis of crowdfunding and traditional funding models reveals subtle differences in their individual advantages and disadvantages, providing insight into the complex realm of infrastructure funding. Conventional models, primarily supported by government funding, possess inherent stability and well-established structures. Exploring the world of crowdfunding goes beyond simple financial transactions. Crowdfunding can promote community involvement and inclusivity in infrastructure development projects (Mollick, 2014).

Government funding, which is distinguished by a centralised process of decision-making and allocation of resources, offers a reliable and foreseeable means of financial assistance (Karahan, Razzolini & Shughart II, 2002). Stability is crucial for carrying out extensive infrastructure projects that have long-lasting consequences, guaranteeing a consistent emphasis on national development priorities. Private investments, motivated by profit, contribute to the financial strength of projects by utilising the knowledge and resources of private entities. Nevertheless, these models occasionally lack the inclusiveness and community engagement that are characteristic of crowdfunding, which in contrast, adds a participatory element to the financing of infrastructure. Crowdfunding provides a platform for a wide range of individuals and communities to contribute to projects that they consider significant or advantageous (Simons et al., 2019). Crowdfunding's democratising effect enables citizens to actively participate in shaping the development landscape, fostering a sense of ownership and connection to the projects they choose to support. Participating in this collective involvement not only increases the project's visibility but also fosters joint accountability for achieving successful results.

Analysing this comparative terrain within the framework of Ghana and Nigeria introduces an extra level of intricacy. These countries, characterised by distinct socio-economic dynamics, infrastructure requirements, and governance frameworks, influence the interaction between traditional and crowdfunding models. Government funding may be more closely aligned with established institutional frameworks, which can provide stability but may also limit community engagement. However, crowdfunding, with its focus on community involvement, can provide opportunities for localised solutions and grassroots engagement, addressing issues related to inclusivity and social impact. It is crucial to comprehend the subtle distinctions of this comparison within the unique dynamics of Ghana and Nigeria. These nations have similarities but also have specific contextual factors that impact the effectiveness of various funding models. Government priorities, regulatory environments, and the socioeconomic landscape influence the ideal balance between traditional and crowdfunding approaches.

An essential aspect of understanding the complex nature of crowdfunding initiatives is the analysis of stakeholder perspectives, which includes the viewpoints of project

initiators, backers, and the general public (Burtch et al., 2013). An extensive investigation is necessary to assess the reception and potential adoption of crowdfunding in Ghana and Nigeria, as these diverse perspectives significantly impact the success and sustainability of such ventures within the specific socio-economic contexts of these countries (Domínguez, Lagares & Garrido, 2020).

Project initiators, who are frequently the main catalysts behind crowdfunding campaigns, have a crucial influence on determining the success of initiatives. Their viewpoints encompass the reasons, difficulties, and anticipations linked to employing crowdfunding as an alternative financial model for infrastructure projects. Gaining comprehension of their experiences offers valuable insights into the intricacies of campaign planning, communication strategies, and the challenges faced during the funding process.

Backers, who comprise the group of individuals who invest in crowdfunding campaigns, contribute both financially and ideologically. Their viewpoints shed light on the factors that influence their decision to endorse a specific project. Key factors to consider include the perceived societal impact, alignment with personal values, and the transparency of the initiative's goals and budget allocations. Examining the viewpoints of supporters is essential for gaining a valuable understanding of the underlying motivations behind crowdfunding backing and the anticipated project results they hold.

The general public, as a wider group of people with an interest in a particular matter, has a substantial influence on determining the overall perception and acceptance of crowdfunding initiatives. Their viewpoints encompass a broad range of attitudes, spanning from curiosity and enthusiasm to scepticism and concern. Gaining insight into the public's perception of crowdfunding for infrastructure projects is crucial for predicting potential obstacles, mobilising broad-based backing, and effectively addressing any concerns that may arise. In the particular context of Ghana and Nigeria, the viewpoints of stakeholders become more important because of the distinct socio-economic environments of these countries. The acceptance or opposition towards crowdfunding can be greatly influenced by cultural subtleties, regulatory structures, and pre-existing attitudes towards financial innovation. Hence, conducting a comprehensive analysis of stakeholder viewpoints is not merely an intellectual

pursuit but a crucial requirement for customising crowdfunding endeavours to harmonise with the varied expectations and requirements of stakeholders in these areas.

This research seeks to enhance the comprehension of crowdfunding dynamics by exploring the various viewpoints of stakeholders. The ultimate goal is to develop strategic recommendations that align with the complex nature of Ghanaian and Nigerian societies. This study adds to the wider scholarly conversation on different ways to fund infrastructure by providing a focused perspective that improves the usefulness and efficiency of crowdfunding in the specific conditions of these West African countries. Crowdfunding, as an innovative financial model, has the potential to significantly contribute to sustainable development goals, specifically in terms of fostering community involvement and addressing environmental concerns (Mollick, 2014). An analysis of these contributions is crucial in assessing the overall influence of crowdfunding on the field of infrastructure development.

Crowdfunding's ability to promote community involvement is a significant aspect of its potential impact on sustainable development. Crowdfunding inherently entails a collaborative endeavour, garnering support from a wide range of backers who possess a common interest in the achievement of a specific project. Within the framework of infrastructure development, this communal engagement goes beyond mere financial donations; it fosters a feeling of collective accountability and empowerment among community constituents. Examining the degree to which crowdfunding initiatives improve community involvement is essential for comprehending how this alternative funding model can stimulate social unity and participatory development processes. Moreover, crowdfunding has the capacity to be in line with environmental considerations that are essential to achieving sustainable development goals. Crowdfunding-supported infrastructure projects may give priority to environmentally friendly practices, renewable energy solutions, and sustainable urban planning. This research seeks to analyse the environmental aspects of infrastructure initiatives funded through crowdfunding. Its objective is to determine the extent to which these projects contribute to larger sustainability objectives, including environmental preservation, resilience to climate change, and the advancement of environmentally-friendly technologies.

Examining crowdfunding within the framework of sustainable development extends beyond its immediate financial dimensions. Gaining insight into the intersection of crowdfunding and sustainable development goals offers a nuanced viewpoint on its potential to promote comprehensive, long-lasting, and socially accountable infrastructure development.

To sum up, crowdfunding is an innovative funding model that has the potential to be used in infrastructure development. This study lays the groundwork for a comparative examination of crowdfunding in Ghana and Nigeria, incorporating theoretical perspectives and contextual factors.

2.3.3 Project Finance

Project finance has its roots in ancient times, but its modern manifestation emerged during the latter part of the 20th century. Project financing can be traced back to historical instances like merchant adventurers in the Middle Ages who invested in voyages and the British Crown financing silver mines through non-recourse financing during the same period (De Nahlik & Fabozzi, 2021; Müllner, 2017). Over the centuries, project finance has developed into an approach of bringing together a group of investors, lenders, and other participants to carry out infrastructure projects that would be too big for any single participant (Changoo, 2015). The contemporary iteration of project finance, characterised by a non-recourse or limited recourse financing framework, arose as a crucial means of directing private capital towards infrastructure projects, especially in developing countries, during the latter part of the 20th century (De Nahlik & Fabozzi, 2021; Fight, 2005). The term "project finance" is commonly used to refer to various financing arrangements and is, in fact, an approach to funding that has been in use for centuries, predating corporate finance. Nevertheless, the technique has regained attention due to the rapid expansion of privately funded infrastructure projects in developing countries (Changoo, 2015). Project finance structures have played a significant role in facilitating various projects in recent times. One notable example is in the late 1990s when it emerged as a crucial means of directing private capital into infrastructure ventures in developing countries. The enduring prevalence of this phenomenon persists, regardless of changes in credit market conditions, variations in construction contract terms, and shifts in the types of

projects assigned to the private sector. This model has also become increasingly important as a main funding mechanism for non-infrastructure investments worldwide.

Before the introduction of project finance, companies depended on the financial stability of their balance sheets to carry out projects. The conventional method entailed funding new ventures through the sale of company-level shares, retained earnings, or the issuance of company debt (Nazara, Sambodo, Hertina, Munizu & Bakri, 2023). Nevertheless, this approach carried a significant peril, as any substantial undertaking had the capacity to endanger the entire organisation. The implementation of the project finance model brought about a significant change in this approach, allowing companies to isolate their risk exposure to specific projects, thereby safeguarding their overall financial position. This innovation enabled established companies to expand their investments in new activities or locations while reducing the risk of disastrous failure.

The project finance model gained popularity among emerging, smaller, and innovative developers who had the necessary technical, financial, and managerial expertise (Josephine, Gautami, & Thillai, 2009). In infrastructure transactions that adhere to the project finance model, developers or governments take the lead in initiating and outlining a project that is well-suited for private sector involvement. The developer who is interested in the project organises it in a way that protects its financial situation from unlimited risk, with a specific emphasis on ensuring the project can sustain itself independently. This requires generating enough monthly revenues to cover operational expenses and generate profits, ensuring the long-term sustainability of the project (Amoa-Gyarteng, 2015).

To mitigate the possible drawbacks, project finance initiatives are commonly carried out through a "special purpose vehicle" (SPV) that is specifically created for the project's purposes. This framework provides protection against uncertainties and, in the event of failure, restricts the use of the funds allocated to that particular project (Penrose, 1996). According to Halland, Beardsworth, Land, and Schmidt (2014), the project finance model differs significantly from the traditional resource development model in terms of its development and production phases. Contrary to resource projects that need a large amount of initial capital, the project finance model usually

requires a smaller upfront investment, provided that a suitable project is identified, the necessary documentation is developed, and a viable financial model is created (Penrose, 1996).

Figure 4 illustrates the structure of the project finance model, highlighting its unique features and phases as described by Halland et al. (2014).

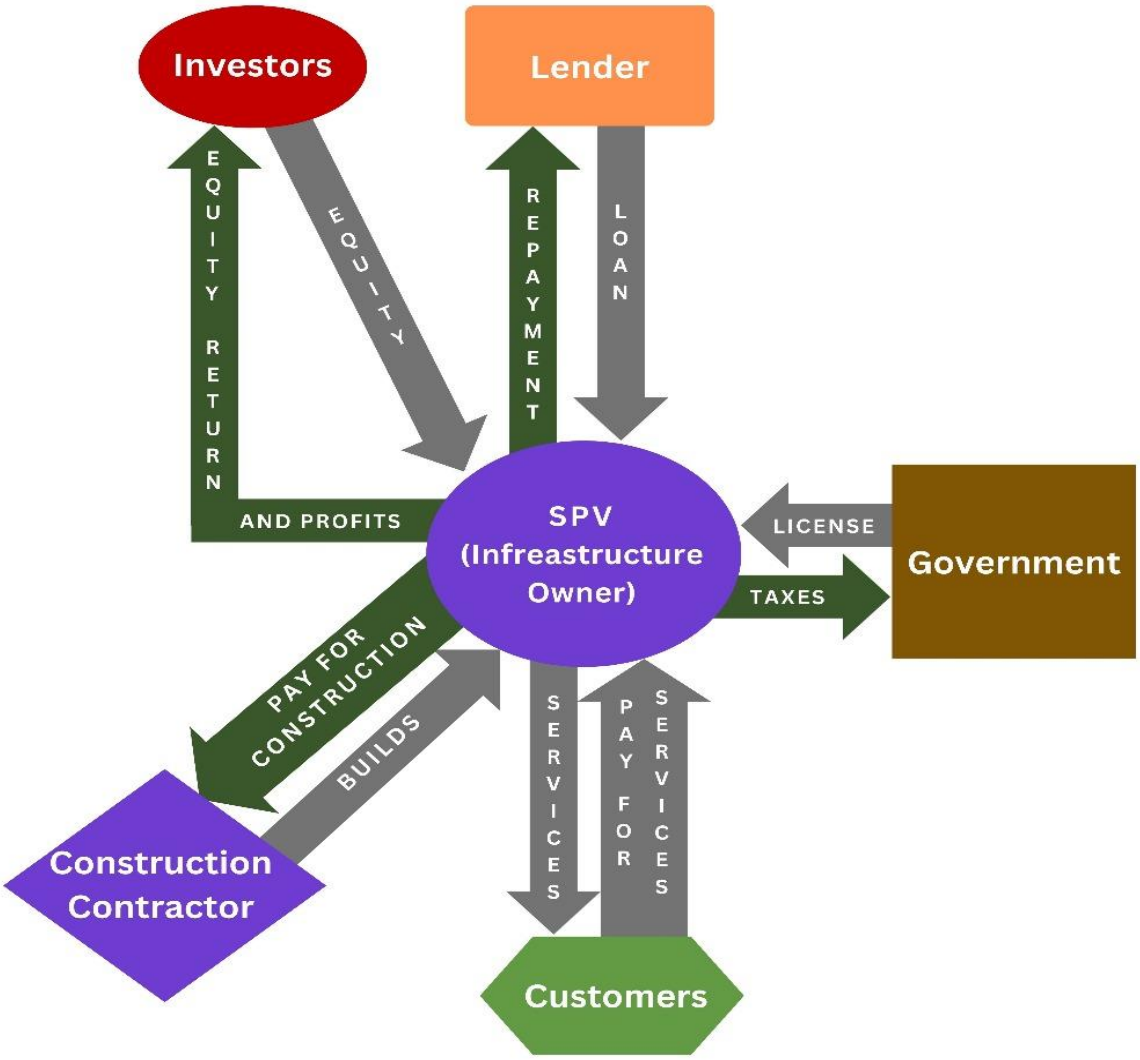

Figure 4: Project Finance Model

Source: Halland et al. (2014)

The government's main role in project finance transactions is to authorise essential licences and support the development and operation of the project. In certain cases, the government may also serve as the entity responsible for issuing tenders, especially

when a state-owned enterprise is the only recipient of the project. When the party responsible for paying for a project is not considered financially reliable, it may be necessary to have a government guarantee in order to secure funding for the project (Halland et al., 2014). In contrast to the resource development model, project finance outputs are frequently used within the country where they are produced (Halland et al., 2014). The model's attractiveness in developing infrastructure without direct fiscal impact is underscored by concerns about affordability as well as the government's dependence on income taxes and potential resource royalties (Halland et al., 2014). Tax holidays and concessional financing are frequently used methods to guarantee continuous funding for operations and maintenance, thereby enhancing public access to vital services (Penrose, 1996).

Furthermore, project finance offers advantages that go beyond financial considerations for governments. The ownership of infrastructure projects by the private sector provides motivation for continuous payments for operations and maintenance throughout the investment life cycle of the project (Dixon, 1991). In order to make services or products from the Special Purpose Vehicle (SPV) more affordable, governments frequently implement tax holidays or offer concessional financing. This is done with the intention of reducing the financial burden on citizens, particularly during the early years when they have high levels of debt to repay (Penrose, 1996).

Unlike the resource development model, which typically involves selling production in global markets, the project finance model often focuses on utilising outputs domestically (Halland et al., 2014). The government's emphasis on domestic matters prioritises the importance of product pricing, as affordability becomes a primary concern that is in line with citizens' willingness to pay for essential services (Penrose, 1996). Corporate income taxes are the main sources of revenue for the government in a private sector project finance transaction. If the project includes a resource element, such as coal-fired power plants located near mines or gas-turbine power plants powered by locally obtained natural gas, the government may also receive royalties from these resources (Halland et al., 2014).

The appeal of project finance stems from its financial feasibility and its capacity to support infrastructure development without exhausting government resources. This

model establishes a system of incentives that promotes a mutually beneficial relationship between developers in the private sector and governments. The private sector acquires a practical platform for investment, while the government accomplishes infrastructure expansion without assuming direct financial risk. This model is a long-lasting and effective way to encourage the growth of sustainable infrastructure in both developing and developed economies (Amoa-Gyarteng, 2015). It does this by using a cooperative approach and reducing risk in project financing.

Ultimately, the project finance model has emerged as a powerful and influential factor in infrastructure financing, providing a strategic and enduring alternative to traditional funding methods. The ability to attract private capital, protect balance sheets from excessive risks, and align incentives for continuous project support has established it as a crucial contributor to infrastructure development on a global scale. As Ghana and Nigeria face the difficulties of upgrading their infrastructure, comprehending the intricacies and dynamics of project finance offers a valuable guide for utilising private investment and guaranteeing the enduring prosperity of crucial projects.

2.3.4 Resource Financed Infrastructure (RFI)

The development of infrastructure in economically disadvantaged countries with abundant natural resources has led to the emergence of a unique financing model called ‘Angola mode’ transactions or ‘Resource-Financed Infrastructure’ (RFI). The RFI model, which has its roots in long-standing models used by governments and private entities, addresses deficiencies found in traditional funding structures (Halland et al., 2014). The historical origins of this concept can be traced back to the mid-nineteenth century, when Peru used substantial guano deposits as collateral for borrowing (Vizcarra, 2009). RFI has become widespread in resource-rich countries throughout sub-Saharan Africa, Latin America, and other regions, thanks to loans provided by state-owned development banks and commercial entities (Rivetti, 2021).

In addition, the term ‘Angola-mode deals’ originated in the 1980s to describe the distinctive characteristics of transactions associated with resource-backed lending. In recent times, Angola was the first to introduce this model in the mid-90s, using future petroleum revenues as guarantees (Brautigam, 2011). In the 2000s, the China Exim

Bank reinforced this strategy by providing comparable loans to Angola (Brautigam, 2011). The uniqueness of Angola-mode deals is emphasised by the lender making direct payments to construction companies, bypassing the government and reducing the likelihood of corruption (Ogwang & Vanclay, 2021). The historical path of RFI highlights its lasting impact, originating from past practices and demonstrating its current importance in transforming infrastructure funding.

This novel funding model establishes a strategic correlation between resource development and infrastructure creation, deviating from traditional approaches. The government grants resource development licences to private entities, establishing a symbiotic relationship. This relationship leverages infrastructure assets and is facilitated by a financing mechanism that is intricately tied to ongoing resource-related activities (Halland et al., 2014). The central element of this arrangement is the granting of a resource development licence, which authorises entities to investigate, exploit, and potentially retrieve valuable resources. Concurrently, the government engages in negotiations to establish a funding system that is connected to projected income generated from resource-related activities. This ensures that the development of infrastructure is in line with the progress of resource extraction efforts (Halland et al., 2014).

Figure 5 provides a visual representation of the resource development model, illustrating the symbiotic relationship between resource extraction and infrastructure funding as described by Halland et al. (2014).

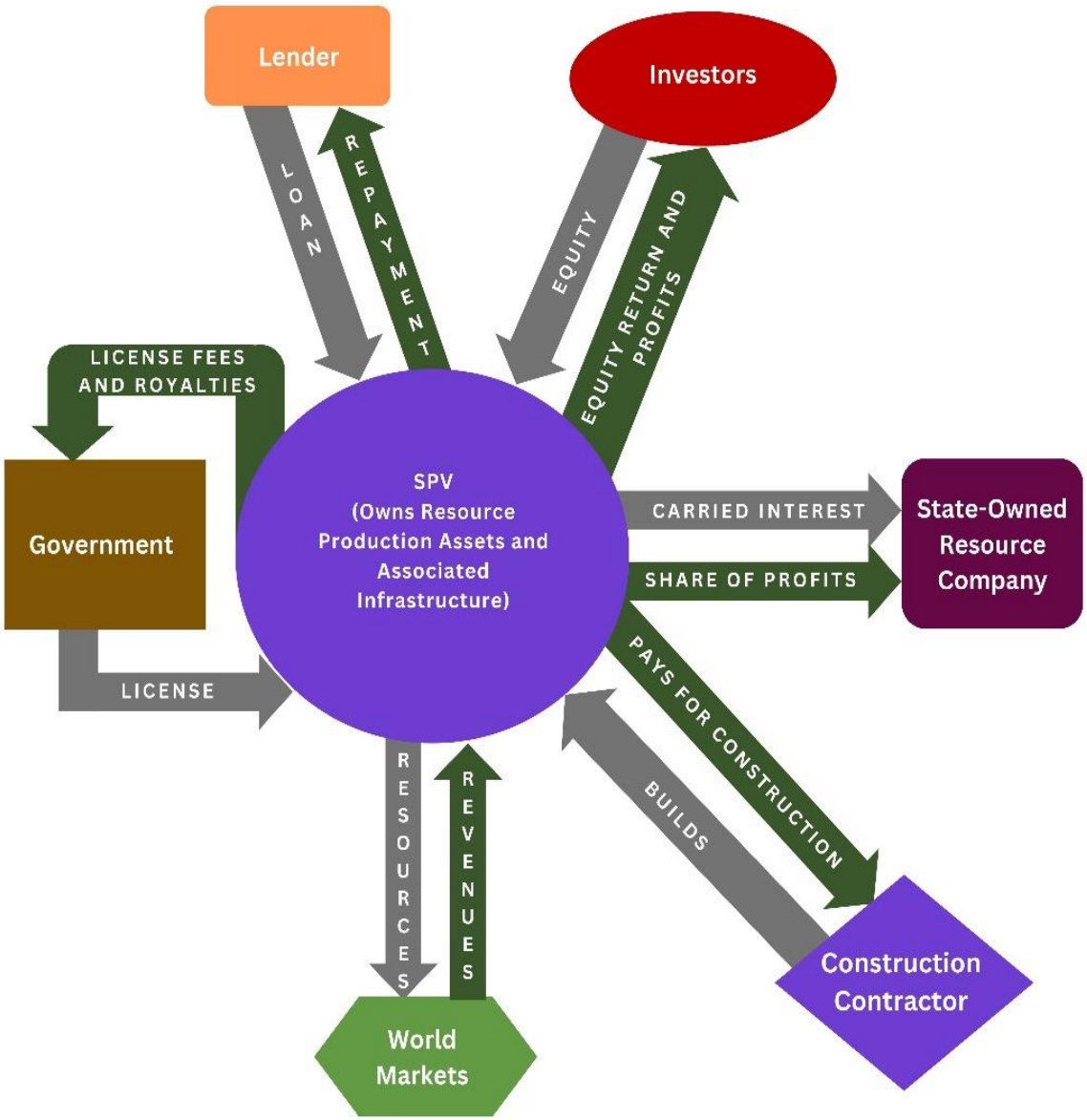

Figure 5: Resource Development Model

Source: Halland et al. (2014)

The RFI model surpasses the conventional division between resource exploitation and infrastructure development by creating a mutually advantageous connection. The model integrates financial profits derived from resource activities, simplifying the process of funding and harmonising the interests of both public and private stakeholders. This promotes a cooperative approach to achieving sustainable economic development. While RFI offers numerous benefits, it is not exempt from certain difficulties, such as the possibility of substantial infrastructure expenses and

the political uncertainties linked to making long-term investments in politically volatile developing nations (Halland et al., 2014).

In her work, Catalina (2009) highlights the intricate relationship between national governments, state-owned companies in the natural resource sector, and the financial mechanisms used in RFI transactions. Collateral arrangements in the RFI domain include the receivables from resource sales, pre-payment for resource sales, access to resource development, and direct collateral for resources. These supplementary methods guarantee the stability of RFI transactions by incorporating fixed interest rates and repayment mechanisms that are synchronised with the dynamics of the commodity market (Catalina, 2009).

Turning to particular case studies, the implementation of RFI has taken place in Ghana. In this context, resource-for-infrastructure agreements entail the provision of natural resources as a means of repaying loans specifically designated for developing infrastructure. RFI transactions in Ghana exemplify this funding model's adaptable and transformative nature, particularly in relation to infrastructure resources. The 2007 agreement between Ghana and China resulted in the establishment of the Bui Dam, with the proceeds from cocoa sales being used to repay the debt (Konijn, 2014). In 2017, China and Ghana made a significant $10 billion agreement termed the Sinohydro. This deal involved China's involvement in Ghana's integrated bauxite-aluminium industry development and substantial investments in infrastructure, including schools, hospitals, road expansions, and railway lines (Oxford Business Group, 2018).

Table 5 provides a detailed breakdown of Chinese RFI loans to Ghana, highlighting specific infrastructure projects funded under the Sinohydro agreement. These projects include road constructions and upgrades across various regions, with allocations and lenders clearly outlined.

Table 5: Chinese RFI Loans to Ghana (US$)

No.	Project	Year	Lender	US$ Allocation
1	Accra Inner City Roads 84 km	2018	Sinohydro Ltd.	$79.9M
2	Kumasi Inner City Roads 100 km	2018	Sinohydro Ltd.	$80.8M
3	Tamale Interchange Project	2018	Sinohydro Ltd.	$39.1M
4	PTC Roundabout Interchange Project, Takoradi	2018	Sinohydro Ltd.	$57.8M
5	Adenta-Dodowa Dual Carriageway 14 km	2018	Sinohydro Ltd.	$71.4M
6	Sunyani Inner City Roads 39 km	2018	Sinohydro Ltd.	$49.3M
7	Western Region and Cape Coast Inner City Roads 32.19 km	2018	Sinohydro Ltd.	$40.0M
8	Upgrading of Selected Feeder Roads in Ashanti and Western Regions 68 km	2018	Sinohydro Ltd.	$45.0M
9	Rehabilitation of Oda-Ofoase-Abirem Road 38 km	2018	Sinohydro Ltd.	$34.0M
10	Hohoe-Jasikan-Dodi Pepesu Road 66.4 km	2018	Sinohydro Ltd.	$49.3M

Source: *Author's own conceptualisation using data from the Boston University Global Development Policy Center (GDPC), Chinese Loans to Africa database (GDPC, 2023)*

This collaboration demonstrates the adaptability of the RFI model in effectively meeting various development requirements in the infrastructure sector. Sinohydro plays a crucial role in the implementation of RFI in Ghana, actively contributing to the advancement of diverse infrastructure projects. The Memorandum of Understanding signed under the Belt and Road Initiative established Sinohydro's investment of US$2

billion in infrastructure development. In exchange, Sinohydro will receive refined bauxite for 15 years, as stated in the Master Project Support Agreement (MPSA) of 2018. The government has committed to financing the entire Engineering, Procurement, and Construction (EPC) contract using the funds generated from the sale of refined bauxite. This creates a distinctive connection between the extraction of resources and the funding of infrastructure projects (Republic of Ghana Ministry of Finance, 2020). Although similar to the Angola Model, this partnership also sparked discussions and difficulties, specifically in handling the instability of oil prices and ensuring economic stability (Aidoo et al., 2017).

In Nigeria, while loans from China have funded transport infrastructure projects, none of these projects are classified as RFI. The loans provided for the transport sector encompass various projects, including the modernisation of railways, the development of light rail systems, the expansion of airports, and the rehabilitation of roads (Boston University GDPC, 2023). The lack of a specific RFI designation in Nigeria demonstrates the intricate implementation of this funding model in various contexts. Although not officially labelled as RFIs, these loans highlight the flexibility of funding structures in meeting specific infrastructure requirements in various situations.

Essentially, "Angola mode" transactions demonstrate a pioneering strategy that showcases a creative collaboration between resource development and infrastructure funding. This model reflects the effectiveness of customised solutions that address the specific difficulties encountered by countries with abundant resources but limited economic means. It highlights the significant impact that RFI (Resource Financing Initiative) can have in revolutionising traditional approaches to funding infrastructure projects.

The RFI transactions display a complex interaction involving central governments, state-owned natural resource enterprises, and ways of funding (Catalina, 2009). The various collateral arrangements in the RFI domain, such as resource sales receivables, resource sales pre-payment, resource development access, and direct resource collateral, emphasise this financing model's complex and adaptable nature (Catalina, 2009). Resource sales receivables are the most common type of collateral arrangement in RFI transactions. This arrangement requires the obligation to sell

predetermined quantities of natural resources (measured in barrels per day, tonnes or an agreed-upon measuring unit) to assigned buyers. The buyers' financial obligations, in return for the natural resources, are directed towards the lender's advantage. This can happen either directly or through a deposit account owned by the borrower, where the lender has the authority to withdraw funds if the borrower fails to repay the loan (Catalina, 2009). Resource Sales Pre-Payments (SPP) are upfront payments made in anticipation of purchasing resources (Catalina, 2009). They are commonly used by commodities traders who acquire natural resources. Simultaneously, access to resource development combines the expected profits from granting mineral development rights to an investor with the structure for repaying the loan. Referred to as "resource-for-infrastructure" or "barter deals," these arrangements demonstrate the mutually beneficial connection between resource development and infrastructure financing. Another alternative method is the utilisation of direct resource collateral, which entails pledging untapped resources that are still located underground, commonly in the form of mineral or oil deposits. These supplementary methods enhance the stability and flexibility of RFI transactions, in line with the ever-changing conditions of the commodity market.

To summarise, the "Angola mode" transactions or Resource Financed Infrastructure (RFI) exemplify an innovative approach that goes beyond traditional limits in infrastructure funding. The successful combination of resource development and infrastructure creation, as exemplified by case studies in Ghana and Nigeria, illustrates the profound impact of RFI in reforming traditional approaches to funding infrastructure. The flexible and sophisticated implementation of this model in various situations highlights its significance and efficiency in tackling the distinct difficulties encountered by countries that have abundant resources but limited economic resources. Continued analysis and investigation of RFI will enhance our comprehension of its consequences and potential improvements in the changing field of infrastructure development

2.3.5 Green Finance

Green finance is a potent solution to the interconnected problems of infrastructure development and environmental sustainability. It provides an alternative funding

approach to meet Ghana and Nigeria's crucial infrastructure requirements while facilitating their shift towards a sustainable future.

Traditional infrastructure models frequently result in significant damage to the environment. Green finance facilitates a significant change by giving priority to environmental sustainability in infrastructure projects. By directing investments towards energy-efficient technologies, renewable energy sources, and climate-resilient infrastructure, it promotes economic growth, job creation, enhanced public health, and long-term environmental advantages (UNEP, 2023). According to the World Economic Forum (2020), this model includes a wide range of financial instruments and frameworks created specifically to support initiatives and projects that are environmentally friendly. It promotes sustainable development by directing funds towards investments that prioritise environmental well-being, including waste management and renewable energy sources (World Economic Forum, 2020). Financial instruments such as green bonds, climate funds, and loans offer opportunities for funding environmentally friendly projects, mitigating the effects of climate change, and encouraging the adoption of cleaner development strategies (Lindenberg, 2014).

A green finance arsenal is designed to meet the specific requirements of projects and provide distinct benefits. Green bonds, such as those mentioned by the Climate Bonds Initiative in 2023, generate funds for environmentally friendly initiatives and offer stable returns on investment that are in line with environmental goals. Climate-aligned funds allocate resources to finance climate-resilient projects in different sectors, such as infrastructure (Zimmerman, Brenner, & Llopis Abella, 2019). Carbon credits generate income for environmentally friendly initiatives employing exchangeable licences contingent upon reductions in emissions (Jennifer, 2023). Public-private partnerships (PPPs) are collaborative arrangements that bring together the public and private sectors to jointly finance and implement projects related to the development of green infrastructure (Shamanina, 2021).

Green finance facilitates various advantages for infrastructure development, thereby creating a pathway towards a sustainable future. Investments in clean technologies and climate-resilient infrastructure reduce carbon footprints, conserve resources, and mitigate pollution (Zhao & Li, 2024). According to the OECD (2012), it promotes

economic expansion through the creation of employment opportunities, stimulating advancements in environmentally friendly technology, and drawing in sustainable financial investments. Additionally, it strengthens the durability of infrastructure by enhancing its ability to withstand the effects of climate change and reinforcing its readiness for disasters (Zhao & Li, 2024).

Both Ghana and Nigeria have significant infrastructure requirements, specifically in the areas of upgrading and expanding road networks to enhance regional trade and overall transportation efficiency. Nevertheless, the presence of financing mechanisms such as constrained public budgets, insufficient involvement of the private sector, and reliance on unpredictable foreign direct investment present notable obstacles (World Bank, n.d.). Moreover, Ghana is struggling with a significant amount of public debt and has limited access to domestic capital markets. On the other hand, Nigeria is dealing with challenges such as corruption, security issues, and heavy reliance on oil revenues (Owusu & Nursey-Bray, 2018; Ilori & Akinwunmi, 2020).

Green finance is a promising solution that can help overcome these challenges and drive the development of sustainable infrastructure. It facilitates access to additional funds by appealing to global investors who are interested in making sustainable investments (Rose, 2020). It promotes increased involvement of the private sector by utilising Public-Private Partnership (PPP) models that include risk-sharing mechanisms and specialised knowledge (Shamanina, 2021). Green bonds, due to their appealing investment returns, facilitate the allocation of resources towards projects that have positive environmental impacts (Rose, 2020).

Table 6 provides a list of bonds issued by Ghana and Nigeria, showcasing the use of green finance instruments such as green bonds to fund sustainable infrastructure projects.

Table 6: List of Bonds Issued by Ghana and Nigeria

Issuer	Date Issued	Currency	Amount	Type	Reference
Ghana	March 2021	USD	3.025 billion	Euro Bond	Ghana Ministry of Finance (2021)
Nigeria	December 2017	NGN	10.69 billion	Green Bond	Adeojo (2022)
Nigeria	June 2019	NGN	15 billion	Green Bond	Adeojo (2022)

Source: *Author's own conceptualisation*

Nigeria has successfully entered the green bond market, representing a noteworthy achievement in sustainable financial endeavours. In 2020, Ghana began its venture into issuing sovereign green bonds, but could not carry it out. However, Nigeria successfully issued its first green bond in 2017, indicating a growing interest in investments that prioritise the environment. This initial achievement not only highlights the increasing demand for environmentally friendly investments but also establishes the basis for future offerings, which may be designated for particular road projects (Climate Bonds Initiative, 2023).

The issuance of two green bonds in Nigeria is noteworthy. The initial launch, which took place in December 2017, raised a total of NGN 10.69 billion. The subsequent issuance, which occurred in June 2019, reached a value of NGN 15 billion. The initial issuance of the green bond experienced a subscription rate exceeding the available amount by 1.12%. Pension fund administrators subscribed to 73% of the total quantity issued. The following green bond achieved a significantly higher oversubscription, reaching 220%. The proceeds from these bonds are allocated to fund projects that are in line with Nigeria's Nationally Determined Contributions (NDCs) (Adeojo, 2022).

In contrast, Ghana has shown a strong dedication to sustainable finance by indicating its plan to issue green and social bonds totalling up to US$2 billion in November 2021. In March 2021, Ghana effectively carried out a bond issuance worth US$3.025 billion. This issuance consisted of four separate parts, known as tranches, and was the first Eurobond issued under the 2021 International Capital Market Programme by the Ghana Ministry of Finance (Ghana Ministry of Finance, 2021). The implementation of green bonds in Ghana is in accordance with the country's goal to shift towards a more

environmentally friendly future, in alignment with its committed obligations under the Paris Climate Agreement. In addition, Ghana is preparing to establish a dedicated green bond exchange, which will enable companies to issue significant amounts of green bonds and provide a platform for investors to participate in trading activities (Ghana Ministry of Finance, 2021).

Both Ghana and Nigeria possess considerable capacity to leverage green finance for sustainable infrastructure development. Ghana has made advancements in policy frameworks. However, Nigeria, with its larger economy and potential for carbon credits, presents even more promising opportunities. To effectively utilise green finance and fulfil their infrastructure requirements without compromising environmental sustainability, both countries must prioritise addressing specific challenges such as corruption and capacity gaps. By adopting green finance, Ghana and Nigeria can lead the way towards a future where development and environmental responsibility are harmoniously integrated.

2.3.6 Asset Securitisation

Asset securitisation is a complex financial process that involves transforming assets that are difficult to sell into securities that can be traded. This is typically done with future cash flows generated by infrastructure projects, which are structured as bonds. These securities are later presented to investors in the ever-changing environment of capital markets, creating a novel means of raising funds specifically for infrastructure development (Zhang, Tjia, Wang & Ersoy, 2021). This financial innovation has played a crucial role in changing traditional funding models, providing governments and private entities with a way to access the inherent value of their infrastructure assets (International Monetary Fund, 2015). Asset securitisation is a process that can convert revenue streams, which are typically long-term and not easily converted into cash, into instruments that can be actively traded in financial markets. This process has a transformative effect on these revenue streams.

In delving deeper into this intricate process, examining the key players involved, the mechanisms at play, and the implications for infrastructure development is essential. Asset securitisation commonly entails the establishment of Special Purpose Vehicles (SPVs), meticulously designed cash flows, and a deliberate alignment of interests

among stakeholders. These elements collectively contribute to the successful implementation of a funding model that provides flexibility, reduces risk, and injects liquidity into the infrastructure sector (International Monetary Fund, 2001).

SPVs, or Special Purpose Vehicles, are a crucial element in the process of asset securitisation. These entities function as separate legal entities established exclusively to manage and possess the securitised assets. Special Purpose Vehicles (SPVs) offer a vital safeguard by segregating the assets from the financial liabilities of the parent company, thereby mitigating the risks associated with the overall financial stability of the organisation (International Monetary Fund, 2001). The effectiveness of asset securitisation depends on the meticulous arrangement of cash flows derived from fundamental infrastructure projects. Choosing how to distribute the assets' revenue towards paying off the securitised debt is a necessary step in this process. Efficient cash flow structuring improves the ability to forecast and depend on investment returns, thereby bolstering the creditworthiness of the securities (International Monetary Fund, 2001).

Ensuring that the interests of all stakeholders are in consensus is a crucial element of asset securitisation. Stakeholders, such as project developers, investors, rating agencies, and regulatory bodies, need to work together to guarantee the achievement and long-term viability of infrastructure projects financed through this approach. Efficient communication and a mutual comprehension of goals are crucial for effectively handling potential conflicts and upholding investor trust (International Monetary Fund, 2001).

The innovative aspect of asset securitisation has substantial ramifications for infrastructure development. It allows governments to utilise current and future revenue streams, offering a way to begin new projects without relying solely on traditional funding sources. The model promotes the optimisation of asset management, thereby harnessing the untapped potential of infrastructure assets and stimulating economic growth (OECD, 2015).

Moreover, the utilisation of asset securitisation to finance infrastructure projects has surpassed geographical limits, achieving successful implementations worldwide. The

financial model has played a crucial role in transforming the approach of governments and private entities towards funding infrastructure projects, resulting in a far-reaching impact that transcends regional boundaries (Zhang et al., 2021).

Asset securitisation has been widely used in the United States to fund transport infrastructure projects on a global scale. An exemplary instance is the process of securitising toll road revenues. State and local governments have utilised the issuance of bonds, which are supported by future toll collections, to access capital markets. This has allowed them to obtain funds to expand, maintain, and enhance essential transportation networks. This approach has not only established a reliable and long-lasting funding source, but it has also improved the ability of transport infrastructure to withstand and operate effectively (Gramlich, 2012).

Similarly, many European nations have utilised asset securitisation as a means to tackle funding difficulties in public infrastructure. European governments have obtained extra funding for infrastructure development by securitising future lease payments from public buildings, including government offices and civic facilities. The aforementioned approach has demonstrated its efficacy in maximising the utilisation of public resources while also serving as a strategic means of infusing funds into infrastructure initiatives (OECD, 2012).

Furthermore, asset securitisation has become increasingly popular in Asia to fund major infrastructure projects. Japan and other countries have examined the process of securitising revenue streams generated by significant public infrastructure, such as toll roads and bridges. Bond issuances have attracted private capital, which has expedited the completion of crucial projects, thereby enhancing the overall economic progress of the region. This strategy is consistent with the overall pattern of Asian economies expanding their funding options to support sustainable infrastructure development (Legenchuk, Pashkevych, Usatenko, Driha, & Ivanenko, 2020).

Asset securitisation has gained considerable traction in emerging markets, particularly where governments encounter distinctive obstacles in funding infrastructure. Governments in Latin America and Africa have adopted this approach to convert income streams from different assets, such as energy projects and public utilities, into

securities. These efforts have offered emerging economies a practical way to attract private investment, promote economic growth, and improve the quality of essential services (Musthaq, 2021).

The widespread implementation of asset securitisation highlights its efficacy in mobilising funds for infrastructure projects. Through the transformation of future revenue streams into tradable securities, governments and private entities can access a wide range of investors, making it easier to inject essential capital into crucial infrastructure projects (Legenchuk et al., 2020). Asset securitisation has demonstrated its effectiveness as a mechanism for efficiently managing assets that already exist. By securitising revenue streams generated by toll roads, public facilities, and other infrastructure assets, stakeholders can maximise the utilisation of these resources, guaranteeing their long-term viability and ongoing contribution to economic growth (Lu, Peña-Mora, Wang, Liu, & Wu, 2019). The widespread achievement of asset securitisation underscores its function in broadening the range of funding options for infrastructure projects. Both governments and private entities have the ability to decrease their dependence on traditional financing methods and instead explore novel approaches to obtaining funds. This will ultimately strengthen the resilience of infrastructure financing models (Lu et al., 2019).

Although asset securitisation has demonstrated positive effects on a global scale, it has also presented certain challenges. A thorough examination is necessary for matters concerning regulatory frameworks, investor confidence, and the appropriate organisation of securitised assets. The global applications of asset securitisation offer valuable lessons that can be used to improve and optimise its implementation in different situations (Legenchuk et al., 2020).

Asset securitisation is a different funding model that stands in sharp contrast to traditional models. It not only enables the use of various sources of funding but also reduces the significant risk typically associated with large infrastructure projects, which can jeopardise the entire company's future (IMF, 2008). This distinction becomes especially apparent when comparing it with traditional models such as government grants or project finance. The unique characteristic of asset securitisation is its

capacity to effectively allocate risk across a wider range of investors, thus promoting a funding environment that is more robust and flexible.

Conventional funding models, such as dependence on government grants, frequently result in reliance on a single funding source. This introduces vulnerability, as changes in government priorities or budget limitations can directly affect the ongoing nature of infrastructure projects. Asset securitisation challenges this established pattern by allowing the involvement of a wide range of investors. The injection of private capital from multiple sources decreases the dependence on a single funding channel, thereby establishing a stronger and more resilient financial environment for infrastructure advancement (International Monetary Fund, 2015).

Asset securitisation allows for a wider range of investors compared to government grants or project finance, which typically involve a smaller group of stakeholders. Institutional investors, private equity firms, and retail investors have the opportunity to engage in the securitisation process. The presence of diverse entities in the infrastructure sector not only increases the availability of funds but also spreads the risk across a wider range of organisations, thereby improving the stability of funding sources (International Monetary Fund, 2015).

Conventional funding models frequently subject companies to substantial risk that could potentially jeopardise the entire company, particularly when large-scale projects are funded through government grants or project finance. Within these models, the outcome of a solitary endeavour can significantly impact the entire organisation, traditionally impeding the progress of innovation and growth. Asset securitisation enables companies to isolate and mitigate the risk linked to specific projects. The failure of a single project does not result in a catastrophic effect on the entire company, which promotes a more entrepreneurial mindset (Allen & McDonald, 2004).

The key advantage of asset securitisation is its inherent ability to distribute risk. Through the process of securitisation, the risk linked to infrastructure projects is spread out among numerous investors by transforming future cash flows into tradable securities in the capital markets. Diversification serves the purpose of not only protecting the originating entity from bearing the complete consequences of project

failure but also appealing to a broader range of investors who are willing to take on risks. Asset securitisation enables the execution of projects that might have been considered too risky using conventional funding models (Allen & McDonald, 2004).

The departure of asset securitisation from high-risk strategies reduces the overall vulnerability of the funding landscape. The model's flexibility in accommodating different credit market conditions, construction contract terms, and project types position it as a versatile funding alternative. Conversely, traditional approaches may encounter difficulties in promptly adapting to evolving market dynamics, thereby constraining their efficacy in the presence of economic uncertainties (Allen & McDonald, 2004). Asset securitisation offers resilience that goes beyond the impact on particular businesses. By fostering a funding landscape resilient to economic fluctuations, the model indirectly enhances the viability of infrastructure projects on a larger scale. The uninterrupted influx of private funds and varied investor involvement contribute to a consistent momentum in the construction and upkeep of essential infrastructure (Legenchuk et al., 2020).

An examination of real-life examples or case studies of asset securitisation used or planned in infrastructure projects in Ghana and Nigeria can teach us a lot about how this funding model really works (Legenchuk et al., 2020). By examining the specifics of these cases, it becomes feasible to analyse results, recognise obstacles, and acquire a nuanced comprehension regarding the suitability and efficacy of asset securitisation in various circumstances.

A significant example in Ghana pertains to the securitisation of toll road revenues to finance a crucial transportation infrastructure project. In light of financial limitations and acknowledging the necessity for substantial expansion of the road infrastructure, the Ghanaian government investigated the possibility of utilising asset securitisation as an alternative means of obtaining funding. The toll road securitisation initiative sought to access additional funds while effectively overseeing the current road assets (Modern Ghana, 2017). In the energy sector, Ghana exemplifies how tax-related inflows can be leveraged to generate substantial government funds while safeguarding its fiscal stance. The Energy Sector Levy Act (ESLA) transaction entails the securitisation of funds obtained from a government-imposed gasoline tax. These funds are intended to

be used for the repayment of existing debts in the energy sector. Due to the depreciation of the Ghanaian currency, it became impossible to pay for energy imports, which caused the accumulation of these debts. The presence of nonperforming loans was impeding the ability of banks to provide loans to fund economic growth in Ghana. ESLA PLC (the Energy Bond SPV) issued two bonds in 2017, one with a 7-year term and the other with a 10-year term. These bonds were backed by tax receivables and marked the beginning of a GHS10 billion bond programme that will span multiple years. Up to now, a total of six bonds have been issued, amounting to nearly GHS8 billion (equivalent to over US$1.3 billion). Domestic institutional investors have primarily funded the bonds. The Government of Ghana, represented by the Ministry of Finance, is responsible for sponsoring the deal. The ESLA bonds are traded on the fixed-income market of the Ghana Stock Exchange (Harwood, 2021).

Both models used in Ghana involved the establishment of a Special Purpose Vehicle (SPV) to supervise the securitisation project. The Special Purpose Vehicle (SPV), functioning as a separate legal entity, enabled the separation of assets from the government's financial statement. The cash flows generated were intentionally organised to repay the securitised debt, appealing to a wide range of investors.

In terms of impact, the toll road securitisation in Ghana showcased the capacity of asset securitisation to broaden the range of funding options for infrastructure projects. The legal and financial separation of the SPV effectively mitigated the government's exposure to the complete risk associated with the project, thereby bolstering investor confidence. The favourable results of this case played a role in enhancing road infrastructure and established a precedent for utilising asset securitisation in comparable endeavours. Again, the government could enhance its immediate cash flow and alleviate budgetary constraints by securitising the future tax stream for the ESLA, thereby avoiding the need to directly allocate funds for servicing the existing debts. Efficient execution of the transaction and prudent handling of debt could potentially enhance Ghana's long-term credit rating, thereby granting the country access to more advantageous borrowing conditions in subsequent periods. The issuance of ESLA bonds enticed domestic institutional investors, thereby fostering the growth of Ghana's capital markets.

In Nigeria, the first future flow securitisation was done in 2017. The company, PTSL securitised the receivables generated from the sale of Expatriate Resident Permits and Alien Cards under the Combined Expatriate Residence Permit and Alien Card scheme. This was done through a series of five-year bonds with a total value of N25 billion (US$65 million). It gained advantages from its association with the government and its 14-year track record. The Combined Expatriate Residence Permit and Aliens Card (CERPAC) transaction helped set the stage for the securitisation of bus ticket receivables in 2019. The Primero Bus Rapid Transit (BRT) transaction involved PTSL, a bus company authorised by the Lagos government to provide bus services, securitising the receivables from its bus ticket sales. This allowed PTSL to raise funds for expanding its fleet and operations through two issuances as part of a N10 billion (US$33 million equivalent) medium-term note programme. PTSL operates the most extensive bus rapid transit route along the West African coast, spanning 35.5 kilometres and serving over 200,000 commuters on a daily basis. PTSL is utilising the funds to augment its operations and meet the increasing customer demand (Harwood, 2021). Once again, the power sector experienced a case study that involved securitising future cash flows from electricity generation and distribution assets. To bridge funding shortfalls in the power sector and attract private investment, the Nigerian government examined asset securitisation as a strategy to unlock capital and improve the financial sustainability of power projects (USAID, 2022).

In order to carry out asset securitisation, a specialised Special Purpose Vehicle (SPV) was created to possess and oversee the cash flows. The SPV worked in collaboration with private investors to securitise these future revenue streams, thereby creating investment-grade securities traded in the capital markets.

The Primero Bus Rapid Transit (BRT) transaction resulted in an improvement of PTSL's rating from B+ to BBB/A, leading to a decrease in its funding expenses. The asset was purchased by domestic institutional investors, and demand exceeded the available supply. The credit was strengthened through the use of over-collateralisation, a cash reserve, a liquidity facility in the form of a standby letter of credit, and a guarantee provided by a local bank. It is officially registered and traded on the Nigerian Stock Exchange.

The power sector asset securitisation in Nigeria demonstrated the versatility of this model in various infrastructure sectors with regards to power transactions. The government used securitisation to attract private investment, implement financial discipline in the power sector, and guarantee the long-term funding of electricity projects. The results of this case study provide insight into the possible use of asset securitisation to tackle funding difficulties in crucial service sectors.

An examination of asset securitisation case studies in Ghana and Nigeria, conducted from a cross-country perspective, identifies shared factors that contribute to the effectiveness of this financial model. The creation of strong Special Purpose Vehicles (SPVs), careful organisation of cash flows, and proactive involvement with a wide range of investors are identified as crucial elements that go beyond national borders.

The creation of specialised Special Purpose Vehicles (SPVs) was crucial for the success of asset securitisation initiatives in both Ghana and Nigeria. These legal entities enabled the segregation of assets, guaranteeing both financial and legal independence from the government's financial records. The special purpose vehicles (SPVs), functioning as intermediaries, efficiently oversaw the securitisation process, bolstering investor trust and safeguarding the originating entities from related risks. This structural element continues to be a crucial foundation for achieving success and serves as a valuable model that can be applied to other countries considering the use of asset securitisation in infrastructure development.

Concurrently, the comparative analysis emphasises the distinct difficulties encountered by each country. These challenges may encompass obstacles related to regulations, political factors, or intricacies specific to the sector. To ensure compliance and legal validity, it was necessary to navigate the regulatory frameworks in both Ghana and Nigeria. Political factors, such as shifts in government priorities, may affect the viability of securitisation initiatives. The power sector presented unique complexities that necessitated customised solutions. Gaining an understanding of these challenges allows for the customisation of asset securitisation methods to match the unique circumstances and overcome obstacles in each country.

Ultimately, incorporating asset securitisation into the comparative examination of infrastructure funding models in Ghana and Nigeria enhances the thoroughness of the analysis and promotes a comprehensive comprehension of the potential impact this funding model can have on advancing infrastructure development. This integration enhances the funding of infrastructure in both nations by analysing distinct factors, evaluating comprehensive dynamics, and enabling well-informed decision-making. It promotes a more robust and customised approach to infrastructure funding. Asset securitisation is a versatile and adaptive tool that can be customised to address the specific needs and challenges of different economies. It contributes to sustainable infrastructure development worldwide.

2.4 Conclusion

This chapter explored the changing landscape of infrastructure funding, moving away from the traditional dependence on public funds. The theoretical underpinnings were established by analysing frameworks such as Wagner's law of increasing state activity (Lamartina and Zaghini, 2011), financial theories (Velez-Pareja & Tham, 2010), and innovation diffusion theory (Rogers, 2003). These frameworks offered valuable perspectives for comprehending the rise and potential of alternative funding models. The chapter went into more detail about these models by explaining what project finance (World Bank, 2014), asset securitisation (Halland et al., 2014), resource-financed infrastructure (Halland et al., 2014), green finance (UNEP, 2023), public-private partnerships (Boyfield, 1992), and crowdfunding are and what their most important features are. The chapter aimed to offer a thorough comprehension of the various options for funding infrastructure development in the contemporary era by analysing them in detail. The significance of this study lies in the fact that traditional approaches are facing difficulties in keeping up with the continuously rising demand for infrastructure investment. This emphasises the necessity for creative and varied approaches to funding, as stated by the Infrastructure Consortium for Africa (2023).

The ensuing chapter presents a critical review of the empirical literature.

Chapter Three
Empirical Literature Review

3.1 Introduction

The chapter aims to provide a practical demonstration of the study's literary foundations. Section 3.2 provides a comprehensive overview of the overall alternative infrastructure funding landscape. Section 3.3 examines the alternative infrastructure models in Ghana, while section 3.4 does the same for Nigeria. Section 3.5 presents a preliminary conceptual framework, and Section 3.6 concludes the chapter.

3.2 Alternative Infrastructure Funding Landscape

Over time, financing infrastructure has become a significant problem for developing nations, particularly in sub-Saharan Africa (Cirolia, 2020). The Group of Twenty (G20) countries estimate that an annual investment of US$1.5 trillion is required to bridge the infrastructure gap, with a significant portion coming from private sources (Tyson, 2018). Developing countries, in particular, must mobilise private-sector funding for infrastructure to create the necessary social and physical infrastructure for economic development. However, attracting more private financing for infrastructure development is one of the primary challenges they face (Biswas & Biswas 2018). Infrastructure has emerged as a critical component for global growth due to its multifaceted implications for social progress and economic impact (Clark, Reed & Sunderland, 2018). Furthermore, the uneven provision and governance of infrastructure are heavily influenced by its funding, financing, and governance structures. likewise, the interactions between urban infrastructure and modern financing have emerged as central themes in these debates (O'Brien, O'Neill & Pike, 2019). Kukah et al. (2022) investigated energy funding mechanisms in Ghana, exploring the benefits and challenges of creative energy infrastructure funding and proposing measures to promote it.

Clark et al. (2018) emphasised the importance of additional research to better understand the factors influencing investment decisions and the future trajectory of private sector companies in terms of sustainable growth. Understanding the tools and their successes or failures, according to Machete and Marques (2021), is also necessary for innovation. It is critical to examine existing alternative funding instruments, their benefits and drawbacks, and their applicability to various sectors.

This understanding is especially important for Sub-Saharan African countries, which are attempting to close the infrastructure funding gap in the face of rising debt vulnerabilities, a prerequisite for achieving sustainable development goals. This is particularly crucial in developing sustainable infrastructure as taxes and loans from international organisations have become a major challenge (Tan & Taeihagh, 2020). Many researchers point out that it is important to determine how much government debt has an impact on domestic investment and economic development given the significance of the public sector's performance in any economy (Kharusi & Ada, 2018; Yusuf & Mohd, 2021; Law et al., 2021). While the majority of these studies concentrate on the connection between debt and economic development, only a few authors have looked at the connection between public debt and investment. Alesina et al. (2002), Vergara (2004), and Forni et al. (2009) have built a solid foundation for additional empirical analysis of the debt-domestic investment nexus.

The general consensus in the literature is that public policy may have a substantial impact on a nation’s level of investment and that excessive debt service levels may lead to a shift away from beneficial investment activities. However, this claim focuses mostly on a single country or emerging nations in general. Using a Fixed Effect model, Omojolaibi et al. (2016) discovered that between 1993 and 2014 in West Africa, the effects of ongoing expenses on foreign debt on private investment were negligible. According to their research, debt (as a percentage of GDP) and external debt stocks (as a percentage of GNI) have a negative impact on domestic investment, indicating that increasing public debt generally has a negative impact on investment levels throughout SSA countries. Therefore, the level of investment is significantly influenced by public policy. High levels of public debt, though, can be detrimental to investment, especially in SSA nations. This is demonstrated by Omojolaibi et al. (2016), who averred that SSA countries generally have a stronger negative impact on investment than other emerging markets. This suggests that when developing and implementing alternative infrastructure funding models in Ghana and Nigeria, it is crucial to carefully consider the impact of public debt on investment. It is also crucial to consider the unique circumstances of West Africa, such as the area's comparatively high levels of public debt.

Recently, various forms of alternative infrastructure funding have been explored by both developed and developing countries including public-private partnerships (PPP), crowdfunding, green financing, value capture mechanisms, and sovereign wealth funds, among others (Udeagha & Muchapondwa, 2023; Mundonde & Makoni, 2023; Chao et al., 2020). These models of funding provided above have varying degrees of impact on infrastructure provision. For instance, whilst PPP may be efficient in the provision of both capital-intensive and less capital-intensive projects (Lomoro et al., 2020), crowd-funding is often appropriate for less capital-intensive projects (Chigova & Van der Waldt, 2019). The rise of sustainability has prompted financial experts and authorities to create different financial instruments and mechanisms to further protect the environment and reduce the emission of excessive carbon and greenhouse gases Ametepey, Aigbavboa, and Thwala (2023).

The literature has primarily centred on the role of PPP in infrastructure development in countries rather than other forms of funding such as crowdfunding, green financing, value capture mechanisms, and sovereign wealth funds. The resort to these sources of funding was borne out of the need to replace the ballooning debt levels of countries with a more sustainable source of funding. Overall, the gains or benefits of PPP have been largely categorised into three main forms. These include the gains to the government, the gains to the citizens and the gains to the private sector or company (Belachew & Shyamasundar, 2013). According to Belachew and Shyamasundar (2013), the gains to the government include an increase in the efficiency of funding, a reduction in the risk associated with infrastructure funding, and improvement in the quality of technology, among others. Also, the gains of PPP to the citizens manifest in the form of improved access to better services and infrastructure. Finally, private partners of PPP benefit from the returns in the form of profit, and employment, among others. These observations of Belachew and Shyamasundar (2013) are supported by Emilio (2015). Alternative infrastructure funding does not have a one-size-fits-all solution, which is one of the main conclusions of the research literature. The best funding strategy for a given nation or project will depend on a number of variables, including the nation's level of economic development, the nature of the infrastructure project, and the country's risk tolerance. While PPPs have been the most popular alternative infrastructure financing strategy in both developed and developing nations,

interest in other alternative funding strategies, including crowdfunding, green financing, value capture mechanisms, and sovereign wealth funds, is on the rise.

In Thailand, Sresakoolchai and Kaewunruen, (2020) argued that the result showed that adopting PPP in infrastructure development has different benefits, advantages and risks, depending on the project phase. As a result, adopting PPP can circumvent major obstacles and deliver some substantial advantages that the conventional strategy cannot (Laverty & Meulien, 2019). This idea of mitigating funding challenges inherent in the traditional approach to funding infrastructure as explained by Sergi et al. (2019) that the PPP mechanism provides some level of sustainability in the funding of projects relative to the traditional method. The flexibility and the applicability of the PPP approach to funding make it suitable for financing any form of project at any level. The PPP approach also ensures that both private and public interests are harmonised by unifying the investments of both entrepreneurs and the government, as well as the development of a highly effective and full-scale implementation of projects within the context of sustainability (Sergi et al., 2019). Public-private partnerships present an alluring way to pool resources from various industry sectors, academic institutions, and non-profit health organisations to overcome the numerous challenges in drug development in the area of health infrastructure, and in a time of constrained resources and increasing regulatory stress (Goldman et al., 2013). Also, Khwidzhili and Worth (2019) argue that new partnerships with financial backing from the private sector can be a helpful addition to larger-scale government initiatives and can fill in any gaps where flexible operations depending on the quality of ideas and solid interpersonal interactions can produce excellent results. More study is still needed on public-private partnerships (PPPs) in the context of developing countries, as these countries face different opportunities and challenges than developed nations.

In Africa, PPP has also been recognised as a vibrant alternative to the traditional methods of funding. A meta-analysis by Mutambatsere (2017), on the usage of PPP in the growth of infrastructure in Africa observed that PPP investment growth is less robust and more erratic than that seen in other developing regions. With a 7% overall cancellation rate across the assessment period, the performance of PPP contracts appears to be getting better over time. PPPs have helped build more infrastructures,

but they have not quite reached their full potential, particularly in terms of improving access to that infrastructure. These observations are validated by Chima and Kasim (2018) who further point out that PPP in Africa takes various forms such as service contracts or outsourcing which involves the hiring of a private company by the government to perform a specific task over a period of time. Other forms of PPP identified by Chima and Kasim (2018) are management contracts, affermage or lease contracts, joint contracts, concessions and Build-Operate-Transfer.

Yet, PPP has been identified to contain major challenges which impede or limit the extent to which governments can fund infrastructural projects. Tan and Zhao (2019) explored the rise of PPP in financing infrastructure in China. According to their paper, even though PPPs are an important opportunity for collaboration and partnerships in financing projects which otherwise would not be efficiently done by only government or the private sector alone, its implementation in China has largely been ineffective. Tan and Zhao (2019) averred out that the central government supported the PPP boom after 2014 to close the investment gap in infrastructure and reduce the skyrocketing municipal debt. However, because there is little private investment, PPPs ultimately turn into a sort of hidden debt with even greater costs. The central government has taken steps to promote private investment and control financial risk, but it is difficult to achieve these goals (Tan & Zhao, 2019). In sub-Saharan Africa, PPPs have been found to be a foundation for corrupt practices and extortion by public officers who engage in such contracts with companies with the aim of duping the state. Thus, PPP have become vehicles of corruption in Africa (Sall, 2020; Makiva, 2021). In Ghana, factors such as delays and non-payment of funds to private partners are some of the difficulties of PPP (Owusu, 2014). Public-private partnerships (PPPs) must be carefully planned and implemented to be successful, particularly in developing countries like Ghana and Nigeria. The problems of corruption and non-payment of funds to private partners must also be addressed. By improving our knowledge of the difficulties and opportunities presented by PPPs in these countries, the study can make a significant contribution to the field. The study will assist in creating suggestions for how to address these issues and guarantee the success of PPP projects in these countries.

Another form of financing that is gaining prominence in Africa is the use of crowd-funding in which contributions are solicited from the public. According to Adams (2014), crowd-funding is a continuation of the innovative strategies that local communities and organisations have continuously developed to raise money for local and community projects. In a similar vein, Brent and Lorah (2017) assert that civic crowd-funding frequently enables residents to vote with their wallets and gives local leaders the authority to initiate beneficial public projects in their neighbourhoods. Thus, Chigova and Van der Waldt (2019) posit that civic crowd-funding's fundamental idea is to create a platform for the exchange of funds from people ready to give or invest in the capital requirements of public goods.

The emerging literature on the viability of employing municipal crowd-funding methods to restore local infrastructure has taken many different forms, such as advocating for the use of civic crowd-funding for urban that is renewal, rehabilitation, and regeneration as well as to enhance the liveability and attractiveness of cities (Chigova & Van der Waldt, 2019). Yet, as advanced by Brent and Lorah (2017), it is crucial to think about the kinds of infrastructure projects that can be funded when looking at how civic crowd-funding can be expanded to improve local communities. Boyle (2016) contends that community-driven initiatives show how simple it is to raise money through crowd-funding. According to Brent and Lorah (2017), municipal projects that are crowd-funded are typically smaller in scope than major city infrastructural projects. This viewpoint is shared by Stiver et al. (2015) who note that numerous projects use crowdfunding on a lesser scale. Again, Brent and Lorah (2017) explained the fact that civic crowdfunding is usually unable to fund major city infrastructure and other public goods due to the capital-intensive nature of such projects. Civic crowdfunding is viewed as a potential answer to Africa's infrastructure funding problem. The need to increase public awareness of civic crowdfunding and the need to foster trust between potential donors and project initiators are two challenges that must be overcome.

Previous research has made valuable contributions to understanding infrastructure funding models in Africa. For instance, the United Nations University - World Institute for Development Economics Research (2023) conducted a study on the role of foreign aid in financing infrastructure projects in Africa. Their study shed light on the difficulties and possibilities related to international aid and gave information on how it affects the

growth of infrastructure. The challenges of foreign aid dependency were discussed, as well as the effectiveness of aid disbursements in assisting infrastructure projects. It was also emphasised how crucial it is to match aid with national development priorities. Their research helped to clarify the function and constraints of foreign aid in providing financial support for infrastructure in West Africa.

According Ranachidi and Izuwah, (2018), research into the role of Public-private partnerships (PPPs) and their ability to close the infrastructure gap in Africa is required. Their study looked at the results and difficulties of PPP projects in Africa, offering insights into their applicability and potential advantages. They examined the variables that affect PPPs' success or failure, including legal frameworks, project selection, risk distribution, and stakeholder engagement. Their research emphasised that to achieve successful PPP outcomes, there must be strong governance structures, efficient risk management, and open decision-making procedures. These results contributed to a better comprehension of the advantages and disadvantages of using PPPs as a different funding model for infrastructure development in West Africa.

Alternative funding models enhance the bankability of road infrastructure projects (Abiru, 2021). Traditional funding mechanisms often lack sustainable revenue streams to support project implementation and maintenance (Hasnat & Bardaka, 2022). However, even though these studies have given useful insights into particular facets of infrastructure funding models, there are still sizable gaps in the body of knowledge. The potential of alternative funding models, such as infrastructure bonds, crowdfunding, and sovereign wealth funds in the context of West Africa, needs more research. While they have the potential to supplement current funding sources and draw in private sector investment, there has not been much research on these models specifically designed for Ghana and Nigeria. It is thus essential to conduct a comprehensive analysis of their applicability, advantages, and difficulties about the infrastructure situation in Ghana and Nigeria. Alternative models address this issue by incorporating revenue generation mechanisms such as tolling systems, congestion charges, or user fees (Będzieszak, 2019). Furthermore, a thorough comparison of Ghana's and Nigeria's funding models is frequently absent from the existing scholarly research. Although individual studies have concentrated on particular nations or

industries, a more comprehensive analysis is required to pinpoint widespread trends, difficulties, and success factors. Comparative analysis can offer insightful information about the efficacy of various funding models, empowering practitioners and policymakers to choose the best infrastructure funding model. The table 7 below presents a summary of various studies conducted on alternative road infrastructure funding that have been identified in earlier empirical studies globally.

Table 7: Summary Alternative Infrastructure Funding Models

Reference	**Method**	**Funding Option**	**Key Findings**
Hough and Smadi (1999)	Qualitative	Taxes and levies	Inadequate road funding is a nationwide issue. Counties possess extensive road networks but do not have sufficient funds to maintain these roads up to current roadway operations standards. Public opposition may prevent the enactment of any of them into legislation.
Mulu and Smith (2008)	Qualitative	PPP	The innovative financing model was established by combining PPP with multilateral and bilateral resources to achieve value-for-money through whole-life-costing and risk transfer.
Miles (2005)	Quantitative	IFS	The Innovative Financing Strategy (IFS) was found to be more advantageous in providing ample, consistent, and efficient funds compared to the General Fiscal Investment Strategy (GFIS). Provincial and local governments found the IFS more favourable and acceptable than the GFIS.
Tadi and Murthy (1997)	Qualitative	Developer fee	Developer fee concept has been used successfully by many cities and counties across the United States.

Feldman (2023)	Qualitative	Fees and PPP	Innovative models such as German “toll collect”, London congestion charging scheme, “toll ring” in Norway and PPP must be adopted.
Koul, Verma, and Arora (2021)	Quantitative	SPVs influence on PPPs	The credibility of promoters has been identified as a significant factor influencing PPP credit ratings. Other significant factors were the type of stretch, regulatory terms and conditions, and the project's ability to produce cash flows.
Brocklebank (2014)	Qualitative	PPP	There is a need for innovative models in financing roads. However, each PPP is unique
Akomea-Frimpong, Jin, Osei-Kyei and Kukah (2021).	Quantitative	PPPs	All current publications on using the PPP model to achieve the UN's SDGs in the country focus on key themes like poverty alleviation, urban development, waste management, and risk management. However, the review found a scarcity of studies on important topics concerning PPPs and sustainable development goals, including climate action, critical resilience, sustainable finance, and clean energy.
Van Rensburg and Krygsman (2020).	Quantitative	road user charges	The proposal suggests a policy based on efficient road user charging to control the demand for road capacity according to marginal social cost, efficient investment to reduce the total public and private investment in road capacity, and efficient road management to synchronise road user charging and investment.
Petrus (2020)	Qualitative	User-based financing, including tolls, fuel taxes, and	Many developing countries struggle with financing road expenditure because the revenue generated from road users is insufficient to cover the total road costs, mainly due to limited capacity and economic factors. Additional funding sources are necessary to cover these deficits.

		vehicle user charges.	
Mawoli (2021)	Qualitative	PPP	All levels of government in Nigeria must investigate, recognise, and utilise sustainable funding methods for the upkeep and development of essential urban infrastructure. Securing sustainable funding for essential infrastructure relies on the cooperation and joint efforts of the public and private sectors in revenue generation, project design, construction, operation, maintenance, and ownership of facilities.
Haq, Saroa, Fattah, and Morshed (2020)	Quantitative and Qualitative	PPP	The public authority is conserving the maintenance budget. The project attains a triple victory. Although it has some constraints, the PPP project has propelled Khulna towards achieving the Sustainable Development Goals.
Casady and Peci (2021)	Qualitative	PPP	PPPs may be Kosovo's sole current alternative for achieving economic growth.

Source: author's own compilation

The table above displays a variety of studies investigating different funding models for infrastructure development, with a specific emphasis on the impact of Special Purpose Vehicles (SPVs) on Public-Private Partnerships (PPPs), road user charges, and user-based financing strategies like tolls and fuel taxes. Koul, Verma, and Arora (2021) stress the importance of promoter credibility in impacting PPP credit ratings, whereas Akomea-Frimpong et al. (2021) emphasise the attention on poverty alleviation, urban development, and waste management in PPPs to achieve the UN's Sustainable Development Goals (SDGs). Van Rensburg and Krygsman (2020) suggest effective road user charging policies to control road capacity and investment, while Petrus (2020) stresses the importance of finding extra funding sources to address shortfalls in road expenditure. Mawoli (2021) emphasises the significance of implementing sustainable funding approaches for urban infrastructure development in Nigeria via Public-Private Partnerships (PPPs) that engage both public and private sectors. Haq

et al. (2020) demonstrate how PPP projects effectively preserve maintenance budgets and progress towards Sustainable Development Goals, whereas Casady and Peci (2021) propose PPPs as Kosovo's main option for economic advancement. These studies highlight the various approaches and difficulties related to alternative infrastructure funding models, with Public-Private Partnerships (PPPs) standing out as a prominent strategy in various situations.

3.3 Assessing Current Alternative Infrastructure Funding Models in Ghana

Ghana, similar to numerous developing countries, encounters a substantial infrastructure deficit, especially in its road system. Conventional funding sources like government budgets and fuel taxes are frequently limited, resulting in insufficient infrastructure investment, which hampers economic growth and social development (World Bank, 2020). It is crucial, for Ghana's sustainable development, to investigate different road infrastructure funding models, as stated by the World Bank in 2020. This section of the paper will examine the current research on alternative financing options in Ghana, offering a thorough evaluation of their practicality, efficiency, gaps and constraints in meeting the country's road infrastructure requirements.

Obeng and Tuffour (2020) conducted a study in Ghana investigating alternative funding sources for road network maintenance in developing countries. Traditional funding sources for road infrastructure development, like tolls and fees, may face political resistance and be challenging to extend. The authors explore the potential of utilising revenue from on-street parking and associated fees to incentivise private partnerships for road maintenance endeavours. The study examines the financial aspects of utilising parking fees to fund road maintenance in the Sunyani Municipality, Ghana. Their results indicate that the on-street parking scheme is economically feasible and has the potential to draw private investments. The paper suggests evaluating equity, efficiency, and impacts in different revenue collection systems and highlights the significance of involving a private sector operator to enhance revenue efficiency. The research emphasises the necessity of creative funding mechanisms, such as Public-Private Partnerships, to aid in the upkeep of urban infrastructure in developing nations like Ghana. However, this research aims to broaden the scope and overcome significant limitations identified by Obeng and Tuffour (2020) regarding the use of on-street parking fees for road maintenance in Ghana. Obeng and Tuffour

(2020) primarily studied one municipality, which restricted the generalisability of their findings. This study's comparative analysis of Ghana and Nigeria offers broader insights that can be applied to various contexts. Obeng and Tuffour (2020) used a qualitative approach, which, although valuable, lacks the rigour of quantitative methods like the Vector Error Correction Model (VECM) and statistical techniques. These quantitative methods allow for more robust comparisons and data-driven conclusions on the effectiveness of different funding models. This research goes beyond financial feasibility to examine the development, economic expansion, and social welfare implications of various funding options for road maintenance and construction. This comprehensive approach offers a more distinct comprehension of the potential benefits and drawbacks linked to each choice. This research expands on Obeng and Tuffour's work by providing a more comprehensive view, using rigorous methods, and exploring various impacts, thus adding valuable insights to infrastructure funding in developing nations.

Boadi (2020) conducted a study to create an optimal framework for Public-Private Partnerships (PPPs) in road projects, with a specific focus on Ghana. The study explores the theoretical foundations of private sector participation in PPP projects, various PPP models, the historical development of PPPs, infrastructure funding, obstacles impacting PPP execution, and optimal strategies for PPP projects. The methodology utilised involves a mixed methods approach incorporating qualitative and quantitative data analysis. Semi-structured interviews were used for qualitative analysis, while statistical tests like Kendall's Coefficient of Concordance and Mann-Whitney U Test were employed for quantitative analysis. The study highlights the significance of overcoming obstacles like the absence of feasible projects, insufficient traffic flow, financial limitations, and political uncertainty to enhance the successful execution of Public-Private Partnerships in the road industry.

Boadi (2020) provides valuable insights into best practices for Public-Private Partnerships (PPPs) in Ghanaian road projects. The author’s research further explores and addresses critical gaps in our knowledge of alternative infrastructure funding on a wider scale. However, this research evaluates various alternative funding models in Ghana and Nigeria and does a comparative analysis of these funding models. This comparative method enables a comprehensive comprehension of

various choices and their appropriateness in various situations, offering valuable perspectives that go beyond the constraints of a singular model. This study delves deeper than just pinpointing best practices by analysing the factors that impact the acceptance and utilisation of new models. This in-depth analysis explores the underlying factors that drive successful implementation in different countries, clarifying the key elements that enhance the acceptance and efficiency of different funding models.

The table 8 below provides a list of research conducted in Ghana relating to road infrastructure funding.

Table 8: Research Conducted in the Area of Road Infrastructure Funding

Reference	**Method**	**Funding Option**	**Key Findings**
Badu, Owusu-Manu, Edwards, and Holt, (2011).	Qualitative	PPP and taxes	The study emphasises that the concept of Infrastructure Financing (IF) is derived from various public finance issues such as government service delivery reform, new tax mechanisms, public-private partnerships, and alternative financing methods. It also discusses how IF has been directed towards sectors like education, roads, water infrastructure, housing, and district assemblies.
Badu, Edwards, Owusu-Manu and Brown, (2012)	Quantitative	PPP	Three primary challenges were identified: investment capacity, implementation, and revenue mobilisation. Findings offer an initial indication of failure when implementing IF.
Amponsah, and Gatete, (2014)	Qualitative	PPP	The study confirms that Public-Private Partnership (PPP) is a viable solution for government funding infrastructure projects like roads in Ghana, despite lack of legal and

			regulatory framework, and potentially improving technical and economic efficiency.
Osei-Kyei, Chan, and Dansoh, (2017)	Qualitative	PPP	The Ghanaian government is implementing Public-Private Partnerships (PPP) to support infrastructure development and urbanisation. Despite challenges, PPP is feasible in Ghana but requires proper restructuring. Key issues include transparency, competition, legal framework, project identification, capacity building, stakeholder engagement, and risk allocation.
Ametepey, Aigbavboa, and Thwala, (2023).	Qualitative	PPP	The Sustainable Road Infrastructure Project focuses on expanding the nation's road system, developing sustainable road infrastructure, and addressing Ghana's legal frameworks, regulations, and laws related to implementing Sustainable Development projects, along with the associated challenges.

Source: author's own compilation

The aforementioned articles provide significant perspectives on Ghana's approach to alternative road funding. However, certain gaps need to be addressed in order to conduct a comparative study with Nigeria.

The table above presents several articles that examine Public-Private Partnerships (PPPs) as a possible remedy in Ghana. These articles discuss the advantages and difficulties associated with such partnerships. Ametepey et al. (2023) examine the Sustainable Road Infrastructure Project, which utilises Public-Private Partnerships (PPPs) to enhance the road network and tackle the legal structures involved in implementing such initiatives. Amponsah and Gatete (2014) affirm the feasibility of public-private partnerships (PPPs) despite constraints in the legal structure, whereas Osei-Kyei et al. (2017) pinpoint crucial obstacles such as transparency and competition that must be resolved for the effective execution of PPPs. Badu et al.

(2012) provide quantitative data on challenges such as investment capacity and revenue mobilisation. This data could be used as a basis for comparing with similar data from Nigeria, if it is available.

Nevertheless, these articles possess certain constraints. Their main emphasis is on PPPs, while disregarding other alternative models such as green financing and asset securitisation. The research also does not include a comparative analysis of Nigeria. Although the articles provide valuable insights specific to the Ghanaian context, they do not explicitly analyse or juxtapose them with the situation in Nigeria, which is a crucial aspect of this study.

Moreover, the research predominantly utilises qualitative methodologies, providing overarching concepts but lacks a comprehensive quantitative analysis. Furthermore, examining the effective elements of PPP implementation in Ghana and the acquired knowledge could provide valuable perspectives for comparison and potential knowledge exchange in the Nigerian context.

3.4 Assessing Current Alternative Infrastructure Funding Models in Nigeria

Table 6 presents a thorough analysis of different funding models for infrastructure in Nigeria, with a specific focus on the crucial contribution of road infrastructure to economic progress. Ikpeazu and Aaron (2019) emphasise the importance of road infrastructure in promoting economic growth, with funding being identified as a major hindrance in Nigeria. They suggest a range of solutions, such as pension funds, foreign direct investment (FDI), and international bond markets, to tackle this issue. Emoh, Edemodu, and Oparaugo (2017) propose the full implementation of the Public-Private Partnership (PPP) as a remedy for Nigeria's lack of infrastructure, which is crucial for attaining sustainable economic growth.

Foster and Pushak (2011) propose investigating the domestic capital market as an alternative means of financing road infrastructure in Nigeria. They contend that accessing domestic capital markets can offer enduring financing solutions. Udeh and Onwuka (2015) stress the importance of increased cooperation between the government and private sector using Public-Private Partnership (PPP) options to

tackle the challenge of developing and maintaining road transport infrastructure, going beyond the government's current resources.

Omoke (2008) conducts a quantitative examination of PPP in Nigeria, emphasising notable obstacles such as unfinished agreements, financial uncertainties, and political instability. The study highlights the necessity of addressing these concerns in order to fully achieve the advantages of the Build-Operate-Transfer (BOT) framework. Abdulkarim et al. (2022) examine the effective accomplishment of overlooked road infrastructure in Nigeria by utilising sukuk bonds, highlighting the government's responsibility in executing supplementary measures to tackle shortcomings in transport infrastructure. Table 9 below shows literature related to road infrastructure funding in Nigeria.

Table 9: Research Conducted in the Area of Road Infrastructure Funding in Nigeria

Reference	**Method**	**Funding Option**	**Key Findings**
Smoke, (2008)	Quantitative	PPP	This study highlights significant challenges, such as incomplete contracts and uncertainties related to finance and politics. Nigeria, a country with a highly flawed and corrupt legal system, unstable and weak financial system, and political instability, reaping the benefits of the BOT framework, it is imperative to tackle these pressing concerns.
Foster and Pushak, (2011)	Qualitative	Capital market	Domestic capital market should be considered as an alternative road infrastructure funding model in Nigeria.
Udeh and Onwuka, (2015).	Qualitative	PPP	The government must revitalise and enhanced its collaboration with the private sector through public-private partnership (PPP) options. This is done to address the

			task of developing and sustaining road transport infrastructure, which exceeds the government's available resources.
Arimoro, A.E., (2016)	Qualitative	Mutual Funds	Mutual funds should contribute to the development of the country by providing the necessary funds to enhance Nigeria's emerging Public-Private Partnership (PPP) system.
Emoh, Edemodu, and Oparaugo, (2017)	Qualitative	PPP	The implementation of Public Private Partnership (PPP) comprehensively is the solution to Nigeria's infrastructural deficit otherwise achieving sustainable economic growth, seems unlikely.
Ikpeazu, and Aaron, (2019)	Qualitative	Bonds, FDI, infrastructure funds	The significant influence of infrastructure on economic growth cannot be overstated. The productivity and output of an economy are directly influenced by road infrastructure, both in terms of contributing to the formation of GDP and serving as an input in the production processes of other sectors. The primary obstacle confronting road infrastructure in Nigeria is funding. Additional options to contemplate encompass pension funds, foreign direct investment (FDI), international bond markets, infrastructure projects as an asset class to entice institutional investors, and infrastructure-related funds.
Abdulkarim et al., (2022)	Qualitative	Bond	The issuance of sukuk bonds has resulted in the successful completion of neglected road infrastructure, bolstered economic growth, and facilitated improved accessibility to vital

			public services for the local population. The input highlights the necessity for the government to implement additional initiatives, such as sukuk bonds, to tackle the deficiencies in transport infrastructure in the region.

Source: author's own compilation

Arimoro (2016) proposes that mutual funds play a significant role in the advancement of Nigeria's emerging public-private partnership (PPP) system, emphasising the crucial role of financial mechanisms in providing support for infrastructure projects. These articles collectively provide insight into different funding options and strategies to tackle Nigeria's infrastructure challenges.

Nevertheless, there are significant deficiencies in the existing body of literature. There is a lack of comprehensive analysis comparing Nigeria and other countries, specifically Ghana, in terms of alternative models for funding infrastructure. Furthermore, although the studies acknowledge the significance of Public-Private Partnerships (PPP), they fail to thoroughly analyse the specific obstacles and achievements associated with its implementation in Nigeria when compared to other nations. Furthermore, the legal and regulatory frameworks governing infrastructure funding in Nigeria are inadequately explored, especially when compared to Ghana. Furthermore, there is a scarcity of research on the socio-economic effects of various funding models on local communities and the wider economy in Nigeria. This research could offer valuable insights for the development and execution of policies.

3.5 Determinants for Accepting New Funding Models

Infrastructure development is a fundamental factor in promoting economic growth and social advancement in both Ghana and Nigeria. Nevertheless, the ongoing limitations in funding have required the study of alternative funding models in order to expedite infrastructure projects. Table 10 summarises key research conducted on the acceptance of funding models, highlighting variables, methodologies, and findings from various studies. This literature review explores the factors that influence the

acceptance of new alternative infrastructure funding models in Ghana and Nigeria, contributing to the comparative analysis of these models in these two countries.

Table 10: Research Conducted on Accepting Funding Models

Reference	Variables	Methodology	Key Findings
Babatunde, Perera, Udeaja, and Zhou, (2014)	Serious commitment from Lagos State Government (LSG), availability of capital, skilled and experienced people to develop, manage and execute the project, identification and allocation of risk, committed consortium to develop the project, enabling environment to invest, existence of enabling legislation, thorough technical and feasibility studies, clear political will, workable business model, robust financial analysis, thorough social and environmental impact assessment studies	Case study	The review highlights the importance of choosing a private partner who can be trusted in terms of both contractual obligations and competence in order to ensure the efficiency of the project. Additionally, it proposes the integration of blended finance models into public-private partnership (PPP) frameworks to tackle challenges associated with accessing private financing and enhance the success of projects.
Chami, (2015)	Budget deficits, procurement procedure, project financial feasibility and project schedule	Survey	The literature review highlights that adopting Public-Private Partnerships (PPP) for road funding can reduce initial government expenses, promote innovation, and enhance public facilities and services.

			The private sector's involvement in funding and developing public infrastructure has increased in recent years, challenging the traditional reliance on government borrowing.
Mbithi, (2017)	Government attributes, political environment, economic environment	Poisson Regression	Project characteristics, political environment, government attributes are key determinants of financing road project.
Liu, Guo, Chen, and Martek, (2021)	Reasonable financing cost (RFS), Suitable financing scale (SFS), Suitable financing maturity (SFM), and Controllable financing risk (CFR).	Questionnaire survey, and Structural Equation Modelling (SEM)	Factors such as asset quality, original equity holder credit, and institutional capacity play crucial roles in the success of PPP-ABS.
Fleta-Asín and Muñoz, (2021)	institutional and economic environments, project size, political stability	Tobit estimation technique	Nations that possess a consistent macroeconomic climate and strong institutional quality tend to attract substantial levels of public-private partnership (PPP) investment.
Anago, (2022)	Poor preparation of contracts, technical competence of public partner, finance costs, political commitment, knowledge transfer and transparency	Case study	The review highlights the importance of choosing a private partner who can be trusted in terms of both contractual obligations and competence in order to ensure the efficiency of the

			project. Additionally, it proposes the integration of blended finance models into public-private partnership (PPP) frameworks to tackle challenges associated with accessing private finance incentives and enhance the effectiveness of projects.
Chan, Sadeq, Fadhil, Cristofaro, and Sarvari, (2022)	Economic barriers, political barriers, legal barriers and organisational barriers,	Kolmogorov–Smirnov test	The implementation of Public Private Partnership (PPP) comprehensively is the solution to Nigeria's infrastructural deficit otherwise achieving sustainable economic growth, seems unlikely.
Toriola-Coker, Owolabi, Alaka, Bello, and Pathirage, (2023)	The safety measures implemented by contractors, the socio-economic impact of the project, the realisation of benefits, community engagement, the creation of employment opportunities for local residents, the enhancement of local infrastructure, the repair of minor roads, the preservation of natural habitats, the prevention of water and air pollution, and the management of noise levels.	Case study	Public-private partnership (PPP) in construction infrastructure has garnered considerable interest in developing nations, mirroring its success in developed countries.

Kharb, Shri, and Saini (2024)	GDP per capita income, political environment (PE), information communication technology (ICT), financial policy and regulations	Total Interpretive Structural Modelling (TISM) method, Matriced' Impacts Croises Appliquee Aaun Classement (MICMAC) approach	Domestic capital market should be considered as an alternative road infrastructure funding model in Nigeria.

The reviewed studies provide valuable insights into different aspects of infrastructure development. However, certain limitations impede a comprehensive understanding of alternative infrastructure funding models (AIFMs) in Ghana and Nigeria.

One constraint is the exclusive emphasis on social and environmental consequences. The case study conducted by Toriola-Coker et al. (2023) provides insight into the significant social and environmental factors associated with Public-Private Partnerships (PPPs). Nevertheless, it does not explicitly tackle the funding models that this study aims to analyse. An examination that compares the structure and funding of Public-Private Partnerships (PPPs) in Ghana and Nigeria would be more pertinent.

One additional constraint is the absence of comparative analysis in certain studies. The research conducted by Chan et al. (2022) identifies the obstacles hindering the implementation of Public-Private Partnerships (PPP) in Nigeria, providing valuable insights. However, to enhance the comparative nature of this research, it is necessary to conduct studies that investigate similar challenges and potential solutions in Ghana. Similarly, Kharb, Shri, and Saini (2024) emphasise the domestic capital market as a

potential Alternative Infrastructure Funding Model (AIFM), but a more comprehensive approach would involve comparing it with Ghana and discussing AIFMs beyond Public-Private Partnerships (PPPs).

Many studies employ case studies to illustrate the difficulties linked to public-private partnerships (PPPs), but they do not include quantitative data analysis. Both the study conducted by Anago in 2022 and the research conducted by Babatunde et al. in 2014 belong to this particular category. Although these studies provide valuable qualitative insights, the inclusion of quantitative data analysis using econometric models would enhance the research and enable more rigorous comparisons between Ghana and Nigeria.

Some studies extend their focus beyond the boundaries of the specific research question. Mbithi (2017) investigates the factors that influence the funding of road projects in Kenya. Although this research is pertinent to the broader subject of infrastructure development, it does not directly pertain to the specific circumstances of Ghana or Nigeria. Chami (2015) examines the overall advantages of public-private partnerships (PPPs) in financing road projects, but does not provide a comparative view or in-depth analysis of different funding models. Fleta-Asín and Muñoz (2021) analyse overall trends in PPP investments, but their study does not specifically focus on AIFMs involved in infrastructure development in Ghana or Nigeria.

Some studies focus on a particular financing technique within a larger model. The research conducted by Liu et al. (2021) offers a compelling illustration, specifically examining the key determinants of success for PPP-ABS (securitisation of PPP projects). This research would be enhanced by conducting a more extensive investigation of different Alternative Infrastructure Funding Models (AIFMs) beyond just Public-Private Partnerships (PPPs), and examining their implementation in both Ghana and Nigeria.

3.6 Impact of Alternative Infrastructure Funding on Development

The compiled literature as shown in table 11 offers a thorough understanding of the connection between alternative methods of funding infrastructure and different indicators of development, such as the development of infrastructure, economic

growth, and social welfare objectives. Although the literature is extensive, there are still several gaps that require further study.

Table 11: Research on the Impact of Road Infrastructure on Development

Reference	**Variables**	**Methodology**	**Key Findings**
Pradhan, and Bagchi, (2013)	Gross Domestic Product, Gross Domestic Capital Formation	Vector Error Correction Model (VECM)	The Indian economy will experience significant growth as a result of the development of transport infrastructure, including both road and rail, as well as increased gross capital formation.
Ivanova and Masarova, (2013)	Employment, wages, consumption, savings, investment, benefits of tourism	Time series and correlation method	Road transport and infrastructure facilitate the movement of individuals and goods, impacting employment levels and living standards. The development of road infrastructure significantly influences tourism growth, foreign investment, and regional development, thereby enhancing overall economic growth.
Siyan, Eremionkhale & Makwe, (2015)	Gross Domestic Product	Regression Analysis	The economic growth in Nigeria is contingent upon the quality and availability of road transport, as well as the level of infrastructure supporting road transport.

			These factors are crucial for facilitating business activities and promoting trade for small and medium size enterprises in Nigeria.
Kalan, (2017)	Road infrastructure capital stocks, road density changes per capita values	Panel data approach	The results indicate that changes in road capital stock or road density per capita do not have a significant impact on the increase in GDP levels for Turkey. If there is already enough capacity, building an extra road will provide diminishing marginal benefits for welfare. In addition, it is important to consider alternative modes of transportation for future studies in this field.
Ng, Law, Jakarni, and Kulanthayan, (2019)	Per capita export, per capita education expenditure and physical capital stock per worker	Panel-Data Regression Analysis	In order to achieve sustainable economic growth, it is crucial to implement road infrastructure development policies in conjunction with other socio-economic and urban growth policies.
Wang, Lim, Zhang, Zhao and Lee, (2020)	geographical distance, economic distance, cultural distance, institutional distance spatial weight matrices	Global Moran's *I* and local Moran scatterplots	One of China's most ambitious initiatives, the Belt and Road Initiative (BRI) has enormous potential to boost

			regional economic growth in Asia, Europe, and Africa.
Magazzino, and Mele, (2021)	Cultural, political, and financial situation	Time Series	The economy's response to changes in socioeconomic structures is generally influenced by the dynamics affecting transport infrastructure.
Zhang and Cheng, (2023)	Road length (ROAD), the length of electrified rail routes (ELEC), and air-transport freight volume (AIR)	Vector Error Correction Model (VECM)	Road transport and infrastructure facilitate the movement of individuals and goods, impacting employment levels and living standards. The development of road infrastructure significantly influences tourism growth, foreign investment, and regional development, thereby enhancing overall economic growth.
Nenavath, (2023),	Per capita income, human development index, GDP growth	ARDL models	India's infrastructure has a long-term positive effect on economic growth. Furthermore, the Granger causality test reveals a one-way relationship from transport infrastructure to economic development.

Khatoon, (2023)	Infrastructure on economic growth, impact of infrastructure on welfare	Panel-Data Regression Analysis	Infrastructure plays a crucial role in determining the distribution of wealth, income, and welfare.

Existing research has primarily focused on the impact of infrastructure development on economic growth, but there is a lack of specific research comparing different infrastructure funding models in Ghana and Nigeria. The studies conducted by Pradhan and Bagchi (2013), Ivanova and Masarova (2013), and Siyan, Eremionkhale & Makwe, (2015) primarily highlight the significance of infrastructure in promoting economic activity. Nevertheless, they fail to directly compare various funding models and their consequences for development outcomes in Ghana and Nigeria.

Furthermore, the current body of research primarily depends on conventional econometric techniques, such as regression analysis and time series analysis, to investigate the correlation between infrastructure funding and development indicators. Although these methods provide valuable insights, they may not fully capture the complex interactions and long-term impacts of alternative funding models on development outcomes. The application of Vector Error Correction Models (VECM) by Pradhan and Bagchi (2013) and Zhang and Cheng (2023) signifies a progression in capturing dynamic relationships. Nevertheless, further investigation employing these econometric methodologies within the specific contexts of Ghana and Nigeria is necessary to offer a comprehensive comprehension of the subject matter.

Furthermore, there is a scarcity of research that specifically examines the social welfare aspects of alternative models for funding infrastructure. Although Ivanova and Masarova (2013) recognise the wider socio-economic consequences of infrastructure development, there is a requirement for more thorough examinations that explicitly evaluate the impacts of various funding models on social welfare indicators, such as the reduction of poverty, access to essential services, and the mitigation of inequality.

In essence, the literature review emphasises the necessity for additional research that fills these gaps through a comparative examination of different infrastructure funding

models in Ghana and Nigeria. This research should employ advanced econometric techniques and consider a wider array of development indicators.

3.7 Conceptual Framework

In academic research, a conceptual framework is a theoretical structure that offers a comprehensive understanding of the phenomena being studied. The research process is guided by a collection of interconnected concepts, definitions, and propositions. Primarily, it functions as a guide for researchers, aiding them in structuring their ideas, identifying crucial variables, and establishing connections among them. (Jha, Chikhalkar, Kharat & Kharat, 2018).

Figure 6 presents the conceptual framework for this study, visually representing the key variables and their interrelationships as derived from the literature.

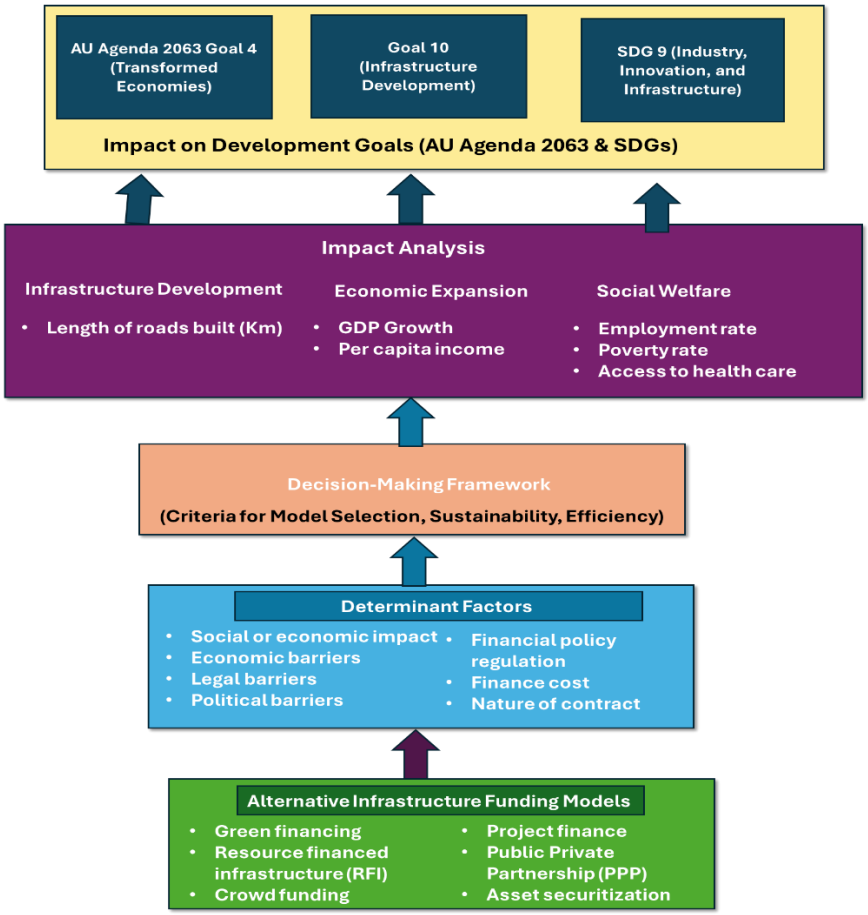

Figure 6: Conceptual Framework
Source: Student's own conceptualisation from literature

The conceptual framework of the study will include concepts pertaining to infrastructure funding, economic development, social welfare, and decision-making processes, in accordance with the outlined research objectives. The framework will incorporate theoretical perspectives such as Wagner's law of increasing state activity, innovation dilution theory, and financial theories. It will also consider the development agendas outlined by the African Union's (AU) Agenda 2063 and the United Nations' Sustainable Development Goals (SDGs), specifically Goal 4 (Quality Education), SDG 9 (Industry, Innovation, and Infrastructure) and Goal 10 (Reduced Inequalities).

This framework is applicable to the study because it presents a systematic way in which the relationship between infrastructure funding models and their effects on development outcomes in Ghana and Nigeria can be analysed. The conceptual framework will start with the analysis of the different models of infrastructure funding that are actively being used in Ghana and Nigeria, such as Public-Private Partnerships (PPPs), green financing, and resource-financed infrastructure (RFI). The evaluation of these models is conducted to determine the extent to which they help overcome the infrastructure deficit and stimulate the economy and social growth. The framework subsequently identifies determinant factors such as economic barriers (for instance cost of finance), legal barriers (for instance, regulatory frameworks) and political barriers (such as policy instability) that contribute to the adoption and success of such types of funding. In the case of Ghana, PPPs have been successfully implemented, thereby in benefiting in terms of the road infrastructure, whereas in Nigeria there has been political and economic obstruction to its progress in the same respect. The last part of the framework looks at the effects and implication of these models with regard to major development indicators which include the development of infrastructure, economic development, social welfare, providing a decision-making tool to policy makers on sustainable and effective models of funding that should focus on the specific contexts of Ghana and Nigeria.

Overall, this conceptual framework arranges variables in alignment with the study's four research objectives (see Section 1.3). These include determinant factors that influence the acceptance and use of alternative infrastructure funding models (Objective 2), and establish the overall effect of infrastructure on GDP (Objective 3). These objectives which work together to help shape the proposed decision-making

framework for long-term funding (Objective 4). The framework indicates these components explicitly for clarity; nonetheless, their interrelationships are empirically tested in Chapters 5, 6 and 7 through comparative analysis and statistical tests.

Building on the analysis of funding models and their impacts, this research presents a decision-making framework that aims to choose and implement infrastructure funding models that are efficient and sustainable. The study customises this framework to suit Ghana and Nigeria's unique circumstances, taking into account the identified determining factors and findings from the impact analysis. The objective is to offer optimal guidelines and standards for policymakers and stakeholders to select the most suitable funding models, guaranteeing enduring advantages and sustainable progress.

3.8 Conclusion

The analysis of existing research was crucial to understanding the alternative models' landscape for funding road infrastructure in Ghana and Nigeria. The literature has identified the factors for the acceptance of alternative funding models in Ghana and Nigeria, as well as the economic variables that affect the development of road infrastructure. However, the significance of these factors varies depending on the jurisdiction, methodology, or sample period of the study. Conducting focused research on Ghana and Nigeria is crucial for developing effective policy strategies. Moreover, this chapter demonstrates the limited extent of research conducted on alternative funding models in Ghana and Nigeria. Therefore, the current study aims to address this gap by specifically examining alternative road infrastructure funding models in these two countries. In the following chapter, the study will focus on the methodology employed to address the research questions.

Chapter Four
Research Methodology

4.1 Introduction

This chapter presents the methodologies that were used to achieve the objectives of this study. The chapter commences by providing a clear elucidation of the research paradigm, approach, and design. The chapter provides additional clarification on the concepts of population and sampling, as well as the methodologies employed for data collection in the study. Following the nature of the research objectives, a mixed-method approach was used. Objective 1 was answered through a qualitative integrative literature review, and the remaining objectives (2-4) were answered through the quantitative form of econometric modelling. The study provided an explanation of the econometric models and estimation techniques utilised. The objectives of the study are as stated in Section 1.3 in Chapter 1 of this thesis.

4.2 Research Paradigm

The positivist paradigm served as the main philosophical framework for conducting this study. Positivism is an appropriate research methodology because it is based on the idea that knowledge is derived from natural phenomena, their characteristics, and relationships, as understood through reason and logic (Bryman, 2012). According to the positivist paradigm, knowledge is derived from observations of the world made from a free and objective position. The world is said to be external and objective (Cohen, Manion & Morrison, 2007). This approach fits with the research's objective, which used secondary data to objectively analyse and compare the results of alternative infrastructure funding models in Ghana and Nigeria. According to the positivist perspective, the ontological premise of this research is that there is a single, observable, and quantifiable reality (Creswell & Plano Clark 2011). This reality, in the context of the research, relates to the models for funding infrastructure and their observable effects on growth in the economy and social welfare in the countries chosen for the research. The research's epistemological premise is that by gathering and analysing quantitative data, knowledge about these funding models and their effects is objectively identified and understood (Creswell & Plano Clark, 2011). The positivist paradigm is consistent with the axiological assumption of this study, which holds that the research can and should be conducted without regard to the researcher's personal beliefs or values. Nonetheless, to best achieve Objective 1,

which entailed synthesising extant conceptual and empirical knowledge on alternative infrastructure funding models, this research took a pragmatic standpoint that enabled the application of an integrative literature review as a qualitative study method. Pragmatism embraces pluralism in methods and acknowledges that it is necessary to use alternative types of evidence to address various research questions (Creswell & Plano Clark, 2011; Tashakkori & Teddlie, 2010). This allowed the study to form a meaningful inference of both empirical and conceptual trends.

By following a structured and systematic process, this research will adhere to the positivist principles. This study made use of secondary data, and since these data are objective, they support the positivist idea that research should be observable and empirical (Cohen et al., 2007). The findings enabled evidence-based recommendations for policy decisions by enabling an objective comparison of the effectiveness of various funding models by using statistical analysis to address the research questions. At the same time, pragmatic components guaranteed that the study remained grounded by a scoping policy literature, theoretical models, and implementation realities.

4.3 Research Approach

In this study, a mixed-methods approach was adopted to address the research objectives. The study is primarily quantitative, using secondary data. Secondary data analysis refers to the use of data that has already been collected for another study. This approach is particularly helpful because it gives the researcher access to a lot of data that would otherwise be expensive or time-consuming to gather independently. Additionally, it enables the examination of trends over time and can provide a wider perspective than data gathered at a single point in time (Johnston, 2014).

In addition to the quantitative component, the qualitative approach of research was applied to respond to Objective 1 by using the integrative literature review (ILR). It was a conceptual and empirical study and a synthesised review that was used to analyse the evolution, typologies, and contexts of alternative infrastructure funding models. The qualitative method provided an opportunity to learn more about the theoretical and practical knowledge, which then became the foundation of the quantitative study.

4.4 Research Design

The research design is the broad approach that researchers use to specifically address the study's purpose, in order to either reply to the research question(s) or test a stated hypothesis or group of hypotheses. The study's goals, the research question(s), or the testing of research hypotheses must "fit" the research design that is being employed (Novosel, 2022). Following the mixed-method approach in the study, a dual-design structure was used. Under Objective 1, a qualitative research design was adopted to make use of the integrative literature review (ILR) method. This involved a review of peer-reviewed scholarly articles, policy reports, and institutional reports to understand the conceptual and contextual framework of alternative infrastructure funding models in Ghana and Nigeria. This design facilitated the development of a theory-based background and classification of funding models applicable to Ghana and Nigeria. The ILR was not used just to establish the background but as a specific methodological component that facilitated analytical generalisation and conceptual clarity (Whittemore and Knafl, 2005; Torraco, 2005; Snyder, 2019). The choice to combine this qualitative technique with econometric analysis is aligned with the pragmatic paradigm of research, which highly regards methodological pluralism and strives to utilise every applicable means to realise answers to research questions (Tashakkori and Teddlie, 2010; Creswell and Plano Clark, 2011)

For objectives 2 to 4, the research design was presented in the form of a comparative, longitudinal (time-series) study based on the analysis of secondary data. This design was suitable due to the fact that the data ranged 2003-2023, and thus the trends and long-term changes in the alternative infrastructure funding models in Ghana and Nigeria can be examined. In this study, a comparative design was used to look at the similarities and differences between Ghana's and Nigeria's alternative infrastructure funding models. This comparative approach helped to identify trends and differences between these two contexts while also shedding light on the unique dynamics of alternative infrastructure funding in each nation. This methodology is especially appropriate for this study because it enables a thorough understanding of the phenomenon by comparing and contrasting alternative infrastructure funding models across various countries (Johnson & Christensen, 2019). The study also employed a longitudinal (time-series) design. This approach involves collecting and analysing data

over an extended period (2003 to 2023) to evaluate trends and changes in the adoption and effectiveness of alternative infrastructure funding models in Ghana and Nigeria (Bryman, 2016). This design fits well with the study's goal of understanding the evolution and long-term impact of these funding models.

Building upon the above, the study could not obtain direct and consistent data of each particular funding model, such as public-private partnerships, asset securitisation, or project finance. As a result, the models were rather studied collectively, and their overall impact was examined through real GDP growth (RGDPG) that was used as an outcome variable. The effectiveness of these models was measured indirectly with the observable indicators such as employment changes, poverty reduction, education improvement, electricity access, and healthcare coverage (Işık, Ongan, Islam, Jabeen, & Pinzon, 2024). These indicators were considered as proxies for the effects of alternative infrastructure funding models.

Examining the relationship between these development outcomes and economic growth enables the study to draw some conclusions about the contribution of alternative funding models, collectively, in terms of national development over time.

4.5 Population and Sampling:

The target population used in this study consists of all the major stakeholders involved in the process of planning, funding, and construction of the public road infrastructure projects that have been implemented in Ghana and Nigeria using alternative sources of funding for infrastructure projects. These agencies are government agencies like the Ghana Ministry of Roads and Highways and the Federal Ministry of Works in Nigeria, the private sector companies such as construction and finance companies, and the multilateral development banks such as the African Development Bank (AfDB) and the World Bank.

Due to the dynamic and changing strata of project partnerships and project financing models, it is difficult to create a fixed population frame (Estache, 2004; Hammami, Ruhashyankiko & Yehoue, 2006). Accordingly, the analysis was carried out on the

reachable population, such as projects and organisations where detailed and provable data could be found over the 2003 - 2023 period. This guaranteed academic rigour and admitted the shortcomings of data.

A purposive sampling technique was applied to select representative projects. This approach is widely used in infrastructure and public policy research to ensure inclusion of the most relevant and information-rich cases (Palinkas et al., 2015). The following selection criteria were adopted: the scale of the project (large/ small), geographic location (urban/ rural), type of funding, such as PPPs, green finance, and status of the project (completed, ongoing, abandoned).

The selection of Ghana and Nigeria was not random and is linked to the fact that both countries have large economies, experience serious infrastructure requirements, and a wide range of experience in alternative types of funding (Debela, 2021; Akomea-Frimpong et al., 2021). This comparative approach also presents data on the influence of context on implementation and the outcomes.

Where no information was available on a particular model of funding, this study assessed the use of these models by evaluating the projects that fall within the categories on the basis of their nature, including funding mechanism, cost and stage of delivery. The success of such projects was evaluated using measurable proxies, that is, the number of roads built, employment change, access to electricity, and better education and access to health care, with the impact studies of comparable infrastructure projects (Magazzino & Mele, 2021).

In summary, although not every actor or project in the population could be included, the sample reflects a broad and reliable picture of alternative infrastructure funding in practice. It balances academic rigour with practical feasibility, offering valuable findings for both scholarship and policymaking.

4.6 Sources of Data

Secondary data was collected for this study, specifically documentary secondary data. Documentary secondary data can be modified over time and space and afterwards

examined for a purpose other than that for which it was originally gathered, since, unlike the spoken word, they endure physically (even digitally) as facts (Hancock, Mueller & Stapleton, 2010). This study also collected descriptive numerical data for analysis. Documentary analysis is an ideal method of gathering information from a wide range of institutions because reports/documents are readily available and, in the case of public organisations, are in the public domain.

According to this study's objectives, a multiplicity of secondary data sources was used to conduct a thorough analysis of alternative infrastructure funding models in Ghana and Nigeria. Academic databases, country-specific reports from the Governments of Ghana and Nigeria, respectively, the World Bank's Private Participation in Infrastructure (PPI) database, the World Bank's Development Indicators (WDI) database, International Monetary Fund (IMF) reports, and African Development Bank (AfDB) reports was used to find this information. Annual data spanning two decades on the variables under study was collected and used for the analysis. Infrastructure values were all denominated in United States (US) Dollars to allow for uniformity. Data used for research analysis was denominated in the same currency units, which is why this study opted for the US Dollars for infrastructure variables to allow for uniform interpretation. It must be noted that this study used the variables as reported by the aforementioned institutions. Secondary data provides a quick and easy way to gather a lot of information without having to conduct primary data collection. However, it is crucial to make sure that the data are accurate, relevant to the research objectives, and from reliable sources (Saunders et al., 2019).

To ensure broad time coverage, annual data between 2003 and 2023 were compiled. The selected span of time was chosen in order to show the evolution of alternative infrastructure funding models across 20 years, and how the policies, economic conditions, and funding patterns changed.

Overall, the sources used were selected due to their credibility, reliability, and development of infrastructure and finance relevance. Their application made it possible to make strong conclusions from the study using correct and comparable data from the two countries.

In conclusion, careful delineation and an understanding of these dependent and independent variables were essential because they serve as the foundation for the research's data collection.

4.7 Data Analysis

The procedure for data analysis was underpinned by the overarching aim of ensuring both the reliability and the validity of the findings. Initially, the data went through a pre-processing stage to ascertain its integrity and suitability for subsequent analysis. This entailed the handling of inconsistencies, the imputation of missing values, and the identification and management of outliers (Templ, 2023). The cleansing of the data is essential for establishing a robust foundation for the ensuing econometric analysis.

The approach of data analysis was informed by the mixed-method design of the research. Objective 1 was covered by an integrative literature review (ILR) qualitative analysis. It included thematic synthesis of published research, policy papers and institutional reports on alternative infrastructure funding models. The ILR allowed the determination of theoretical gaps, emergent model typologies, and contextualization to African and national policy landscape. It was also directly related to making up the conceptual framework, which is found in Chapter 8.

For the quantitative objectives (2-4), time series econometric techniques were employed. Research Objective 2 is where Multiple Linear Regression, specifically Ordinary Least Squares (OLS), was applied to understand the direct associations between indicators of infrastructure and economic growth. In estimating the linearities of relationships between variables, OLS is popularly applied in infrastructure and development studies (Gujarati, 2004). This model was appropriate for examining the strength and direction of these relationships using annual macroeconomic data.

This is also in line with other empirical approaches which have been applied previously in similar research works with data constraints on particular funding models. As an illustration, Yurdakul and Kamasak (2020) explored the effects of PPPs on the GDP growth in Turkey, explaining that at the time of the study, no direct financial information on each form of funding was publicly available, precisely why the authors chose the

number of PPP projects to measure infrastructure investment. Similarly, the study employs other observable development variables such as length of road, availability of electricity connection and employment as proxies to measure the overall impact of alternative infrastructure funding models on real GDP growth.

Research Objective 3 was analysed using the Autoregressive Distributed Lag (ARDL) model, which allowed the study to estimate both short-run and long-run effects of infrastructure-related indicators on GDP growth. The ARDL model is suitable for the study of empirical time series in empirical research that involves a variable combination of I (0) and I (1) (Pesaran, Shin & Smith, 2001). The recommended reason why the model of ARDL was selected was due to the mixed order of integration variables involved, where some were I(0) and others I(1). ARDL used was an appropriate model in the present structure of data. The lag structure was selected based on the Akaike Information Criterion (AIC), ensuring statistical rigour.

To assess the direction of influence between variables, Granger causality tests were conducted. Granger (1969) introduced Granger causality testing, which is often applied in macroeconomic studies in order to measure predictive associations. These tests assisted in ascertaining whether it was possible to predict change in one variable by change in another as opposed to mere correlation.

Research Objective 4 was fulfilled using the outcomes from the earlier specified research objectives, culminating in the proposed decision-making framework on alternative funding models.

These techniques gave an option in the manipulation of data time series, and the analysis was able to form patterns and associations that are significant to policy and planning.

4.8 Econometric Models

4.8.1 Introduction to Econometric Modelling

This study used secondary data for empirical analysis, similar to earlier studies on PPP infrastructure investments (Jensen & Blanc-Brude, 2006; Sharma, 2011;

Panayides, Parola, & Lam, 2015; Mundonde, 2022). This study uses a quantitative approach to modelling to evaluate the effect of alternative infrastructure funding models on real economic growth/ development outcomes in both Ghana and Nigeria. The outcome variable is RGDPG, which denotes real national income growth. Nevertheless, due to the difficulty in isolating direct quantitative effects of a particular infrastructure funding model, like Public-Private Partnerships (PPPs), Asset Securitisation, and Project Finance, over time, this study approximates the collective effect of these infrastructural models using their contribution to RGDPG.

In order to quantify this impact in an observable manner, the paper regresses RGDPG with a set of independent variables dictating the effects of these alternative funding models. These are infrastructure related development indicators which are Length of Roads Built (LR), Number of households with Access to Electricity (NHE), Access to Healthcare (AHC), Per Capita Income (PCI), Change in Employment Rate (CEI), Change in Poverty Rate (CPR) and Improvement in Educational Attainment (IEA).

By doing this, the study creates a reliable empirical framework to estimate how the outputs of alternative infrastructure funding models impact national development. Three models were employed for this purpose. These were Multiple Linear Regression (OLS) to estimate direct effects of the explanatory variables on economic growth (RGDPG), the Autoregressive Distributed Lag (ARDL) Model to estimate both short-run and long-run dynamics, and the Granger Causality Test (within the ARDL framework) to determine predictive causal relations between variables.

This modelling structure offers both robustness and flexibility and is suitable for macroeconomic datasets with mixed stationarity properties.

4.8.2 Specification of the Multiple Linear Regression Model (OLS)

To examine the direct influence of alternative infrastructure funding outcomes on national income growth, the study employed a Multiple Linear Regression (OLS) model. This model estimated the linear relationships between real GDP growth (RGDPG) and key explanatory variables that serve as proxies for the effectiveness of infrastructure funding outcomes. The regression model was used specifically to

address Research Objective Two, which seeks to identify the main factors that influence the acceptance of alternative infrastructure funding models in Ghana and Nigeria. The statistical measurement allowed a complete description of the data to be employed in the study.

In examining the nexus of Alternative Infrastructure funding models and growth, this study followed Dele (2007) and specified the growth of output explained by quantitative easing and other relevant variables. The study was built on previous works that explicitly modelled the externalities of public infrastructure investment (Estache, Perrault & Savard, 2012). The closest work to this study is that of Boccanfuso et al. (2014).

The functional form of the model, which regresses economic growth on alternative infrastructure funding models plus other variables, is given as:

$$\mathrm{RGDPG} = \mathrm{f}\,(\mathrm{PCI}, \mathrm{CEI}, \mathrm{CPR}, \mathrm{IEA}, \mathrm{LR}, \mathrm{NHE}, \mathrm{AHC}) \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 4.1$$

where *RGDPG* is defined as real growth of national income, *PCI* as Per Capita Income, *CEI* as Change in Employment Rate, *CPR* as change in Poverty Rate, *IEA* as Improvement in educational attainment, *LR* as Length of road built, *NHE* as Number of households with access to electricity and *AHC* as access to health care.

The mathematical form of equation 4.1 is given as:

$$RGDPG_t = \beta_0 + \beta_1 PCI_t + \beta_2 CEI_t + \beta_3 CPR_t + \beta_4 IEA_t + \beta_5 LR_t + \beta_6 NHE_t + \beta_7\, AHC + \varepsilon_t \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 4.2$$

where β_0 is the intercept capturing autonomous real growth, β_1, β_2, β_3, β_4, β_5 β_6, *and* β_7 as coefficients of Real growth of national income, Per Capita Income, Change in Employment rate, Change in Poverty rate, Improvement in educational attainment, Length of Road Built, Number of households in access to electricity, and Access to Health care, respectively. *t* represents the time series property of the variables, and ε is the disturbance error term.

Gujarati (2004) notes that transforming certain variables to their natural logarithm forms may lead to better results as the magnitude of the variables is reduced. Coefficients can also be interpreted as elasticities if both dependent and independent variables are in the logarithm form.

As such, a level-log model will be employed, which is given as:

$$RGDPG_t = \beta_0 + \beta_1 PCI_t + \beta_2 \ln(CEI_t) + \beta_3 \ln(CPR_t) + \beta_4 \ln(IEA_t) + \beta_5 \ln(LR_t) + \beta_6 \ln(NHE_t) + \beta_7 \ln(AHC_t) + \varepsilon_t \quad \ldots\ldots 4.3$$

This model allows the researcher to find out how a percentage change in these explanatory variables will have a unit effect on the dependent variable (Gujarati, 2004).

4.8.3 Specification of the ARDL Model and Rationale

This research study utilised the Autoregressive Distributed Lag (ARDL) model to analyse the short-run and long-run relationships between real economic growth and infrastructure-related socio-economic variables. This model was chosen because of its flexibility in being able to work with datasets where variables are comprised of different orders. To be a common element of macroeconomic time series data (Pesaran & Shin, 1997; Pesaran, Shin, & Smith, 2001), it has an I(0) and I(1) and not an I(2).

The general form of the ARDL model used in this study is given as follows:

$$\Delta RGDPG_t = \alpha_0 + \sum_{i=1}^{p} \beta_i \Delta RGDPG_{t-i} + \sum_{j=0}^{q1} \gamma_j \Delta PCI_{t-j} + \sum_{k=0}^{q2} \delta_k \Delta CEI_{t-k} + \sum_{l=0}^{q3} \theta_m \Delta CPR_{t-1} + \sum_{m=0}^{q4} \emptyset_m \Delta IEA_{t-m} + \sum_{n=0}^{q5} \psi_n \Delta LR_{t-n} + \sum_{o=0}^{q6} \lambda_o \Delta NHE_{t-0} + \sum_{r=0}^{q7} \kappa_r \Delta AHC_{t-r} + \rho ECT_{t-1} + \varepsilon_t \quad \ldots\ldots 4.4$$

Where:

RGDPG = Real economic growth

PCI = Per Capita Income

CEI = Change in Employment Rate

CPR = Change in Poverty Rate

IEA = Improvement in Educational Attainment

LR = Length of Roads Built

NHE = Number of Households with Access to Electricity

AHC = Access to Health Care

Δ = First difference operator

ECT_{t-1} = Error correction term lagged one period

α_0 = Intercept

β_i, γ_j, $\delta_{k,}$ θ_m , $\emptyset_m$, ψ_n, λ_o , κ_r = Short-run dynamic coefficients

ρ= Speed of adjustment coefficient

ε_t = Error term

The reason for using the ARDL model is that it is fairly efficient and unbiased when the sample is small, and also it has the added benefit that both short-run and long-run effects are distinguished in a single-regressions system. In addition, the ARDL bounds testing method enables strong inference of long-run associations without necessitating that the variables included be of equivalent order of integration, as long as none is I(2). The method is especially convenient in the applicability of this study since the unit root tests denoted a combined element of I(0) and I(1) variables in the Ghana and Nigeria variables. Thus, ARDL methodology not only reflects the integration order, but also gives some insight into the impact of the alternative infrastructure funding models on the economic growth in both countries.

4.8.4 ARDL Lag Length Selection and Bounds Test Procedure

Prior to the estimation of the ARDL model, there was a need to establish the suitable lag length for each individual variable. The Akaike Information Criterion method (AIC) was chosen as a way of determining the best lag length in this research since this approach balances parsimony and model fit and is best applied in small and medium-sized samples. Each country was considered separately in its lag order selection, as an unrestricted VAR model structure was used after stationarity of the variables was established.

The ARDL(1,1,1,0,1,1,1,0) specification was obtained in the Ghana model, where the structure of optimum lags yielded by the AIC guide was used. In the case of Nigeria, the best specification was ARDL (2,1,2,1, 2, 2, 2, 1). Such different lag structures agree with the fact that these relationships are dynamic, and their interaction is with variables of macro-economic and infrastructure-connected nature within each country (Pesaran, Shin, & Smith, 2001).

Having defined the model, the Bounds Test of cointegration is used to test the existence of a long-run relationship among the variables. The bounds testing procedure, developed by Pesaran et al. (2001), is particularly useful when the variables are integrated of mixed orders, I(0) and I(1).

The null hypothesis of the bounds test is that there is no long-run relationship among the variables:

Null Hypothesis (H_0):

$H_0: \lambda_1 = \lambda_2 = \cdots = \lambda_k = 0$

(There is no long-run relationship among the variables.)

Alternative Hypothesis (H_1):

$H_1 : At\ least\ one\ \lambda_i \neq 0$

(There exists a long-run relationship among the variables.)

The F-statistic calculated using the bounds test of ARDL is compared with critical values of I(0) and I(1) calculated (Pesaran et al., 2001). When the F-statistic is greater than the upper limit, it rejects the null hypothesis that there was no cointegration, and there must then be a long-run relationship. When the statistic is less than the lower bound, then the null hypothesis cannot be rejected. The number between implies indecisive evidence.

Under both the Ghana and Nigeria models, the F-statistic indicates that the bounds test exceeded the upper critical bound at a level of significance of 5 per cent, thus proving the presence of a long-run association among variables. This validation

enabled the analysis of the study to continue, making an estimation of the long-run dynamics and also short-run dynamics by using the ARDL Error Correction Model (ECM) framework.

4.8.5 Estimation of Long-Run and Short-Run ARDL Results

In line with the ARDL bounds testing procedure provided by Pesaran et al. (2001), the analysis produced both long-run and short-run relationships between RGDPG and major explanatory variables. The ECM framework helped in the interpretation of short-run behaviour and the change to long-run equilibrium (Engle & Granger, 1987). The methodology is suitable when dealing with models of variables that have been integrated at unequal levels as evidenced in previous works (Pesaran & Shin, 1999).

4.8.6 Granger Causality Tests

To determine the direction of influence between variables, the study applied the Granger causality test following the estimation of the ARDL model. Granger causality analysis is based on the principle that a variable X Granger-causes another variable Y if past values of X provide statistically significant information about future values of Y, beyond what is contained in the past values of Y alone (Granger, 1969).

Within the context of the study, the test was applied to determine the predictive value of infrastructure-related variables such as per capita income (PCI), change in employment rate (CEI), and access to health care (AHC) over real GDP growth RGDPG, and vice-versa. The test had been conducted on the basis of stability and correctness of the ARDL models, and the validity of the assumptions of the stationarity had been fulfilled by differencing using the stationary values when needed.

Granger causality was applied in the view of the ARDL-ECM framework that enabled the application of the short-run and long-run dynamics. The test aids in finding the predictive relationships in the short run, and in the long run, it determines the causality as evidenced by the significance of the lagged error correction term.

The Granger causality test, based on the null hypothesis, is that the lagged values of the independent variable are not Granger-causing the dependent variable. If this null hypothesis is rejected at conventional significance levels, for instance at 5%, it implies a statistically significant predictive relationship.

This approach adds an important layer to the analysis by revealing not just correlation, but potential causal linkages, offering richer insight into the effectiveness of alternative infrastructure funding models. The direction and strength of these causal relationships are discussed in detail in Chapters 5 and 6, in line with the empirical results for Ghana and Nigeria.

Table 12 explains the variables used in this study and the circumstances under which they were applied in related studies.

Table 12: Notations, Variables and Sources

Notation	**Variables**	**Data sources**	**Supporting literature**
Alternative Infrastructure Funding Models (AIFM)			
AIFM_CapitalRaised	Amount of capital raised through each funding model	Ghana Infrastructure Investment Fund (GIIF), World Bank PPI database, Ghana, Ministry of Finance, Bank of Ghana, Nigeria Infrastructure Concession Regulatory Commission	Akomea-Frimpong, Jin, Osei-Kyei and Kukah (2021); Anago (2021); Kavishwar (2022); Debela (2019); Cherkos and Jha (2021); Osei-Kyei and Chan (2018); (Akanyonge 2022)

		(ICRC), Nigerian Investment Promotion Commission (NIPC), Central Bank of Nigeria (CBN)	
AIFM_EconomicExpansion	Economic expansion linked to each alternative funding model	IMF's World Economic Outlook (WEO) database, World Bank's World Development Indicators (WDI) database, AfDB's African Economic Outlook database, GIIF, ICRC	Mukoki, (2022); Khan, Zhang, Kumar, Zavadskas and Streimikiene (2020); Goodfellow (2020); Tsaurai and Ndou (2019)
AIFM_SocialWelfare	Impact of alternative funding models on social welfare outcomes	PIDG database, World Bank PPI database, IMF WEO, World Bank PPI database, GIIF, ICRC	Noorzai (2020); Khan, Zhang, Kumar, Zavadskas and Streimikiene (2020);

AIFM_InfrastructureDevelopment	The level of infrastructure development associated with each alternative funding model	PIDG database, World Bank PPI database, IMF WEO, World Bank PPI database, GIIF, ICRC	Magazzino and Mele (2021); Välilä (2020); Broniewicz and Ogrodnik (2020)
Economic and other control variables			
CGDP	% change in GDP	World Bank WDI database, IMF WEO database, AfDB's African Economic Outlook database, Ibrahim Index of African Governance (IIAG)	Omodero (2019); Nnamdi and Yusuff (2019)
PCI	Per capita income	World Bank WDI database, IMF WEO database, AfDB's African Economic Outlook database, Ibrahim Index of African Governance (IIAG)	Gil-Alana, Mudida and Zerbo (2021); Ogbuji, Mesagan and Alimi (2020); Semanou and Uslu (2019)

CEI	% change in employment rate	Ghana Statistical Service (GSS), Nigeria National Bureau of Statistics (NBS), International Labour Organization (ILO) World Employment and Social Outlook Database, Ibrahim Index of African Governance	Gaddis, Oseni, Palacios-Lopez and Pieters (2022); McMillan and Zeufack (2021)
CPR	% change in poverty rate	GSS, NBS, World Bank WDI database, Ibrahim Index of African Governance	Aderogba and Adegboye (2019)
IEA	Improvement in educational attainment	World Bank WDI database, GSS Ghana Multiple Indicator Cluster Survey (MICS) database, NBS	Oladosu, Chanimbe and Anaduaka (2022); Kaiser and Barstow (2022); Olatunji, Yoade and

		Nigerian Education Data Survey (NEDS) database, UNESCO Institute for Statistics (UIS) Global Education Database, Ibrahim Index of African Governance	Adeyemi (2021)
LR	Length of roads built (Km)	World Bank WDI database, GSS, NBS, Ibrahim Index of African Governance, World Bank PPI database	Onokala and Olajide (2020)
NHE	number of households with access to electricity	World Bank WDI database, GSS, NBS, Ibrahim Index of African Governance (IIAG)	Tehero (2021); Anoke (2022)
AHC	Access to health care	World Bank WDI database, GSS, NBS, Ibrahim Index of African	Amedari and Ejidike (2021); Ikenyei Ngozi and Julie (2022);

		Governance (IIAG)	Mensah, Huchet-Bourdon and Latruffe (2014)

Source: Author's own conceptualisation

In order to perform a precise regression analysis, the stationarity of time series data is first validated using the Augmented Dickey-Fuller test (Chang & Park, 2002).

4.9 Estimation Strategy

This section will present the estimation procedures adopted to find the effect of factors that influence Ghana and Nigeria's acceptance and use of alternative infrastructure funding models. Time series analysis requires stability in the data and parameters for the estimation (Gujarati, 2004). For this reason, this study followed three (3) main steps to estimate the partial effects of the explanatory variables on development outcomes. The stationarity properties of all variables were tested using the Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests to avoid the risk of spurious regression results, especially when using annual macroeconomic data (Sackey & Atogebania, 2017). To solve this, all non-stationary variables were differenced once prior to their inclusion in the estimation to ensure stability of data with respect to ARDL and OLS estimation. This aligns with the macroeconomic instability commonly seen in developing economies (Gujarati, 2004; Brooks, 2014). Consequently, post-estimation diagnostics were also performed in the study, such as tests of autocorrelation (LM test), heteroscedasticity (Breusch-Pagan test), normality (Jarque-Bera test) and model specification. Stability tests were performed using Cumulative Sum (CUSUM) and Cumulative Sum of Squares (CUSUMSQ) to ensure parameter constancy of the ARDL model over time.

This combination of these processes and adaptation to empirical data issues enabled the methodology to be solution-focused by means of credible econometric methods in line with the best practice.

4.9.1 The Augmented Dickey-Fuller (ADF) Test

The ADF test may be expressed by the following equation:

$$\Delta Y_t = \alpha_1 + \alpha_2 t + \alpha_3 Y_{t-1} + \sum_{i-1}^{p} \beta_i \Delta Y_{t-1} + \varepsilon_t \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 4.5$$

where Y_t is the time series variable, t is the time/trend variable, α1 and α2 are the estimated parameters, Δ is the first difference operator, β_i is the various estimated parameters of the differenced values of the lagged variables, and ε_t is the white noise error term. Based on Equation 4.5, the hypothesis that there is a unit root, or the time series is unstable: α3 = 0, is tested. If the null hypothesis is rejected, then the series is stable. The series is non-stationary and, as such, possesses a unit root if we fail to reject the null hypothesis. This was tested in Sackey and Atogebania (2017).

4.9.2 Philip-Perron (PP) Test

Philips and Perron (1988) developed a more robust test for stability in time series, which makes non-parametric correction to test statistics by correcting for autocorrelation and heteroscedasticity in the error terms. The PP test can provide mechanisms to deal with deviations from having white noise in the estimated regression. The PP test regression is specified as:

$$\Delta Y_{t-1} = \alpha_0 + \beta Y_{t-1} + \varepsilon_t \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 4.6$$

Based on equation 4.6, this study tested the null hypothesis that β = 0, which proves the existence of a unit root, against the alternative hypothesis of no unit root. If we fail to reject the null hypothesis, then the series is non-stationary, and thus possesses a unit root. If, however, the null hypothesis is rejected, then the series is stable (Egbetunde, 2012).

4.10 Diagnostic and Stability Testing

This study further conducted various diagnostic tests to ensure that the estimates and models are consistent. This study applied the Jarque-Bera test of normality, skewness, and kurtosis to ensure the estimated models, including multiple regression and ARDL, are normally distributed, and the Lagrange-Multiplier (LM) test to ensure the model is free from autocorrelation.

4.11 Discussion of Empirical Results

The results of the estimation techniques employed to answer the research questions will be presented and explained. It particularly presents summary statistics of study variables, the results of stationarity, as well as the findings from the Multiple Linear Regression (OLS), Ganger Causality and the ARDL estimation models that sought to explain the growth of economic output with infrastructure funding and other relevant variables.

4.12 Validity and Reliability

Careful consideration was given to ensuring internal validity, which is a measure of how accurately the research's findings reflect the fact being studied. The threats to internal validity were mitigated by using reliable econometric models, such as the Ordinary Least Squares (OLS) and the ARDL model. These models will be adopted for this study because they are better at capturing both short-run and long-run dynamics among variables, giving a more accurate representation of the underlying relationships. In-depth diagnostic tests will also be performed to make sure that the underlying hypotheses of the econometric models are not flawed, such as tests for serial correlation, heteroscedasticity, and model specification. In effect, the outcomes become more credible as a result.

Adopting a carefully chosen sample that is representative of the larger population will strengthen external validity, which is concerned with the generalisability of the findings beyond the sample used in the study. The information will come from reliable databases and publications, so you can be assured that it is current and pertinent. In order to separate the effects of alternative infrastructure funding models from other confounding factors, control variables must also be used. This guarantees that the findings have wider applicability and are not just artefacts of the sample or environment.

Several methods were used to strengthen reliability, which denotes consistency and repeatability of the findings. To handle anomalies, outliers, and missing values, the data pre-processing stage will first and foremost involve stringent data cleansing

procedures. This is essential to ensuring that the data is free of mistakes that might impair the validity of the conclusions. Additionally, this study's ability to be replicated by other researchers with reliable results is ensured by the use of well-established econometric models and thorough documentation of the methodologies used. In empirical research, this reproducibility is a sign of reliability. Ultimately, a meticulous sensitivity analysis will be carried out to determine how modifications to the models' parameters and assumptions affect the outcomes.

4.13 Proposal of Decision-Making Framework

To establish a strong decision-making framework for infrastructure funding in Ghana and Nigeria, it is necessary to analyse the frameworks created by scholars from around the world. Before reviewing existing frameworks, this study adopts a structured approach to framework development by integrating insights from the analysis of determinant factors influencing infrastructure funding in Ghana and Nigeria. This methodological approach ensures that the proposed framework is both empirically grounded and contextually relevant.

The development of this framework follows an adaptive and comparative approach, incorporating key principles from existing decision-making models while contextualising them to the unique economic, infrastructural, and policy landscapes of Ghana and Nigeria. The process involves three key stages.

The first stage of the process involves a critical assessment of infrastructure funding determinants, ensuring that key economic, social, and institutional factors influencing funding decisions are embedded in the framework. The second stage reviews established decision frameworks (e.g., Camane, 2013; Henn, 2015; Owolabi et al., 2020) to extract key principles relevant to infrastructure funding models in emerging economies. The final stage integrates these insights into a structured framework that aligns with the AU's Agenda 2063 and the Sustainable Development Goals (SDGs), ensuring policy coherence and long-term sustainability.

To establish a strong decision-making framework for infrastructure funding in Ghana and Nigeria, it is necessary to analyse the frameworks created by scholars from around the world. Scholars have researched and developed frameworks, which the

study examines to understand their advantages and potential uses in the specific context of these West African nations.

Camane (2013) presents a systematic structure for evaluating different options for funding infrastructure projects in South Africa. This framework emphasises the importance of project feasibility, which includes taking into account technical, economic, and environmental factors. Financial sustainability is a crucial factor in ensuring that projects generate adequate income or user fees to cover expenses and attract investment. Efficient risk distribution between public and private partners is vital, reducing risks such as construction delays or operational issues. The framework examines different funding mechanisms, such as user fees, government subsidies, public-private partnerships (PPPs), and loans from commercial banks.

In a similar vein, Henn (2015) concentrated on developing a comprehensive financing evaluation framework for public infrastructure projects that considers multiple dimensions. The objective of this framework is to enhance the process of making decisions regarding public infrastructure investment by incorporating a wider array of criteria compared to those typically employed. It utilises a combination of cost-benefit analysis and multi-criteria analysis to assess different financing methods for large-scale infrastructure projects. The framework integrates both financial and non-financial impact metrics to evaluate the funding alternatives from a societal standpoint.

Owolabi et al. (2020) propose a specialised framework for evaluating and analysing risks in public-private partnerships (PPPs) related to infrastructure projects. This framework places a high value on the viewpoint of financiers, with a specific focus on recognising and reducing different risks linked to PPPs, including political risk, construction risk, operational risk, and currency fluctuation risk. Effective methods for reducing these risks involve implementing contractual safeguards, obtaining insurance coverage, and utilising risk transfer mechanisms. Project cash flow analysis is a crucial factor in guaranteeing satisfactory returns for both public and private partners. The framework also assesses the project's long-term viability by evaluating the financial strength of all partners participating in the PPP.

In addition, Kapesa, Mugano and Fourie (2021) provide a more comprehensive outlook on infrastructure development in developing nations, utilising knowledge gained from the Zimbabwean context. Their study focuses on the problem of inconsistent decision-making in Zimbabwe's financing of public infrastructure projects. They contend that a well-defined framework is essential for the efficient and effective allocation of funds. The research highlights a deficiency in the existing literature concerning a comprehensive framework that is specifically tailored for funding public economic infrastructure in developing nations. In order to fill this void, the authors suggest a framework consisting of seven stages. The stages cover the entire process of developing infrastructure, starting with identifying the infrastructure gap and ending with evaluating the project. The intermediate phases include preliminary investigations to determine feasibility, evaluations of potential risks, financing options selection, and project execution with ongoing monitoring. While acknowledging the existence of similar frameworks for water and sanitation projects, the authors distinguish their work by adopting a more comprehensive approach applicable to various public economic infrastructure projects.

Mundonde and Makoni (2024) created a framework model for financing sustainable water and sanitation infrastructure projects in Zimbabwe, focusing on three essential components. Their research specifically focused on Public-Private Partnerships (PPPs) as a means of financing in this sector. They also assessed different financing options that are accessible for PPPs in the water and sanitation sector. Additionally, Mundonde and Makoni (2024) applied the Tobit regression model to analyse the factors that impact the effectiveness of PPP financing for water and sanitation infrastructure in Zimbabwe, concluding that financial market development is pivotal in enhancing the economic and market conditions that render Public-Private Partnerships (PPPs) a feasible financing alternative for these projects.

Through a rigorous examination of these academic frameworks, this study can equally identify the essential components necessary for an effective and enduring infrastructure funding framework in Ghana and Nigeria.

4.14 Ethical Considerations

This study strictly abided by all ethical guidelines of research. No data was collected prior to requesting and receiving ethical approval from UNISA's Department of Finance, Risk Management and Banking's research ethics committee. Additionally, the study acknowledged the work of all scholars by citing their work in-text, as well as including their names in the list of references at the end and as references on all borrowed works.

4.15 Conclusion

This chapter outlined the methodological principles that guided the study. The chapter commenced by providing a summary of the study's goals and objectives. Subsequently, the research paradigm, approach, design, population, sampling, and data sources were elaborated upon more comprehensively. Afterwards, the baseline econometric models were defined. Subsequently, there was an examination of the pre-estimation strategies. The chapter concluded with a concise summary of the ethical considerations.

The following chapter presents the empirical findings obtained from this study, along with the interpretation and discussion of the results.

Chapter Five

Empirical Data Analysis and Interpretation of Findings on Ghana

5.1 Introduction

This chapter presents an empirical analysis of the factors that influence the acceptability and utilisation of alternative infrastructure funding models in Ghana. The chapter begins with a descriptive statistic of the variables, statistical analysis, including Multiple Linear Regression (OLS) and the Autoregressive Distributed Lag (ARDL) model to examine the determining components. It then examines how these funding models (measured by economic growth) are related to key variables, including educational enrolment, access to healthcare, and poverty reduction. Finally, the chapter concludes.

5.2 Descriptive Statistics

This section presents the summary statistics of the variables used in the study. The study commenced by determining the functional form of the model, which regresses economic growth on alternative infrastructure funding models, plus other variables as discussed in Chapter 4.

The data variables that were applicable in this study were RGDPG which is defined as real economic growth, PCI as Per Capita Income, CEI as Change in Employment Rate, CPR as change in Poverty Rate, IEA as Improvement in educational attainment, LR as Length of road built, NHE as Number of households with access to electricity and AHC as access to health care. Using data collected on Ghana, the results are presented in Table 13.

Table 13: Descriptive Statistics of Variables (Ghana)

Variable	Observation	Mean	Std Dev.	Q1	Median	Q3
RGDP	20	4.99	3.29	2.12	4.60	6.86
PCI	20	7.20	0.59	6.95	7.39	7.68
AHC	20	52.50	6.67	47.25	54.20	58.30
LR	20	2.37	0.17	2.25	2.42	2.48
NHE	20	68.04	13.91	56.70	67.45	79.85
IEA	20	0.43	0.79	- 0.08	0.41	0.82
CEI	20	67.26	1.19	66.53	67.45	68.24
CPR	20	4.30	8.27	-	3.67	6.96

Table 13 above presents a summary of the descriptive statistics of the variables used in this study. The table provides information on the means and medians, measures of dispersion (interquartile range) and standard deviations of the study variables.

The results of the descriptive statistics show that, on average, the percentage change of GDP (RGDP) is just below 5 with a standard deviation of 3.29. This suggests a moderate level of variability in RGDP values across the sample used in the study. The result also shows a median value of 4.6 for RGDP with scores ranging from 2.12 to 6.86. These findings indicate periods of economic fluctuation affected by infrastructure development and other macroeconomic factors. The fluctuation in growth underscores the necessity for reliable and efficient infrastructure investment, corresponding with the thesis's emphasis on alternative funding models to promote sustainable and stable economic growth.

In conjunction with this, the result on per capita income (PCI) indicates a mean of 7.20 with a relatively low standard deviation of 0.59 and a median value of 7.39, which is slightly higher than the mean value. The interquartile range, which is calculated as Q3 minus Q1, is 0.73, reflecting less variability in the middle 50% of the PCI values. This indicates that most individuals' incomes are relatively stable, exhibiting minor fluctuations, which signifies a consistent income distribution within the population throughout the study period. This emphasises that, although income levels are stable, there may be a necessity for more focused infrastructure investment to enhance growth and elevate overall income levels further.

Furthermore, the result on access to healthcare (AHC) shows an average value of 52.50 with a standard deviation of 6.67 indicating a moderate level of access to healthcare values. The median value for access to healthcare is indicated as 54.20, with values ranging from 47.25 to 58.30, showing a wider range of values in the central portion of the data. This indicates that although healthcare is accessible to many people, access remains inequitable. There is a necessity for enhanced infrastructure, such as rural clinics, to ensure a more equitable distribution of healthcare access among the population.

In addition, on average, 2.37km of road was built in Ghana each year from 2003 to 2022, with a standard deviation of 0.17. Over the period, the length of roads built ranges from 2.25km to 2.48km, with a median length of road of 2.42km. The consistent yet comparatively low rate of road construction indicates that infrastructure development regarding roads has been stable, albeit constrained. This suggests that

Ghana should expedite road construction initiatives, especially in rural regions, to enhance transportation and stimulate economic activities, such as linking farmers to markets or decreasing travel time for enterprises. Enhanced investment in road infrastructure may catalyse economic growth and augment access to services nationwide.

The finding regarding the mean number of households with access to electricity (NHE) is about 68, with a standard deviation of 12.91, indicating a wide range of households with access to electricity across the sample. The result on NHE indicates a median number of households with access to electricity as 67.45, with an interquartile range of 23.15. This indicates that although most households access electricity, significant disparities exist.

In terms of improvement in educational attainment (IEA), the results show a mean of 0.43 with a standard deviation of 0.79, indicating a large variability in the IEA values. The median value is 0.42 which is slightly below the mean with an interquartile value of 0.90. This indicates that although certain regions may have experienced notable advancements in education, such as increased graduation rates or enhanced school enrolment, others have fallen short.

The percentage change in employment rate (CEI) is, on average, about 67% with a standard deviation of 1.19. The result shows a median of 67.45% change in employment rate over the period of 2003 to 2022, with an interquartile range of 1.71% indicating minimal variability among the central 50% of the sample data used for the study. The consistent increase in employment indicates that infrastructure initiatives and economic policies may have facilitated job creation steadily.

In contrast, based on the sample for the study, on average, Ghana's percentage change in poverty rate (CPR) is about 4.30% with a standard deviation of 8.27. The result indicates a 3.67% median for the change in poverty rate in Ghana from 2003 to 2022. The significant variability in poverty reduction suggests that, despite an increase in employment, the advantages of work may not be uniformly allocated, resulting in intermittent or decelerated poverty reduction during specific intervals.

5.3 Correlation Analysis

Table 14 presents the results of the correlation among the various variables of the study. The results of the correlation between the variables are all statistically significant at a 10% significance level. The real growth of national income, also known as the percentage change in GDP (RGDP), indicates a moderate positive relationship with the percentage change in employment rate (CEI). Thus, a percentage change in RGDP increases the percentage change in the employment rate of the country. On the other hand, RGDP has a negative relationship with the number of households with access to electricity (NHE) and the length of roads built (LR). This means that an increase in RGDP results in a decrease in the number of houses with access to electricity and the length of roads built. Similarly, RGDP according to the correlations analysis proves to have a negative relationship with per capita income (PCI) and access to healthcare (AHC). However, this relationship does not align with the current prevailing conditions.

Focusing on the relationships between per capita income and the other variables, it is identified that PCI shows a strong positive relationship (0.910) with access to healthcare, which suggests that when per capita income increases, access to healthcare also increases significantly. Similarly, the results of the correlation analysis show that PCI has a positive relationship with the number of households with access to electricity and the length of roads built. On the contrary, PCI shows a negative relationship with percentage change in employment rate.

Table 14: Pearson Correlation Analysis of Variables (Ghana)

Variables	RGDP	PCI	AHC	LR	NHE	IEA	CEI	CPR
RGDP	1.000							
PCI	-0.301	1.000						
AHC	-0.345	0.910	1.000					
LR	-0.381	0.394	0.414	1.000				
NHE	-0.580	0.892	0.866	0.571	1.000			
IEA	-0.195	0.298	0.140	0.024	0.124	1.000		
CEI	0.623	-0.584	-0.691	-0.766	-0.770	0.011	1.000	
CPR	-0.098	0.021	0.023	-0.093	0.096	-0.073	0.128	1.000

The table presents the result of correlation of percentage change in GDP (RGDP), per capita income (PCI), percentage change in employment rate (CEI), percentage change in poverty rate (CPR), improvement in educational attainment (IEA), length of roads built (LR), number of households with access to electricity (NHE), and access to healthcare (AHC). All correlation results are significant at a 10% significance level.

Access to healthcare further reveals a strong positive association with the number of households with access to electricity and a moderate relationship with the length of roads built; thus, an increase in access to healthcare results in more households having access to electricity and an increase in the length of roads built. Access to healthcare, however, proves to have a negative relationship with percentage change in employment, indicating that an increase in access to healthcare results in a decrease in the employment rate.

Moreover, the length of roads built is shown to have a positive relationship with the number of households with access to electricity and a negative relationship with the percentage change in employment rate. The results of the study show that the number of households is negatively correlated with the percentage change in employment rate, while improvement in educational attainment (IEA) has a very weak correlation with all other variables, with the strongest being a weak positive correlation with per

capita income. This suggests that improvements in educational attainment have little association with the other variables in this analysis.

From the correlation, it is evident that the percentage change in employment rate has a positive association with RGDP and a negative relationship with access to healthcare, length of roads built, and number of households with access to electricity. Percentage change in poverty rate, on the other hand, proves to have weak correlations with all other variables, with the strongest being a weak positive correlation with the number of households with access to electricity.

In summary, the correlation analysis reveals complex relationships between the variables. Strong positive correlations are observed between PCI and AHC, as well as PCI and NHE, indicating that economic prosperity is closely linked with social development indicators like healthcare and electricity access. However, the negative correlations between CEI and several other variables are intriguing and may reflect underlying factors or policies that affect employment rates differently from other indicators of economic and social development.

5.4 Diagnostic Tests

Table 15 below presents the results of unit root tests done on the study variables using the Augmented Dickey-Fuller (ADF) test and Phillips-Perron (PP) test. Both tests are used to determine the stationarity of a time series. The table provides the critical values for the ADF and PP tests, the test statistics, as well as the significance level of the results.

Table 15: Augmented Dickey-Fuller Test and Phillips-Perron Test Results (Ghana)

	Augmented Dickey-Fuller Test	Phillips-Perron Test
Variables	**Test Statistics (Critical Value: -2.63)**	**Test Statistics (Critical Value: -3.24)**
RGDP	-1.357	-2.33
PCI	-1.432	-1.607
AHC	-1.535	-3.734**
LR	-3.714***	-3.047
NHE	-0.742	-4.131***
IEA	-4.606***	-3.118
CEI	-2.421	-2.229
CPR	-3.595	-4.278***

The table presents the estimates of the Augmented Dickey-Fuller (ADF) test and the Phillips-Perron test of the study variables. The t-statistics for each variable estimate are shown with ***, **, * indicating that the results are statistically significant at p< 0.01, p <0.05, and p<0.1, respectively.

The findings in Table 15 revealed that the percentage change in GDP (RGDP) from 2003 to 2022 is stationary under both ADF and PP tests because the t-statistics are less than the critical values. Similarly, per capita income (PCI) is stationary in this study as its t-statistics under both ADF and PP tests (that is, -1.432 and -1.607, respectively) are below the critical values. For access to healthcare (AHC), the results show stationarity under the ADF test and non-stationarity under the PP test. The result under the PP test is statistically significant at 5%. While the result under the ADF test shows that the length of road built is non-stationary and statistically significant at 1%, the PP test result shows stationarity of the variable, which is not statistically significant.

Moreover, the ADF test indicates that the number of households with access to electricity (NHE) is stationary with no statistical significance, while the result under the PP test proves NHE to be non-stationary and statistically significant. In terms of improvement in educational attainment (IEA), the ADF test shows non-stationarity with a 1% significance level, and the PP test shows stationarity of the variable. Both ADF and PP tests prove the percentage change in employment rate (CEI) to be stationary.

On the other hand, the percentage change in poverty rate (CPR) is non-stationary under both the ADF and PP tests, with the result under the PP test being statistically significant at a 1% significance level.

In summary, AHC, LR, NHE, IEA, and CPR are non-stationary and are in congruence with the conclusion of the extended Nelson Plosser data, which states that many macroeconomic time series are characterised by the presence of a unit root. Thus, many macroeconomic time series appear non-stationary.

5.5 Regression Analysis

Infrastructure Development was proxied by the length of roads built (LR), reflecting the physical expansion of transport infrastructure. Economic Expansion was measured through Per Capita Income (PCI), representing economic improvements linked to infrastructure investments. Social Welfare was captured through Change in Employment Rate (CEI), Change in Poverty Rate (CPR), Access to Health Care (AHC), Improvement in Educational Attainment (IEA), and Number of Households with Access to Electricity (NHE), which collectively indicate how infrastructure financing influences quality of life. This aligns with established econometric practices where proxy variables help assess policy impacts (Jerven, 2015; Easterly & Levine, 1997). This approach ensures alignment and seeks to analyse how alternative funding models influence infrastructure development, economic growth, and social welfare. Although the study does not directly measure the funding models themselves as dependent variables, the proxies provide a meaningful and statistically valid method for evaluating their broader impact. This approach has been used in previous studies assessing infrastructure investment outcomes in emerging economies (Banerjee, Duflo, & Qian, 2012; Calderón & Servén, 2010).

Table 16 presents the results from the Multiple Linear Regression analysis (Estimated using Ordinary Least Squares – OLS). The coefficients of the independent variables, z-statistics and significance level are indicated in the table below. The result of the cointegration test indicates that the intercept of the regression model is 48.8314. This means that when all other independent variables are equal to zero, the expected percentage change in GDP (RGDP) is 48.8314.

Table 16: Multiple Linear Regression analysis (Estimated using Ordinary Least Squares – OLS) (Ghana)

Dependent Variable	**OLS Regression** RGDP Coefficient (z-statistics)
Intercept	48.8314
PCI	-21.834*** (-23.61)
CPR	0.7351*** -31.78
CEI	-0.090 (-0.31)
IEA	-6.837*** (-32.39)
NHE	0.804*** (-23.340)
LR	26.399*** (-19.520)
AHC	-0.150** (-2.36)

The Table presents the result of the multiple regression test of percentage change in GDP (RGDP), per capita income (PCI), percentage change in employment rate (CEI), percentage change in poverty rate (CPR), improvement in educational attainment (IEA), length of roads built (LR), number of households with access to electricity (NHE), and access to healthcare (AHC). The z-statistics for each regression estimate are shown in parentheses with ***, **, and * indicating statistical significance at 1%, 5% and 10%, respectively.

Further analysis reveals that per capita income (PCI) is negatively related to RGDP (-21.834) and is statistically significant at a significance level of 1%. The percentage change in poverty rate is seen to be positively associated with RGDP with a significance level of 1%. This result implies that a percentage change in the poverty rate increases RGDP. The coefficient of percentage change in employment (CEI) rate is -0.090, indicating a negative relationship between CEI and RGDP. Thus, a percentage change in employment rate will reduce the RGDP. This result is, however, not statistically significant.

Additionally, the results indicate that improvement in educational attainment is negatively correlated with RGDP and highly significant at a significance level of 1%. This result in the context of Ghana is unexpected as improvements in education are typically associated with economic growth. On another breadth, the number of households with access to electricity (NHE) shows a positive and statistically significant (coefficient=0.804) relationship with RGDP at a significance level of 1%. Similarly, the length of roads built (LR) shows a strong positive relationship with RGDP at a 1% significance level (coefficient=26.399). This result is consistent with expectations, as infrastructure development is usually associated with economic growth. Finally, the coefficient of access to healthcare is -0.150, suggesting that a negative relationship exists between access to healthcare and RGDP, which is unexpected. However, the result is statistically significant at a 5% significance level.

In summary, the regression analysis suggests significant relationships between RGDP and several independent variables. However, some of the expected signs of the relationships are not consistent with economic theory, such as the negative relationships with PCI, IEA, and AHC.

5.6 Robustness Check

This section examines the robustness of the regression outputs, using diagnostic tests such as the Jarque-Bera for normality and the Durbin-Watson statistic for autocorrelation. In addition, the ARDL model is applied to validate both short-run and long-run relationships.

5.6.1 Jarque Bera Test

Table 17 presents the results of the Jarque-Bera test conducted to test the normality of the data used for this study.

Table 17:Jarque-Bera Test (Ghana)

Variable	Pr (Skewness)	Pr (Kurtosis)	adj chi2	P-Value
Residuals	0.451	0.692	0.780	0.678

The result of the study indicates that the p-value of skewness is 0.451, which is above the significance level of 5%, indicating that the residuals (that is, the differences

between the observed values and the values predicted by the model) of the regression are not significantly skewed. Similarly, the result indicates that the p-value of kurtosis, which is 0.692, is above the significance level of 5%, indicating that the kurtosis of the residuals is not significantly different from that of a normal distribution. The p-value of chi-square indicated as 0.678 is greater than the significance level of 5%, thus, the residuals of the regression model are normally distributed. In sum, given the assumption of normality for regression analysis, the model is adequately specified, the standard errors, confidence intervals, and hypothesis tests associated with the regression coefficients are valid.

5.6.2 Durbin Watson Test

Table 18: Durbin Watson Test (Ghana)

	d-statistic
Residuals	2.465

Table 18 shows that the Durbin-Watson statistic for the residuals is 2.465. This value indicates the degree of autocorrelation present in the regression residuals. A Durbin-Watson statistic close to 2 suggests that there is little to no autocorrelation. Since the d-statistic of 2.465 is greater than 2, it implies a slight negative autocorrelation among the residuals. Generally, values between 1.5 and 2.5 are considered acceptable, indicating that the regression model does not suffer from significant autocorrelation issues.

5.7 ARDL Model Estimation and Interpretation

The following section shows the empirical outcomes of the estimation of the Autoregressive Distributed Lag (ARDL) model in the case of Ghana. The use of the ARDL model is justified by the fact that the variables were determined to have a mixed order of integration, as opposed to a single order, which was the case in the use of the Augmented Dickey-Fuller (ADF) unit root tests, as discussed in previous sections.

In addition, the ARDL models are ideal for relatively small to medium sample sizes because they produce reliable and consistent estimations. The ARDL approach is also used to describe the co-estimation of the short-run dynamics and the long-run

relationships, thereby assisting a more critical evaluation of the impact of the variables that are related to infrastructure on economic growth in both contexts of time.

The estimation steps start by carrying out ARDL bounds testing for cointegration to test the presence of a long-run equilibrium among the variables. This is then followed by presentation of the long-run and short-run ARDL and diagnostic tests to determine how reliable the model was, and Granger causality tests to determine how the variables relate to each other.

5.7.1 ARDL Bounds Test

The ARDL bounds testing method was used to measure the presence of a long-run relationship in the variables. It is noted that the F-statistic of the bounds test gave a value of 3.975, which is then compared with the tabled critical values of the bounds at the 10, 5, and 1 per cent level of significance.

Table 19: ARDL Bounds Test (Ghana)

Test stat	Test stat	*k*
F statistic	3.975	7
Critical bound value		
Significance	**I(0) bound**	**I(1) bound**
10%	2.45	3.52
5%	2.86	4.01
1%	3.74	5.06
Decision: Cointegration confirmed		

Table 19 reveals that the F- statistic calculated using the data available on Ghana is between 3.975 (I(0)) and 4.01 (I(1)), the lower and the upper limits respectively at the 5% level. Although technically, the result is on the inconclusive region, the F-statistic value exceeds the upper threshold of the significance level at 10% (I(1) = 3.52), which provides adequate support in favour of cointegration at a lower level.

This finding provides the compelling reason to reject the null hypothesis of no long run relationship between the variables at 10% level and concurs with the practice that cointegration should be accepted where the theory as well as the diagnostic testing can be used to support the hypothesis (Narayan, 2005; Pesaran et al., 2001). This conclusion is in agreement with the fact that in the long-run, there exists an equilibrium that associates the real growth of GDP and the chosen indicators of infrastructure and socio-economic variables in the case of Ghana. It further confirms the relevance of using the ARDL model, which presupposes verification of cointegration before estimating the long-run coefficients and short-run error correction factors. Nkoro and Uko (2016) highlight that the ARDL bounds testing method is particularly important in an environment where they mix integration (i.e., I(0) and I(1)) and assert that cointegration may be arrived at with a 10% significance when backed by theoretical relevance and stability of the underlying model.

Therefore, based on both statistical results and inherent justification based on the empirical work in the past, it is found that a long-run relationship exists that enables the use of the ARDL model for further estimation.

5.7.2 ARDL Long-run and Short-run Results

The ARDL model estimation results indicate the estimated long and short run coefficients, which are listed in Table 20. The findings show that all the growth factors, namely per Capita Income, Change in Employment Rate, Improvement in Educational attainment, and Length of Road infrastructure, are positively and significantly related to the long-run real GDP growth. This means that the sustained gains in income, employment, education and developing the infrastructure are meaningful in terms of long-term economic performance in Ghana.

Table 20: ARDL Long-run and Short-run Results (Ghana)

Variable	Coefficient	Std. Error	t-Statistic	p value
Long-run				
PCI	0.004**	0.002	2.34	0.022
CEI	0.752***	0.19	3.95	<0.001
CPR	-0.027	0.034	-0.79	0.431
IEA	0.068**	0.032	2.15	0.035

LR	0.743***	0.192	3.87	<0.001
NHE	0.025	0.031	0.81	0.42
AHC	0.041	0.029	1.43	0.16
Short-run				
D.RGDPG(-1)	-0.642***	0.125	-5.14	<0.001
D.PCI	0.002**	0.001	2.38	0.02
D.CEI	0.508**	0.21	2.42	0.018
D.CPR	-0.012	0.018	-0.67	0.504
D.IEA	0.042	0.023	1.83	0.072
D.LR	0.497***	0.13	3.82	<0.001
D.NHE	0.016	0.021	0.76	0.451
D.AHC	0.033	0.026	1.27	0.21
ECM(-1)	-0.571***	0.119	-4.8	<0.001

NB: *, **, and *** denote significance at 10%, 5%, and 1% levels, respectively. The ECM term is negative and significant, confirming adjustment toward equilibrium.

In the short run, the immediate impact of PCI, CEI and LR is also high and positive, making it clear that these three factors play a present role in stimulating GDP. Access to healthcare (AHC), electricity (NHE) or poverty reduction (CPR) were other variables which were not significant in the long-term or short-term.

The error correction term (ECM) is very significant at a negative coefficient of -0.571, and is a strong and stable rate of convergence to the long-run equilibrium following the short-run effects. This shows the existence of a valid long-run relationship between the variables, which were previously indicated by the Bounds test.

5.7.3 Stability Diagnostics – Ghana (ARDL Model)

The findings of the stability testing of ARDL are demonstrated in Table 21.

Table 21: Model Stability Test Results (Ghana)

Test	Result	Interpretation
CUSUM Test	Line remains within 5% bands	The model is stable over time

CUSUMSQ Test	Line remains within 5% bands	The model is stable over time

Note: The CUSUM test indicates that the parameters of the ARDL model for Ghana are stable over time.

Both the CUSUM and CUSUM of Squares (CUSUMSQ) tests display that the lines are not out of the 5 percent significance bands, which implies that the parameters of the model remain stable within the sample period.

This confirms the fact that the ARDL model is structurally stable, and the relationships that may be ascertained among the variables throughout time are logically dependable. The model may therefore be found to be highly reliable in the interpretation and forecasting of the policies, given the sample period.

5.7.4 Model Fit and Diagnostics – Ghana (ARDL Model)

The diagnostic tests were carried out to determine the statistical reliability and stability of the ARDL model of Ghana. These included the goodness-of-fit test, serial correlation test, heteroskedasticity test, and normality of residuals. Table 22 summarises the results.

Table 22: Model Fit and Diagnostics (Ghana)

Test	Statistic	p-value	Decision (5%)
R-squared	0.8205	—	**Good fit**
Adjusted R-squared	0.6204	—	**Acceptable**
Breusch-Godfrey Serial Correlation LM Test	$\chi^2 = 27.25$	0.001	**Reject H_0**: Serial correlation **present**
Breusch-Pagan / Cook-Weisberg Heteroskedasticity Test	$\chi^2 = 2.76$	0.0964	**Fail to reject H_0**: Constant variance assumed

Jarque-Bera Normality Test (Skewness/Kurtosis joint test)	$\chi^2 = 1.41$	0.4951	**Fail to reject H_0**: Residuals are normally distributed
White's Heteroskedasticity Test (robust)	$\chi^2 = 35.17$	0.898	**Fail to reject H_0**: Homoskedasticity present

The Ghana ARDL model shows a strong fit and acceptable adjusted explanatory power. Despite the presence of serial correlation, the model passes both normality and heteroskedasticity tests, especially White's robust test which confirms stable variance. These results support the statistical reliability of the regression outcomes.

As the results have shown, there is a high degree of fit, as the R-squared of 0.82 and an acceptable adjusted R-squared of 0.62 imply that the model captures a reasonably large part of real economic growth variability. The Jarque-Bera test indicates that the residuals meet the normality requirement and that the model is not heteroskedastic based on the Breusch-Pagan test and White Heteroskedasticity.

Nevertheless, the Breusch-Godfrey LM test shows that there is serial correlation at lag 2, which can affect the consistency of estimators. It implies that although the model is reasonably stable, one should exercise caution when using time-related coefficients and possible improvements to the model, like adding more lags or robust standard errors, can be carried out in future estimations.

5.7.5 Granger Causality Test

To gain a better insight into which direction influence flows between the indicators concerning infrastructures and economic growth, the Granger causality test was employed based on quarterly Ghana data. The test analyses whether previous values of the independent variables are useful in forecasting movements in real GDP growth (RGDPG).

Table 23: Granger Causality Tests (Ghana)

Null Hypothesis	F-Statistic	Prob.	Decision
PCI does not Granger-cause RGDPG	3.212**	0.047	Reject
CEI does not Granger-cause RGDPG	4.456***	0.015	Reject
CPR does not Granger-cause RGDPG	1.117	0.292	Do not reject
IEA does not Granger-cause RGDPG	2.765**	0.069	Reject at 10%
LR does not Granger-cause RGDPG	5.822***	0.004	Reject
NHE does not Granger-cause RGDPG	0.823	0.411	Do not reject
AHC does not Granger-cause RGDPG	1.32	0.254	Do not reject

NB: *, **, and *** denote significance at 10%, 5%, and 1% levels, respectively. The null hypothesis is that the variable does not Granger-cause real GDP growth.

The findings indicate that all the variables, namely Per Capita Income (PCI), Change in Employment (CEI), Educational Attainment (IEA), and Length of Road Infrastructure (LR), have gained statistically significant Granger-causal links to real GDP growth at usual levels of significance. This means that, more precisely, null hypotheses of these variables are rejected and, therefore, values of the indicators in the past can be used to predict relevant values of the growth of the economy in Ghana to a significant degree. The highest estimation is noticed in both CEI and LR cases, which are significant at the 1 percent level, indicating the instant economic importance of employment development and the growth of the road infrastructure.

Conversely, variables as Change in Poverty Rate (CPR), Access to Electricity (NHE) and Access to Health Care (AHC) fail to provide a statistically significant Granger-causal relationship between the variables and RGDPG. These findings suggest that although all these factors are important constituents of socioeconomic development, their direct impact on the short-run GDP growth is limited, or it can be channelled through other structural determinants which are not included in this model.

On the whole, the Granger causality analysis confirms the general findings of the ARDL model. It confirms the opinion that not every factor connected with infrastructure has the same extent of impact on economic growth, in particular, employment, income, education and transportation infrastructure have proved to be more immediate and predictive in the case of Ghana.

5.8 Summary Discussion of Key Results

In this section, the primary conclusions of the OLS regression and ARDL model, and their Granger causality offerings, are synthesised in order to gauge the effects of alternative infrastructure funding models on the economic growth and social welfare in Ghana. The OLS regression determined the initial estimates of association between the infrastructure-related variables and real GDP growth (RGDPG), whereas the ARDL model resolved these relationships into short-run and long-run operations. The Granger causality tests also shed more light on the flow of influence among the variables

The regression analysis indicates a negative relationship between alternative infrastructure funding models and changes in per capita income. This result aligns with Bird and Slack (2003), who contend that infrastructure funding through taxation may diminish disposable income, potentially limiting short-term economic growth. The decline in disposable income may result in decreased consumption and savings, thereby hindering overall economic activity. Nonetheless, the ARDL model provided a more complex view: the PCI and RGDPG were significantly and positively related in the long run and the short run ($p < 0.05$), indicating that the increasing income level is eventually leading to a period of addressing sustainable economic growth. This is in line with Calderon and Serven (2004), who argue that a better level of income makes it easier to achieve infrastructure-led growth. In addition, the Granger causality test indicated that there is both a causal relationship between PCI and RGDPG, with a dynamic mutually reinforcing interdependence between the two variables (that is, increasing income leads to increasing infrastructure results, and vice versa). Recent studies corroborate this, indicating that although alternative models such as Public-Private Partnerships (PPPs) may encounter short-term fiscal limitations, they promote long-term economic advantages by enhancing infrastructure quality and efficiency

(Mandiriza, Fourie, & Madumo, 2021). The marginal significance of this relationship in the per capita income model indicates that the impact of infrastructure funding on income is likely contingent upon factors such as the type of infrastructure and the existing economic conditions. This indicates that particular funding models may be more appropriate for certain economic conditions than others. This evidence highlights that infrastructure investments in developing economies may yield mixed outcomes depending on governance, project management, and economic environment (Appiah, Onifade, & Gyamfi, 2022).

The positive correlation between changes in the poverty rate and alternative funding models offers significant insight into the distributional impacts of these models. Nevertheless, there was no statistically significant relationship ($p > 0.05$) between CPR and poverty outcome in both the short and long run, though the ARDL model showed that CPR has a statistically significant relationship at the long run. Siemiatycki (2010) posits that funding mechanisms such as user fees or public-private partnerships (PPPs) may adversely impact low-income populations, as these demographics may struggle to afford the expenses associated with infrastructure services. This may intensify poverty levels, especially if critical services such as water and electricity are affected. Conversely, Engel, Fischer, and Galetovic (2014) contend that public-private partnerships (PPPs) can yield efficiency improvements and innovations that ultimately benefit all income strata by enhancing infrastructure quality and decreasing long-term expenses. This also suggests that while PPPs provide efficiencies, the socio-economic inclusivity of such models requires strong regulation to avoid exacerbating inequalities (Berka & Dreyfus, 2021. The notable correlation identified in the regression highlights the necessity of developing inclusive funding models that address the requirements of marginalised communities, especially in situations where access to essential services is vital for alleviating poverty. Nonetheless, the outcome of the ARDL model revealed that there was no statistically significant impact of CPR in both the short and long run ($p > 0.05$), suggesting that the effects of infrastructure funding may not directly influence poverty outcomes. The Granger causality test was also not found to have any causality going to RGDPG based on CPR.

The ARDL results indicate that CEI has a significant influence on RGDP in the short run ($p = 0.018$) and no significance in the long run. This implies that the amount of employment gains through infrastructure is only realised at project implementation stages, as was the case with Iossa and Martimort (2015). Nonetheless, its Granger causality test revealed no Granger causality between CEI and RGDPG, which suggests that the infrastructure employment impacts might be temporary unless combined with a broader intervention across labour markets

The significant relationship between changes in educational attainment and alternative funding models is rather unforeseen. Enhanced infrastructure is anticipated to improve educational outcomes by providing better access to schools and learning resources (Monity & Abam, 2024). The observed relationship may indicate short-term disruptions due to infrastructure construction or a reallocation of public funds from education to infrastructure projects, resulting in temporary setbacks in educational advancement. This also suggests that large-scale infrastructure projects often divert public resources from social sectors like education, leading to short-term negative effects, especially in lower-income communities (Seidu, Young, Robinson, & Michael, 2020). This discovery indicates the necessity for meticulous planning in the execution of infrastructure projects to mitigate negative effects on educational systems, especially in low-income communities. The significance of IEA on RGDPG was confirmed based on the long-run positive impact on the latter, which has been found to be statistically significant ($p < 0.05$) using the ARDL model. Nevertheless, the Granger causality test failed to substantiate the causal relationship between IEA and GDP, implying that improvement in education does not affect growth in any direct or immediate way

The OLS regression indicated a positive relationship between NHE and RGDPG. The ARDL model, however, did not exhibit a significant direct effect, neither in the short run nor the long run. Nevertheless, the Granger causality test found that NHE Granger-causes GDP, and this is an implication that it has a somewhat indirect but effective role. In healthcare access (AHC), the ARDL and OLS models did not record any significant effects, and the Granger causality test also showed that there was no direct impact on GDP. This evidence indicates that whereas social investment is critical, its economic implication is not likely to be as immediate or take effect via non-GDP mechanisms (Jackson, 2020). The higher R-squared value indicates that alternative

funding models are notably effective in enhancing electricity access, presumably owing to the augmented investment and efficiency improvements these models facilitate. These findings underscore the potential of innovative funding mechanisms, such as public-private partnerships, to address infrastructure deficiencies and improve service delivery in underserved areas. And, indeed, the ARDL model showed that road infrastructure (LR) displays a significant and strong positive impact on RGDPG both in the short and in the long term ($p < 0.001$), proving to be once again a growth-enhancing asset. This is supported by the Granger causality results, which indicate that causality between LR and GDP is unidirectional.

5.9 Conclusion

This chapter's econometric analysis thoroughly examined the impact of the different infrastructure funding models on socioeconomic outcomes in Ghana. The regression analysis demonstrated both positive and negative correlations between funding models and indicators, including per capita income, poverty rates, employment, educational attainment, and access to electricity. It was determined that while specific funding models could improve infrastructure quality and accessibility, they may also exacerbate inequalities, particularly among marginalised populations. The analysis revealed that the effects of these models were context-dependent, shaped by the nature of the infrastructure and the overarching economic landscape.

This analysis of Ghana's infrastructure funding models yields essential insights into their economic impacts. These insights contribute to the formulation of a decision-making framework, as outlined in this study's Research Objective 4, ensuring that infrastructure funding strategies align with equitable and sustainable development goals.

On the whole, the total ECM term under the ARDL model was statistically significant and negative, which confirmed the presence of a stable long-run relationship. The Granger causality tests further corroborated the study results by revealing directional dependencies, particularly between income, road infrastructure, and electricity access, and further justifying the econometric model used in the research.

The ensuing chapter considers the empirical analysis and discussion of findings pertaining to the Nigerian context.

Chapter Six

Empirical Data Analysis and Interpretation of Findings on Nigeria

6.1 Introduction

This chapter presents an empirical assessment of the factors that influence the acceptability and utilisation of alternative infrastructure funding models in Nigeria. It also examines the effects of these models on infrastructure development, economic growth, and social well-being. The chapter commences with a descriptive statistical analysis of several important indicators, including improvement in Percentage change in GDP (RGDP), Per capita income (PCI), Percentage change in employment rate (CEI), Percentage change in Poverty rate (CPR), Improvement in educational attainment (IEA), Length of roads built (Km) (LR), Number of households with access to electricity (NHE), Access to health care (AHC). These statistics offer valuable insights into the central tendencies, variability, and distribution of each variable, providing a foundation for understanding the trends in the dataset and the dynamics of development in the context of the study. It then examines how these funding models are related to key variables, including economic growth, educational enrolment, access to healthcare, and poverty reduction. Finally, the chapter concludes with a summary of the key findings.

6.2 Descriptive Statistics of Variables

Table 24 shows the percentage change in GDP (RGDP) as a key measure of economic performance. The mean RGDP is recorded at -0.716, reflecting a slight average decline in economic output. However, the considerable variability, as indicated by a standard deviation of 24.057, suggests that economic performance was highly volatile. The first quartile (Q1) value of -5.654 shows that a significant portion of the data experienced negative GDP growth, while the median value of 0 indicates that half of the observations saw no change in GDP. The third quartile (Q3) value of 5.702 demonstrates that only a quarter of the observations experienced positive GDP growth, underscoring the uneven nature of the economic performance. These findings underscore the pivotal role of economic performance in influencing the successful implementation of infrastructure funding models. The volatility and irregular growth

patterns indicated by the descriptive statistics imply that Nigeria's infrastructure funding approaches, especially those dependent on funding from abroad or public-private partnerships, may be susceptible to economic recessions. This underscores the necessity for policy frameworks that can alleviate economic shocks and foster more inclusive and stable growth, essential for the long-term sustainability of infrastructure projects and, consequently, economic development.

Table 24: Descriptive Statistics of Variables (Nigeria)

Variable	N	Mean	Std. Dev.	Q1	Median	Q3
RGDP	20	-0.716	24.057	-5.654	0	5.702
PCI	20	7.597	0.349	7.539	7.666	7.791
AHC	20	2.687	0.107	2.588	2.698	2.773
LR	20	0.477	0.886	-0.112	0.337	1.435
NHE	20	3.967	0.032	3.945	3.945	3.989
IEA	20	0.944	1.639	0	0.905	1.401
CEI	20	-3.236	1.363	-4.168	-3.698	-2.781
CPR	20	1.94	0.609	1.439	1.966	2.178

In addition to GDP, per capita income (PCI) serves as a measure of individual economic welfare. With a mean of 7.597, the data indicates a relatively stable income level across the population during the period studied. A low standard deviation of 0.349 confirms the consistency of income levels, with Q1 at 7.539, the median at 7.666, and Q3 at 7.791. These closely aligned quartile values suggest limited income disparity within the population, indicating a relatively homogenous income distribution. The uniformity and consistency of income levels throughout Nigeria during this period indicate that the populace could sustain specific infrastructure funding models necessitating public investment. The results align with recent studies that highlight the crucial importance of economic growth and infrastructure quality in emerging nations (Banerjee, Duflo, & Qian, 2020; Deleidi, Iafrate, & Levrero, 2020). Nonetheless, the comparatively modest income levels underscore the necessity for funding models that accommodate the restricted financial capacity of individuals. This necessitates more inclusive funding strategies that harmonise public contributions with government or

private-sector participation to prevent overburdening the populace, thereby ensuring both the sustainability of infrastructure projects and equitable access to their advantages.

Furthermore, access to healthcare (AHC) reflects the population's ability to access necessary medical services. The mean AHC value of 2.687 indicates moderate access to healthcare services, with minimal variation across observations, as shown by a standard deviation of 0.107. The quartiles—Q1 at 2.588, the median at 2.698, and Q3 at 2.773 - suggest that healthcare access is fairly uniform across the population. Despite this, the findings imply that there is room for improvement in expanding healthcare access to underserved areas. It means that, on average, people living in Nigeria possess moderate access to healthcare, with minimal disparity in healthcare access among the population. The majority of individuals possess comparable access levels, as evidenced by the narrow range between the lower and upper quartiles.

In terms of Infrastructure development, particularly road construction, it plays a critical role in supporting economic growth and improving living standards. The mean value for the length of roads built (LR) is 0.477 km, indicating modest progress in road construction. However, the high standard deviation of 0.886 reflects inconsistent progress across the dataset. The first quartile (Q1) value of -0.112 suggests that some regions experienced stagnation or reductions in road construction, while the median value of 0.337 indicates moderate gains in the majority of the dataset. The third quartile (Q3) value of 1.435 shows that a quarter of the observations experienced significant progress in road construction. The disparity in road construction indicates a necessity for more equitable infrastructure development among regions. It underscores that while some regions have experienced substantial advancements, others have fallen behind, potentially obstructing overall economic growth and accessibility. This indicates that more focused funding models for infrastructure are essential to achieve equitable development, emphasising regions with slower progress to improve national connectivity and economic growth.

The provision of electricity serves as a vital indicator of infrastructural development and quality of life. The mean number of households with electricity access (NHE)

stands at 3.967, indicating that a significant portion of the population has access to electricity. The low standard deviation of 0.032 shows minimal variation across observations. The Q1 and median values are both 3.945, while Q3 is 3.989, indicating a high degree of consistency in electricity access among households, suggesting notable progress in electrification across the population. The significant consistency in electricity access indicates successful electrification initiatives in Nigeria, positively impacting infrastructural development and overall quality of life. Nonetheless, this suggests that although most households have attained access, there may still be segments of underserved communities that necessitate focus.

Educational attainment is a critical factor in human capital development and socioeconomic progress. The mean improvement in educational attainment (IEA) is 0.944, indicating modest gains. However, the high standard deviation of 1.639 reflects significant variability, suggesting that some regions experienced substantial progress while others saw little to no improvement. The Q1 value of 0 indicates that 25% of the observations reported no improvement in educational attainment. Meanwhile, the median value of 0.905 and the third quartile (Q3) value of 1.401 suggest that most regions experienced some level of improvement, albeit modest. The disparity in educational achievement significantly affects infrastructure funding models. It indicates that although general advancement is occurring, specific interventions may be required in underperforming areas to guarantee equitable access to educational resources. This may entail prioritising funding in areas demonstrating minimal advancement, thereby improving educational outcomes and fostering overall human capital development and socioeconomic progress. Rectifying these disparities can cultivate a more proficient workforce, promoting economic growth and stability.

Moreover, the employment rate serves as a measure of economic health and the economy's ability to provide jobs. The mean percentage change in employment rate (CEI) is -3.236, indicating a general decline in employment over the studied period. The standard deviation of 1.363 suggests moderate variability in employment rate changes, with some regions performing better than others. The first quartile (Q1) value of -4.168 shows that 25% of the data experienced significant employment declines, while the median value of -3.698 and the third quartile (Q3) value of -2.781 suggest that most observations recorded negative employment growth. A declining

employment rate can restrict the financial ability of the populace to help fund infrastructure, necessitating funding mechanisms that account for prevailing economic difficulties. Moreover, it underscores the necessity of generating employment opportunities in conjunction with infrastructure projects, as enhanced job prospects can bolster public support and engagement in funding initiatives.

Finally, the poverty rate (CPR) reflects shifts in socioeconomic well-being. The mean percentage change in poverty is 1.94, indicating a slight increase in poverty during the study period. The standard deviation of 0.609 points to moderate variability in poverty rate changes. The first quartile (Q1) value of 1.439, the median of 1.966, and the third quartile (Q3) of 2.178 suggest that most observations experienced increases in poverty, though the extent of these increases varied across the dataset. These findings have significant implications for the funding of infrastructure and economic policy. An escalation in poverty can deplete public funding resources and diminish the financial capability of households to invest in infrastructure initiatives. Thus, it underscores the imperative for inclusive funding models that consider the socioeconomic conditions of the populace.

In conclusion, the descriptive analysis of these variables paints a mixed picture of the socioeconomic conditions during the period under review. Indicators such as per capita income, access to healthcare, and electricity provision show relative stability and progress. However, key indicators like GDP growth, employment, and poverty reflect more volatile and challenging conditions, highlighting economic disparities across different regions. Inconsistent progress in infrastructure development, especially in road construction, and modest gains in educational attainment further underscore the need for targeted interventions. Policymakers can use these findings to design strategies that promote sustainable development, reduce poverty, and foster inclusive growth.

6.3 Correlation Analysis

The Pearson correlation table provides insights into the strength and direction of linear relationships between eight variables central to this study: Real Gross Domestic Product (RGDP), Per Capita Income (PCI), Number of Households with Access to

Electricity (NHE), Access to Healthcare (AHC), Improvement in Educational Attainment (IEA), Percentage Change in Employment Rate (CPR), Consumer Expenditure Index (CEI), and Length of Roads Built (LR). The Pearson correlation coefficient, which ranges from -1 to 1, indicates the degree of association between two variables, with values closer to 1 or -1 reflecting stronger positive or negative relationships, respectively.

Table 25: Pearson Correlation Analysis of Variables (Nigeria)

Variables	RGDP	PCI	NHE	AHC	IEA	CPR	CEI	LR
RGDP	1.000							
PCI	-0.107	1.000						
NHE	0.314	0.234	1.000					
AHC	0.299	0.488	0.103	1.000				
IEA	-0.097	-0.035	0.340	-0.031	1.000			
CPR	0.116	-0.353	0.061	-0.283	0.335	1.000		
CEI	0.218	0.058	0.955	0.258	0.283	0.905	1.000	
LR	-0.405	0.557	0.342	0.130	-0.120	-0.378	0.311	1.000

The table presents the result of correlation of percentage change in GDP (RGDP), per capital income (PCI), percentage change in employment rate (CEI), percentage change in poverty rate (CPR), improvement in educational attainment (IEA), length of roads built (LR), number of households with access to electricity (NHE), and access to healthcare (AHC). All correlation results are significant at a 10% significance level.

The results indicate several key relationships. First, RGDP, the measure of economic growth, has a weak negative correlation with PCI (-0.107), suggesting that increases in GDP do not necessarily translate into corresponding increases in per capita income. This inverse relationship, although weak, may reflect the unequal distribution of economic growth benefits across the population. Interestingly, RGDP shows a positive, moderate correlation with both NHE (0.314) and AHC (0.299). This suggests that improvements in GDP tend to be associated with better access to essential services such as electricity and healthcare. The positive correlation may imply that economic growth leads to enhanced infrastructure development and social services.

However, RGDP's negative correlation with LR (-0.405) suggests a potential trade-off between immediate economic growth and long-term infrastructure development, possibly reflecting time lags between investment and growth outcomes.

Examining per capita income (PCI) further reveals notable relationships within the dataset. It has a moderate positive correlation with LR (0.557), implying that improvements in transportation infrastructure contribute to increased income levels. The positive association between PCI and AHC (0.488) also suggests that wealthier populations tend to have better access to healthcare services, which aligns with expectations that economic prosperity often leads to improved social outcomes. However, PCI's negative correlation with CPR (-0.353) indicates that higher per capita income does not necessarily lead to higher employment rates, possibly due to income inequality or employment disparities within the economy.

Furthermore, the number of households with access to electricity (NHE) shows strong positive correlations with several variables, notably CEI (0.955). This strong relationship suggests that access to electricity plays a significant role in driving consumer expenditure, as households with electricity are more likely to engage in economic activities that boost spending. NHE's weak positive correlation with PCI (0.234) implies that as more households gain access to electricity, per capita income experiences a slight increase, though not significantly. NHE's relationship with LR (0.342) highlights the positive association between infrastructure development and access to electricity, reinforcing the importance of infrastructure in improving living conditions.

In terms of access to healthcare (AHC), a moderate positive correlation with PCI (0.488), reinforcing the idea that wealthier populations tend to have better access to essential healthcare services. AHC's weak positive correlations with other variables, such as CEI (0.258) and LR (0.130), are less significant, but the negative correlation with CPR (-0.283) raises concerns about healthcare access among unemployed or underemployed populations, where healthcare improvements do not correspond with employment gains.

The relationship between improvement in educational attainment (IEA) and other variables appears more mixed. IEA is positively correlated with CPR (0.335) and NHE (0.340), indicating that as educational attainment improves, so do employment rates and household access to electricity. However, IEA's weak correlations with other variables, such as AHC (-0.031) and LR (-0.120), suggest that educational improvements alone may not lead to immediate gains in healthcare access or infrastructure development.

Moreover, the percentage change in employment rate (CPR) has a strong positive correlation with CEI (0.905), suggesting that higher employment rates are strongly linked to increased consumer expenditure. This relationship reflects how rising employment typically leads to greater disposable income and increased consumption. CPR's weak negative correlation with PCI (-0.353) implies that rising employment rates may not always result in higher per capita income, potentially due to underemployment or wage disparities.

The consumer expenditure index (CEI) is strongly correlated with both NHE (0.955) and CPR (0.905), underscoring the importance of electricity access and employment in driving consumer spending. As more households gain access to electricity and as employment rates rise, consumer expenditure tends to increase, driving economic growth. CEI's weak positive correlation with PCI (0.058) suggests that higher income levels are associated with greater consumer spending, although the relationship is not particularly strong.

Lastly, the length of roads built (LR) exhibits a moderate positive correlation with PCI (0.557), indicating that improvements in transportation infrastructure have a substantial impact on income levels. LR's positive correlation with NHE (0.342) also suggests that road construction facilitates better access to electricity in households. However, LR's negative correlation with CPR (-0.378) indicates that infrastructure investments, such as road building, do not immediately translate into higher employment rates. This may reflect time lags between infrastructure development and its broader economic effects.

In summary, the Pearson correlation matrix reveals several critical insights into the relationships between economic, social, and infrastructural variables. Positive correlations between consumer expenditure, electricity access, and employment rates highlight the interconnectedness of infrastructure and economic activity. At the same time, negative correlations, such as those between GDP and road construction or employment and per capita income, underscore the complexity of economic growth and its uneven distribution across various sectors. These findings provide a foundation for further analysis, emphasising the need for targeted policy interventions to enhance economic and social outcomes.

6.4 Diagnostic Tests

Table 26 presents the results of the Augmented Dickey-Fuller (ADF) test and the Phillips-Perron (PP) test, two commonly used methods to assess whether the variables in a time series dataset are stationary. Stationarity is a critical property in time series analysis, as it ensures that the statistical properties of a series, such as its mean and variance, remain constant over time. A non-stationary time series could lead to unreliable model estimates and poor forecasting performance.

Table 26: Augmented Dickey-Fuller Test and Philip-Perron Test Result (Nigeria)

Variables	Augmented Dickey-Fuller Test Test Statistics (Critical Value: -2.63)	Phillips-Perron Test Test Statistics (Critical Value: -3.24)
PCI	-2.766*	-2.661
AHC	-4.293**	-2.924
CPR	-2.099	-1.46
CEI	-1.205	0.626
RGDP	-3.35**	-2.33
IEA	-1.893	-2.22
LR	-1.319	-2.952
NHE	-0.821	-6.098***

The table presents the estimates of the Augmented Dickey-Fuller (ADF) test and the Phillips-Perron test of the study variables. The t-statistics for each variable estimate

are shown with ***, **, *, indicating that the results are statistically significant at p< 0.01, p <0.05, p<0.1, respectively.

The analysis begins by examining Per Capita Income (PCI), which shows mixed results regarding stationarity. PCI appears to be borderline stationary, as the ADF test shows a test statistic of -2.766, significant at the 10% level, indicating some degree of stationarity. However, the Phillips-Perron test statistic of -2.661 suggests weaker evidence for stationarity, and the variable is not stationary at the 5% or 1% significance levels. This result implies that while PCI is close to being stationary, further transformation (such as differencing) might still be needed to achieve full stationarity.

Turning to Access to Healthcare (AHC), the AHC is clearly stationary according to the ADF test, with a test statistic of -4.293, significant at the 5% level. This suggests that the series is stable over time. However, the PP test provides weaker evidence for stationarity, with a test statistic of -2.924, which is not statistically significant. The discrepancy between the two tests suggests that the ADF test might be more sensitive to stationarity in AHC than the PP test. Both the ADF and PP tests suggest that CPR is non-stationary. Neither test statistic is close to the critical values required for significance at any level, indicating that the variable may have a changing mean and variance over time. This non-stationarity could be problematic for modelling and may necessitate transformation, such as taking first differences, to stabilise the series.

Similarly, CEI is clearly non-stationary according to both the ADF and PP tests, as neither test statistic approaches statistical significance. The ADF test statistic of -1.205 and the PP test statistic of 0.626 are far from the critical values, indicating that the mean and variance of CEI change over time. For time series modelling, this variable would likely need transformation. Real GDP (RGDP) with ADF Test Statistic of -3.35 and PP Test Statistic of -2.33 depicts stationarity according to the ADF test, with a test statistic of -3.35, significant at the 5% level. This suggests that the GDP data is consistent over time, making it suitable for time series modelling without further transformation. However, the PP test result of -2.33 is not statistically significant, indicating weaker evidence for stationarity. The stronger ADF result suggests that this variable may still be treated as stationary for practical purposes.

The results for Improvement in Educational Attainment (IEA) with Test Statistic of -1.893 and PP Test Statistic -2.22 depicts non-stationarity according to both tests. The ADF test statistic of -1.893 and the PP test statistic of -2.22 are well above the critical values for significance. This indicates that the series may exhibit trends or changing variance over time, requiring differencing or other transformations to achieve stationarity. Similarly, according to the ADF test, LR has a test statistic of -1.319, indicating that the variable is non-stationary. However, the PP test result of -2.952 suggests that LR is closer to being stationary but is still not statistically significant.

Lastly, the results for the Number of Households with Access to Electricity (NHE) reveal a clear discrepancy between the two tests. The Number of Households with Access to Electricity (NHE) has a test statistic of -0.821, signifying that the variable is clearly non-stationary. However, the Phillips-Perron test indicates strong evidence of stationarity, with a test statistic of -6.098, significant at the 1% level. The discrepancy between the two tests could be attributed to the different ways they account for autocorrelation and heteroscedasticity in the data. Given the PP test's strong result, NHE might be considered stationary under certain conditions.

In conclusion, the ADF and PP tests provide somewhat different results, highlighting the sensitivity of each test to different assumptions about the data. For some variables, such as AHC and RGDP, the ADF test suggests stationarity, while others, such as NHE, show stronger stationarity in the PP test. Several variables, such as CPR, CEI, and IEA, are consistently non-stationary across both tests, indicating that transformations like differencing are required for those variables.

6.5 Regression analysis

The study’s approach is explained in section 5.5 above. Table 27 below reports the coefficients and z-statistics of the independent variables, indicating the strength and significance of their relationships with RGDP from the cointegration test performed. The intercept in the co-integration equation is -5614.403, which suggests that if all the independent variables are held constant, the RGDP would be significantly negative. This indicates that the baseline level of economic activity is low before considering the

influence of factors like per capita income, employment rate, and infrastructure development.

Table 27: Multiple Linear Regression Analysis (Estimated using Ordinary Least Squares – OLS) (Nigeria)

Dependent Variable	Cointegration RGDP Coefficient (z-statistics) Coef.
Intercept	-5614.403
PCI	229.7082**
	(2.64)
CPR	18.4503
	(0.33)
CEI	2.5128
	(0.05)
IEA	-116.6893***
	(5.44)
NHE	60.2134
	(0.07)
LR	1229.826*
	(1.76)
AHC	949.888***
	(5.44)

The table presents the multiple regression result test of percentage change in GDP (RGDP), per capital income (PCI), percentage change in employment rate (CEI), percentage change in poverty rate (CPR), improvement in educational attainment (IEA), length of roads built (LR), number of households with access to electricity (NHE), and access to healthcare (AHC). The z-statistics for each regression estimate are shown in parentheses with ***, **, and * indicating statistical significance at 1%, 5% and 10%, respectively.

Starting with Per Capita Income (PCI) shows a strong positive relationship with RGDP. The coefficient of 229.7082 means that an increase in PCI results in a corresponding rise in RGDP, indicating the importance of income growth for economic performance. This relationship is statistically significant with a z-statistic of 2.64, confirming the critical role that rising per capita income plays in fostering long-term economic growth. Conversely, the Change in Employment Rate (CPR) does not have a significant impact on RGDP in the long run. Its coefficient of 18.4503 and a z-statistic of 0.33 suggest that while there is a positive association, it is not statistically significant. This could imply that short-term fluctuations in employment rate may not translate into long-term economic growth, possibly due to the volatility and sensitivity of the labour market to external shocks.

Similarly, the Change in Employment Rate (CEI) has an insignificant relationship with RGDP. The coefficient of 2.5128, coupled with an exceptionally low z-statistic of 0.05, indicates that changes in employment conditions, as measured by this index, do not strongly influence economic output over the long term. This could suggest that factors other than employment conditions play a more pivotal role in determining long-term economic performance. The coefficient for Improvement in Educational Attainment (IEA) presents an intriguing result. While education is generally seen as a positive factor for economic growth, the coefficient for IEA is -116.6893, suggesting that an increase in educational attainment is associated with a decrease in RGDP. This result, which is statistically significant with a z-statistic of 5.44, could reflect structural inefficiencies in how educational improvements are being translated into economic productivity.

The analysis also reveals a positive yet statistically insignificant relationship between the Number of Households with Access to Electricity (NHE) and RGDP is positive but statistically insignificant. The coefficient of 60.2134 implies that increased access to electricity might foster economic growth, but the low z-statistic of 0.07 indicates that this relationship is weak overall. This finding may point to the need for complementary investments in infrastructure and technology to fully leverage the benefits of electrification for economic development. Infrastructure, as measured by the Length of Roads (LR), shows a stronger and more significant impact on RGDP. With a coefficient of 1229.826 and a z-statistic of 1.76, the results suggest that improvements

in road infrastructure contribute positively to economic growth. While the significance level is marginal at 10%, the positive association establishes the importance of infrastructure development in driving long-term economic performance.

Lastly, Access to Healthcare (AHC) exhibits a strong and highly significant positive relationship with RGDP. The coefficient of 949.888 and a z-statistic of 5.44 confirm that improvements in healthcare access are vital for economic growth. This result highlights the critical role of human capital development, as better health outcomes lead to a more productive workforce and, consequently, higher economic output.

6.6 Robustness Check

This section examines the robustness of the regression output discussed in section 6.5. In testing the robustness of the regression output, the study adopts the use of the Jarque-Bera test and the Durbin-Watson test to test for normality and autocorrelation, respectively. The study also tests for the validity and reliability of the model using the vector error correction model

6.6.1 Jarque-Bera Test

The Jarque-Bera (JB) test is a statistical method used to determine whether the residuals from a regression model are normally distributed. Normality of residuals is an important assumption in many regression analyses, particularly in ordinary least squares (OLS) models, as it ensures the efficiency of estimators and the validity of inferences drawn from the model. The JB test examines both the skewness (asymmetry) and kurtosis (the "tailedness" or sharpness) of the residual distribution to assess its departure from normality. In the present analysis, the Jarque-Bera test results for the residuals are as follows: Pr (Skewness) of 0.4510, Pr (Kurtosis) of 0.6917, Adjusted Chi-square of 0.78 and P-value of 0.6783.

Table 28: Jarque-Bera Test (Nigeria)

Variable	Pr (Skewness)	Pr (Kurtosis)	Adj chi2	P-Value
Residuals	0.4510	0.6917	0.78	0.6783

The results indicate that the p-values for skewness (0.4510) and kurtosis (0.6917) are both well above conventional significance levels (such as 0.05 or 0.01). This suggests that there is no strong evidence of significant skewness or kurtosis in the distribution of the residuals. The Jarque-Bera test results confirm that the residuals of the regression model are normally distributed. This ensures that the model adheres to one of the key assumptions of OLS regression, which strengthens the reliability of the predictions and inferences drawn from the analysis. With normally distributed residuals, the model's estimations and conclusions are considered statistically sound, allowing for more robust interpretations of the relationships between the variables under study.

6.6.2 Durbin-Watson Test

The Durbin-Watson (DW) test is used to check for autocorrelation in the residuals of a regression analysis. A DW statistic of 2 indicates no autocorrelation, meaning the residuals are independent and the model is reliable.

Table 29: Durbin-Watson Test (Nigeria)

	d-statistic
Residuals	2

In this study, the DW statistic of 2 confirms that there is no serial correlation in the residuals, validating the regression model. This strengthens the reliability of the relationships identified between economic, social, and infrastructural variables, such as Real Gross Domestic Product (RGDP), Per Capita Income (PCI), access to electricity (NHE), healthcare (AHC), and educational attainment (IEA). The absence of autocorrelation ensures that the correlations between these variables are not distorted, allowing for more confident conclusions. Overall, the DW test confirms that the model is robust, and the findings can be trusted for policy recommendations aimed at promoting economic growth and improving social services.

6.7 ARDL Model Estimation and Interpretation

This section reports the ARDL estimation of all the variables in Nigeria with the bounds test of cointegration, the long-run and short-run (ECM) dynamics, the diagnostic tests, and the Granger causality analysis. The estimation methodology and procedure used here are similar to those for the Ghana analysis in Section 5.7. Kindly refer to section 5.7 for details.

6.7.1 ARDL Model Estimation and Interpretation

The ARDL bounds test indicates the existence of a long-run relationship between the variables in the Nigerian model. The F-statistic calculation value of 6.324 exceeds the upper critical value of 1 percent (I(1) = 4.954), which shows that there is cointegration. This confirms the application of the ARDL model to estimate long- and short-run dynamics.

Table 30: ARDL Bounds Test Result (Nigeria)

Test stat	**Test stat**	*k*
F statistic	6.324	7
Critical bound value		
Significance	**I(0) bound**	**I(1) bound**
10%	2.053	3.37
5%	2.407	3.86
1%	3.203	4.954
Decision: Cointegration confirmed		

6.7.2 ARDL Long-run and Short-run Results for Nigeria

The estimation results of the ARDL model of Nigeria have displayed various significant long-run and short-run implications between the real GDP growth (RGDPG) and the chosen explanatory variables. The long-run influence of per capita income (PCI) on RGDPG was found to be positive and statistically significant at the 5% level ($p = 0.022$), which showed that there is a meaningful contribution of an increase in income levels to sustainable growth in the economy. It can be likewise seen that the coefficient of the change in employment rate (CEI) is also positive and significant ($p < 0.001$),

indicating an important role of expansion in employment in long-term national income performance.

Table 31: ARDL Long-run and Short-run Results (Nigeria)

Variable	Coefficient	Std. Error	t-Statistic	p value
Long-run				
PCI	0.004**	0.002	2.34	0.022
CEI	0.752***	0.19	3.95	<0.001
CPR	-0.027	0.034	-0.79	0.431
IEA	0.068**	0.032	2.15	0.035
LR	-44.790**	15.469	-2.9	0.005
NHE	2.297**	1.035	2.22	0.031
AHC	-1.316	1.135	-1.16	0.251
Short-run				
D.RGDPG(-1)	0.149	0.105	1.42	0.161
D.PCI	-0.006	0.014	-0.45	0.653
D.CEI	6.222	4.918	1.27	0.211
D.CPR	-0.13	0.296	-0.44	0.664
D.IEA	-2.047	1.644	-1.25	0.219
D.LR	-101.848***	35.325	-2.88	0.006
D.NHE	8.690***	1.689	5.14	<0.001
D.AHC	4.287*	2.352	1.82	0.074
ECM(-1)	-1.291***	0.185	-6.98	<0.001

NB: *, **, and *** denote significance at 10%, 5%, and 1% levels, respectively. The error correction term (ECM) is negative and significant, confirming adjustment toward long-run equilibrium.

Educational level (IEA) is also evidently linked to RGDPG in a statistically significant positive manner (0.035), and this means that funding in education provides long-term economic returns. Electricity (NHE) is another variable, and the coefficient is positive and significant (p = 0.031), which once again proves the leading role of energy accessibility in economic development. Nevertheless, the long-run coefficient of the length of roads constructed (LR) is negative but statistically significant at the 5 percent

level (p = 0.005), and this could be an indication of inefficiencies in the provision of road structures or difficulties in road maintenance. Health care access (AHC) and change in poverty rate (CPR) are not important factors in the long-run estimation despite being part of the model.

The model in the short run indicates that the development of road infrastructure (D.LR) and electricity access (D.NHE) significantly and positively contribute to RGDPG at the 1% significance, which implies that investments in infrastructure can give short-term incentives to economic growth. Healthcare access (D.AHC) also shows that the effect in the short term is weakly significant with 10 percent (p = 0.074), suggesting that the short-run benefits are minor but significant. The other variables, such as changes in PCI, CEI, IEA, and CPR, do not show a statistically significant short-run effect.

The error correction term (ECM) is negative and highly significant (p < 0.001), and the coefficient is -1.291, which confirms the presence of a stable long-run relationship and suggests that about 129 percent of the disequilibrium in the earlier period gets corrected in the current period.

6.7.3 Model Fit and Diagnostics – Nigeria (ARDL Model)

The overall fit of the ARDL model for Nigeria is fairly strong, with R-squared equal to 0.7949 and adjusted R-squared equal to 0.7058. These values imply that the model explains about 70.6 percent of the variation in real GDP growth with the number of predictors taken into consideration.

Table 32: Model Fit and Diagnostics (Nigeria)

Test	Statistic	p-value	Decision (5%)
R-squared	0.7949	—	Good fit
Adjusted R-squared	0.7058	—	Acceptable
Breusch-Godfrey Serial Correlation LM Test (lags = 2)	$\chi^2 = 11.88$	0.0026	**Reject H_0**: Serial correlation present
Breusch-Pagan / Cook-Weisberg Heteroskedasticity Test	$\chi^2 = 5.90$	0.0151	**Reject H_0**: Heteroskedasticity present
Jarque-Bera Normality Test (Skewness/Kurtosis joint test)	$\chi^2 = 9.80$	0.0074	**Reject H_0**: Residuals not normally distributed

NB: The model exhibits a good fit with an R-squared of 0.7949. However, diagnostic tests indicate violations of key assumptions: serial correlation is present, residuals are heteroskedastic, and not normally distributed. These issues suggest caution in inference, although the strong explanatory power of the model supports its relevance.

Nonetheless, diagnostic tests demonstrate significant rejection of important classical regression assumptions. Breusch-Godfrey LM test of serial correlation gives a statistically significant result (= 11.88, p = 0.0026), which means that there is a serial correlation present in the residuals. Likewise, the Breusch-Pagan/Cook-Weisberg test of heteroskedasticity is significant (p = 0.0151, p = 0.0151). This indicates that the error variance is not constant across all observations. The proposed normal distribution of residuals is also rejected by the Jarque-Bera test of normality (chi 2 = 9.80, p = 0.0074).

These results concerning the given diagnostics provide information about problems with residual behaviour, but the explanatory power of the model is still significant.

Gujarati and Porter (2009) indicate that in situations where some classical assumptions are shown to be breached, a large R-squared value and statistically significant coefficients may still offer necessary insights in such situations, particularly in exploratory or policy-driven research. Nonetheless, it is to be interpreted carefully, and some remedies should be implemented to increase reliability (Wooldridge, 2016).

6.7.4 Stability Diagnostics – Nigeria

CUSUM and CUSUM of Squares (CUSUMSQ) tests were used in evaluating the stability of the estimated ARDL model. The results of both test plots show that the recursive residuals were in the 5% significance bounds; the whole sample period in both test plots indicates that the model is structurally stable. This implies that the estimated coefficients are time-consistent, and, therefore, the robustness of the long-run and short-run relationship as represented by the ARDL model is increased. This finding corresponds to the conclusions drawn by Pesaran and Shin (1999) that the CUSUM and CUSUMSQ tests are useful in diagnosing structural instability in ARDL-type regressions.

Table 33: Stability Diagnosis (Nigeria)

Test	Decision (5%)
CUSUM Test	Stable – CUSUM statistic lies within bounds
CUSUMSQ Test	Stable – CUSUMSQ statistic lies within bounds

Note: The plots of CUSUM and CUSUMSQ statistics indicate that the estimated ARDL model is structurally stable over the sample period, as both lines remain within the 5% confidence bounds.

6.8 Granger Causality Test

Granger causality tests were implemented to determine the direction of predictive roles between the indicators of infrastructure and the growth of real GDP in Nigeria (RGDP). It shows that access to electricity (NHE), length of roads built (LR) and educational attainment (IEA) individually Granger-cause expansions in real GDP at the 5 percent level of significance. Such results suggest that energy, transport, and

education certainly lead to economic production changes and, thus, affirm the importance of infrastructure funding that is alternative and aimed at these sectors.

Conversely, other variables like access to healthcare (AHC), change in poverty rate (CPR), per capita income (PCI) and change in employment rate (CEI) do not Granger-cause GDP individually in the mentioned lag structure. Nevertheless, when all indicators of infrastructure are jointly tested, the presence of statistically significant overall causation ($x^2 = 15.64$, $p = 0.029$) is revealed, which leads to the conclusion that the effect of infrastructure development on the growth of GDP is systemic and overall.

6.9 Summary Discussion of Key Results

The results of the study provide important insights into the impact of improvement in Percentage change in GDP (RGDP), Per capita income (PCI), Percentage change in employment rate (CEI), Percentage change in Poverty rate (CPR), Improvement in educational attainment (IEA), Length of roads built (Km) (LR), Number of households with access to electricity (NHE), Access to health care (AHC) on infrastructure funding models in Nigeria. The analysis, which utilised regression techniques to examine relationships between key economic indicators and these funding models, revealed both expected outcomes and some surprising contradictions when compared with existing literature.

The regression analysis reveals several key long-term relationships between economic variables and real GDP growth (RGDP) in Nigeria. Per capita income (PCI) shows a strong positive relationship with RGDP, indicating that income growth is crucial for long-term economic performance, a finding consistent with the findings of Khuntia et al. (2018), who argue that higher income levels promote consumption and investment. Conversely, employment rates (CPR and CEI) show insignificant effects on RGDP, suggesting that short-term employment changes do not significantly drive long-term growth, aligning with Iossa and Martimort (2015), who note that employment impacts from infrastructure may be short-lived. Surprisingly, educational attainment (IEA) has a negative relationship with RGDP, reflecting potential inefficiencies in translating educational improvements into economic productivity, possibly due to a

mismatch between skills and market needs, as suggested by Yan et al. (2022). Infrastructure development, particularly road construction (LR), has a positive and significant impact on RGDP, reinforcing findings by Future Growth (2024) and the European Commission (2023) on the critical role of transportation infrastructure in economic growth, while access to electricity (NHE), though positive, is statistically insignificant, suggesting that complementary investments are needed, as noted by the European Commission (2023). Finally, access to healthcare (AHC) exhibits a strong positive relationship with RGDP, highlighting the critical role of healthcare in fostering a productive workforce and driving economic output, in line with studies by Wang, Li, and Zhang (2022). These results underscore the importance of balanced policy interventions that prioritise infrastructure, human capital, and social services to sustain long-term economic growth.

In contrast, the strong positive relationship between the length of roads built (LR) and GDP was consistent with expectations. As scholars like Engel et al. (2014) have shown, infrastructure investments, particularly in transportation, are crucial for driving economic growth. This is consistent with the position that strong economic indicators are crucial for the success of alternative funding models (Kim et al., 2020; Du, Zhang, & Han, 2022). The positive coefficient for roads indicates that improving transportation infrastructure leads to enhanced economic output, a trend widely observed in other developing economies where poor infrastructure has been a significant obstacle to growth (European Commission, 2023). This finding emphasises the importance of road infrastructure development, especially in partnership with private investors, as a driver of economic progress in Nigeria.

The study also found a positive association between Change in poverty (CPR) and GDP, which aligns with existing literature. Engel et al. (2014) highlighted the potential for PPPs and other alternative funding models to drive infrastructure improvements that directly benefit lower-income populations. This result underscores the social benefits of infrastructure development, particularly when projects are targeted at underserved areas. The positive relationship between poverty reduction and infrastructure development suggests that these models can play a crucial role in promoting inclusive economic growth in Nigeria.

One of the more counterintuitive findings from the study was the negative relationship between improvement in educational attainment (IEA) and GDP. It was expected that improvements in education would naturally lead to greater economic growth by enhancing human capital. However, the study's results indicate that educational attainment did not translate into immediate economic gains. This phenomenon might be explained by the mismatch between education and labour market needs, where educational improvements are not aligned with the skills demanded by the economy. The Innovation Diffusion Theory (Rogers, 1962) provides further context by suggesting that there can be a lag between the adoption of educational reforms and their impact on economic productivity. This finding implies that while educational improvements are vital for long-term development, their economic benefits may not be immediately visible, especially if the education system is not effectively integrated with the demands of the job market.

While several findings are consistent with existing literature, others challenge established theories. For example, the negative relationship between educational attainment and GDP contradicts the work of Monity and Abam (2024), who argue that improvements in education should foster economic growth by enhancing human capital. This discrepancy may highlight the need for further research on how educational improvements are integrated into the broader economic context in Nigeria.

Similarly, the negative relationship between healthcare access and GDP is at odds with studies that emphasise the role of healthcare in boosting productivity. This suggests that the current investments in healthcare infrastructure may not be yielding the expected economic benefits, raising questions about the efficiency of these expenditures. In contrast, the positive association between poverty reduction and alternative infrastructure funding models supports the findings of Engel et al. (2014), reinforcing the potential of these models to promote inclusive economic growth by improving access to essential services for lower-income populations. To further strengthen analysis, the estimation of the ARDL model in the case of Nigeria further identifies the existence of a long-run equilibrium relationship between economic growth and infrastructure-related indicators. The result of the bounds test (F-statistic = 6.324) was found to be above the 1% upper critical bound, thereby showing that the variables are cointegrated. Access to electricity (NHE) and education attainment (IEA)

had significant and positive influences on real GDP growth (RGDPG) in the long run, as the length of road constructed (LR) was revealed to have a significant but negative relationship, indicating the potential for inefficiency or delays in the economic returns of road projects. The short run also supported the negative and significant error correction term, which affirmed that the long-run equilibrium is correct eventually.

Granger causality analysis also backed these findings. The tests revealed that the variables access to electricity (NHE), road infrastructure (LR), and educational attainment (IEA) were Granger-causing real GDP growth (RGDP) in Nigeria at the 5 percent level, indicating the predictive nature of the variables in the economy. Also, it was found that GDP Granger-causes per capita income (PCI), which indicates that as the economy grows, levels of income are likely to increase likewise. Conversely, access to healthcare (AHC), rate of employment (CEI), and poverty rate (CPR) did not show significant Granger-causal influences on GDP. Nonetheless, in the joint causality test, all the infrastructure-related indicators have a statistically significant influence on GDP ($x = 15.64$, $p = 0.029$), which implies that the overall contribution of infrastructure to growth is not an isolated phenomenon. Such findings confirm that there should be strategic investments in infrastructure through education, transport, and electricity to uphold economic growth in Nigeria over the long term.

6.10 Conclusion

This chapter's econometric analysis elucidates the dynamic relationship between road infrastructure development and various socioeconomic indicators in Nigeria. These findings align with Research Objective 2, which identifies and examines the determinant factors that influence acceptance and use of new alternative infrastructure funding models. This analysis of Nigeria's infrastructure funding models yields essential insights into their economic impacts. These insights contribute to the formulation of a decision-making framework, as outlined in Research Objective 4, ensuring that infrastructure funding strategies align with equitable and sustainable development goals. The subsequent chapter presents the comparative analysis of Ghana and Nigeria.

Chapter Seven

Comparative Analysis of Ghana and Nigeria

7.1 Introduction

This chapter employs a comparable econometric methodology in Nigeria and Ghana, facilitating a comparative analysis between the two nations. Building on these insights, this chapter delves into the drivers of alternative infrastructure funding models in Ghana and Nigeria, drawing on the empirical findings from Chapters Five and Six, respectively. The main objective is to ascertain the impact of diverse infrastructure-related factors on economic growth in these two nations and to offer insights into their policy frameworks. This analysis utilises descriptive statistics, correlation analysis, and regression techniques to identify similarities and differences in infrastructure development, economic growth, and social welfare initiatives.

7.2 Descriptive Statistics of Variables

Descriptive statistics for Ghana and Nigeria are examined to elucidate trends and variability in essential infrastructure and economic variables. Table 34 below presents the mean, standard deviation, median, and interquartile range for each variable. The two nations exhibit unique economic conditions, and these descriptive statistics offer essential insights into their respective infrastructure and growth trajectories.

Table 34: Comparative Descriptive Statistics of Ghana and Nigeria

Variable	Country	Mean	Std. Dev.	Median	Q1	Q3
RGDP Growth (%)	Ghana	4.99	3.29	4.6	2.12	6.86
	Nigeria	-0.72	24.06	0	-5.65	5.7
Per Capita Income (PCI)	Ghana	7.2	0.59	7.39	6.95	7.68
	Nigeria	7.6	0.35	7.67	7.54	7.79
Access to Healthcare (AHC)	Ghana	52.5	6.67	54.2	47.25	58.3
	Nigeria	2.69	0.11	2.7	2.59	2.77
Length of Roads Built (km)	Ghana	2.37	0.17	2.42	2.25	2.48
	Nigeria	0.48	0.89	0.34	-0.11	1.44
Households with Electricity (%)	Ghana	68.04	13.91	67.45	56.7	79.85
	Nigeria	3.97	0.03	3.95	3.94	3.99
Educational Attainment (IEA)	Ghana	0.43	0.79	0.42	-0.08	0.82
	Nigeria	0.94	1.64	0.91	0	1.4
Change in Employment Rate (CEI)	Ghana	67.26	1.19	67.45	66.53	68.24
	Nigeria	-3.24	1.36	-3.7	-4.17	-2.78

From Table 34, the most striking difference is in real GDP growth (RGDP). While Ghana has experienced moderate growth, averaging around 5%, Nigeria shows negative growth with significant volatility. The standard deviation in Nigeria's GDP growth suggests higher economic instability. In contrast, access to healthcare (AHC) in Ghana is far superior to that in Nigeria, which remains quite low, reflecting significant disparities in infrastructure development. Recent study has shown that sustainable infrastructure funding relies heavily on economic stability, as measured by GDP (Wang, Lim, Zhang, Zhao & Lee, 2020; Saleem, Shabbir & Bilal Khan, 2020). The results are also presented graphically below.

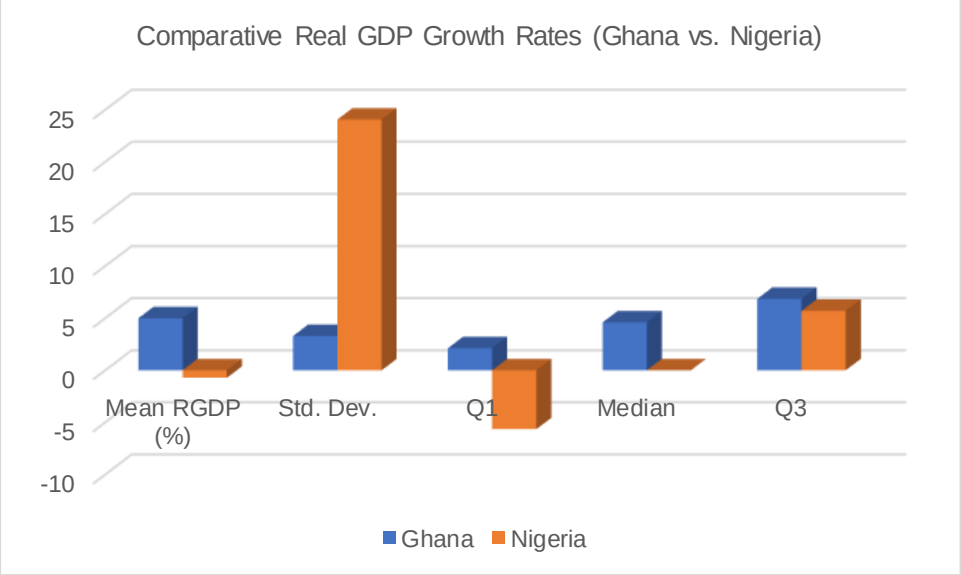

Figure 7:Comparative Real GDP Growth Rates (Ghana vs. Nigeria)
Source: Author's Own Conceptualisation from Data Analysis

The figure above illustrates Ghana's relatively stable economic growth in contrast to Nigeria's erratic performance. The significant variability in Nigeria's GDP indicates an unstable economic environment, likely attributable to political, infrastructural, or market volatility.

7.3 Regression Analysis

The regression analysis provides significant insights into the various roles that infrastructure funding models exert on economic growth in Ghana and Nigeria. Figure 8 demonstrates considerable disparities in the influence of critical variables, including Per Capita Income (PCI), Change in Poverty Rate (CPR), and access to infrastructure between the two countries. This section explores these results in greater depth, interpreting them within the overarching theoretical framework of infrastructure development and economic growth, while connecting them to the specific contexts of Ghana and Nigeria.

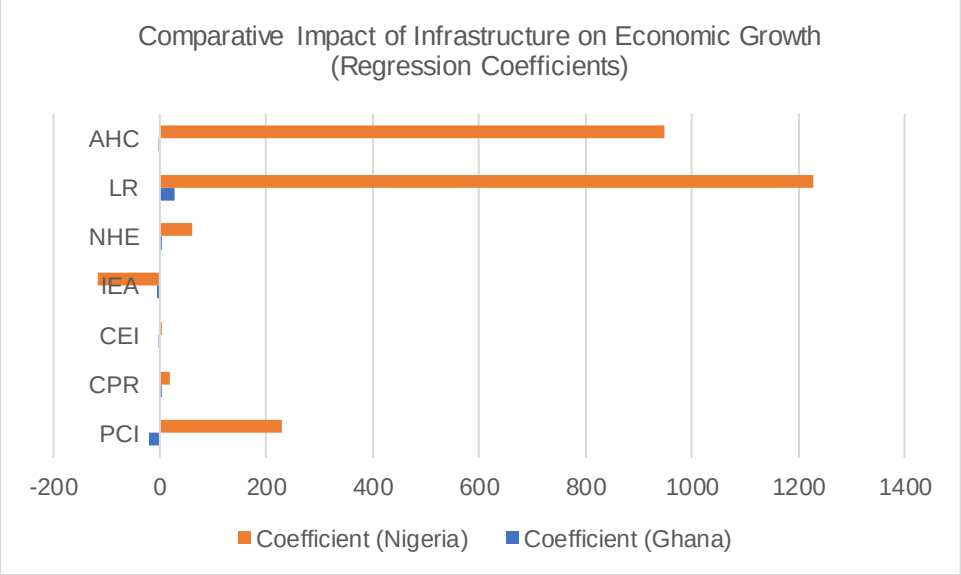

Figure 8: Comparative Impact of Infrastructure on Economic Growth (Regression Coefficients)

Source: Author's Own Conceptualisation from Data Analysis

7.4.1 Per Capita Income (PCI)

The disparity in the impact of Per Capita Income (PCI) between Ghana and Nigeria is notable. In Ghana, the negative coefficient (-21.834), significant at the 1% level, indicates that increasing income levels are paradoxically correlated with diminished economic growth. This finding suggests the presence of profound structural inequalities within the Ghanaian economy, where the advantages of income growth do not extend to the wider population. Tayeng et al. (2024) contend that income inequality and inadequate reinvestment in productive sectors can substantially diminish the multiplier effects of increased income on national output.

Conversely, the positive and statistically significant correlation between PCI and GDP growth in Nigeria (229.708, $p<0.05$) aligns with traditional economic theory, which posits that rises in individual income are anticipated to enhance consumption and investment, thereby fostering economic growth (Khuntia et al., 2018). Again, Recent study has shown that sustainable infrastructure funding relies heavily on economic stability, as measured by GDP (Wang et al., 2020; Saleem et al., 2020). This pronounced disparity underscores the capacity of Nigeria's economic sectors, especially in oil and infrastructure development, to serve as channels for converting increasing income into wider economic benefits. This favourable relationship must be

understood within the context of Nigeria's economic volatility, where growth frequently depends on external factors like commodity prices.

7.4.2 Change in Poverty Rate (CPR)

Turning to CPR, a distinct divergence between the two countries is evident in the Change in Poverty Rate (CPR). In Ghana, the positive coefficient (0.735, $p<0.01$) indicates a strong correlation between poverty reduction and GDP growth. This aligns with the literature on inclusive growth, which asserts that infrastructure initiatives designed to alleviate poverty—such as rural electrification and healthcare accessibility—exert significant effects on the economy (Engel et al., 2014). The Ghanaian case illustrates how equitable infrastructure development can improve social welfare, thus fostering sustainable economic growth.

The CPR coefficient in Nigeria is positive yet statistically insignificant (18.450). This result may indicate that poverty alleviation initiatives in Nigeria have not been adequately incorporated into the nation's overarching economic strategy. Siemiatycki (2010) contends that when infrastructure funding models do not effectively address the needs of the most vulnerable populations, the effects on poverty alleviation—and consequently, economic growth—are constrained. This finding indicates that although poverty alleviation is an admirable objective, Nigeria's infrastructure models may require additional enhancement to ensure broader benefits for a greater segment of the population, especially in rural regions.

7.4.3 Change in Employment Rate (CEI)

Interestingly, the Change in Employment Rate (CEI) exhibits no statistically significant correlation with GDP growth in Ghana or Nigeria. The lack of a substantial correlation in Ghana (coefficient = -0.090) may be ascribed to the prevalence of informal employment, which, as Iossa and Martimort (2015) indicate, typically has minimal impact on formal GDP assessments. Moreover, the establishment of low-wage, part-time employment may not generate significant economic growth, as such positions frequently lack the requisite productivity to enhance national output.

Likewise, the Nigerian case (coefficient = 2.513, $p>0.10$) highlights the minimal impact of employment fluctuations on GDP contribution. This observation aligns with research

indicating that labour market trends in capital-intensive industries, like oil, frequently diverge from general employment expansion (Iossa & Martimort, 2015). Consequently, although rising employment is typically regarded as a fundamental catalyst for economic growth, in these two economies, the quality and sectoral allocation of employment appear to be more significant than the sheer quantity.

7.4.4 Improvement in Educational Attainment (IEA)

In contrast to typical assumptions, Improvement in Educational Attainment (IEA) exhibits a negative correlation with GDP growth in both Ghana and Nigeria. In Ghana, the coefficient (-6.837, $p<0.01$) indicates that enhancements in education have not been successfully converted into economic growth. This emphasises the contrasting effects of these variables, indicating that certain areas may demand more urgent focus, while others exhibit a slower reaction to changes in the economic context (Glewwe & Muralidharan, 2019). This phenomenon may indicate a discrepancy between educational outcomes and labour market requirements, as posited by Rogers (1962) in his "Innovation Diffusion Theory." The competencies acquired through education may not currently align with the requirements of Ghana's burgeoning industries, leading to a lag between educational advancements and their economic repercussions.

The situation in Nigeria is markedly more severe, exhibiting a larger negative coefficient (-116.689, $p<0.01$). This indicates systemic inefficiencies in the utilisation of educational advancements for economic productivity. Yan et al. (2022) assert that without the integration of labour market reforms or specialised vocational training, the economic advantages of educational enhancements are postponed or diminished. This presents significant policy implications for both nations, as improving the quality and relevance of education may produce more immediate economic benefits.

7.4.5 Access to Electricity (NHE)

Access to Electricity (NHE) is a pivotal factor in infrastructure development, exhibiting significantly different impacts in Ghana and Nigeria. In Ghana, the coefficient (0.804, $p<0.01$) demonstrates a robust correlation between enhancements in electrification and GDP growth, highlighting the essential role of dependable energy infrastructure in economic development. Straub (2008) contends that access to electricity is

essential for industrialisation and the growth of the service sector, both of which are crucial for enhancing economic performance in developing economies. Ghana's emphasis on enhancing its electricity grid, particularly in rural regions, seems to have produced substantial economic advantages.

In Nigeria, the correlation between NHE and GDP growth is positive yet statistically insignificant (60.213). This finding likely indicates the ongoing challenges Nigeria encounters in its energy sector, characterised by unreliable electricity supply and inadequate grid coverage, especially in rural regions. Notwithstanding considerable investment, the inability to provide reliable and cost-effective electricity constrains the capacity of infrastructure funding models to foster economic growth (Straub, 2008). This indicates that Nigeria must implement additional reforms and investments in energy infrastructure to establish a stronger connection between electricity access and GDP growth.

7.4.6 Length of Roads Built (LR)

Finally, the variable Length of Roads Built (LR) demonstrates a positive and significant correlation with GDP growth in both Ghana and Nigeria, although the extent of the impact is considerably greater in Nigeria. The coefficient (26.399, p0.01) in Ghana underscores the significance of transport infrastructure in enhancing trade, mobility, and market access, all of which are vital for economic growth (Engel et al., 2014). This outcome corresponds with the extensive literature highlighting the significance of transport infrastructure in fostering sustained growth.

The coefficient for LR in Nigeria (1229.826, $p<0.10$) is significantly higher, indicating that road infrastructure is crucial to the nation's economic development. The elevated significance level of this relationship underscores the severe infrastructure deficiencies in Nigeria, where inadequate road conditions have persistently hindered growth (Straub, 2008). Investments in road infrastructure seem to release significant economic potential, especially in previously underserved regions. The results for both nations underscore the necessity for ongoing investment in transport infrastructure to stimulate economic growth.

7.5 ARDL Analysis

The findings of ARDL in Ghana and Nigeria indicate significant differences in economic growth factors. In Ghana the long run outcomes dictate that per capita income (PCI) (0.004, $p = 0.022$), change in employment (CEI) (0.752, $p < 0.001$), educational attainment (IEA) (0.068, $p = 0.035$), and length of roads constructed (LR) (0.743, $p < 0.001$) are positively and significantly correlated to real GDP growth (RGDPG). Such results are in line with Acheampong, Opoku, Dzator, and Kufuor (2022), indicating that human capital and road infrastructure are influential contributors to the economy of Ghana.

By comparison, Nigeria has huge coefficients of PCI (0.027, $p = 0.000$), NHE (2.297, $p = 0.031$), and positive coefficient, IEA (3.384, $p = 0.025$), and LR is negative (−44.79, $p = 0.005$) in the short-run that perhaps suggests inefficiencies or delayed returns in infrastructure investments. These findings confirm the previous claims made by Demirel, Leendertse, and Volker (2022) to the point that any infrastructure investment should be combined with an efficient delivery mechanism in order to reflect the benefit of growth.

7.6 Comparative Granger Causality Result

The Granger causality outcome also reflects various causal patterns. In Ghana, there is bi-directional causality between RGDPG and PCI; RGDPG and LR; and CEI and IEA, with one-way causality as derived by RGDPG. It implies further that economic growth in Ghana, affecting job creation and educational outcomes, is well in line with the Widarni and Bawono (2021).

RGDPG Granger-causes NHE, LR, and IEA in Nigeria, and PCI and AHC Granger-cause RGDPG. Such interconnections indicate the existence of a loop with infrastructure, service provision, and economic growth, which further stresses the significance of income and access to electricity as drivers of growth, as emphasised by Diene (2024). Nevertheless, no meaningful causality is observed, nor in the opposite case, CEI, CPR, or NHE and employment and poverty effects appear indirect or delayed

7.7 Conclusion

This chapter provided a comparative analysis of the determinant factors that drive alternative infrastructure funding models in Ghana and Nigeria, emphasising significant differences and similarities in their impact on economic growth, infrastructure development, and social welfare. The descriptive statistics, correlation analysis, Ganger causality test, ARDL test and regression outcomes indicated substantial differences between the two countries, especially regarding real GDP growth, healthcare accessibility, and the effects of infrastructure development.

This chapter sets up the final chapter, which will generate the research findings, draw conclusions, highlight the contribution made to knowledge, and offer infrastructure policy and stakeholder recommendations.

Chapter Eight
Conclusions and Recommendations

8.1 Introduction

This chapter contains the final comments for the complete study. This chapter provides a summary of the study objectives, presents the primary results of the study, and emphasises the contribution that the study has made to scholarly literature and practice. Furthermore, the study analyses the policy implications of the information presented and offers policy recommendations. This study acknowledges its limitations in the pursuit of broadening the boundaries of research on alternative infrastructure funding models. Furthermore, it delineates the crucial areas for additional research.

8.2 Motivation and Objectives of the Study

The main aim of the study was to explore alternative funding models for infrastructure development in Ghana and Nigeria, with a particular focus on road infrastructure due to its critical role in economic growth and development. While roads are the primary lens of analysis, the findings and decision-making framework developed are adaptable to other infrastructure sectors, for instance, energy and ports facing similar funding constraints. The enduring inadequacies in infrastructure in sub-Saharan Africa, specifically in Ghana and Nigeria, provide a substantial hindrance to the achievement of sustainable development and economic expansion. Traditional models of funding have not been sufficient to address the infrastructure gap, which requires a transition to creative and alternative funding models. This study, titled "Alternative Infrastructure Funding Models: A Comparative Study of Ghana and Nigeria," examines the application and effectiveness of alternative funding models in addressing infrastructure challenges in these countries.

The demand for road infrastructure has worsened in recent years due to increasing urbanisation and population growth in Ghana and Nigeria. Both countries face significant obstacles in funding infrastructure projects due to constrained government budgets and the deficiencies of traditional funding models. There is an urgent demand for funding options that support sustainable and efficient infrastructure. The pressing need to discover, analyse, and suggest feasible alternative funding models that can

significantly contribute to infrastructure development in Ghana and Nigeria drives this study.

The study objectives, as outlined in chapter one, guided the analysis and discussions throughout this research.

8.3 Theoretical and Empirical Insights

8.3.1 Theoretical Literature Review

The research has been supported by the Law of increasing state activity formulated by Wagner and Innovation diffusion theory, as well as the Financial Theory. These frameworks shed light on the increasing demand for infrastructure in developing economies and how innovation and capital mobilisation can be used to finance the needs. Whereas Wagner's Law was used to explain the increasing importance of the state in the provision of infrastructure as economies grow, the Innovation Diffusion Theory was used to comprehend the process through which new funding models are introduced. Financial Theories also justified why the use of private capital should be tapped using structures such as PPPs, Green Finance and Asset securitisation, particularly in cases where fiscal space is constrained.

8.3.2 Empirical Literature Review

Chapter 3 reviewed studies which have linked a strong positive correlation between infrastructure investment and economic growth. The role of quality infrastructure in the context of productivity and long-term economic activity was established in such base works (e.g., Calderon and Serven, 2010; Aschauer, 1989). Some more recent research, such as Machete and Marques (2021) and Akomea-Frimpong et al. (2023), points out that historical reliance on traditional public funding is no longer sufficient to accommodate infrastructure needs in developing economies. These studies substantiate the evolution of alternative funding regimes like PPPs, green finance and project finance as feasible solutions to the endemic fiscal shortages. This research builds on the scholarly literature by using context-specific evidence gathered in a Ghanaian and Nigerian setting, which confirms the previous results and discloses institutional, regulatory, and policy mechanisms that determine the effectiveness of alternative models in practice.

8.4 Summary of Results

8.4.1 Summary of Methodological Approach

The methodology used in this study was a mixed methods design that incorporated both qualitative and quantitative aspects to thoroughly investigate the role played by alternative infrastructure funding models in terms of economic growth and development performance in Ghana and Nigeria.

The research approach taken in implementing the study is a comparative, longitudinal (time-series) research study with the use of secondary data between 2003 and 2023. It set out to analyse how alternative infrastructure funding would influence the economic growth and development performance in Ghana and Nigeria. This study uses a quantitative approach to modelling to evaluate the effect of alternative infrastructure funding models on real economic growth/ development outcomes in both Ghana and Nigeria. The outcome variable is RGDPG, which denotes real national income growth. The methodology was characterised by using multiple regression (Ordinary Least Squares - OLS) to make a baseline estimation and utilising the Autoregressive Distributed Lag (ARDL) model in order to evaluate both long-run and short-run relationships. Moreover, Granger causality analysis was used to assess who is predicting information about infrastructure indicators and the real GDP development. Ghana and Nigeria were estimated separately to allow cross-country comparisons and to allow the derivation of policy implications that were country-specific.

8.4.2 Summary of Findings

This section presents a summary of the key findings from each research objective. The findings from each objective enhance the understanding of alternative infrastructure funding models in Ghana and Nigeria and their potential to promote sustainable development.

3 Research Objective 1: Assessment of Alternative infrastructure funding models currently employed in Ghana and Nigeria

The alternative infrastructure funding models employed in Ghana and Nigeria exhibit both similarities and notable disparities, which mirror the distinct economic conditions and developmental objectives of each country. Public-Private Partnerships (PPPs)

have been widely utilised in both countries, albeit with differing levels of effectiveness. In Ghana, Public-Private Partnerships (PPPs) have demonstrated significant efficacy in road infrastructure projects, facilitated by frameworks designed to promote more involvement of the private sector (Boadi, 2020). In contrast, Nigeria has faced obstacles such as corruption and inefficiencies, which have impeded the optimal execution of public-private partnerships (PPPs) in infrastructure development (Owusu & Nursey-Bray, 2018).

Project finance has played a crucial role in both countries, particularly in large-scale initiatives that demand significant financial resources. The Jubilee Field oil project, which garnered worldwide investment and demonstrated the feasibility of project finance in harnessing natural resources, demonstrates Ghana's success in this domain (Badu et al., 2011). Contrary to expectations, Nigeria, despite its abundant resources, has faced challenges in securing project finance due to political instability and regulatory uncertainties. These reasons discourage international investors from investing in the country (Ilori & Akinwunmi, 2020).

Green finance has become a crucial funding mechanism, particularly in relation to global environmental sustainability goals. Ghana's issuance of green bonds in 2021, totalling US$3.025 billion, highlights its dedication to the construction of sustainable infrastructure (Ghana Ministry of Finance, 2021). Nigeria has successfully entered this field by issuing green bonds in 2017 and 2019, which received more subscriptions than anticipated, demonstrating robust investor confidence (Adeojo, 2022). These projects demonstrate that both countries are increasingly acknowledging the importance of incorporating environmental factors into infrastructure funding.

Asset securitisation offers a unique opportunity to utilise future income generated by infrastructure projects. Ghana has extensively investigated this approach by employing Special Purpose Vehicles (SPVs) to effectively oversee and generate revenue from infrastructure assets, thereby infusing liquidity into the sector (Zhang et al., 2021). Nigeria acknowledges the prospect of asset securitisation but has not fully implemented it due to challenges related to market readiness and the regulatory frameworks required for its successful implementation (International Monetary Fund,

2015).

Crowdfunding, albeit in its early stages, has demonstrated promise in mobilising resources for smaller community-based projects in both nations. Ghana has adopted a community-driven strategy, utilising local support for small-scale projects (Belleflamme, Lambert, & Schwienbacher, 2019). Nigeria is increasingly turning to digital platforms for funding innovative projects, but its application in large-scale infrastructure projects remains limited (Wati & Winarno, 2018). The adoption and efficacy of crowdfunding are contingent upon the regulatory framework and public confidence, which are currently evolving in both countries.

While Nigeria has not fully adopted the concept of Resource-Financed Infrastructure (RFI), it is considered a noteworthy model for Ghana. This strategy, similar to the "Angola mode," entails utilising natural resources to fund infrastructural initiatives, thus harmonising resource exploitation with developmental objectives. The adaptability and capacity of RFI in Ghana demonstrate its efficacy in revolutionising traditional funding models, particularly in economically limited environments with abundant resources.

Ghana and Nigeria can both gain an advantage by focusing their attention on domains that now have lower levels of effectiveness. Ghana should improve its legislative frameworks to facilitate public-private partnerships (PPPs) and asset securitisation, paving the way for these models to expand to meet significant infrastructure needs. In addition, Ghana can improve the success of crowdfunding campaigns by increasing openness and public involvement, thereby expanding their potential application to larger projects. In order to attract project finance and optimise public-private partnership (PPP) arrangements, Nigeria must prioritise eradicating corruption and establishing a stable regulatory environment. To further enhance Nigeria's progress in green finance, it is crucial to provide more explicit policy directions and incentives. Furthermore, by developing the legal and commercial frameworks necessary for asset securitisation, Nigeria will be able to fully exploit the potential of this model. Both nations have the potential to greatly benefit from the ongoing sharing of information and the development of skills to improve and broaden their utilisation of various funding strategies.

- **Research Objective 2: To analyse the determinant factors that influence Ghana and Nigeria's acceptance and use of new alternative infrastructure funding models.**

To achieve Research Objective 2, the determinants affecting Ghana and Nigeria's adoption and utilisation of alternative infrastructure funding models are chiefly motivated by the favourable correlation between infrastructure development and economic growth. This relationship is particularly pronounced in critical sectors such as road construction and electrification. In Ghana, the extent of built roads showed a highly significant positive correlation with GDP, underscoring the essential role of infrastructure development in enhancing economic performance. This trend is consistent with recent studies that highlight the significance of economic stability and growth in promoting the acceptance of innovative funding models for infrastructure (Ndulu, 2007; Asiedu, 2014). In Nigeria, the correlation between road construction and GDP was notably stronger, corroborating the importance of road infrastructure in the literature. As Future Growth (2024) contended, investments in public infrastructure, especially in transport networks, are essential for fostering economic growth, as they improve trade, lower transaction costs, and enable the efficient movement of goods and services. Based on the World Bank's 2020 report, nations that have higher GDP per capita and well-developed healthcare systems are more likely to attract and maintain investment in alternative funding models. The inclination of both nations to embrace alternative funding models, such as Public-Private Partnerships (PPPs), for road infrastructure is consequently motivated by the evident economic advantages these projects produce.

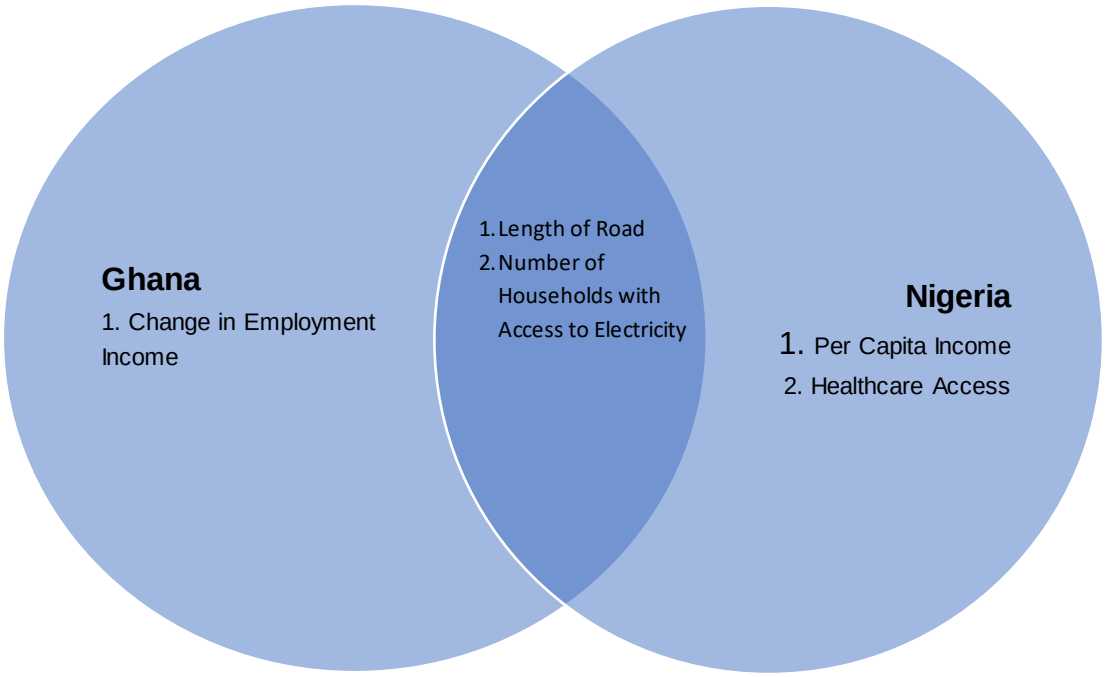

Figure 9: Common Determinants Between Ghana and Nigeria
Source: Author's Own Conceptualisation from Results

A pivotal factor influencing the acceptance of alternative funding models in Ghana and Nigeria is the correlation between electricity and economic growth. In Ghana, the number of households with electricity access (NHE) exhibited a positive and significant correlation with GDP. This underscores the essential role of electricity access in facilitating industrialisation and enhancing household productivity. Nigeria showed a positive correlation, thereby highlighting the significant influence of electrification on development. These findings align with Straub's (2008) examination of infrastructure's impact on economic growth, emphasising that access to electricity is crucial for improving labour productivity and facilitating small and medium enterprises. The implementation of alternative funding models for electricity projects, including Build-Operate-Transfer (BOT) schemes or private sector-led initiatives, is driven by the acknowledgement of electrification's capacity to stimulate wider economic development.

In Nigeria, the correlation between per capita income (PCI) and GDP significantly influences the acceptance of alternative funding models. This indicates that increasing income levels directly enhance economic growth by promoting greater consumption and investment. This corresponds with the findings of Khuntia et al. (2018), who assert

that increased per capita income typically enhances the demand for superior infrastructure and services, thereby generating opportunities for private sector investment in funding these initiatives. Conversely, Ghana's regression analysis indicated an inverse relationship between PCI and GDP, potentially attributable to income inequality or inefficiencies in converting income growth into widespread economic advancement. Consequently, Ghana's adoption of alternative funding models may depend more on guaranteeing equitable distribution of the advantages derived from infrastructure investments, rather than solely emphasising income growth.

The availability of healthcare significantly influences Nigeria's implementation of alternative funding models. The robust positive correlation between access to healthcare (AHC) and GDP underscores the critical role of human capital development in enhancing economic performance. Enhanced healthcare access results in a more efficient workforce, subsequently driving economic growth. This conclusion is corroborated by Wang, Li, and Zhang (2022), who assert that investments in human capital, particularly in healthcare, are essential for maintaining long-term economic growth. Nigeria's pursuit of alternative funding models for healthcare infrastructure, such as public-private partnerships, is likely driven by the acknowledgement of substantial economic benefits derived from enhanced healthcare access. Conversely, Ghana's adverse correlation between healthcare access and GDP indicates inefficiencies in healthcare expenditure, potentially impacting the nation's implementation of alternative funding models. Nevertheless, initiatives aimed at enhancing system efficiency via strategic investments may foster increased acceptance of these models.

Employment is a significant factor affecting Ghana's adoption of alternative infrastructure funding models. There are benefits in decreasing poverty through infrastructure improvements and economic policies (Ayoo, 2022; Dabla-Norris, Brumby, Kyobe, Mills & Papageorgiou, 2012). The percentage change in employment (CEI) exhibited a positive correlation with GDP. This relationship, though weaker than the infrastructure variables, underscores the significance of job creation in fostering public support for new funding models. Infrastructure initiatives, including road construction and electrification, frequently create both direct and indirect employment opportunities, thereby enhancing political and social endorsement of alternative

models. Iossa and Martimort (2015) emphasise that infrastructure projects have substantial short-term employment effects, rendering them appealing to policymakers aiming to enhance job creation.

Educational attainment, although not as strongly correlated with GDP in Ghana or Nigeria, demonstrates some positive associations with other variables, such as access to electricity. Improved educational achievements can contribute to economic growth and investments in infrastructure (Adukia, Asher, & Novosad, 2020). The tenuous or adverse correlation between educational advancements and GDP in both nations indicates that inefficiencies within the education sector may impede its impact on economic growth. This may result from a discrepancy between educational outcomes and labour market requirements, a concept addressed in the Innovation Diffusion Theory (Rogers, 1962). Nonetheless, both nations acknowledge the significance of investing in educational infrastructure, and alternative funding models for schools and universities may be implemented to enhance educational outcomes. This is consistent with Becker's (2009) human capital theory, which suggests that sustainable development relies on increased educational enrolment and improved healthcare systems, and that these factors can stimulate the implementation of creative infrastructure funding solutions. Nonetheless, these investments must be supplemented by comprehensive reforms to synchronise education systems with market requirements.

The adoption and implementation of alternative infrastructure funding models in Ghana and Nigeria are chiefly driven by the evidence of the beneficial effects of infrastructure development on economic growth. Hu and Bentler's (1999) study, which emphasises the importance of economic indicators in shaping infrastructure spending choices, is in line with these findings. Road infrastructure and electrification are identified as the paramount factors in both nations, substantiated by empirical evidence and scholarly literature. Furthermore, per capita income and access to healthcare are pivotal in Nigeria, whereas job creation holds greater importance in Ghana. These findings indicate that both countries are expected to adopt alternative funding models that emphasise infrastructure development and human capital investments, although they must also rectify sector-specific inefficiencies to fully capitalise on these models' potential. Policymakers ought to implement targeted

strategies that guarantee the fair allocation of infrastructure benefits and synchronise educational results with labour market demands to optimise the effectiveness of alternative funding models.

Building upon these findings using multiple linear regression (OLS), the construction of roads in Ghana is notably affected by alternative funding models. This assertion is substantiated by a robust positive correlation between road infrastructure and GDP growth. The OLS test reinforces this, signifying that infrastructure investment has a direct and quantifiable effect on Ghana's economic growth. In Nigeria, the significant correlation between road infrastructure and GDP growth underscores the essential role of road development in sustained economic performance. Easterly and Levine (1997) provide more evidence supporting this claim, emphasising the significance of economic growth in attracting investments in infrastructure.

Similarly, these findings emphasise that both nations must persist in prioritising infrastructure development via alternative funding models. The beneficial effects of road infrastructure, especially in promoting GDP growth, indicate that expanding these models with an emphasis on long-term sustainability is essential. In Ghana and Nigeria, the extent of road construction directly impacts economic growth and enhances social services, fostering a virtuous cycle of development.

The economic expansion, indicated by per capita income and employment rates, exhibits divergent results in the two nations. In Ghana, per capita income demonstrates an inverse correlation with real GDP in the OLS analysis. This indicates that although infrastructure development has favourably affected various facets of economic growth, its direct influence on income levels is constrained. Employment rates, indicated by the percentage change in employment, exhibit a weak correlation with real GDP, suggesting that alternative funding models have not substantially enhanced employment. This indicates that more focused employment policies are necessary to convert infrastructure investments into job creation and wider economic advantages.

In Nigeria, per capita income exhibits a significantly positive correlation with GDP growth. This underscores the adaptive characteristics of Nigeria's economy concerning alternative funding models. Nonetheless, similar to Ghana, the

employment rate (CEI) exhibits an inconsequential correlation with GDP. This indicates that although per capita income may be increasing, comprehensive employment improvements have not occurred, highlighting structural impediments in labour markets.

Both nations must adopt employment-centric policies associated with their infrastructure investments to tackle these challenges. Establishing employment initiatives in industries that gain from infrastructure enhancement, such as the construction of roads, can more directly facilitate economic growth. The beneficial effect on per capita income in Nigeria underscores the potential for expanding these models, contingent upon prioritising employment generation.

The social welfare agenda, which includes access to healthcare, electricity, and education, highlights significant disparities between the two nations. In Ghana, the correlation between households with electricity access and GDP growth is positive, indicating that infrastructure development enhances living standards. The healthcare data indicates an inverse correlation with GDP, underscoring inefficiencies in healthcare delivery systems. Educational attainment, indicated by advancements in education, exhibits an inverse correlation with GDP growth, implying that educational reforms have yet to yield economic productivity gains.

The social welfare agenda in Nigeria yields similarly ambiguous outcomes. Access to electricity is positively correlated with infrastructure funding, whereas access to healthcare exhibits a positive and statistically significant relationship with GDP. Educational attainment demonstrates an unexpected inverse correlation with GDP growth, indicated by a coefficient of -116.6893. This highlights a significant challenge in both nations, where educational reforms have failed to align with labour market demands, resulting in a disjunction between human capital development and economic growth.

The figure below illustrates the strong relationships between alternative infrastructure funding models and their effects on infrastructure development, economic expansion, and social welfare in Ghana and Nigeria. At the centre is "Alternative Infrastructure Funding Models," which includes mechanisms such as public-private partnerships (PPPs) and project finance, as earlier discussed in the literature review. From this central node, connections are drawn to infrastructure development, shown by the

length of roads built, which has a significant positive impact on GDP in both countries. Economic expansion is represented by per capita income, showing a strong correlation in Nigeria, indicating that infrastructure investments drive income growth. Social welfare is reflected in access to electricity and healthcare, with both demonstrating positive effects on economic growth, particularly in Nigeria. The feedback loops indicate that as infrastructure and social services improve, they further reinforce the effectiveness of these funding models, creating a cycle of sustainable development.

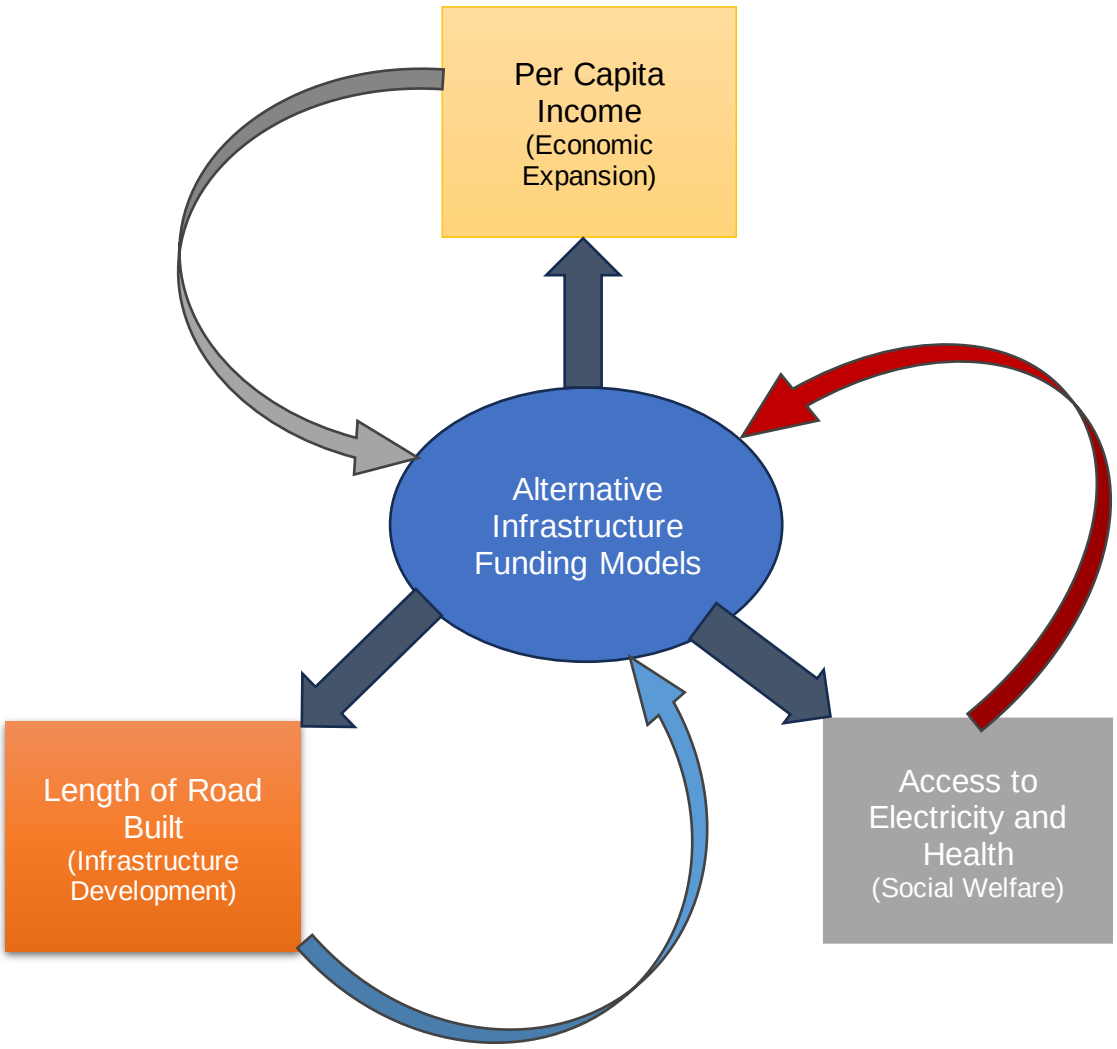

Figure 10: Relationship between alternative infrastructure funding models and *infrastructure development, economic expansion, and social welfare agenda*

Source: Author's Own Conceptualisation from Data Analysis

The correlation between alternative infrastructure funding models and infrastructure development, economic growth, and social welfare is evident in both Ghana and Nigeria. Infrastructure development, electricity accessibility, and enhancements in healthcare have been significantly correlated with GDP growth in both nations. Nonetheless, disparities persist in converting these investments into wider economic advantages, especially in the realms of employment and education.

Based on these findings, it is advised that Ghana and Nigeria enhance their implementation of alternative funding models, emphasising sustainability and inclusivity. Employment generation should be prioritised, with policies aimed at sectors that directly benefit from infrastructure development. Moreover, reforms in healthcare and education are essential to guarantee that these sectors fully contribute to economic growth and social development. By concentrating on these domains, both nations can optimise the advantages of alternative funding models, promoting enduring, sustainable development.

- **Research Objective 3: To examine the cointegrating and causal relationships between the alternative infrastructure funding models and infrastructure development, economic expansion, and the social welfare agenda, respectively.**

The short and long run and causal analysis results indicated that the alternative infrastructure funds selected as models influence the development of infrastructure and growth of the economy to a large extent, with the accessibility of electricity, construction of roads, and enhancement of education. ARDL and Granger causality outcomes also show that infrastructure indicators like access to electricity and road length play major roles in the growth of real GDP, which confirms Wagner's Law, which says that the activity of the state increases with economic development habits. This concurs with the argument presented by Calderon and Serven (2010) that infrastructure positively influences growth through productivity aspects. In addition, the marginal short-term impacts of certain models support the opinion of Machete and Marques (2021), which argues that alternative financing instruments are more valuable when incorporated into long-term plans of development. These findings also reveal the presence of systemic causality in evaluating infrastructure indicators

collectively, which supports empirical arguments by Aschauer (1989) on infrastructure investment as a pillar of economic performance and levels of welfare.

- **Research Objective 4: Decision Framework**

A suitable decision-making framework for efficient and sustainable infrastructure funding in Ghana and Nigeria requires many layers. Figure 11 explains the steps in the proposed decision framework.

Figure 11: Decision Framework for Alternative Infrastructure Funding Models
Source: Author's Own Conceptualisation from Data Analysis

The decision-making framework established for effective and sustainable infrastructure funding in Ghana and Nigeria is strategically aligned with the AU Agenda 2063 Goals and the United Nations Sustainable Development Goals (SDGs). Each step of the framework incorporates key variables, including Per Capita Income (PCI),

Real GDP (RGDP), access to healthcare (AHC), length of roads built (LR), and the number of households with electricity access (NHE), to ensure that infrastructure initiatives advance the objectives of economic transformation, sustainable industrialisation, and connectivity.

Step 1: Problem Identification and Objective Setting

This stage commences with the identification of infrastructure deficiencies and the establishment of explicit objectives for infrastructure enhancement, concentrating on factors such as Per Capita Income (PCI), Access to Healthcare (AHC), Length of Roads (LR), Educational Attainment (IEA) and Number of Households with Electricity (NHE). These variables facilitate the evaluation of the present condition of the economy and social infrastructure, establishing a basis for tackling Agenda 2063 Goal 4 and UN SDG 9, which underscore economic diversification and resilience. This initiative aims to bridge shortfalls in healthcare, transportation infrastructure, and electricity accessibility, thereby advancing the objective of cultivating inclusive economic growth and enhancing overall quality of life. This action corresponds with Research Objective 2 that determined the essential variables affecting adoption of alternative infrastructure funding models. The choice of these particular indicators has been guided by the empirical coefficients indicating their importance to national development priorities.

Step 2: Identification of Potential Funding Models

In the next step, the framework delineates diverse alternative funding models, including Public-Private Partnerships (PPPs) and Green Finance, by evaluating the nation's economic indicators such as Real GDP (RGDP) and Per Capita Income (PCI). These models are essential for attaining economic diversification and industrial resilience in accordance with Agenda 2063 Goal 4. The framework promotes sustainable industrialisation, as delineated in SDG 9, by selecting funding models aligned with a country's economic strength, thereby enabling Ghana and Nigeria to attract investment for the development of resilient infrastructure that fosters innovation. This step is connected with Research Objective 1, which presented the existing alternative funding models in use in Ghana and Nigeria. To elaborate on this evaluation, the framework places such models into a strategic decision-making context.

Step 3: Assessment of Economic and Social Impact

This phase involves assessing the social and economic impacts of potential funding models by examining their influence on RGDP, employment rates (CEI), Educational Attainment (IEA), healthcare accessibility (AHC), and poverty levels (CPR). This emphasis on these variables corresponds with SDG 9 and Agenda 2063 Goal 10, which prioritise the advancement of world-class infrastructure that improves connectivity and industrialisation. This step guarantees that infrastructure investments promote inclusive economic growth, thereby enhancing socioeconomic resilience, alleviating poverty, generating employment, and improving access to essential services. Research Objective 3 forms the foundation of this step, and the ARDL and Granger causality analyses showed a significant long-term relationship and short-term relationship between the infrastructure funding proxies and these socioeconomic measures. These empirical results support the incorporation of such variables in the impact assessment phase.

Step 4: Selection of Optimal Model

Upon evaluating the economic and social ramifications, the framework identifies the most appropriate funding model for the project. The selection is influenced by factors including Length of Roads (LR), Number of Households with Electricity (NHE), and Educational Attainment (IEA). They have long-run predictive value. These variables are essential for advancing Agenda 2063 Goal 10, which advocates for comprehensive infrastructure to enhance connectivity throughout Africa. By choosing models that prioritise the enhancement of road networks and electricity accessibility, the framework directly aids in achieving the objective of constructing resilient infrastructure and fostering sustainable industrialisation, as highlighted in SDG 9. This measure is also informed by the empirical evidence presented in Objective 3, in which LR and NHE were empirically observed to be predictively relevant to RGDPG. The results can be used in the selection of the most effective models.

Step 5: Implementation Strategy and Stakeholder Engagement

The framework subsequently transitions to implementation, engaging essential stakeholders including the government, private sector, and development partners. This phase is essential for guaranteeing that infrastructure projects are properly

funded, coordinated, and executed efficiently. The emphasis on stakeholder engagement corresponds with Agenda 2063's objective of establishing robust partnerships to attain world-class infrastructure. This step also advances SDG 9 by promoting intersectoral collaboration to stimulate innovation and inclusive industrial development, while guaranteeing that infrastructure projects are sustainable and resilient. This step makes Research Objective 4 operational by providing a plan on how coordination of the institutions and stakeholders should be coordinated according to the realisation of the desired models. Objective 4 had as a key result to develop the framework itself.

Step 6: Monitoring, Evaluation, and Adjustment

The final step involves continuous monitoring and evaluation of the infrastructure projects based on variables like Educational Attainment (IEA), employment rates (CEI), poverty rates (CPR), and electricity access (NHE). This stage ensures that projects remain aligned with the goals of economic diversification, connectivity, and sustainability. It directly supports Agenda 2063 Goal 10, which focuses on infrastructure connectivity, and SDG 9, which aims to foster sustainable industrialisation. By regularly evaluating the impacts of the projects, policymakers can make necessary adjustments to ensure that infrastructure investments continue to promote economic growth and social welfare. This step is also based on the results of Research Objectives 3 and 4, which explains why they should be used as the monitoring indicators. The empirical results give the reason behind including these particular indicators in the feedback loop of the model of decision making.

In summary, every phase of the decision-making framework is meticulously crafted to align with the objectives of Agenda 2063 and the UN Sustainable Development Goals, guaranteeing that infrastructure initiatives promote economic growth while enhancing resilience, innovation, and inclusivity throughout Africa.

8.5 Contribution to Knowledge, Policy Implications and Recommendations

This research aimed to enrich the current body of knowledge on alternative infrastructure funding models by addressing significant gaps identified in previous studies. Existing research on funding models for road infrastructure in Ghana and

Nigeria is limited, with a predominant focus on Public-Private Partnerships (PPPs). However, alternative funding models can enhance the bankability of road infrastructure projects (Abiru, 2021). Table 7 summarises the studies on alternative funding for road infrastructure, highlighting the need for a broader exploration of funding sources beyond PPPs. These studies have primarily examined PPPs, road user charges, taxes, and fees. By exploring a wider range of funding sources, this study fills a critical gap in the literature and contributes to a more comprehensive understanding of alternative infrastructure funding models.

This research aims to overcome the limitations identified in previous studies and broaden the range of alternative funding models for road infrastructure in Ghana and Nigeria, based on the findings from Table 7. Hough and Smadi (1999) emphasised the widespread problem of insufficient funding for roads and the difficulties caused by public resistance to taxes and levies. This study investigates alternative funding models that alleviate the strain on public debt, which currently constrains infrastructure projects. Mundonde (2022) developed a framework model for financing sustainable water and sanitation infrastructure in Zimbabwe. His study was limited to PPP without recourse to other alternative funding models. Mundonde (2022) identified factors such as financial market development (FDX) and governance indices (GIX) as key in determining financing water and sanitation infrastructure in Zimbabwe. This study fills a critical gap by expanding the study to cover Ghana and Nigeria with varied funding models. This study has added factors such as GDP per capita and access to education as key determinants of the success of funding infrastructure projects. While this study introduces these new variables, it builds upon the foundational work of Miles (2005), who discovered that the Innovative Financing Strategy (IFS) is more beneficial compared to the General Fiscal Investment Strategy (GFIS).

Furthermore, this research expands the range of funding models for infrastructure projects by incorporating models such as asset securitisation. Akomea-Frimpong et al. (2021) identified an absence of research on crucial subjects pertaining to public-private partnerships (PPPs) and the achievement of sustainable development goals. This study aims to fill this gap by studying how different funding models can be in line with the Sustainable Development Goals. Van Rensburg and Krygsman (2020) proposed an effective policy for charging road users. This study assessed the

feasibility of implementing alternative funding models in Ghana and Nigeria, taking into account the socio-economic circumstances. Additionally, this study aimed to broaden the understanding and explore different funding models for road infrastructure in Ghana and Nigeria. It utilised quantitative methods, specifically multiple regression and vector error correction models (VEC), to analyse and expand the scope of alternative funding approaches. Among the studies summarised in Table 7, seven employed qualitative methodologies while six employed quantitative methodologies. The qualitative studies comprise Hough and Smadi (1999), Mulu and Smith (2008), Tadi and Murthy (1997), Feldman (2023), Brocklebank (2014), Petrus (2020), and Casady and Peci (2021). The quantitative studies comprise the works of Miles (2005), Koul, Verma, and Arora (2021), Akomea-Frimpong et al. (2021), Van Rensburg and Krygsman (2020), Mawoli (2021), and Haq et al. (2020).

Obeng and Tuffour (2020) conducted a study in Ghana to explore alternative funding options for maintaining road networks in developing nations. It was discovered that traditional funding sources for the development of road infrastructure, such as tolls and fees, encountered political opposition and were difficult to expand. Nevertheless, this study expanded the range and addressed substantial constraints highlighted by Obeng and Tuffour (2020) regarding the utilisation of on-street parking charges for the upkeep of roads in Ghana. The study conducted by Obeng and Tuffour (2020) focused primarily on a single municipality, limiting the applicability of their findings to a broader context. This study extended beyond the assessment of financial viability to analyse the consequences for development, economic growth, and social well-being of different funding alternatives for road construction. On the other hand, this study has expanded on the factors to be considered for funding infrastructure in Ghana, as summarised in the studies on alternative infrastructure funding in Ghana and Nigeria in Tables 8 and 9, respectively.

This study makes a **substantial contribution to the existing knowledge** on infrastructure funding by examining the changing nature of green finance in West Africa, with a specific focus on Ghana and Nigeria. Nigeria has effectively issued green bonds, showcasing a feasible route for funding sustainable infrastructure. In contrast, Ghana is currently in the initial phases of its green finance endeavour, as it has recently released its green bond guidelines via the Securities and Exchange

Commission (SEC) in 2024. This endeavour, backed by the International Finance Corporation (IFC), signifies a crucial advancement in the establishment of a green bond market in Ghana. The decision framework presented in this study will provide guidance for the process of securing funds through green finance in Ghana. This framework provides an organised approach for incorporating green bonds into the country's infrastructure funding strategy. This study underscores the importance of conducting thorough economic assessments to identify appropriate funding strategies, involving stakeholders through informative campaigns and educational initiatives, and implementing rigorous monitoring and evaluation processes to ensure that projects are in line with economic and social objectives. This research offers a comprehensive decision-making framework that not only fills the gaps found in previous studies, but also establishes a model for effectively implementing green finance initiatives in emerging markets such as Ghana. The framework is specifically designed to ensure that the issuance of green bonds contributes to sustainable development, fosters economic growth, and promotes the fair distribution of infrastructure benefits.

This study provides a valuable academic contribution by uncovering the restricted role that the Ghana Stock Exchange (GSE) and the Nigerian Stock Exchange (NSE) currently have in funding infrastructure projects. This observation emphasises the need for specific policy actions by the governments of Ghana and Nigeria, in collaboration with their Securities Exchange Commissions (SECs), to strengthen the participation of stock markets in infrastructure funding. One of the proposed measures is to modify structural policies in order to increase the accessibility of stock markets for infrastructure companies, including those with shorter operational histories. This policy recommendation is essential, given the discovery that traditional public funding is inadequate to stimulate substantial GDP growth without the addition of private sector investment, as evidenced by the weak and statistically insignificant correlation between employment rates and GDP in both Ghana and Nigeria. Implementing such policy modifications could enhance the appeal of long-term infrastructure projects to potential investors. Enhancing the involvement of stock exchanges in this field has the potential to significantly boost the accessibility of investment and operational funds required for sustainable infrastructure development in Ghana and Nigeria. Again, policy measures should prioritise the development of a robust corporate bond market, which can function as a reliable avenue for institutional investors, such as insurance

companies and pension funds, to allocate funds towards infrastructure projects. Collaborating with appropriate regional and international financial institutions to issue bonds denominated in local currencies has the potential to enhance market confidence and establish standards for issuers with lower credit ratings. This, in turn, can encourage investment in the financial markets of Ghana and Nigeria.

This thesis enhances the understanding of the Sustainable Development Goals (SDGs) by examining a wide array of funding models that can be used to facilitate infrastructure development in Ghana and Nigeria. This research investigates various financial instruments, including green finance, asset securitisation, project finance, and resource finance infrastructure. The aim is to support SDG 9, which focuses on promoting innovation, inclusive and sustainable industrialisation, and resilient infrastructure. This addresses the urgent requirement for economic diversification and resilience, as highlighted in the objective of transforming economies in Agenda 2063. The thesis presents a comprehensive examination of these funding sources, offering a diverse strategy for closing the infrastructure gap and improving connectivity and communications infrastructure. This comprehensive financial strategy facilitates the achievement of both Agenda 2063 and the SDGs, showcasing how diverse funding sources can collectively propel sustainable development in the region.

It is crucial for policymakers in Ghana and Nigeria to give priority to investments in sectors that have a substantial influence on the overall socioeconomic condition. To enhance infrastructure development plans, it is recommended that organisations such as the Ghana Investment Promotion Centre (GIPC), Ghana Infrastructure Investment Fund (GIIF), and Nigeria's Infrastructure Concession Regulatory Commission (ICRC) collaborate with the Ministries of Education and Health to incorporate these sectors. This technique is corroborated by analogous recommendations in research conducted by Oyedele (2016).

According to the results of the multiple regression analyses, it is recommended that road infrastructure investments take into account the long-term equilibrium relationships between key variables. Thus, it is imperative for policymakers to devise enduring infrastructure policies that are in line with the objectives of national development. The responsibility of developing comprehensive, multi-faceted

development plans, as suggested by Tsekeris (2014), should be entrusted to organisations like Ghana's National Development Planning Commission (NDPC) and Nigeria's National Planning Commission (NPC).

Moreover, considering the variation in GDP growth rates, it is imperative to implement adaptable funding models that can accommodate economic fluctuations. This entails allocating reserve funds and enacting policies that enable the reallocation of resources in response to fluctuating economic circumstances. Therefore, it is imperative for the Ministries of Finance in both Ghana and Nigeria to build adaptable budgeting frameworks to accommodate these changes. The adaptable approach is essential for sustaining infrastructure development in the face of economic uncertainty, as emphasised by Zhu, Shi, and Lempert (2020).

On the other hand, Nigeria's economic patterns, which are rather solid, indicate that a consistent and reliable funding model can be successful. Therefore, by guaranteeing consistent investment in road infrastructure, we can sustain and steadily enhance the sector, preventing any disruptions caused by frequent changes in policies. The Nigerian Sovereign Investment Authority (NSIA) and Ghana Infrastructure Investment Fund (GIIF) should prioritise the establishment of reliable sources of funding, in accordance with stability-oriented approaches.

In addition, the ongoing analysis and monitoring of data are crucial for efficient infrastructure development. Policymakers should implement strong systems for frequent updates to socioeconomic data, conducting cointegration tests, and making projections to guarantee that decisions are grounded in the most up-to-date knowledge. Thus, it is imperative for national statistical offices, such as the Ghana Statistical Service (GSS) and Nigeria's National Bureau of Statistics (NBS), to take the lead in these endeavours. An evidence-based approach is essential for formulating policies that are dynamic and responsive, in accordance with the suggestions.

8.6 Limitations of this Study and Suggestions for Future Research

Although this work has made valuable contributions, it is important to recognise that there are some limitations that need to be acknowledged. The analysis relies on a restricted data set consisting of twenty (20) observations per country, which may not

comprehensively encompass the intricacies of the infrastructure funding landscape. In most cases, this limitation is largely based on data availability. In spite of the availability of quarterly macroeconomic data in both Ghana and Nigeria, a long-side consistent time series of all eight variables under review, including healthcare access, energy, and education, can be reliably obtained only up to a twenty-quarter span. The study continued with this matched framework to ensure an in-depth and comparative analysis of the two nations.

Studies to be conducted in the future would strive to capture bigger and broader databases, especially with the development of data collection techniques across countries. This will improve reliability, external validity and generalisability of findings of research regarding the socio-economic impacts of various infrastructure finance schemes.

Furthermore, the study solely concentrates on road infrastructure, which, although crucial, is just one component of the broader infrastructure development. Subsequent research should broaden its focus to encompass more categories of infrastructure, such as electricity and telecommunications, to attain a more all-encompassing comprehension of funding models for infrastructure.

Furthermore, the study's dependence on secondary data sources may add biases pertaining to the accuracy and comprehensiveness of the data. Future studies can incorporate primary data collection methods, such as surveys and interviews, to verify and enhance the findings.

Once again, the research failed to explicitly consider the indices of quality of institutions or governance to carry out and execute the infrastructural projects. The future research could combine such factors as corruption indices, the effectiveness of the public sector, or the quality of regulation to provide more relevant policies. Although this study offers a comparative examination of Ghana and Nigeria, it fails to investigate the intra-country regional variations that could have a substantial influence on investments in infrastructure and development. Future studies should focus on doing regional analysis within these countries to reveal specific localised dynamics and provide policy recommendations that are tailored properly.

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