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Master's Thesis

The impact of Transport Infrastructure on Economic Growth: A Focus on the Nigerian Case

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Declaration

I declare that I have worked on my master's thesis titled " Empirical Analysis on the Relationship between Transport Infrastructure and Economic Growth: A Focus on the Nigerian Case" by myself and I have used only the sources mentioned at the end of the thesis. As the author of the master's thesis, I declare that the thesis does not break any copyrights.

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The impact of Transport Infrastructure on Economic Growth: A Focus on the Nigerian Case

Abstract

Economic growth and development in Nigeria have experienced fluctuations over the years. While there are various factors responsible for the declining economic growth, this research has focused on transport infrastructure, seeking to find the relationship between them. The research, using empirical analyse, investigates the relationship that exists between transport infrastructure and economic growth. To find answers to the research questions, data were collected from the World Bank, NBS, and other relevant secondary sources, spanning from 1997 to 2022. The study employed summary statistics, trend analysis, correlation, and regression analysis to reveal the relationship between transport infrastructure and economic growth in Nigeria. The study, therefore, found that while the real GDP experiences a downward slope over the years, transport services, however, does not significantly affect the growth of Nigerian economy. Factors such as endogeneity issues and limited data were identified as limitations that may have affected the findings of this research. The research, thus, underscores the importance of private and public investments in transport infrastructure to stimulate economic activities. Additionally, the study also emphasizes the need for deliberate and targeted interventions to solve the deficiencies in Nigerian transport sector and strengthen institutional capacity. By increasing private investment and prioritising sustainable development in the transport sector, this research suggests that Nigeria can improve access to trade and other core economic activities as well as unlock its full economic potential.

Keywords: Transport infrastructure, economic growth, road, rail, sea, and air transport, infrastructure deficiencies.

Vliv dopravní infrastruktury na hospodářský růst: Zaměření na případ Nigérie

Abstraktní

Hospodářský růst a rozvoj v Nigérii v průběhu let prodělaly výkyvy. Zatímco za klesající ekonomický růst jsou zodpovědné různé faktory, tento výzkum se zaměřil na dopravní infrastrukturu a snažil se najít vztah mezi nimi. Výzkum pomocí empirické analýzy zkoumá vztah, který existuje mezi dopravní infrastrukturou a ekonomickým růstem. Abychom našli odpovědi na výzkumné otázky, byla shromážděna data ze Světové banky, NBS a dalších relevantních sekundárních zdrojů za období od roku 1997 do roku 2022. Studie využívala souhrnné statistiky, analýzu trendů, korelaci a regresní analýzu k odhalení vztahu mezi dopravou. infrastruktura a hospodářský růst v Nigérii. Studie proto zjistila, že zatímco reálný HDP zažívá v průběhu let klesající tendenci, dopravní služby však růst nigerijské ekonomiky významně neovlivňují. Faktory, jako jsou problémy s endogenitou a omezená data, byly identifikovány jako omezení, která mohla ovlivnit zjištění tohoto výzkumu. Výzkum tak podtrhuje význam soukromých a veřejných investic do dopravní infrastruktury pro stimulaci ekonomických aktivit. Kromě toho studie také zdůrazňuje potřebu promyšlených a cílených intervencí k vyřešení nedostatků v nigerijském dopravním sektoru a posílení institucionální kapacity. Zvýšením soukromých investic a upřednostněním udržitelného rozvoje v odvětví dopravy tento výzkum naznačuje, že Nigérie může zlepšit přístup k obchodu a dalším klíčovým ekonomickým činnostem a také uvolnit svůj plný ekonomický potenciál.

Klíčová slova: Dopravní infrastruktura, ekonomický růst, silniční, železniční, námořní a letecká doprava, nedostatky infrastruktury.

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1.0 Introduction

Transportation is core to economic development in every country (Hasselgren, 2018). The choices of transportation management, development, and methods significantly determine the survival, thrive, or decline of cities and countries. A country's investments in the infrastructure of its transport system – railways, roads, ports, etc. – have a significant influence on the socio-economic growth of the country in question. Investing in the transport infrastructures has become a new orientation in the political atmosphere to strongly hold the economic growth. The role transportation infrastructure plays in the growth and development of an economy has always been a concern in the economic and business space and among scholars and researchers. Similarly, for few decades now, researchers have studied the relationship between transport infrastructure and economic growth in countries and varying results have been produced overtime. In general, road, railway, seaports, and airports are considered as core developmental infrastructure necessary for economic transformation.

However, irrational planning of transport infrastructure can be linked to unfavourable consequences which include huge transport fatalities, environmental devastation, and declined transport performance (Tong and Yu, 2018; Neeson et al., 2015; Laurence et al., 2014; Andrey et al., 2014). Similarly, environmental issues such as air (carbon) and noise pollution and their health implications cannot be overlooked when studying transportation (Saretta et al., 2019; Huang et al., 2016).

Furthermore, studies focusing on the Nigerian transport sector are beginning to gain so much popularity and importance due to the differing perspectives through which researchers tend to offer improved policy to tackle the issues discovered and better the sector significantly in order

to proffer an effective and efficient and par standard transport system in Nigeria. With the increasing population and economic activities, the demand for transport services have dramatically surged; however, the supply of transport services plunges, mainly due to inadequate infrastructure of the transport system. Meanwhile, Zou et al. (2008) explained transport infrastructure as the arteries responsible for the flow of goods and people, information, and other materials or resources necessary for economic flourishment. For instance, the transfer of agricultural products produced in the rural area to the urban areas for further distribution to final consumers can be facilitated by better transport infrastructure; that is, economic activities are better facilitated when there is presence of improved transport system.

1.1 Problem Statement

Despite the knowledge about the importance of transportation in the growth of an economy, the state of the Nigerian transport infrastructure is still in a sad state (Akande et al., 2013). Although there has been variety of research on infrastructural development and economic growth, interests in transport infrastructure have not been largely explored in Nigeria. Research (Obi, 2009; Adeniji, 2000) discovered that less than 50% of the Nigerian federal road networks are in fair state with nothing less than 50 deaths per day; the rail system transport less than 2.3 million people and 300,000 tonnes per day; there has been increasing reports of seaport congestion and pipeline vandalization, and the airways continues to experience crash with airports not exactly in their best state. Adding these recorded losses and transport inefficiencies as economic costs, the high rate of productive man-hour loss makes it evident that the transport sector imperatively requires attention, both from the academia and the policymakers (Dimnwobi et al., 2017).

Globally, Nigeria still ranks relatively low in infrastructural development despite its large economic space and advantage which negatively influence the ease of doing in the country (Igwe

et al., 2013). Similarly, the low investments in transport system have contributed significantly to the deficient infrastructural development and also its economic blows (Okechukwu et al., 2021). The current state of the country's transport infrastructure falls short when compared to its equals across the world, and the major key factors are poor transport management system and infrastructure and inadequate investment, among others (Uma et al., 2014). Each government has made huge differences; however, efforts and investments in this sector is still lacking, causing drawbacks for government's agenda for accelerated economic growth and development (Ilori, 2004).

Hence, finding the linkages between the transport infrastructural investment and development and the economic growth in Nigeria is a necessary effort towards providing academic basis for the realities of the Nigerian transport infrastructure. By establishing evidence that the investments on transport infrastructure in Nigeria contributes to the development of Nigerian economy, this paper focuses on providing statistical and real-time evidence that corroborates the reality of the Nigerian economy through the state of its transport sector.

2.0 Goal and Objectives

2.1 Research Goals

Although there are a myriad of literature and research works that focus on the factors affecting the Nigerian economy, this research targets the exploration of the Nigerian transport system, investigating the government expenditure on infrastructural development of the transport network in the country. Similarly, the investigation primarily focuses on finding the relationships and the direction of such relationships between the Nigerian economy and the government investment on transport infrastructure. Therefore, this research aims to find the linkages between transport infrastructure and the Nigerian economy, and how the infrastructural state of the sector impacts the economy.

2.2 Research Objectives

Following the broad aims of this research, the partial objectives of this paper are outlined below:

- To understand the current state of the Nigerian transport sector
- To establish a link between transport infrastructure and the Nigerian economy
- To investigate the impacts of transport infrastructure on the Nigerian economic growth
- To make suggestions and recommendations on how to improve the Nigerian economy through the transport sector.

2.3 Research Questions

- What are the trends and current state of the Nigerian transport sector?
- What relationships do the transport infrastructure and the Nigerian economy have?
- How does transport infrastructure impact the Nigerian economic growth?

2.4 Research Hypothesis

Hypothesis 1:

H_0: There is no significant relationship between the Nigerian economy and transport infrastructure.

H_1: There is a significant relationship between the Nigerian economy and transport infrastructure.

Hypothesis 2:

H_0: Transport infrastructure has no significant impacts on the growth of the Nigerian economy.

H_1: Transport infrastructure has significant impacts on the growth of the Nigerian economy.

2.5 Country's Background: Nigeria

Nigeria, located on the western part of Africa, is the most populated African country with a diverse geography and a population around 200 million people (World Bank, 2023). Similarly, the country's economy is one of the largest in the continent with a major dependence on the oil sector (Anthony et al., 2023). Due to its overdependence on oil revenue, the oil price fluctuations over the years continued to play a key determinant of the country's economy despite that a larger percentage of its population are involved in farming. Since the late 1990s, the country has begun the privatisation of its government-owned enterprises to reduce government costs, mitigate the huge effects of low oil prices, and maintain the qualities of services rendered, and the most affected sectors include transportation, power, and communications (Anthony et al., 2023; Nigeria HC UK, 2023).

Currently, the country runs on an unsteady flow of revenue and the government's major approach to improving the situation through borrowing loans from local and international sources. Consequently, much of the country's budget is directed to loan repayment and debt servicing (Anthony et al., 2023).

Importantly, the Nigerian transport system was built upon its colonial master's framework, since the British influence of the country's governance and socio-economy (Hoyle, 2013). The evolution of the Nigerian transport system began with the adoption of cycles – motorbikes, bicycles, and then vehicles – cars and trucks. The use of boats, ships, trains and railways, aircraft, and pipelines marked the civilisation of the country and its transportation system (Okolo and Ehikwe, 2015). The railway system began in 1898 in Lagos, Nigeria, and the Lagos Harbour operations commenced in 1907. The railway network was extended in the same year to Port Harcourt and Enugu, after Kano in 1912, reaching the major regions of the country at the time (Nwodo et al., 2020).

2.6 Scope of the Study

The key focus of this research is to find empirical answers to the question of whether the state of the transport infrastructure affects the growth of the Nigerian economy. In particular, the research aims to explore the current state and trend of the transport infrastructure in Nigeria, highlighting the lapses and improvements over the years. Similarly, the research seeks to find connection and causal factors linking the sorry state of the Nigerian transport infrastructure to the growth of the country's economy. The research covers a wide array of necessary data and information that allow for the exploration of the subject.

2.7 Research Organisation

This research is categorised into well-organised five chapters, with each chapter focusing on a significant aspect of the research process in order to provide unambiguous research for readers. The chapter one, which mainly introduces the research subject, encompasses the study background, problem statement, research aims and objectives, research questions and hypothesis, scope of the study, and a summary to the chapter. Chapter two focuses on exploring previous research and literature, including review of theoretical basis for the research subject. Also, chapter three provides the methodologies adopted in the process of the study, while chapter 4 employs the methodologies in order to produce research outcomes and findings. Lastly, chapter five covers the summary, discussion, recommendations, and conclusion based on all the processes involved in the study.

3.0 Literature Review

This chapter provides a careful and in-depth analysis of relevant studies, theories, perspectives, and concepts around the Nigerian transport infrastructure and the economic growth. This section begins with an overview of transport infrastructure and historical background of Nigerian transport system and explored broad empirical studies and concepts, arguing the impacts of transport infrastructure development on Nigerian economic growth.

3.1 Overview of Transport infrastructure

Researchers and economists have continued to show interests in the factors of a country's socio-economic environment that can facilitate the growth of the economy. One of the many important factors is the transportation sector, which includes the system and the infrastructure (Okechukwu et al., 2020). While the transport system encompasses the country's choice of interconnectedness of cities, the transportation infrastructure encompasses all human actions, industrialisation of the transport sector, environmental structure, and method of linking cities. Many studies (Huang et al., 2016; Hoff et al., 2010; Kaluza et al., 2010; Ebara et al., 2003) have highlighted in the past that transport network contributes positively to the socio-economic development and life quality through the creation of urbanisation via intra and inter-city linkages. In general, transport infrastructure is linked with its positive contribution on urban convergence and dispersion; therefore, the national and international economic growth significantly and positively influenced (Tong and Yu, 2018; Holl and Mariotti, 2018).

Many emerging economies have continued to focus on promoting economic growth by increasing infrastructure development which transport infrastructure is a major part and researchers have focused on finding the impacts of transport infrastructure on developing economies' growth (Liu and Zhou, 2006; Ghosh and Meagher, 2005). However, these studies

have returned with inconsistent research outcomes. While some studies excellently support that increase in infrastructural development in the transport sector will significantly lead to an improved economic performance with countries like South Africa (Kularatne, 2006), Belgium (Meersman and Nazemzadeh, 2017) and India (Pardhan and Bagchi, 2013; Dash and Sahoo, 2010) with significant evidence, other studies argue that increasing investment in transport infrastructure as well as other infrastructural development in any country will lead to a crowding out effect of private investment and hence, reducing the economic transformation and growth of any country (Schclarek, 2007). At the same time, some studies report that poverty and recession is strongly believed to be a result of underinvestment in transport infrastructure (Serven and Calderon, 2004).

Transport infrastructure is broad, linking cities and incorporates human activities, industrialisation, and the increase in population of the socio-economic and environmental structures. Many studies have linked the transport infrastructure and network to contribute significantly to socio-economic development and a higher standard of living by creating intra- and inter-city connectivity during urbanisations (Huang et al., 2016; Hoff et al., 2010; Kaluza et al., 2010; Ebara et al., 2003). While developing transport networks and infrastructure, global sustainability objectives such as low-carbon and sustainable growth are not to be overlooked (Saretta et al., 2019; Huang et al., 2016). While studies (Tong & Yu, 2018; Holl & Mariotti, 2018) have associated urban transport infrastructure to the dissemination and convergence of urban cities, they have found that transport infrastructure significantly improves international and regional economic growth. However, needless or excessive focus on transport development without reasonable consideration of other relevant determinants of good standard of living may lead to adverse effects of economic and sustainable growth, such as high rate of traffic fatalities,

environmental degradation, CO2 emissions and pollution, and overall reduced transport performance (Tong & Yu, 2018; Neeson et al., 2015; Laurence et al, 2014; Andrey et al., 2014; Verburg et al., 2011).

In recent years, the impacts of transport infrastructure have become a debatable issue in the literature, and largely, the discussion has tilted towards its influence on the significant promotion of economic development for both public and private sectors (Giang & Sui Pheng, 2011; Cohen, 2010). The development of the public and private sectors of countries significantly depends on the infrastructural development of the transport system, particularly in the developed countries where a strong relationship has been established between transport infrastructural development and economic development. According to Paganelli (2011), no road means there is no transportation, which implies there will be no trade, no growth in productivity, no economies of scale, and neither will there be economic development. According to different studies by Cigu et al. (2018) and Njoh (2012), investment in transport infrastructure, largely in the rail transport, seaports, and airports, afford business the opportunity to develop their visibility, reachability, and transport facility to enjoy access to production resources, goods, customer base, and distribution channels, linking to economic clusters and fuelling the growth of the economy.

Many researchers (Subhra & Nath, 2017; Achour & Belloumi, 2016; Banister & Berechman, 2001) have agreed that one of the forces driving a nation's economic and social development through an excellent and efficient public, private, and production investment is the infrastructural development of the transport system. Particularly, as maintained by Salinas-Jiménez (2004), transport infrastructure encourages international investments, reduces cost of travelling, and widens the trade between common resources. Transport infrastructure, in truth, plays an essential role in the growth of industrialisation n terms of social capital, with evident multiplier impacts on

regional development, manufacturing promotion and efficiency, and factor re-allocation, which are geared towards the promotion of industrial growth and accumulation, population, and the economy (Fageda & Gonzalez-Aregall, 2017; Holl, 2004).

Although transport infrastructure, according to (Wang et al., 2018), can only have impact on the economy if specific financial, economic, institutional, and political foundations are laid. Typically, the impacts of the transport infrastructure and system vary on the national and regional economy based on the differences the economic realities of the rural and urban settlements (Loo & Banister, 2016). Furthermore, in some cases, there may be a conflict between immediate rewards and long-term growth, and the magnitude of the impacts of transport system over time may be inconsistent (Cohen, 2010). Nonetheless, transport infrastructure plays a significant role in promoting to the productivity and economic prosperity, although not entirely consistent through time. Infrastructural development of the transport system promotes economic growth, provides access to global producers and consumer markets, lowers product prices, and makes global production more efficient and cost-effective through lowered transport costs and increased linkages and accessibility (Meersman & Nazemzadeh, 2019; Agbigbe, 2016). Vernables and Overman (2014) explain that transportation helps in the retention of benefits of specialisation efficiency. In the same vein, Trimbath (2014) discovers that the US economy enjoys the economic benefits of efficient specialisations due to the country's effective transport infrastructure, allowing US companies to produce more, become a desirable place for expatriate companies, and become more globally competitive in goods and services production.

3.2 Historical Background of the Nigerian Transport System and Infrastructure

In many developing countries, like Nigeria, economic development policies point to the weaknesses present in exploring the relationship between the national economic growth and

investments in transport infrastructure, and how economic growth can happen in the several stages of development concepts, in which transportation plays a part (Lindsey & Santos, 2020; Lemes et al., 2020). Looking through the colonial road and transport system still in use in the country, with less focus on long-term commitment to sustainably promote the economy, many developing countries as Nigeria view economic development planning differently from transport development planning and investment (Onokola & Olajide, 2020; Batool & Goldman, 2020). In many of these developing countries, most transport infrastructure is built on the back of the road infrastructure system, with no economic viability, environmental assessments, and feasibility studies that relate with the design and expenditure of the transport infrastructure as it is carried out in the developed countries. Many developed countries devoted many considerations into their transport infrastructural development from the formative days of industrialisation and continue to renew and amend the transport systems to fit in new realities and developments. Although developing countries like Nigeria has also invested hugely into the development of their transport systems, since the link to economic development has been established through a myriad of literature (Onakola & Olajide, 2020; Agbigbe, 2016).

Nigeria's need for adequate transportation cannot be overemphasised, considering it large territory area of 910,768 square kilometres, six percent annual GDP-growth rate, and a population of over 200 million (Igberi & Ogunniyi, 2013). The current infrastructural state of Nigeria's transportation is in poor condition and falls below the standards set by the developed countries and other countries it is compared with in terms of economic strength (Bello-Schünemann & Porter, 2017) (see Figure 1). The several Nigerian past administrations have paid insufficient attention to the development of transport infrastructure as a strategy to generate fast economic growth and development.

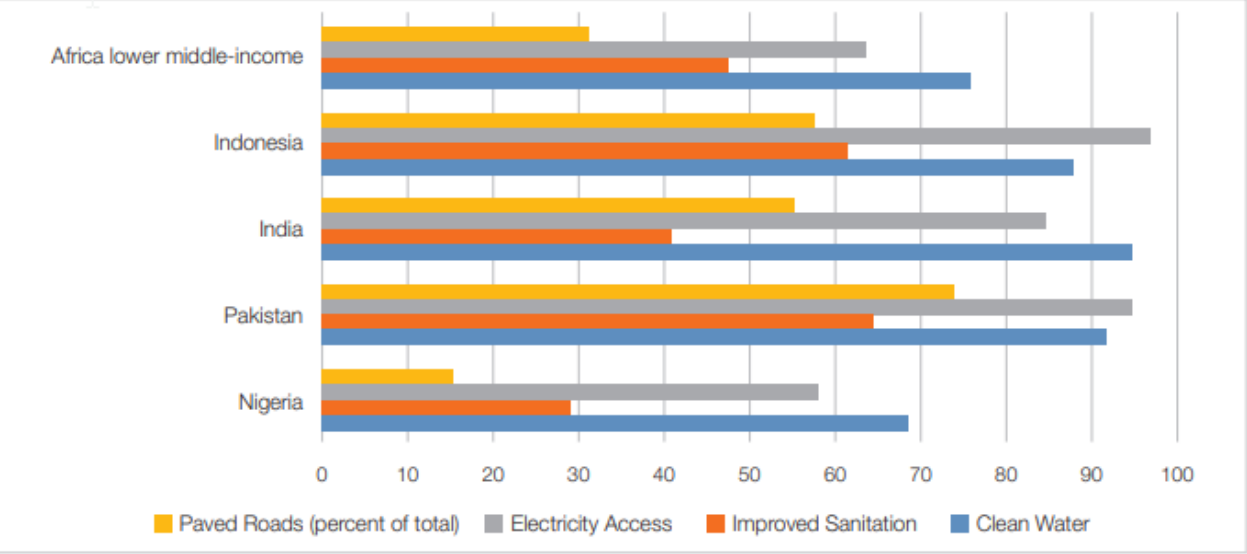

Figure 1. Infrastructure in Nigeria and other countries (Bello-Schünemann & Porter, 2017)

Globally, Nigeria scores poorly in terms of infrastructure quality and logistics performance index (see Figure 2 and 3), affecting the ease of carrying out business in the country. Low investment in the transportation has resulted in the existing infrastructure gap. Bad management of and low investment in transport infrastructure have resulted in a massive infrastructure deficit (Effiom & Ubi, 2016). An estimated $15 billion is needed each year to effectively address Nigeria's infrastructure deficits. Although, the country has adopted the public-private partnership initiatives, in line with worldwide trends in transport infrastructure development, the road and rail infrastructure development using the public-private partnership model are still in its early phases (Kadiri et al., 2015). In the Nigerian aviation business, concessioning, a form of business model in that allows for improved air transport services, has only one successful example in the Lagos International Airport (Adeniran & Gbadamosi, 2017). Although the seaports concession recorded the most success amongst the forms of transportation in Nigeria (Eniola et al., 2014). One cannot overemphasise the role played by the partnership between the private and public

sectors in the developing the transport infrastructure, although the effectiveness of this partnership depends on the enabling framework (Nguyen et al., 2022).

Figure 2. Logistics/Transport Global Ranking for Nigeria and South Africa (WEF, 2022)

Index Component	Rank/137	Value	Trend
2nd pillar: Infrastructure	132	2.0	
2.01 Quality of overall infrastructure	131	2.3	
2.02 Quality of roads	127	2.5	
2.03 Quality of railroad infrastructure	97	1.5	
2.04 Quality of port infrastructure	116	2.8	
2.05 Quality of air transport infrastructure	125	2.9	
2.06 Available airline seat kilometers millions/week	66	227.7	
2.07 Quality of electricity supply	136	1.4	
2.08 Mobile-cellular telephone subscriptions /100 pop.	117	81.8	
2.09 Fixed-telephone lines /100 pop.	134	0.1	

Figure 3. Nigeria's Global Infrastructural Ranking (WEF, 2022)

The transportation sector in Nigeria has become increasingly important as portrayed by the various findings of researchers who are attempting to develop better insights for policymaking that are beneficial to the sector, resulting in a more effective, efficient, and standard transportation system (Ochei & Mamudu, 2020). Therefore, the need for robust and developed transport infrastructure across the country have greatly surged as the year goes by. Similarly, the inadequate transport infrastructure has affected the flow of transport services and their contributions to the economy (Onokola, 2002). While Zou et al. (2008) likened the transport system to the arteries, allowing the flow of goods, information, and people, which are essential for the smooth running of the economy, sectors such as the agricultural sectors are able to transport products from the rural areas to the urban cities for trade, the transport system allows the circulation of products across regions of the country, promoting trade and economic growth.

In Nigeria, empirical studies estimating the impacts of investment in transport infrastructure on the growth of the economy are scarce. Nonetheless, the economic growth enjoys a positive impact by transport infrastructure, when measured in physical sense (Loto, 2006). Additionally, the effects of investment in transport infrastructure, traffic-related accidents, and congestions on the economy was examined by Nwakeze and Mulikat (2010), built upon the Cobb Douglas production function, and their findings demonstrated the economy benefits from an increasing transportation investment while accidents and congestions slow down the economy. Other variables used in explaining the relationship between transport infrastructure and economic growth incudes the total road network, labour force, physical capital, automobile density, and road related accidents. These variables, thus, explained that while improved transport infrastructure in Nigeria would improve economy. On the same note, Ogun (2010) explained that poverty in Nigeria can be reduced through proper investment in the infrastructural development.

Poverty reduction has been linked with physical and social infrastructure, and thus, standard of living, a yardstick for measuring poverty, was examined to explain the impacts of urban infrastructural development in Nigeria on the economic status of the people. According to Ogun (2010), infrastructural development leads to poverty reduction which leads to increase in economic growth. This is line with other studies (Ojo, 2020; Ebuh et al., 2019; Agbigbe, 2016) that have investigated the connection between transport infrastructure and other forms of social and physical infrastructures and economic growth in Nigeria, suggesting massive investments in transport infrastructure as well as other forms of basic infrastructural facilities would dramatically increase economic growth, tackle poverty, and ensure increased standard of living (Nnaukwu & Emenike, 2022).

3.3 Forms of Transport System and Their Impacts

3.3.1 Road Transport in Nigeria and Its Impacts

Road and highways, according to Duranton et al. (2013), have direct impacts on the major aspects of economic growth, such as cost of manufacturing, economic efficiency, and interprovincial trade. The significance of the road and highway transport infrastructure is more pronounced because most economic activities largely rely on use of highways for their goods and services transportation. Road expansion improves the road networks to accommodate more vehicles and volumes of traffic, thus, contributing to the improved product flow efficiency within and beyond regions. An upgrade to the road network and infrastructure allows a nation to handle economic production and other activities that largely rely on vehicles to move goods and other economic resources. Thus, improved road transport system enhances economic growth, saves money for businesses and individuals who rely on the form of transport to do business (Duranton et al., 2013). Similarly, Bofinger (2011) explains that road transport serves as a growth driver

and plays a significant role in mobilising economic actors and activities, such as people, goods, and service providers within an economy. In this light, Tiza et al. (2022) express that the Nigerian economy is largely impacted by the functionality and state of the transport system, especially the road infrastructures and networks, since about 90% of the macroeconomic operations in the country relies on road transportation. In comparison with other forms of transport, the road transport system contributes significantly to Nigeria's economic growth (Tiza et al., 2022). The Nigerian important highways link the north and south (see Figure 4) to promote exports from the hinterland and serve as a major connection for the old economies of the north and south. The Nigerian has continued to allot a significant part of the government budget to the maintenance and development of the road transportation (Adepoju, 2021).

Figure 4. Map of Nigeria's Road Network (Darmola, 2021)

Before the colonial days, Nigerians utilise horses and other old means transport to navigate routes until the first motorist road in 1906 (Tiza et al., 2022). The road, built between Oyo and Ibadan, was constructed to ease the transportation of British Officers and their carts. Nigeria, at the time, had about 3,200km of road; however, massive development in the road transportation since the 1970 oil boom, increasing the km of road transportation on a national basis from 6,500km in 1960 to 10,000km in 1970 and 29,000km in 1980s. Although, after these series of development, Nigerian road system has experienced an overall standstill until recently. Thus, allowing researchers to agree that the overall rating of the Nigerian road transportation system is

poor and there is a need for intensive upgrade and development of new routes (Nwafor & Onya, 2019).

Agricultural products in Nigeria are primarily transported and distributed to the markets by road transport; hence, researchers such as De (2018) concludes that road transportation needs an upgrade to ensure the promotion of agricultural system and the standard of living of people, especially in the rural area. Similarly, road transportation increases investors' accessibility the core components of economy, thus, promoting investment and economic growth (Ehizuelen & Bodybobton, 2013). Estache and Wodon (2014) explain that transport infrastructural development is for three reasons in the Sub-Sahara African nations, and they are: development and expansion of the agricultural system, upgrade of standard of living, and promoting economic activities since poor roads have been linked to high input and product costs. Thus, the poorer the road transport system, the poorer and rural the Nigerian society since road transport system is the main route connecting linking the multifarious sectors of the Nigerian economy (Ehizuelen, 2015).

According to Canning and Benathan (2000), there are evidence from several studies and statistical analysis suggesting that investments in smooth and accessible roads, particularly in countries with infrastructural deficiency, lead to economic prosperity. Example such as the investment in roadway infrastructure in Sri Lanka showed above 60% increase in industrial output (Gunasekera et al., 2008). Similarly, in China, the development of the road transport has been reported to be a significant contributor to the rising national GDP growth, especially the rural road development which contributed about four times what the highways did due to their lesser costs and higher connectivity to local economies (Fan & Chang-Kang, 2008). In the same vein, Ding (2013) discusses how the steady investment in the improvements of urban and

important regional roadways positively affected China's GDP share of both the manufacturing and service industries. On the other end, multiple studies have found that improved road infrastructure may not translate to economic growth (Banerjee et al., 2012; Jiwattanakulpaisarn et al., 2009). For instance, increased investments in highway infrastructure in North Carolina, investigated by Jiwattanakulpaisarn et al. (2009) counties showed no significant impact on employment growth between 1985 and 1997, and Banerjee et al. (2012) discover that there are no significant impacts of improved highways and paved roads on the growth of the GDP per capita in China.

Since businesses are a yardstick to measure the economic prosperity of a country, the road transport impacts on the ease of business can explain the economic effects of improved road infrastructure. According to Koźlak (2017), improving road transports can reduce the costs of operating vehicles and increase the delivery time since the speed at which resources and goods are moved between suppliers and buyers. This promotes economic growth since it takes into consideration increased specialisation in management and assembling as well as the efficiencies that follow. Step changes in vehicle design and improvements in vehicle technology have always been linked to periods of accelerated economic growth. In fact, the construction of canals, ports, and delivery lines, railroads, metropolitan mass transit rail systems, and airports has in each case promoted increased exchange between population centres and monetary action, whether nationally or internationally (Koźlak, 2017).

Historically, there are more positive connections between road infrastructure development and promotion of economic growth, agricultural system, trade, commerce, industry (Puentes, 2015). Thus, there are more evidence that countries have been able to sustain higher economic growth due to the increased investment in road transport (Wudad et al., 2021; Ng et al., 2019; Puentes,

2015). In contrast, most poor countries, especially in the Sub-Sahara African region, with pronounced economic reliance on agriculture, which contributes to their challenges of growing their economies (Mukasa et al., 2017). An efficient road infrastructure and solid road network create a competitive advantage in moving commodities economically. However, bad road network systems or the lack of road infrastructure, on the other hand, are impediments to urbanisation and socioeconomic growth. Aside from that, empirical research (Canning & Bennathan, 2000; Gannon & Zhi, 1997) has shown that increasing road infrastructure development in seclusion from other socioeconomic development factors such as physical capital, human capital, health, and education has a negative effect on economic growth. Thus, these studies argued that economic growth may have no significant impact on the national economy; however, when integrated with socioeconomic factors, the positive impacts of road transport are well demonstrated.

3.3.2 Railway Transport in Nigeria and Its Impacts

Due to the decreased cost per person per load as the train load increases, rail transportation is typically the best option for big traffic flows when speed is also advantageous. For a long time, Nigeria's single-narrow-gauge railway line, built during the colonial era, served as the only means of transporting freight between the northern and southern regions of the nation. Less than 5% of the gross domestic products of the transportation industry in Nigeria are accounted for by rail transportation. Even while rail has always made up a very small fraction of the value generated in transportation, its share of value added is decreasing because automobile transport (for both freight and passengers) has essentially replaced all of the traffic that rail once carried. The Nigerian Railways' subordinate position is a classic example of a transportation strategy that has marginalised a valuable and affordable mode of transportation to support the expansion of

privately owned long haulage transport services. The following are the results of this policy: (i) The Nigerian Railway Corporation [NRC] is now a dormant entity wholly dependent on government funding. (ii) A disjointed, unregulated road transportation network run by the private sector that offers passenger and freight services. These have the following effects: (i) congested traffic on metropolitan roads. (ii) an increase in the number of deadly traffic accidents caused by shoddy driving, badly maintained cars, and lousy roads. (iii) Escalating pollution of the environment. The abrupt devaluation of the Naira has also made things worse as more and more private car owners join the ranks of irate commuters and travellers (Nigerians Stat, 2023).

The railway's efficiency in moving large numbers of people and products across vast distances by land is its primary benefit. Rail transportation is inexpensive, energy efficient, and ecologically benign. The railway, when effectively linked with other modes of transportation, provides an important stimulant for socioeconomic growth and development. For these reasons, railways are recommended for countries with high land, human, and resource costs, such as Nigeria. As a result, it is not unexpected that Nigeria's reliance on rivers and creeks as the primary mode of transportation moved to railroads as soon as rail transit became accessible. According to Onokala (2002), the penetration stage was related to the construction of the railway network from the ports of Lagos and Port-Harcourt inland into Nigeria during the colonial period. The railway cut into Nigeria's interior, providing direct access by modern means of transit from the shore to other sections of the country for the first time. The colonial administration built the railway network in Nigeria to enable it to evacuate minerals, agricultural raw materials, and forest resources from the country's interior, as well as to sell imported manufactured goods in these locations. It was utilised to connect the country's various regions, fostering inter-regional trade and improving industrial and economic development. Except for a

tiny branch line built in 1964, the majority of Nigeria's railway network was built between 1896 and 1964. Nwafor (1982) outlined the important milestones and dates linked with the building of the Nigerian railway network's various portions. The network consists of 3,505 route kilometres with a single line gauge of 1.067 metres. With a maximum axle load of 13.5 tonnes, the maximum allowed speed is only 64 kilometres per hour. The Nigerian railways were dieselised in 1966, and more efficient and cost-effective diesel engines replaced coal-powered engines. There have been no major modifications or extensions to Nigeria's railway network since its initial construction. The network connects the major seaports of Lagos and Port-Harcourt with the country's major urban centres (see Figure 5).

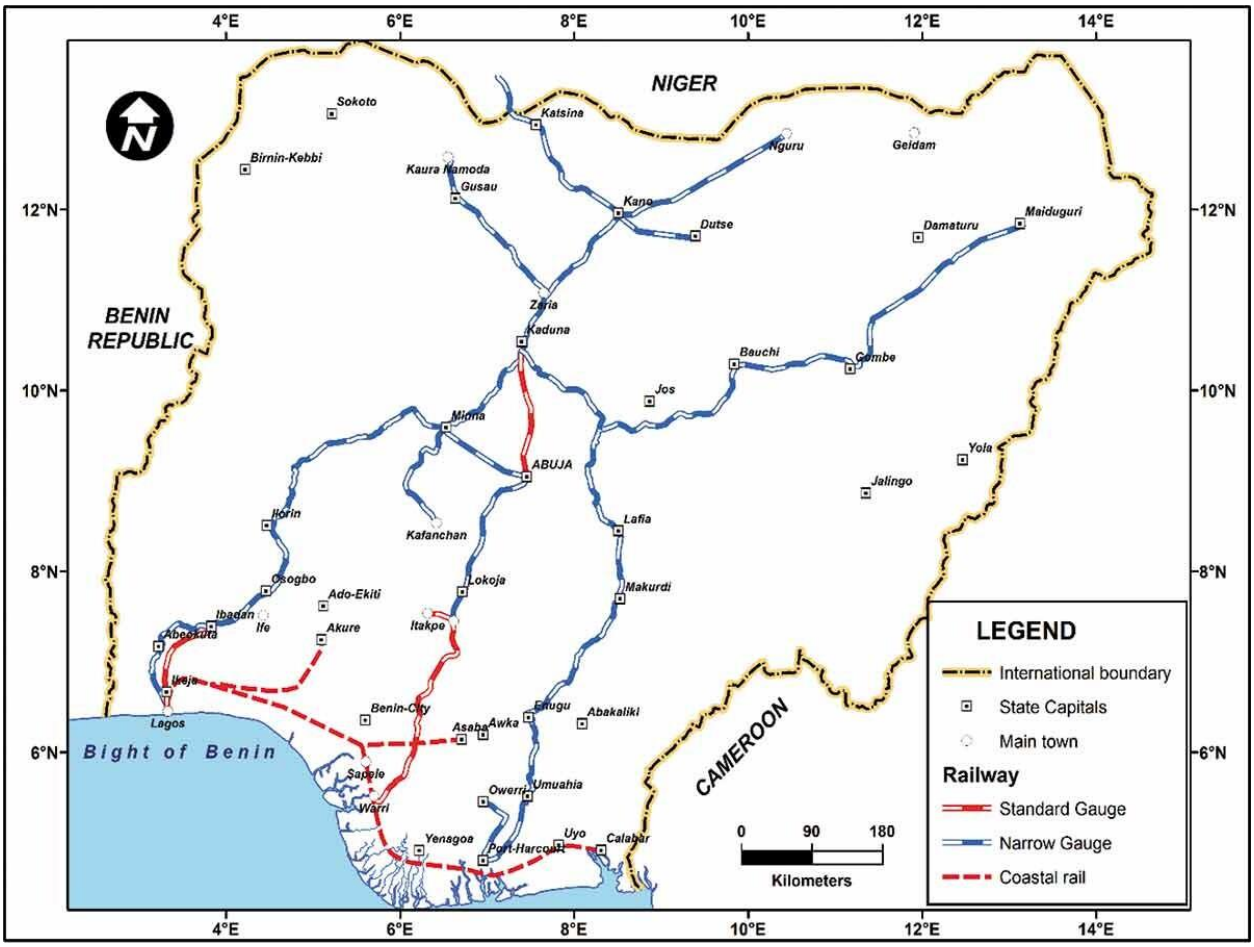

Figure 5. Map for Nigeria's Railway Network

Despite its shortcomings, the Nigerian railway system contributed significantly to Nigeria's overall economic development during the colonial and early independence periods by enabling the development of all parts of the country for agricultural exports, specifically cocoa in the west, groundnuts and cotton in the north, and palm produce in the southeast. It permitted the evacuation of minerals for export from the country's interior (for example, coal from Enugu and tin from Jos). It promoted long-distance inter-regional trade in diverse items within the country. Unfortunately, the performance of Nigeria's railway system has been steadily declining, and the operating account deficit has been growing since 1960. The proportion of export commodities in railway freight traffic has fallen from a high of 53% in 1968/1969 to 13% in 1973/1974 and less than 2% in 1982. From the middle of the 1970s (during the country's "oil boom"), there was a steady decrease in the performance of the Nigerian railway system, until it nearly came to a standstill for a variety of apparent reasons. This loss might be ascribed to growing competition from quicker and more flexible vehicle transport (for goods and people), as well as deterioration of railway transport services. It can also be ascribed to a general drop in traditional export commodities, particularly groundnuts, which used to account for a substantial share of rail freight. In addition to these difficulties, Nigeria's railway transportation system has gotten worse, becoming sluggish, unreliable, and woefully insufficient.

In the past forty years, 15.5 million people and 2.4 million tonnes of freight have been transported at the greatest rates, respectively. By 2001, less than 300,000 metric tonnes of traffic were moving. Less than 1% of Nigeria's total land transportation is now carried out by rail. The Nigerian railway system's realignment highlights its flaws, including the lack of east-west links and the predominance of two north-south lines from the north to the ports of Lagos and Port Harcourt. Poor management and institutional constraints in the country's current organisational

structure of the railway system have a negative impact on the situation. The Nigerian rail network is owned, run, managed, funded, and under government control. In today's globalised economy, this does not promote efficiency and productivity. In fact, the Nigerian railway infrastructure is no longer economically feasible due to years of neglect. Over the last three or four decades, it has deteriorated in every way, falling into a vicious spiral of dropping traffic, endemic deficits, and decreasing capacity to serve its clients, resulting in greater revenue loss. Furthermore, the existing railway network no longer connects the country's key population, resource, and activity centres. Railways, on the other hand, are highly suggested for countries with enormous areas of land, people, and resources, such as Nigeria.

According to Onokala (2002), the national railway system's alignment has a severe flaw in that it lacks east-west train connections. A railway line connecting Port-Harcourt to Onitsha and then to the west of the Niger River has been discussed but not pushed seriously. There were also proposals to expand the network by adding east-west lines to connect the two existing north-south lines. The proposed lines (275 kilometres) for the envisaged iron and steel complex are the Ajaokuta-Otukpo and Warri-Ajaokuta-Itakpe lines.

The majority of the railway infrastructure now in use is old, out-of-date, inadequate, badly maintained, and no longer functioning. Because the Nigerian railway system is crucial for coordinating transportation in the country, it must be modernised as a whole. The country had a consistent growth rate and can be ascribed to a surge in agricultural output, which contributed over 80% of the GDP in the early 1970s, as well as the development of crude oil, which is currently the foundation of the economy (CBN, 2011). Rail transportation does, however, not consistently contribute to economic growth over time. Before the discovery of crude oil, Figure 1 above depicts an increase in rail output from 1970 to 1980 (Apanisile, 2013). After that, the

nation's rail output declines as a result of inadequate budgetary support from the federal government and bad management by the Nigerian Railways Corporation (NRC), which is charged with overseeing the subsector. Only around one-fifth of the transportation sector's budget is allocated to the rail transport subsector (CBN, 2011). The railway system is claimed to have seriously deteriorated as a result of a lack of resources required to keep the tracks and infrastructure in excellent operational order, depicted in the figure below (see Figure 6).

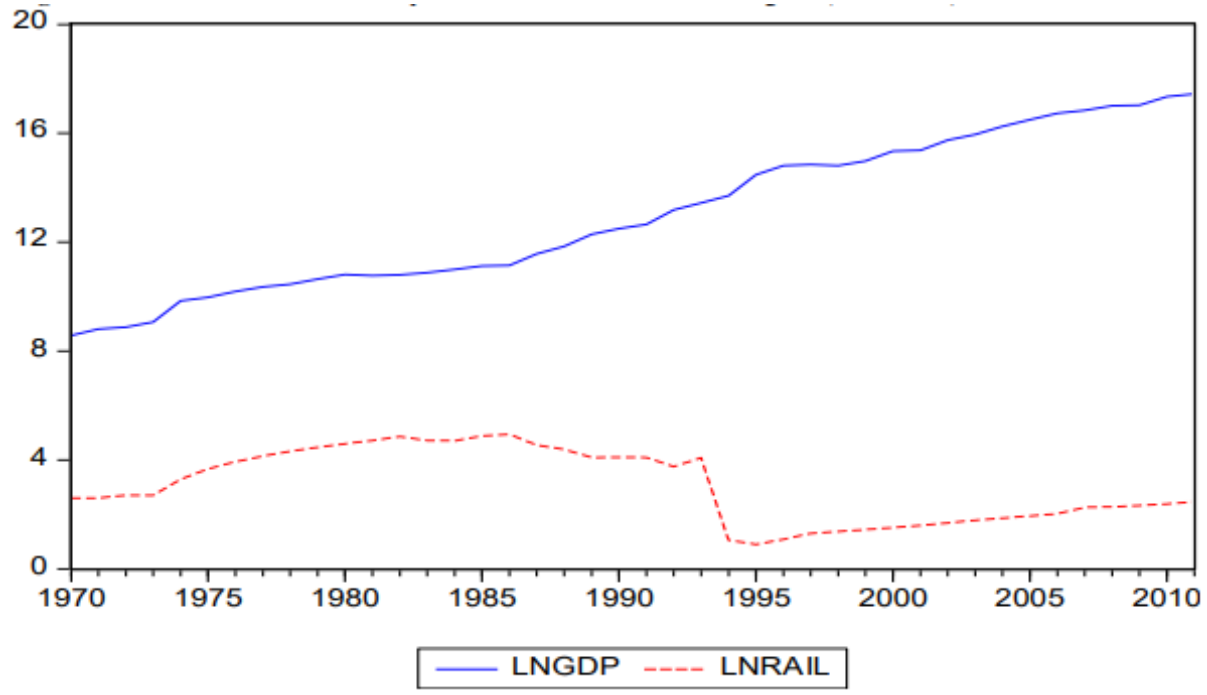

Figure 6. Rail Transport and Economic Performance in Nigeria (1970-2011) (Apanisile, 2013)

3.3.3 Air Transport Development in Nigeria and Its Impacts

Air transportation in Nigeria experienced its growth after the Second World War, when the British Royal Air Force handled the Nigerian air transport system and that of other West African colonies. After the end of the Second World War, Nigeria, Sierra Leone, Ghana, and Gambia collectively formed the West African Airways Corporation (WAAC) under the British colonial rule, with its headquarters situated in Lagos, Nigeria to ensure steady transportation between

these colonies and their colonial nation, Britain (Akpogomeh, 1995). However, after Nigeria and Ghana attained independence, WAAC was abolished to allow both independent countries independently be in charge of their own airways. Nigeria, in its pursuit of an independent airline operation, founded the Nigerian Airways Limited, which served as the national carrier. Ever since, the Nigerian government has continued to invest significantly in the development of air transportation. As a result, upgraded modern aircraft (DC-3, F27, F28, and subsequently DC-8, DC-10, Boeing 707, Boeing 737, and Boeing 474) were imported into the nation, which increased the nation's air traffic significantly (Filani, 1975, Bardi, 1987, Ogunjumo, 1992, and Akpoghomeh, 1995). The Nigerian air transport system flies across several continents such as Europe, North America, and Asia as well as within East and West Africa and monopolised domestic air transport services until the 1980s when the system became inefficient to serve teeming air transport service demands; therefore, pushing the government to allow private and commercial airlines for domestic air transport services. The National Civil Aviation Policy (NCAP) of 2001 arranged the liberalisation and privatisation of Nigeria's aviation. According to Onokala (2002), Nigeria's civil aviation sector has transcended from a solely government operation in the 70s and 80s to a more commercial, liberalised industry where there are evident private sector involvement in the aviation operations as experienced in other developed and developing nations of the world.

Indeed, domestic and international traffic in Nigeria have increased dramatically during the previous two decades, with domestic traffic increasing from 5.2 million to 8.4 million between 2001 and 2007. The situation in Nigeria is comparable to what is reported at the worldwide level, where the International Air Transport Association (IATA) estimated global total domestic air passenger traffic of 1,249,000,000 in 2007, an increase of 8% over 2006 (IATA, 2008).

Arik Airlines, Air Peace, Aero Contractors, Bellview Airlines, Associated Airlines, Capital Airlines, Overland Airlines, and Chanchangi Airlines are among the private airlines now operating in Nigeria. In Nigeria, several foreign airlines operate. International airports may be found at Abuja, Lagos, Enugu, Port Harcourt, and Kano. The number of government-owned airports in Nigeria has gradually expanded throughout the years. Nigeria presently has 22 airports, several of which are being converted to international airports capable of handling contemporary aircraft. Because of the intrinsic advantage of speed in a situation where large spatial disparities in resource endowment and production occur, such as in Nigeria, air transportation's important and unavoidable role in the movement of people across the country has contributed significantly to Nigeria's economic development.

According to Onokala (2012), because of improving economic situations, Nigerians are more eager to travel by air than ever before. Bardi (2017) investigated the geographical organisation and growth trend of Nigerian domestic aviation passenger traffic. He confirmed that domestic air passenger traffic in Nigeria has been steadily increasing, and that the domestic air passenger network transitioned from partially connected networks in 2003 and 2006 to a Hub-and-spoke system in 2010 and 2014, as most airlines chose Lagos and Abuja as their operational and hub hubs. The presence of these hubs indicates the maturity of the country's air transport network. As a result, air transportation is expanding at an alarming rate and offers enormous potential for the growth of tourism in Nigeria. In reality, there is a lot of space for growth in Nigerian airways transportation. Airports have a significant impact on various essential factors of regional economic growth and encourage the rapid distribution of critical goods and services. An airport benefits from delivery services as well as a variety of professional services. Minimum-fare airports bring business to a region, resulting in increased employment, money, and productivity.

Airport services that are effective and dependable reduce delivery times while increasing area and business profitability. The provision of effective and dependable airport services will have an impact on a company's standing in an industry.

The global economy is the sole driver of the air transportation system, which also serves as a key economic stimulus. According to the International Air Transport Association (IATA), there are four million direct jobs in the aviation industry globally, which contributes to an output of $400 billion. The expansion of government sectors like hotels, tourism, and other related industries is facilitated by the efficiency and quality improvements in air passenger services. Trade is promoted and the whole economy is made more efficient by enhanced air cargo operations, free movement of people, and information (Nwaogbe et al., 2013). Through the output it supports farther down its supply chain, the sector indirectly contributes another NGN 17 billion. The money spent by the staff of the airlines and their supply chains accounts for an additional NGN 11 billion. In total, these airlines employed about 61,000 people in Nigeria and the economy with roughly NGN 58 billion. The ground-based aviation infrastructure supports an additional 31,000 employment through its supplier chain in addition to the 37,000 employees it directly employs. Construction workers who construct or maintain airport facilities are only one example of the occupations that are indirectly supported. The expenditure of people working in the supply chain and ground-based infrastructure of the aviation industry supports an additional 30,000 jobs. The GDP of Nigeria receives a direct 29 billion NGN contribution from the ground-based infrastructure. Through the output it supports farther down its supply chain, it indirectly contributes another NGN 16 billion. The expenditure of employees who work in ground-based facilities and its supply chain generates an additional NGN 16 billion (Oxford Economics, 2012).

3.3.4 Ports and Inland Waterways in Nigeria and their Impacts

Sea and inland ports connect regions to international markets and are often a low-cost means of delivering huge commodities to and from remote locations. Improvements to port effectiveness will thus benefit interregional international trade while also contributing to employment growth and regional efficiency. Such advances in efficiency have an impact on profitability by enhancing the transfer of large quantities of goods to remote places and by broadening the customer reach of firms and regions that use port infrastructure (Bartholdi & Hankman, 2011).

Onokala (1994a) investigated the pre-colonial stage of transport development in Nigeria and discovered that prior to contact with Europe, there were trade routes of tracks and waterways in various parts of Nigeria acting as key channels of communication by employing canoes. Nigeria's largest interior waterways are the Niger and Benue rivers, which divide the country into east, west, and north parts. The two rivers merge in Kogi State in Lokoja. Both rivers originate outside of Nigeria, although approximately 1440 kilometres of the Niger and 960 kilometres of the Benue flow within the country. River Sokoto and River Kaduna are key tributaries of the River Niger in Northern Nigeria, whereas Gongola River and Katsina Ala River are major tributaries of the River Benue. Hadeija River and others drain into Lake Chad in north-eastern Nigeria. Other notable coastal rivers in South-western Nigeria include the River Ogun, the River Osse, and the Oshun River; in South-eastern Nigeria, the coastal rivers include the Cross River, the Imo River, the Aboine (Ebonyi) River, and other tributaries of the River Niger such as the Anambra and Mamu Rivers. The navigable sections of these rivers and several of their tributaries were the only means of communication between the outside world and significant regions of Nigeria, as well as among the settlements along the rivers. The importance of inland waterways and seaports in Nigeria's economic development was such that the various ports along the

country's beaches and rivers increased, fell, or totally disappeared as the pattern of trade inside the country and with the outside world changed. The early colonial period of transport development in Nigeria began in the early nineteenth century, with the creation of scattered ports and trade stations for commercial activities along the coastline. Lagos, Gwato, Forcados, Koko, Burutu, Akasa, Brass, and Calabar were among the ports and trading centres, each having a fairly limited hinterland. However, as the interior was penetrated and eventually controlled, new trade routes were established, and as a result, some ports such as Gwato, Brass, Koko, Forcados, and others declined in importance or became extinct, while others such as Lagos, Warri, and Port-Harcourt became dominant.

Until the latter half of the nineteenth century, early foreign traders who came to Nigeria relied on water transport using the numerous creeks and rivers from which they communicated with specialist traders from inland trading communities such as Arochukwu, Awka, and Nkwere traders in the interior of south-eastern Nigeria. Furthermore, several coastal and riverine populations, such as the Efik, Opobo, Bonny, and Calabar people, conducted direct trade with European ships. According to Atubi and Onokala (2007), rivers were utilised in Delta State during the early history of trade between the Portuguese and the Ijaw, Itsekiri, Ukwuani, Bini, and Urhobo. They dealt in palm oil and other agricultural commodities, as well as human captives later on. The slaves were walked along the coast while the palm oil and agricultural items were delivered by head-loading to depots and then conveyed in dug-out canoes to the ports for export. Later, as British merchants penetrated and acquired control of the interior, they switched from trading slaves to trading vegetable oil and other export commodities, pushing out Portuguese, Dutch, and other merchants. They also increased their inland activities through river boats and barges using Niger Delta parts of Warri and Buntu, as well as other river ports such as

Sapele, Onitsha, Ajaokuta, Idah, and Baro. According to Onokala (2002), the period following World War I and II saw remarkable development in water transportation in Nigeria, primarily through the introduction of powered motor boats, government launches, motorised ferries, and engine boats and canoes for carrying goods and passengers along the River Niger and other major rivers, as well as transportation from one side of the river bank to the other. Although an outboard engine boat (the Erico) was used on the River Niger between Onitsha and Asaba, the River Niger remained a natural impediment to road transport until the first Niger Bridge, linking Asaba and Onitsha, was built in 1965/66 and opened as a toll bridge, but toll collection was later abolished. Other important river crossings in Nigeria include the Ajaokuta bridge near the confluence of the Rivers Niger and Benue in Lokoja, as well as the Makurdi Bridge across the River Benue. The second bridge over the Niger River is currently under development.

The formation of the Nigerian Ports Authority (N.P.A) in 1954/55 was linked to the construction of modern seaports in Nigeria, and Nigerian ports have since played a prominent role in the country's foreign trade. When Nigeria gained independence in 1960, it possessed major seaports in Lagos and Port-Harcourt, as well as minor ones at Warri and Calabar, which met the country's marine needs. By the second half of the 1970s, Nigeria's port facilities were badly overburdened as a result of the oil boom and the concomitant enhanced level of living, which resulted in a significant rise in import traffic. The expansion put significant pressure on the port infrastructure, causing delays in ship processing and excessive demurrage. Lagos, a significant seaport, experienced severe traffic issues between 1974 and 1977. In response, a significant investment program was launched, developing the Tin Can Island ports complex and the Roll-on Roll-Off (RORO) ports in Lagos. Between 1975 and 1980, the port's capacity increased dramatically by roughly 300 percent.

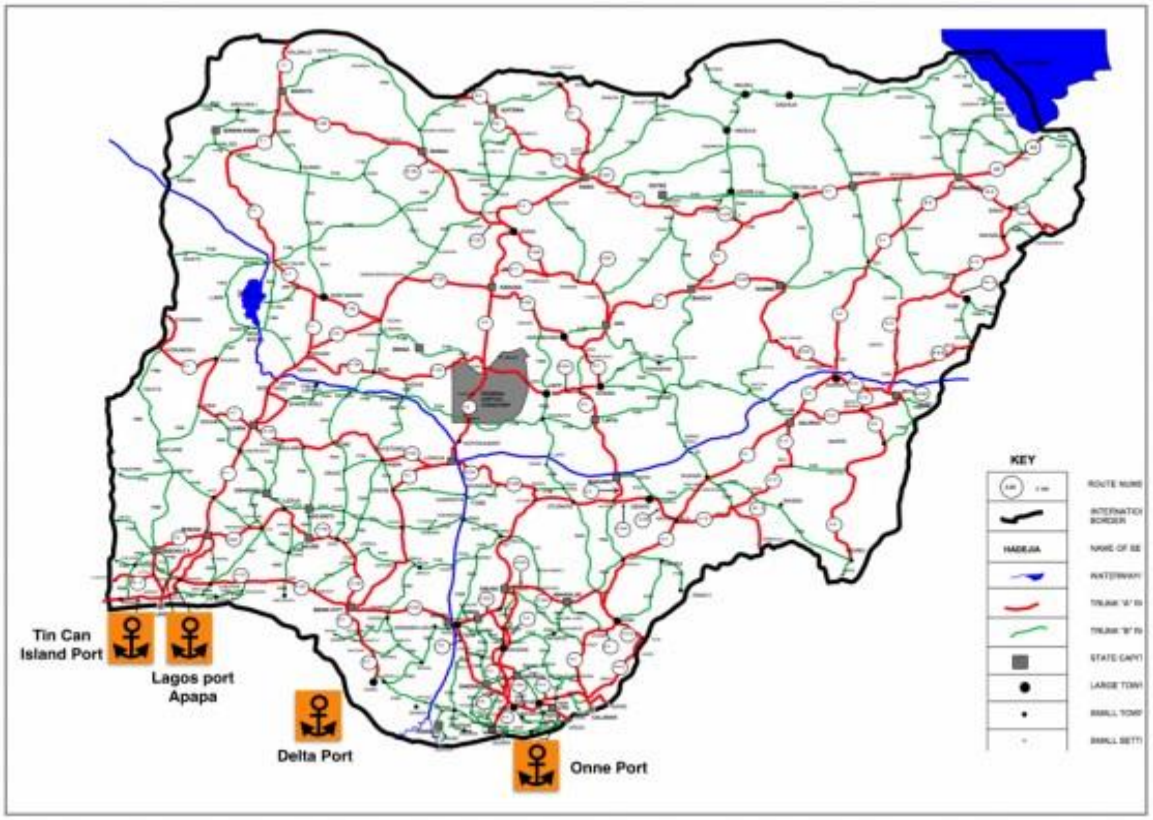

Figure 7. Seaports in Nigeria Map (Federal Ministry of Power, Works & Housing)

The principal seaports of today include the ports of Lagos, Tin Can Island, the Delta ports complex (see Figure 7), which includes the ports of Warri, Sapele, Koko, and Burutu, Port-Harcourt, and Calabar. The ports of Sapele, Aboh, Onitsha, Asaba, Idah, Baro, Ajaokuta, and Makurdi are significant river crossings on the Rivers Niger, Benue, and other rivers. The Nigerian Ports Authority (NPA) currently owns 128 private jetties, 11 oil terminals, 8 port management authorities, and 13 major ports. All ports depend on imports for their traffic. Overall cargo throughput climbed from 20 million tonnes in 1998 to 30 billion tonnes in 2000, with Nigeria now having a total cargo handling capacity of more than 35 million tonnes. In general, most ports lack proper port infrastructure and specialised berths, yet have excess capacity in regular berths. In addition to severe port congestion, Nigerian ports have additional

challenges such as the usage of old and dilapidated haulage facilities in cargo handling, as well as fixed rates and quotas imposed by the government. Udo & Ogundana (1966) and Ogundana (1966, 1967, 1970, 1971, and 1973b) went into great detail on port evolution and competitiveness in Nigeria, as well as the implications and challenges that come with it. Port users responded to these hard conditions by using alternate ports along West Africa's coast, such as the Port of Cotonou in the Republic of Benin, Lomé Port in the Republic of Togo, Accra Port in Ghana, and Doula Port in Cameroon, among others. Currently, much of the trade that would have used Nigerian ports is redirected to other ports around the West African coast, despite the Port Reform Act of 2003, which attempted to revitalise Nigerian ports by expanding and modernising the ports infrastructure.

3.4 Theoretical Framework

This analytical paradigm can be included into theoretical investigations of both endogenous economic growth theory (Romer, 1990, 1986; Lucas, 1988) and neoclassical economic growth theory (Solow, 1957). The development of transportation infrastructure is combined with other unobservable social, physical, and policy elements to form the residual term of economic progress in the neoclassical economic growth theory. According to the endogenous economic growth theory, infrastructure investment's externalities serve as the main driver of long-term economic growth. Therefore, the strategy focuses on the externalities of the expansion of transportation infrastructure on economic growth and treats it as a component of physical capital. According to Sturm et al. (1998), many OECD nations reduced public investment in the 1970s and 1980s to balance out the rise in debt interest payments and social security disbursements. Sturm (1998) evaluated the macroeconomic impacts of the fall in public capital investment over the previous quarter-century in the majority of OECD countries. He also looked at the causes of

this decline. A summary of the theoretical and empirical research on the relationship between public investment and economic growth was presented by Romp and De Haan in 2007. They enumerated the ways in which public capital can have a substantial impact on growth and stated that while not all research has indicated that public capital fosters economic growth, more recent studies have proven this to be the case. Stauvermann and Kumar (2014) discovered that foreign capital tax competition results in inefficient tax rates, leading in lower welfare and growth rates. They did this by using an OLG model that includes endogenous growth and public capital.

3.5 Empirical Review of Relevant Literature

More academics are beginning to investigate the impact of building transportation infrastructure on economic growth from an empirical analysis standpoint. However, depending on the economies, sample times, and useful methodologies used, the results of these empirical research are typically inconclusive. On the one hand, several researchers—including Ighodaro (2010), Hong et al. (2011), Jiwattanakulpaisarn et al. (2012), Pradhan and Bagchi (2013), and Achour and Belloumi (2016)—have discovered that improvements in transportation infrastructure do significantly contribute to economic growth. According to Aschauer (1989), one of the primary functions of government expenditure is to increase production, with basic facilities like streets, roads, airports, public transportation, sewerage systems, and water systems having the strongest capacity to do so. This implies that financial investments in transportation infrastructure support economic expansion. Based on VECM, Ighodaro (2010) investigated the long- and short-term effects of transportation infrastructure on economic development in Nigeria and discovered a long-term enhancing effect and a negligible short-term effect. This study was able to distinguish between long- and short-term results because to the usage of VECM. However, the study had

several flaws because it did not begin with an exhaustive measurement of the expansion of transportation infrastructure.

In a similar vein, Jiwattanakulpaisarn et al. (2012) examine how roadway capacity affected regional economic development in 48 neighbouring US states. While their study was exploratory and cut across several states in the United States, their tool of measurement to investigate the country's transportation infrastructure and its impact on economic growth it was, however, unclear and inconsistent. Similar to the study carried out by Ighodaro (2010), Pradhan and Bagchi (2013) also investigated the long- and short-term effects of transport infrastructure development on economic growth in India using the VECM model. The study reveals that the on the long run, transport infrastructure has a significant one-directional impact on the growth of the economy. Several recent studies, such as Wang et al. (2020), Saidi et al. (2018), Maparu and Mazumder (2017), and Meersman and Nazemzadeh (2017), also identify that transport infrastructure development contributed significantly to the progression of a nation's economy.

On the other far side of research, some researchers discover that the impact of transportation infrastructure on economic growth is non-substantial or even the opposite, as Yu et al. (2012) argued that promoting transportation infrastructural development does not stimulate regional economic growth in low low-income areas. Although the study only concentrated on their relationship between economic growth and transport infrastructure and was prior to the financial crisis period, leaving out the external shocks and the stimulus fiscal policies implemented following the global financial crisis of 2008. It is common for many studies to link the negative and negligible impacts of transport infrastructure development to the crowding-out effects of public investments. That is, increasing governmental investment reduces economic growth by

crowding out private consumption and investment (Andrade and Duarte, 2016; Hooper et al., 2021).

According to Engelstoft et al. (2006) and Blasio and Addario (2010), the industrial agglomeration effect and an increase in total factor productivity (TFP) were two key elements in how the expansion of transportation infrastructure impacted economic development. Improvements in transportation infrastructure can lower transit costs (Wetwitoo and Kato, 2017; Efthymiou and Antoniou, 2015; Sakamoto, 2012), as well as increase the endowment of local resources (Melo et al., 2009; Venables, 2007), in terms of the industrial agglomeration effect. Regarding the TFP effect, upgrades to transportation infrastructure can widen the market (Bernard et al., 2019; Lin, 2012), ratchet up competition, and entice new businesses to enter the market and introduce innovative products (Deng et al., 2014; Cechura, 2018).

Antle (1983) established the link between transportation infrastructure and economic growth by measuring the effects of transportation and communication infrastructure on aggregate agricultural productivity using a Cobb-Douglas production function for 47 low and emerging economies and 19 developed economies. The study discovered a robust and positive relationship between infrastructure level and aggregate agricultural productivity. This finding is consistent with the study carried out by Aschauer (1989), which discovered that the GDP elasticity with respect to core infrastructure (such as highways, mass transit services, airports, electricity and gas, sewerage, and streetlights) was 0.24 and concluded that core infrastructure contributed more to productivity than other types of infrastructure in the United States. Similarly, other studies (Eberts, 1990; Munnell, 1990; Garcia-Mila & McGuire, 1992) discover that some public capital infrastructure has high output elasticity. Fernald (1999) investigated the beneficial impact of transportation infrastructure, reporting that the output elasticity of highway investments in the

US economy from 1953 to 1989 was 0.35. He observed that sectors that rely heavily on road transportation have greater development in factor productivity than others. Stephan (2000) examined the effects of public infrastructure (including transportation and human capital infrastructure) on local private production using a panel data set of 327 German counties and discovered that transportation and human capital positively contribute to local private sector productivity and output. Fan and Zhang (2004) assessed the effects of rural infrastructure (road density) on farm and nonfarm production using China's 1996 Agricultural Census dataset. Using a simultaneous equation approach, they concluded that rural infrastructure and education play a far larger effect in nonfarm sector production than agriculture productivity. Khadaroo and Seetanah (2008) examined the relationship between transport capital and economic growth in Mauritius from 1950 to 2000 using a dynamic time series analysis in a vector error correction model (VECM) framework and discovered that transport infrastructure contributed positively to Mauritius' economic performance. From 1970-71 to 2007-08, Tripathi and Goutam (2010) investigated the long-run equilibrium relationship between road transport, employment, production, and gross capital formation in India. They employed the vector auto-regression (VAR) approach to examine the impact of road transport on such macroeconomic variables. Their research found that road transport has a significant and favourable long-run link with economic growth and gross public capital formation. This finding is consistent with Pradhan and Bagchi (2013), who found that transport infrastructure (road and rail) contributed positively to economic growth in India from 1970 to 2010. Using the vector error correction model (VECM), they discovered bidirectional causality between road infrastructure and economic growth as well as road infrastructure and gross domestic capital formation in India, as well as unidirectional causality from railway infrastructure to economic growth and gross domestic capital formation.

Mohamand et al. (2016) discovered similar results. They used a panel data set of developed and less developed regions to assess the influence of transportation infrastructure on economic growth in Pakistan. Their findings revealed bidirectional causation between transportation infrastructure and economic growth in affluent and developed provinces, but unidirectional causality between economic growth and transportation infrastructure in undeveloped areas. From 1990 to 2011, Maparu and Mazumder (2017) investigated the causal links between transportation infrastructure (road, rail, aviation, and port infrastructure), economic development, and urbanisation in India. They conducted their investigation using numerous time series estimation techniques, including the Engle and Granger cointegration test, the Johansen cointegration test, the vector error correction model (VECM), and the Granger causality test. Their findings revealed that, in the long run, transport infrastructure is cointegrated with economic development, and that, in most situations, the directional of causality is from economic development to distinct sub-sectors of transport infrastructure, lending support to Wagner's law. However, no causality from urbanisation to transportation infrastructure has been discovered, but the opposite is not true, as unidirectional causation runs from highway and port transportation to urbanisation. Wessel (2019) used a gravity equation model with European trade flows to examine the effects of specific modes of transport infrastructure on trade. The study's findings revealed that different forms of transport infrastructure have different trade consequences. Rail and air infrastructure are more responsive to quality increases in the associated infrastructure, but road density has a positive trade effect rather than road quality.

3.6 Literature Gap

This chapter provides an overview of the significance of transport infrastructure and its impacts on economic development in Nigeria. It highlights the role of transport infrastructure in

promoting economic growth, both in the context of Nigeria and globally. Additionally, the chapter reviews relevant empirical literature, showcasing various studies that support the positive impact of transport infrastructure on economic growth. While the chapter offers valuable insights into the relationship between transport infrastructure and economic development, some notable gaps remain. First, it would be beneficial to explore the specific challenges and barriers that hinder the efficient development and maintenance of transport infrastructure in Nigeria. Factors such as corruption, inadequate funding, and institutional constraints are important areas that warrant further investigation. More so, the chapter primarily focuses on the positive impacts of transport infrastructure, but it is crucial to consider potential negative consequences, such as environmental degradation and social equity issues, which may arise from infrastructure development. A more comprehensive analysis should encompass a balanced view of the costs and benefits associated with transport infrastructure in Nigeria.

4.0 Methodology

The detailed methodology for the study into the impacts of transport infrastructure on Nigerian economic growth is presented in this chapter. This chapter examines the applied research philosophy, approach, strategy, and techniques in the finding the interrelationship between transport infrastructure and economic growth. It does so within the context of Saunders' et al. (2019) research framework. Additionally, sample methods, selection standards, and pertinent information about the research instruments used in this study are included in the chapter.

4.1 Research Philosophy

Theories and assumptions regarding the nature and fundamental characteristics of a reality understudied in research, known as ontology, and how the understanding of this reality is developed and justified (epistemology) (Scotland, 2012). Although there are a number of philosophies in research, each of them forms a base system for the development of knowledge through beliefs and assumptions (Saunders et al., 2019). In this research, however, research philosophy of positivism will be adapted to form the base system for the assumptions and beliefs that back the study into the effects of transport infrastructure on Nigerian economic growth.

Positivism, largely regarded as a form of empiricism since it bases its assumptions of knowledge development on actual evidence rather than human experience (Kivunja & Kuyini, 2017). The philosophy doubts that interpretation and meaning to social phenomena can be scientifically adequate; thus, it emphasises mathematical approach previously formulated theories to investigating social realities (Khanna, 2019). The pursuit of knowledge that will hold as a universal and functional truth across all industries or related countries and cultures led to the application of positivist philosophical stands into managerial and social sciences (Saunders et al., 2019). Accordingly, positivism argues that knowledge can only be derived from experience and

evidence. That is, research, that prioritises observation and free from human interferences, produces accounts and facts that aligns with an independent reality. Positivism's association with empiricism is the agreement that observation and measurement are central to knowledge development (Žukauskas et al., 2018).

Therefore, this research is premised on the idea that observable and measurable information is gathered and objectivity is prioritised. The research into the effects of transport infrastructure on the Nigerian economic growth can only be examined externally as there are many numerical indicators to the economic growth and transport development and investment in the economy.

4.2 Research Approach

Research is credible and accepted when they follow the systematic ways to investigating and achieving their research objectives. The research approach is basically the direction of reasoning in research, seen as the process of drawing conclusions to new and existing knowledge. Although there are two to three research approaches, the positivist's stand aligns with the deductive approach (Cresswell, 2013). This approach seeks to comprehend how justification moves from belief in the premises to belief in the conclusion. The direction of research, in this form of reasoning, depends on previously existing knowledge, hypothetical theory, or model (Mertens, 2014). Using this approach, hypothetical theories used as basis for developing new knowledge must have been repeatedly verified using as many quantifiable data as feasible. Thus, if the outcomes of the newly researched area validate pre-existing models and knowledge, the model is referred to as law-like; however, if the outcomes do not validate, the research is seen as new knowledge and be referenced for future research (Bahrudin & Han, 2020). Thus, deductive reasoning basically involves the objective measurement of large quantity of data, following the process of validation and generalisation.

Since the research adopts a positivist base for assumption, the research can become reliable if it follows the process of validation through previously existing models and theories and thus, generalises accordingly. The investigation into the effects of transport infrastructure on the Nigerian economy, thus, gathers measurable data and builds its outcomes on pre-existing verified theories and models in the academia.

4.3 Research Strategy

Quantitative and qualitative research strategies possess cons and pros and are applicable in, most cases, different research efforts (Daniel, 2016). Although they both may reflect the actual reality understudied in research, the interference of subjectivism may increase the risk of bias (Frampton et al., 2022). Thus, the quantitative research strategy, which concerns itself with objective investigation and observation of social happenings through the adoption of measurement and numerical computation of data, offer a more credible strategy to find answers to the research questions this study seeks (Rahman, 2016). With quantifiable variables and statistical tools, the quantitative research method collects data, analyses, interprets in an approach that tests, develops understanding, describes, and predicts social reality (Apuke, 2017). Outcomes in quantitative research are more likely to reflect the quality of data gathered and analysis conducted (Ali & Bhaskar, 2016); however, it reeks of the risk of numerical data not efficiently painting the reality understudied (Frampton et al., 2022). Thus, emphasis is made on the collection of data since it provides the fundamental requirements for analysis (Kabir, 2016). Although, statistical estimations test the viability of the data collection against one another to find issues of multicollinearity which shows the compatibility and interconnectivity of the variables used. Nonetheless, quantitative research is a fast, efficient, and reliable strategy to investigating complex and broad situations such as the effects of transport infrastructure on the

Nigerian economy. The Nigerian economy is a broad concept and can be associated to several factors. Likewise, transport infrastructure is a broad aspect of the economy and may need several understandings of its branches and they affect the economy; therefore, grasping all the broad concepts and reality in numerical data proffers an efficient and easy strategy into finding their interrelationships.

4.4 Time Horizon

The data gathered to investigate how the transport infrastructure affect the growth of Nigerian economy includes a trend over the years; therefore, the research adopts a longitudinal data method between 1998 and 2020. While the year 2020 may be affected by COVID-19 pandemic, data on the most recent years are incomplete and largely unavailable. This offers a consistent insight into how the variables under study have changed over the years and they affect each other. Since positivism believes that reality is fragmental and tangible (Yilmaz, 2013), the research measures variables against one another and actualise the direction of their relationships over time.

4.5 Techniques and Procedures

This section of the research methodology presents the procedures, tools, and techniques employed in the collection, analysis, and interpretation of data, such as data collection tools and sources, methods of estimation, model specification, and model evaluation procedures.

4.5.1 Data Collection and Sources

Data collected for the research are quantitatively sourced from World Bank database and the Nigerian Bureau of Statistics. Adequacy in data collection cannot be overemphasised as data gathered must reflect the reality of the social phenomenon and must logical and in line with

theoretical frameworks (Taherdoost, 2021). The Table 1 presents the variables and their relevance in this study:

Table 1. Variables for the Model

S/N	Variables	Relevance	Source
1	Real GDP Growth	This measures the economic growth in Nigeria	National Bureau of Statistics
2	Air Transport	This measures the number of passengers the Nigerian air transported.	World Bank's WDI
3	Government expenditure on transportation	This is the annual budget for transportation in Nigeria	National Bureau of Statistics
4	Transport Service	This data measures the transport service percentage of the Nigerian service exports in the balance of payment (BoP).	World Bank's WDI
5	Logistics performance index	This measures the quality and structure of logistics and supply chain in Nigeria	World Bank's WDI
6	Private investment on transportation	Investments in the private transport	World Bank's WDI
7	Railway passenger transported	The number of passengers' railway transport moves annually.	World Bank's WDI

8	Railways goods carried	The number of goods Nigerian railways carried	World Bank's WDI
9	Corruption Perception Index (CPI) Transparency Score	This measures the level of corruption in the country.	World Bank's WDI

4.5.2 Methods of Estimation

This study, initially, conducted a trend analysis to evaluate the direction of change in the variables over the years under study. Similarly, summary statistics was conducted to demonstrate the average values of the variables, the spread from their average, and the lowest and highest recorded under the period under the review. Afterwards, a pre-estimation test was conducted adopting the Augmented Dickey-Fuller Unit Root test in order to examine the stationarity of each variable adapted in the research model. This is to evade the result of a spurious regression results. With a mix of stationary and non-stationary variables at I(0), an Autoregressive distributed lag (ARDL) cointegration test was necessary to avoid spurious regression result and ensure no long-run relationships among the variables.

Lastly, an ARDL short-run and long-run regression analysis was conducted to examine the relationships between transport infrastructure and the Nigerian economic growth. Post-estimation tests such as multicollinearity test (Variance Inflation Factor), heteroskedasticity test (Breusch-Pagan-Godfrey), autocorrelation test (Breusch-Godfrey LM test), and normality of residual test (Jarque-Bera normality test) were conducted to verify the outcomes of the regression analysis do

not violate classical linear regression model assumptions and can be generalised (Omimakinde, 2022; Ghosh and Dinda, 2019).

4.5.3 Model Specification

The model specification for this research follows the firm of the generalised Cobb-Douglas production model. The production function entails the transport services and the gross domestic product (GDP) and other variables such as government expenditure as a percentage of the GDP, logistics performance index, private investment in transport, Country Policy and Institutional Assessment (CPIA) transportation, and corruption index, which are significant in determining the state of transport infrastructure in the country. This study adapted the models employed in Akanbi et al. (2013) and Omimakinde (2022) studies. The Cobb-Douglas production function goes thus:

$$Y = K^{\propto}(AL)^{1-\propto} \tag{1}$$

Where:

Y = Aggregate output

K = Aggregate capital

A = Marginal cost of production

L = Aggregate labour

Since the model in this study wants to determine the level of effectiveness of the activities of productivity in the economy, the equation is divided by AL all through, and thus:

$$\frac{Y}{AL} = \frac{K^{\propto}(AL)^{1-\propto}}{AL} \tag{2}$$

Then,

$$\frac{Y}{AL} = K^{\propto}(AL)^{1-\propto}(AL)^{-1} \quad (3)$$

Thus,

$$\frac{Y}{AL} = K^{\propto}(AL)^{1-\propto-1} \quad (4)$$

The equation can be simplified into:

$$\frac{Y}{AL} = K^{\propto}(AL)^{-\propto} \quad (5)$$

$$\frac{Y}{AL} = \frac{K^{\propto}}{(AL)^{\propto}} \quad (6)$$

$$\frac{Y}{AL} = \left[\frac{K}{AL}\right]^{\propto} \quad (7)$$

Thus, y can be substituted for $\frac{Y}{AL}$ and k can be substituted for $\frac{K}{(AL)}$

Therefore, the equation can be expressed as an intensive Cobb-Douglas production function:

$$y = k^{\propto} \quad (8)$$

Thus, when the relationship in the equation before is made linear in a bid to eliminate the systematic change in spread, the equation is then expressed as:

$$lny = lnk^{\propto} \quad (9)$$

In this research, the base line equation is expressed as:

$$lny = \propto lnk \quad (10)$$

therefore, the model of this paper, according to the Cobb-Douglas production function is presented as:

$$lnGDP_t = \propto_0 + \propto_1 lnAirTra + \propto_2 lnPrivInv + \propto_3 lnGovExp + \propto_4 lnLogPerf + \propto_5 lnTranServ + \propto_6 lnRailGood + \propto_7 lnRailPass + \propto_8 lnCorrupInd + \mu_t \quad (11)$$

Where:

lnGDP = log of Real Gross Domestic Product

lnAirTra = log of Air transport data

lnPrivInv = log of Private investment on transport

lnGovExp = log of Government expenditure on transport

lnLogPerf = log of Logistics performance score

lnTranServ = log of Transport services score

lnRailGood = log of total of annual railway cargo

lnRailPass = log of total railway passenger

lnCorrupInd = log of corruption index

ln = logarithm of the variable

μ = error term

4.5.4 Model Evaluation Procedure

Evaluation methods are an important aspect of research, aiding the determination of research outcomes conformity with previous studies and theoretical assertions. In this research, the a-priori expectation was employed to evaluate the extent of the study's outcomes.

A-priori Expectations

Table 2. A-Priori Expectations

Coefficients	A-priori Expectations
$\propto_1 > 0$	This is expected to have a positive relationship; that is, when air transport increases, GDP will also increase.
$\propto_2 > 0$	This is expected to have a positive relationship; that is, when private investment on transport increases, GDP will also increase
$\propto_3 > 0$	This is expected to have a positive relationship; that is, when government expenditure on transport increases, GDP will also increase.
$\propto_4 > 0$	This is expected to have a positive relationship; that is, when logistics performance increases, GDP will also increase.
$\propto_5 > 0$	This is expected to have a positive relationship; that is, when the percentage of transport services increases, GDP will also increase.
$\propto_6 > 0$	This is expected to have a positive relationship; that is, when number of railway goods increases, GDP will also increase.
$\propto_7 > 0$	This is expected to have a positive relationship; that is, when railway passenger increases, GDP will also increase.
$\propto_8 < 0$	This is expected to have a negative relationship; that is, when corruption

	increases, GDP is expected to decrease.

Source: Author's compilation, 2023

5.0 Data Presentation and Findings

This chapter focuses on the analysis and presentation of the data obtained from the Central Bank of Nigeria (CBN) statistical bulletin, and the World Bank's World Development Indicators (WDI). The chapter presents trend analysis with the use of line graphs in order to examine the movement of variables. It also gives a unit root test to find out if each variable is stationary and in what order it integrates, and a cointegration test to see if there is a long-term relationship between the model's non-stationary series. A regression analysis is also presented to examine the relationship between transport infrastructure and economic growth in Nigeria.

5.1 Trend Analysis

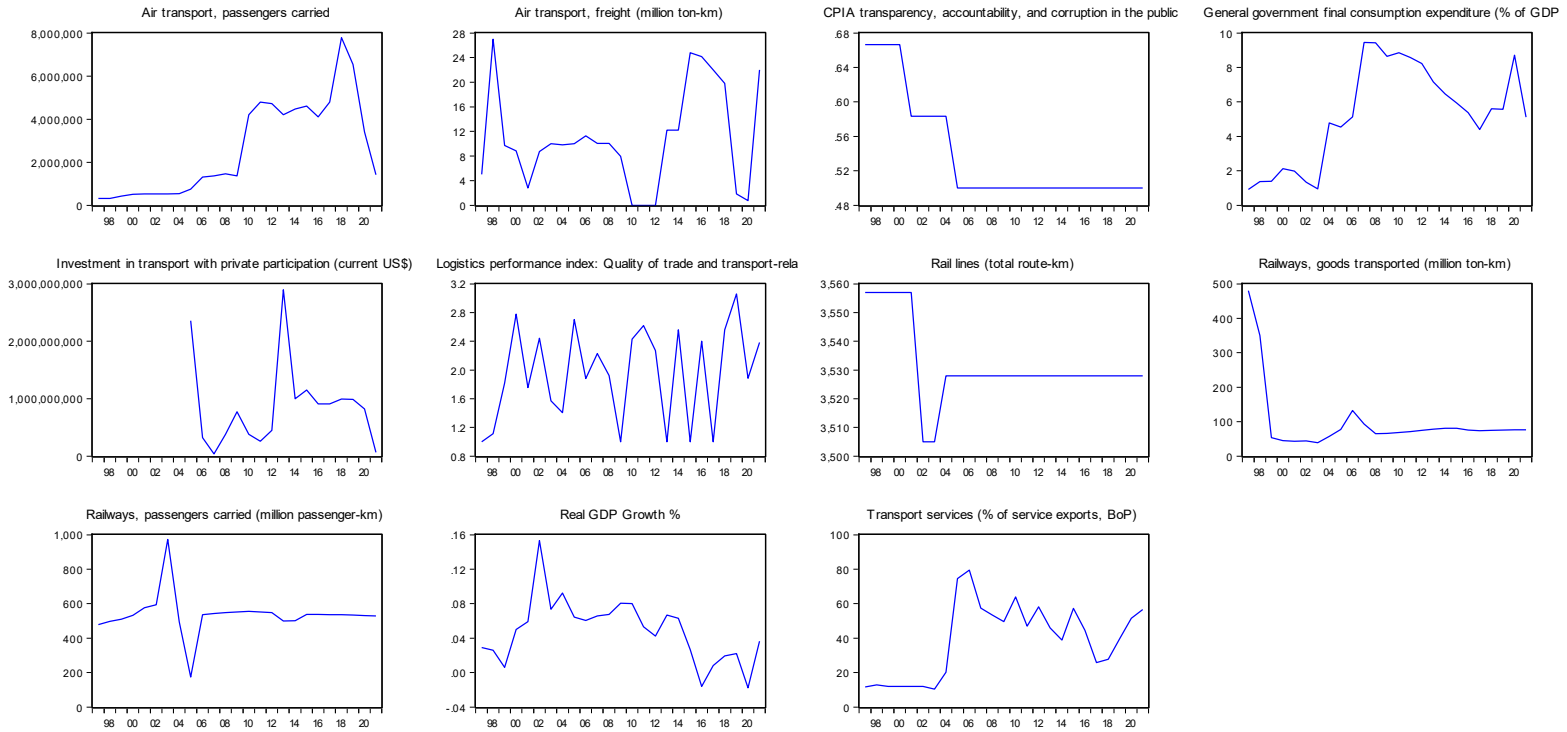

Figure 5.1: Trend Analysis of Variables

The figure 8 above shows the trend of each of the variables over time. The figure presents a line graph for real GDP growth, air transport freight, air transport passenger, Corruption index,

Figure 8. Trend Analysis of Variables (Author's Computation, 2023)

government expenditure, private investment in transportation, Nigeria's transportation performance index, rail line total route, railway used to transport good, transportation services as a percentage of GDP and railways passenger's car.

Figure 9. Real GDP Growth % (NBS, 2023; Author's Computation, 2023)

The figure 9 above shows that real GDP growth exhibited a downward trend throughout the period under investigation. This, suggest that economic growth in Nigeria has slowed and declined overtime due to weak domestic economy.

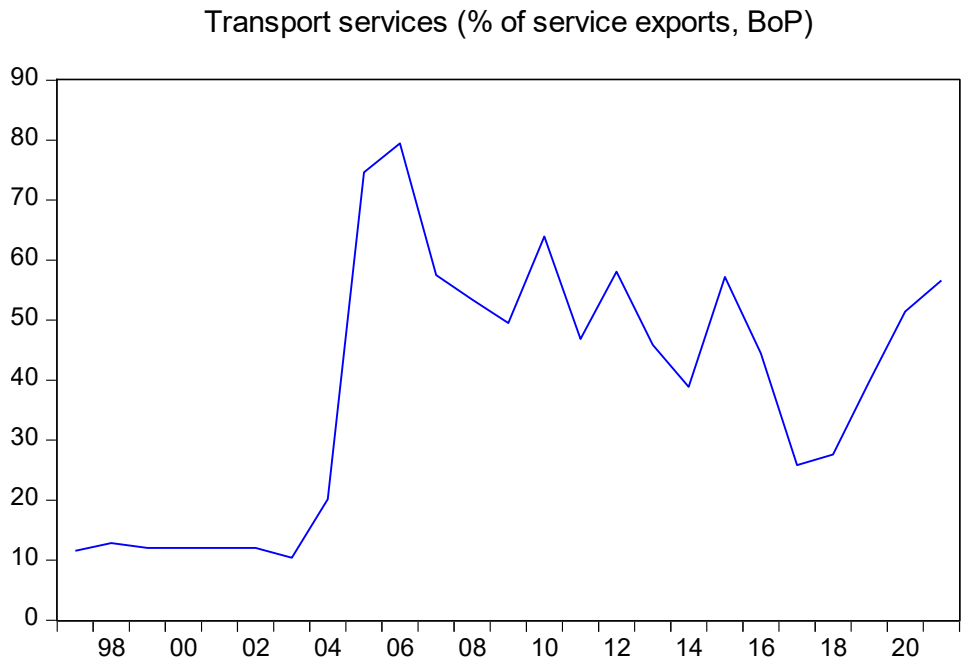

Figure 10. Transport Services (% of Service exports, BoP) (WDI, 2023; Author's Computation, 2023)

Transportation services has been increased since 1997 saw a huge spike in 2003 and has stayed elated since 2005, as depicted in Figure 10 above. Although there have been pullbacks, transport services as a percentage of GDP in Nigeria have remained elated. All variables saw decline in 2020 which Covid-19 pandemic that brought global economic activities to a halt and a slump in economies globally.

5.2 Summary Statistics

Table 3. Summary Statistics Results

	Mean	**Median**	**Maximum**	**Minimum**	**Std. Dev.**
real_gdp_growth__	0.042495	0.053079	0.080369	-0.02	0.031110
air_transport__freight__	11.12187	10.03600	24.80196	0.000000	8.838884
air_transport__passenger	3604503.	4197375.	7786144.	747648.0	2027801.

cpia_transparency__accou	3.000000	3.000000	3.000000	3.000000	0.000000
general_government_final	6.893309	6.464486	9.448340	4.403315	1.813487
investment_in_transport_	8.65E+08	8.18E+08	2.90E+09	40000000	7.55E+08
logistics_performance_in	2.053057	2.270000	3.060000	1.000000	0.672018
rail_lines__total_route_	3528.000	3528.000	3528.000	3528.000	0.000000
railways__goods_transpor	78.79883	75.46599	132.1267	64.97119	15.17534
railways__passengers_car	514.4408	536.4555	554.2773	173.6320	89.16255
transport_services____of	51.24365	51.41510	79.47318	25.85297	14.23738

Source: Author's Computation, 2023

The summary statistic results presented in Table 3 are shown as the average value of variables over the period (mean), spread from this average behaviour (standard deviation), the lowest recorded during the period (minimum), and the highest recorded during the period (maximum).

As for real GDP growth which is proxied for economic growth, the results show that it has a mean value of 4.2 percent over the period, a standard deviation of 3.01 percent, a minimum of -0.2 percent, and a maximum of 8.02 percentages. These indicate that the average real GDP growth obtainable by the country during the period under investigation was 4.2 percent, with a spread of 3.01 percent from this average behaviour.

Transportation services as a percentage of the GDP has a mean value of 51.24 percent over the period, standard deviation of 14.23 percent, minimum of 25.85 percent and maximum of 79.47 percent. These indicate that average transport services as a percentage of GDP between 1997 and 2022 is 51.24 percent with a spread of 14.23 percent from this average behavior.

Corruption index, proxied by CPI transparency score, Nigeria scored an average of 3 points out of 6 points, with a minimum of 2.5 points and maximum of 3 points out of 6 points.

Government expenditure as a percentage of GDP averaged 6.89 percent over the period, with a standard deviation of 1.8 percent, minimum of 4.4 percent and maximum of 9.44 percent. These indicate that average government expenditure as ratio of GDP during the period under investigation was 6.89 percent with a spread of 1.8 percent of GDP from this average behavior. The lowest government expenditure recorded during the period was 4.4 percent of GDP while the highest government expenditure recorded during this period was 9.45 percent of GDP.

Logistics performance index: Quality of trade and transport-related infrastructure (1=low to 5=high), from 1997 through 2022, Nigeria scored an average score of 2.05, with a minimum of 1 and the maximum of 3 points. The variable has a spread of 0.67 points.

Private investment in Nigeria's transport structure totalled $14.7 billion, with an average of $864 million. The variable saw the highest private spending in transportation in 2013, with a total expenditure of $2.9 billion and a minimum of $40 million in 2007.

5.3 Correlation Analysis

This section presents the correlation coefficients of the relationship between the transport infrastructure, economic growth in Nigeria and each of the other variables considered in this study. It presents the correlation coefficients of the relationship among the explanatory variables as well. This is carried out to verify if the relationships among explanatory variables are not very high to the extent of causing a multicollinearity problem in the regression model.

Table 5.2: Correlation Matrix of Variables

Table 4. Correlation Matrix of Variables

	Air_Transport__Freight__	Air_Transport__Passenger	General_Government_Final	Investment_In_Transport_	Logistics_Performance_In	Railways__Goods_Transpor	Railways__Passengers_Car	Real_Gdp_Growth__	Transport_Services____Of
Air_Transport__Freight__	1.0000	0.0160	-0.6286	0.1482	-0.3353	0.1046	-0.0185	-0.3379	-0.2670
Air_Transport__Passenger		1.0000	-0.1753	0.1213	0.1816	-0.2831	0.3305	-0.4425	-0.6972
Government_Expenditure			1.0000	-0.3435	-0.0636	-0.2806	0.3919	0.3797	0.1168
Private Investment_In_Transport_				1.0000	-0.2487	-0.1321	-0.6016	0.0231	-0.0810
Logistics_Performance_In					1.0000	-0.0257	-0.2292	-0.0429	0.0817
Railways__Goods_Transpor						1.0000	0.0030	0.0929	0.4916
Railways__Passengers_Car							1.0000	-0.1641	-0.3718
Real_Gdp_Growth__								1.0000	0.4404
Transport_Services____Of									1.0000

Source: Author's Computation, 2023

The results of correlation analysis in Table 4 show that real GDP growth rate has positive correlation coefficients with transportation services (% of GDP), government expenditure, private investment in transportation and good transportation through rail services. On the other hand, real GDP growth (economic growth in Nigeria) has negative correlation coefficients with air transport freights and passenger, logistic performance, and rail transportation cargoes. This implies that real GDP growth moves in the same direction with transportation services (% of GDP), government expenditure, private investment in transportation and good transportation through Rail services but moves in opposite direction with air transport freights and passenger, logistic performance, and rail transportation cargoes. This can also imply that higher levels of real GDP growth rate are associated with higher levels of the former variables and lower levels of the latter variables and vice versa.

CPI (corruption index) transparency and rail route were excluded from the analysis due to perfect correlation between the variables. Hence, the variables were dropped from the analysis.

The result also shows the relationships that exist among other variables. However, since the importance of these relationships is to verify that there are no high relationships among them that could cause multicollinearity problem in the regression model, the goal here is to observe the correlation coefficients of these relationships. Given that the correlation coefficients presented in Table 4.2 for the relationships among all explanatory variables are below 0.8, following the rule of thumb that correlation coefficient below 0.8 will likely not result to multicollinearity problem, these variables can therefore be safely used in the regression model of this study without a consequence of severe multicollinearity.

5.4 Pre-Estimation Tests

Unit Root Test

The unit root test presented in this work follows the Augmented Dickey-Fuller procedure. The test was carried out to examine the stationary nature of each of the variables used in the models of this research work in order to avoid the consequence of having a spurious regression result arising from conducting Ordinary Least Squares method with non-stationary series.

Table 5. Augmented Dickey Fuller Unit Root Test

VARIABLES	t-statistic	P-value	Crit. Val. At 5% level	P-value	Order of Integration
Real GDP growth	-6.532	0.0001	-3.62	-	I(1)
Air Transport Freight	-5.584	0.00008	-3.622	-	I(1)
Air Transport Passenger	-3.688	0.0450	-3.63	-	I(1)

Govt Exp.	-5.147	0.0021	-3.62	-	I(1)
Private investment	-4.0715	0.0281	-	-	I(0)
Logistics Performance	-6.0719	0.0003	-	-	I(0)
Railways Goods	-4.4748	0.0111	-	-	I(0)
Railway Passenger	-4.844	0.0040	-	-	I(0)
Transport service %	-4.3016	0.0127	-4.56	-	I(1)

Source: Author's Computation, 2023

Presented in Table 5 above is a test for the presence of unit root in each of the variables used in the model. Unit Root Test is a test to ascertain if the variables used in this model are stationary or non-stationary series. The unit root tests are conducted in this study following the Augmented Dickey-Fuller (ADF) procedure. As seen in figure 8, some of the variables exhibit trend (either downward or upward) over time, hence, the trend and intercept option were chosen while conducting unit root test for such variables. The intercept is chosen for other variables that are not trending with time. The ADF results reveal that all variables are not stationary at level at 5% significance level except private investment, logistic performance score, goods transported through rail and passengers carried. This is indicated by each of the p-values of other variables being greater than 0.05 and each of their ADF test statistics being less than the 5% critical value and the p-values of private investment, logistic performance score, goods transported through rail and passengers carried being less than 0.05 and each of their ADF test statistics being greater than the 5% critical value.

Since the decision rule is to reject the null hypothesis that a variable has a unit root (i.e., the variable is a non-stationary series) if p-value is less than significance level (or if t-statistic is greater than the 5% critical value) and accept null hypothesis if otherwise, the result clearly suggests a failure to reject null hypothesis at level for other variables aside private investment, logistic performance score, goods transported through rail and passengers carried. This means that private investment, logistic performance score, goods transported through rail and passengers carried are stationary at level and hence, regarded as I(0) (integrated-of-order-zero) variables while others are not. However, the result reveals that each of other variables became stationary at first difference (i.e., when each of them is differenced once). The table shows that each of their t-statistics is now greater than the critical values and their respective p-values are now less than 0.05, suggesting the rejection of null hypothesis that there is unit root and accepting the alternative that there is no unit root. This indicates that these variables are stationary at first difference, hence, regarded as I(1) (integrated-of-order-one) series.

These results suggest that there are combinations of I(0) and I(1) variables in this study. The implication of this result is that using the Ordinary Least Squares (OLS) method to estimate the parameters will lead to spurious regression results if there is no long-run cointegration. This necessitates the test of cointegration to check if at all there is a long-run relationship among the stationary and non-stationary variables used in the model. This is done through the ARDL bounds test procedure for cointegration because of the different order of integration found among the variables. The result of the cointegration test is presented in Table 6.

Cointegration Test

Table 6. ARDL Bounds Cointegration Test

Test Statistic	Value	K
F-statistic	1.208724	3
	Critical Value Bounds	
Significance	I(0) Bound	I(1) Bound
10%	2.72	3.77
5%	3.23	4.35
2.5%	3.69	4.89
1%	4.29	5.61

Source: Author's Computation, 2023

Table 6 presents the result of the cointegration test for the variables in concern in order to verify if there exist long-run relationships among them. The bounds test procedure was conducted because there is different order of integration among the variables. The bounds test results present the F-statistic and the critical value bounds at different levels of significance. Since 5% significance level is chosen in this study, the F-statistic is therefore compared to the critical value bounds at 5% significance level.

The test's null hypothesis states that there is no long run cointegration (or relationship). This can be verified by comparing the F-statistic value with the critical bounds. If the value is greater than the I(1) bound the null hypothesis is rejected and the conclusion is therefore that there is a long-run relationship. If the F-statistic value is less than the I(0) critical bound then the null hypothesis is not rejected and the conclusion is that there is no long run relationship.

Looking at the F-statistic value of 1.208724, which is lesser than the I(0) critical value bound of 3.23 at 5% significance level, the test's null hypothesis is not rejected. Therefore, there is a no long run relationship. A conclusion can then be arrived at that a long-run relationship does not exist among the stationary and non-stationary series in the model. The implication of this is that, only the short-run estimates could be generated for the parameters of the model through the ARDL short-run error correction model. These results are presented in Table 7.

5.5 Regression Analysis

This section presents the regression analysis to examine the relationship between transport infrastructure and economic growth in Nigeria. The dependent variable is economic growth proxied by real GDP while the independent variable is transportation services percentage of GDP. Variables such as Rail lines, passengers carried by air and rail, freight carried by air and rail, private investment in transportation, and government expenditure as a percentage of GDP were included in the model as control variables. The ARDL short- and long-run method was used to estimate the parameters of the model.

Table 7. ARDL Short-Run Regression Results

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
REAL_GDP_GROWTH_ _(-1)	0.598256	0.214358	2.790924	0.0315
TRANSPORT_SERVICES____	-7.99E-06	0.000416	-0.019206	0.9853
LOGISTICS_PERFORM	-0.013568	0.014387	-0.943083	0.3820

ANCE_				
INVESTMENT_IN_TRA	-2.12E-11	6.95E-12	-3.057859	0.0223
NSPORT				
C	0.054504	0.091934	0.592865	0.5749

R-squared	0.912867	Mean dependent var	0.052422
Adjusted R-squared	0.709555	S.D. dependent var	0.038361
S.E. of regression	0.020674	Akaike info criterion	-4.744109
Sum squared resid	0.002564	Schwarz criterion	-3.998021
Log likelihood	64.81314	Hannan-Quinn criter.	-4.582188
F-statistic	4.489996	Durbin-Watson stat	2.386828
Prob(F-statistic)	0.037230		

Source: Author's Computation, 2023

Table 7 presents the result of OLS regression to examine the relationship between transport infrastructure and economic growth in Nigeria. The reported R-squared of the model shows that the model explains about 91% of variations in economic growth in Nigeria. The reported F-statistic shows a value of 4.489, with p-value of 0.0372 which indicates that it is statistically significant. This indicates that the overall model is statistically significant and in good fit.

Evaluating the independent variables of the model, in the short run, lag of GDP growth rate, has a positive coefficient in the result, which is 0.598. On the other hand, transportation services as a percentage of GDP, private sector investment, and logistics performance have negative coefficients in the result, which are -7.99, -2.1 and -0.01 respectively. Looking at the significance of these coefficients through the p-value, lag of GDP growth rate, and investment in

transportation services have p-values of 0.0315, and 0.0022 respectively, which is lower than 0.05 (i.e. 5% significance level), while transportation services as a percentage of GDP and logistics performance have p-values of 0.98 and 0.38 respectively, which are greater than 0.05. The lower p-value of the coefficient of investment in transportation services indicates that it is statistically significant in affecting economic growth at 5% significance levels while the higher p-values of transportation services as a percentage of GDP and logistics performance indicate that they are not statistically significant in affecting economic growth.

The significant negative coefficient of investment by the private sector in transportation shows that private investment is not significant in stimulating economic growth, and vice versa. This result shows that a percentage increase in private investment will lead to 0.002 percentage decline in economic growth. Although this result might seem contrary to expectations, it perfectly sums up the structural deficiency in Nigeria. Due to bureaucracy, corruption, nepotism and unstable business environment, private investments into the country could have negative effects, rather than the positive results expected.

Overall, the regression results show that in the short-run private investment in Nigeria's transportation sector has a significant impact on economic growth. Although negative, which shows the unconducive business environment and lack of stable framework for private business to thrive and contribute to economic growth.

5.6 Post-Estimation Tests

Some post-estimation diagnostics were conducted and presented here in order to verify if the regression result of this study does not violate some classical linear regression model assumptions and are thus valid to make relevant conclusions and generalizations. These tests include the multicollinearity test (through the variance inflation factor – VIF), the autocorrelation

test (through the Breusch-Godfrey LM test), the heteroskedasticity test (through the Breusch-Pagan-Godfrey) and the normality of residuals test (through the Jarque-Bera normality test).

Table 8. Result of Variance Inflation Factor – VIF

Variable	Coefficient Variance	Centred VIF
REAL_GDP_GROWTH__(-1)	0.047450	3.238708
TRANSPORT_SERVICES____OF	1.73E-07	3.186709
LOGISTICS_PERFORMANCE_IN	0.000146	2.755525
INVESTMENT_IN_TRANSPORT_	6.78E-23	1.807638
C	0.008452	NA

Source: Author's Computation, 2023

The result of variance inflation factor (VIF) which is meant to further verify that the OLS result does not suffer from multicollinearity problem is presented in Table 8. The result shows the coefficient variance of each of the explanatory variables and their corresponding centred VIF values. Given that the VIF values are all low and below the rule of thumb threshold value of 10 beyond which the variables are suspected to cause multicollinearity problem in the regression

result, it can then be concluded that the regression result is free from severe multicollinearity problem.

Table 9. Result of Breusch-Godfrey Serial Correlation LM Test

Model	F-statistic	p-value
Economic Growth	3.75	0.12

Source: Author's Computation, 2021.

The result presented in Table 9 is that of the autocorrelation test conducted following the test procedure of Breusch-Godfrey LM test. The test yielded an F-statistic value of 3.75 and p-value of 0.12. Given that the test's p-value is greater than 0.05, this means that the statistic is not significant. Therefore, the null hypothesis of the serial correlation test which states that 'there is absence of serial correlation' is not rejected at 5% significance level. This implies that the regression result is free from serial or auto correlation problem.

Table 10. Result of Breusch-Pagan-Godfrey Heteroskedasticity Test

Model	F-statistic	p-value
Economic Growth	0.561516	0.824935

Source: Author's Computation, 2023

The result presented in Table 10 is that of the heteroskedasticity test conducted following the test procedure of Breusch-Pagan-Godfrey test. The test yielded an F-statistic value of 0.5615 and p-value of 0.8249. Given that the test's p-value is greater than 0.05, this means that the statistic is not significant. Therefore, the null hypothesis of the heteroskedasticity test which states that

'there is constant variance' is not rejected at 5% significance level. This implies that the regression result is free from heteroskedasticity problem.

Figure 5.2: Histogram for Normality of Residual

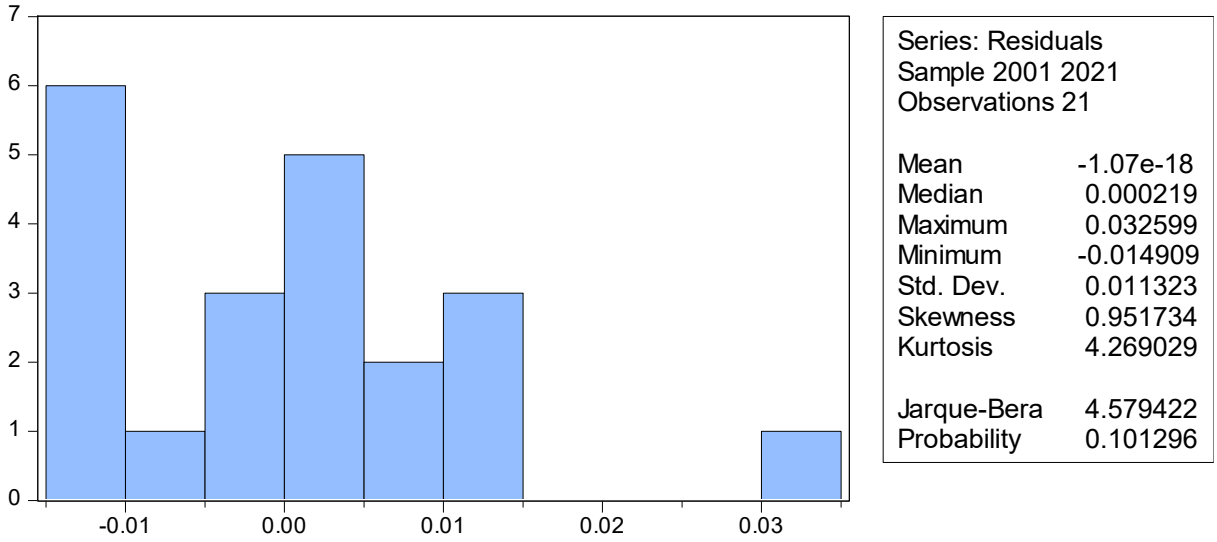

Figure 11. Histogram for Normality of Residual (Author's Computation, 2023)

The diagram presented in Figure 11 is the histogram, which is meant to show the distribution of the residual of the regression model. This is important to verify if the normality assumption of the classical linear regression model is not violated in the estimated result. Since a precise conclusion may not be reached looking at the diagram, the Jarque-Bera normality statistic is presented alongside the diagram to examine if the residual of the model is normally distributed. With the Jarque-Bera normality statistic value being 4.579 and its p-value being 0.1012 and greater than 0.05, the statistic is not significant at the 5% significance level. Therefore, the test's null hypothesis, which states that the residual series is normally distributed, could not be rejected, and hence, the residual series of the regression result is normally distributed, and the normality assumption of the classical linear regression model is not violated.

6.0 Discussion

The findings for this dissertation, presented in the preceding chapter establish a connection between transportation infrastructure and investment with the economic growth in Nigeria with statistical backings. Forging ahead, it is necessary to extensively discuss the findings of this dissertation in relations to previously existing literature and the research objectives to offer a comprehensive and contextual understanding of the found statistical relationships between the variables within the study. These research questions, through which the discussions are built, are presented as thus:

1. What is the trend and current state of the Nigerian transport sector?
2. What relationships do the transport infrastructure and the Nigerian economy have?
3. How does transport infrastructure impact the Nigerian economic growth?

6.1 Trend and Current State of the Nigerian Transport Sector

The findings presented in the previous chapter of this dissertation (Section 5.1) presented the trend analysis and descriptive statistics, providing comprehensive context to the state of transport infrastructure in connection to the Nigerian economic growth. First, the trend of the Nigerian Gross Domestic Profit (GDP) has been a downward trajectory, suggesting a concerning situation. Many studies and reports (Zhang & Cheng, 2023; Kodongo & Ojah, 2016; Omoruyi, 2020) have linked poor infrastructure, especially transport, to the weak economic growth. Hence, the trend, in line with several studies, suggests that economic growth and transport infrastructure are positively correlated; that is, when economic growth trend is upward, transport infrastructure trend should be corresponding. According to the Zhang and Cheng (2023), efficiency in the transport system for any nation serve as a significant, positive factor for economic growth through reduced costs of transaction with increased trade and investment. Therefore, Nigerian

economic growth experiencing a decline underscores the gap in the infrastructural development of the transport systems to foster growth and stimulate economic activities.

Meanwhile, transportation services as a percentage of the GDP experience a sustained increase over the years under study. This delineates the need and significance of the transport sector in any economy, with focus on the Nigerian economy. The growth depicted in the findings of this dissertation aligns with the reality and importance of transportation in growing an economy, despite the infrastructural challenges the transport systems face in Nigeria. The steady growth in transport services is well established in the literature (Koźlak, 2017; Bastiaanssen, Johnson, & Lucas, 2020; Chatman & Noland, 2011; Hasselgren, 2018), emphasising the importance of transport services in a growing economy, as it serves as the blood-carrying vein for the economy. Therefore, in Nigeria, transportation continues to stay as a resilient factor contributing to the growth of the economy. In the same vein, the trend analysis in this dissertation (Section 5.1) shows that the Nigerian government averagely spends 6.89% of the GDP on transportation. Many scholars and studies have established a positive connection between government expenditure on transport development and economic growth. However, the Nigerian transport infrastructure continues to be in a sorry state. Although the Nigerian road system gets the biggest attention among the various forms of transport system with a current road network of 197,000km and about 18% of it paved (Ebelechukwu et al., 2024). While the government expenditure on transportation seems moderately good, according to the trend analysis, previous studies have emphasised the importance of a working governance framework to ensure transparency and accountability of government expenditure on transport development to stimulate economic activities and growth (Docherty, Marsden, & Anable, 2018).

Unfortunately, the logistics performance index for Nigeria, showing the quality of trade and transport-related infrastructure, is 2.05 on the average. This index reflects that Nigerian logistical infrastructure is not in good form, that there is plenty of room for improvement while suggesting that Nigeria has an existing logistical capability although they are not efficient. When logistics performances are enhanced to efficiently facilitate trade activities, transaction costs are reduced, and economic competitiveness are enhanced. Research has emphasised the importance of efficient and high-performance logistics in any economy; they are drivers of economic growth (Sezer & Abasiz, 2017; Khadim et al., 2021). Additionally, private investments in transport infrastructure are a significant contributor to the overall infrastructural state of the transportation system in any country. Nigeria, according to the result of this research, records a significant private sector investment. This indicates that for an efficient transport system to be developed, there is a need for the collaboration of private and public sector. The Nigerian private sector has consistently invested in the transport infrastructure. For instance, Nigerian government has embraced public-private partnership in developing transport infrastructure, especially the road transport (Babatunde et al., 2013; Nwannebuike & Onuka, 2015).

Overall, the findings of the current state and trend of the Nigerian transport infrastructure indicate that the Nigerian transport system is resilient in its contribution to the overall economy despite its current poor state. The findings also establish that there is a significant private and public investment in the transport sector, although these investments are not entirely effective in making the transport infrastructure efficient to stimulate economic activities further. The research, therefore, demonstrates that there are challenges such as poor infrastructure, fluctuating investment patterns, and low logistics performance.

6.2 Relationship between the transport infrastructure and the Nigerian economy

One of the many important factors is the transportation sector, which includes the system and the infrastructure (Okechukwu et al., 2020). Several studies have previously emphasised that transportation networks have a favourable impact on socio-economic development and quality of life by fostering urbanization through connections within and between cities (Huang et al., 2016; Hoff et al., 2010; Kaluza et al., 2010; Ebara et al., 2003). The findings of this study contradict the findings of other previous studies explored in the theoretical part (Tong & Yu, 2018; Holl & Mariotti, 2018; Huang et al., 2016; Hoff et al., 2010; Kaluza et al., 2010; Ebara et al., 2003).

The findings of this study revealed that real GDP growth (economic growth in Nigeria) has a positive correlation with transportation services (% of GDP), government expenditure and private investment in transportation and good transportation through rail services but it had a negative correlation with air transport freights and passenger, logistic performance and rail transportation cargoes which seems counterintuitive and it does not follow the a-priori expectation stated in the methodology. This implies that real GDP growth moves in the same direction with transportation services (% of GDP), government expenditure, private investment in transportation and goods transportation through rail services but moves in opposite direction with air transport freights and passenger, logistic performance and rail transportation cargoes. This can also imply that higher levels of real GDP growth rate are associated with higher levels of the former variables and lower levels of the latter variables and vice versa. It is expected that increase in expenditure on transport infrastructure should lead to economic growth as seen in South Africa, Belgium and India (Kularatne, 2006; Meersman & Nazemzadeh, 2017; Pardhan & Bagchi, 2013; Dash & Sahoo, 2010). However, the result of this study demonstrates otherwise.

In order to explain this contradiction in the findings, the Nigerian transportation sector has been inhibited by factors like economic recession, poverty and corruption. Economic recession which the world was been plunged into since the COVID-19 pandemic and poverty are still extant realities in Nigeria. Equally, this study revealed Nigeria had a score of 3 out of 6 on the corruption index revealing a perfect correlation between corruption and the nation's GDP – although excluded from the analysis. Similarly, some previous studies (Serven & Calderon, 2004) have highlighted recession and poverty as factors that may slow down the economic growth and development of a country specifically in the aspect of infrastructure.

The findings of this study also indicated that air freights, passengers and rail transportation cargoes have a negative correlation with real GDP growth. This lack of contribution to Nigeria's GDP can be attributed to inadequate rail transportation networks as there has not been many extensions since majority were constructed in 1896 and 1964. This finding implied that higher levels of real GDP growth rate are associated with lower levels of air freight, air passengers and rail cargoes which can be explained by the overdependence on privately owned road transport haulage services.

6.3 Transport Infrastructure and Impact on Nigerian Economic Growth

Many emerging economies have continued to focus on promoting economic growth by increasing infrastructure development which transport infrastructure is a major part and researchers have focused on finding the impacts of transport infrastructure on developing economies' growth (Liu & Zhou, 2006; Ghosh & Meagher, 2005). However, these studies have returned with inconsistent research outcomes. According to the findings of this study, investment in transportation services indicates that it is not statistically significant in affecting economic growth. This corroborated by Cigu et al. (2018) and Njoh (2012), that investment in transport

infrastructure, largely in the rail transport, seaports, and airports, afford business the opportunity to develop their visibility, reachability, and transport facility to enjoy access to production resources, goods, customer base, and distribution channels, linking to economic clusters and fuelling the growth of the economy. The findings, therefore, highlight the significance of both private and public investment in the development of an efficient transportation system in order to stimulate economic growth.

This study also revealed that overall, short-run private investment in Nigeria's transportation sector has a significant impact on economic growth. Although negative, which shows the unconducive business environment and lack of stable framework for private business to thrive and contribute to economic growth.

6.4 Limitations

Although the findings of this research have provided comprehensive and valuable insights into the effect of transport infrastructure on Nigerian economic growth, the research, however, is not without shortcomings that may be addressed and improved for further research to provide more accurate findings. Hence, this section discusses the limitations of this dissertation in order to understand the applicability of the research results.

This research collected secondary data for the analysis and investigation of the reality surrounding transport infrastructure and its impact on Nigerian economy. Meanwhile, the availability and quality of secondary data may be limited and not adequately reflecting the reality of the variables. For example, the data collected on corruption and investments on transport infrastructure may not reflect the entirety of the reality in Nigeria as there are still issues of accurate data collection and management in the country. Moreover, the use of aggregated data may also indicate certain limitations such as overlooking regional variations in the development

of transport system and infrastructure within Nigeria, which can implicate the generalisability of the research findings. Additionally, the analysis in this research was built upon certain assumptions and simplifications that may imply limitations in the robustness of the research findings. A good instance is the assumption of constant parameter and linearity in the regression model, which may limit the ability of this research to capture the dynamic and non-linear aspects of the connection that exists between economic growth and transport infrastructure. Also, the analysis excluded specific variables due to choices of model specification, data limitations, and other statistical incoherence, overlooking the significant impact of these variables in the research outcomes.

Furthermore, the research analysis may experience endogeneity challenges in the connection between economic growth and transport infrastructure, where the direction of causal factors is ambiguous. For instance, the findings of this research maintain that economic growth is positively impacted by private investment in transport; however, there is a possibility that decisions of private sector to invest in transport infrastructure are facilitated by growth in the economy. The research's inability to capture the endogenous factors in the analysis may limit the accuracy of the estimated coefficients and impede the reliability and validity of the research results. Moreso, the limited focus of this research on Nigeria only delineates that the findings of this study may not be directly relevant to other countries with different socio-economic and cultural contexts, infrastructural challenges, and institutional frameworks. Hence, it is advisable to be cautious when making generalisation of the findings of this study beyond the context of the Nigerian economy.

6.5 Policy Implications and Recommendations

With the comprehensive findings and discussion this dissertation provides in preceding sections, it is necessary to develop policy implications and useful recommendations to ensure this research stimulate appropriate actions towards improving transport infrastructure and promoting the growth of the Nigerian economy. First, it is important to increase public expenditure on transport infrastructure since the research findings show that the investment of the private sector significantly impact the Nigerian economy in a positive way. Hence, the government should increase its investment in transport infrastructure to stimulate economic growth. The investment should include all forms of transport to enhance connectivity, economic efficiency, reduce costs of transportation, and promote trade. Similarly, public-private partnerships should be encouraged to develop transport infrastructure in Nigeria. In order to address the separate challenges impeding the investments in public and private sectors, the government can promote a joint partnership of both public and private sectors, leveraging the capital and innovative capabilities of the private sector in developing the transport system in Nigeria. Public-private partnerships have been found to be an effective approach to deliver successful large government projects, helping to overcome financing bottlenecks and risks of transfer projects.

Additionally, Nigeria experiences serious transport infrastructural inadequacy, especially in the underserved and rural regions of the country. This research recommends that policymakers should focus on spending a significant portion of the public funds for infrastructure on critical transport infrastructure projects that promote regional development and address existing infrastructural challenges. Also, innovative approaches should be employed in developing transport infrastructure. This includes development of fast railway, modernised ports and airports, and expanded road networks to enhance access to trade. In the same vein, policymakers

should look into strengthening institutional capacity for effective planning, building, management, and regulation of Nigerian transport system. To provide quality and adequate transport infrastructure that facilitate trade and other economic activities, there is a need to ensure consistent development and management of transport structures. The Nigerian government has the Ministry of Transportation to oversee all the infrastructural development in the transport sector; other agencies include Federal Roads Maintenance Agency (FERMA), Nigerian Ports Authority (NPA), Nigerian Maritime Administration and Safety Agency (NIMASA), Nigerian Civil Aviation Authority (NCAA), Federal Airports Authority (FAA), and Nigerian Railway Corporation (NRC). While there are several governmental agencies and parastatals responsible for the development and maintenance of various transport infrastructure in Nigeria, there is a need to increasingly strengthen their institutional capacities to discharge the responsibilities innovatively and effectively. The capacity-building must focus on improving the management, monitoring, evaluation, and maintenance of transport infrastructural projects. Moreso, policymakers and relevant institutions must ensure there is an upgraded regulatory environment to ensure accountability and transparency as well as mitigating bureaucratic hurdles in developing transport infrastructures for private and public sectors.

Lastly, the Nigerian transport infrastructure should evolve with the worlds demand for sustainable development. The government and relevant policymakers should ensure that the process of transport infrastructural development as well as the transportation systems are in line with the global sustainability goals. That is, transport infrastructures are environmentally viable. Green transport systems, such as electric railways, promotion of cycling, public transit systems, electric vehicles, and infrastructures powered by renewable energy are sustainable solutions that policymakers in Nigeria should embrace going forward.

7.0 Conclusion

This chapter presents the concluding overview of the overall research, summarising the key findings and making a closing remark on the research process and outcomes.

7.1 Summary and Conclusion

This dissertation provided a comprehensive evaluation of the relationship that exists between Nigerian economic growth and transport infrastructure, taking transport as a causal factor. The research is a combination of several chapters, from introducing the research topic to developing aims and objectives of the study, to exploring existing studies to find gaps in the literature, to developing a methodological framework on which the research is conducted. This study, thus, collected secondary data from relevant sources such as the World Development Indicator of the World Bank, National Bureau of Statistics, and various existing, relevant literature to understand the context of the study. Through trend analysis, descriptive statistics, correlation matrix, and regression analysis, this study evaluated the impact of transport infrastructure on economic growth in Nigeria, providing answers to the research questions and valuable implications for practice and policy.

The study analysed trends of critical variables relevant to the research to reveal patterns and fluctuations in the short- and long-term. Thus, a downward slope in the real GDP growth, significant fluctuations in private investment and transport services as a percentage of the GDP, and a fluctuating logistics performance index were all revealed in this study. These trends are a pointer to the historical overview of relevant transport and economic variables in Nigeria, underscoring how Nigeria has fared over time. Similarly, the study also included summary statistics to present useful information on the average values, distribution, and variability of key variables. The findings of this study, therefore, revealed significant variation in government

spending on transport, economic growth, private investment, and other variables, underlining the complexity involved in measuring Nigerian transport infrastructure and system against her economic growth. While the correlation matrix examines the relationship between transport infrastructure and economic growth in Nigeria, underscoring the direction and magnitude of the connection, regression analysis offered more in-depth insights into the relationship, revealing the impact of transport infrastructure on economic growth for both short- and long-term. The findings, however, indicated that transport variables such as logistics performance index, private investment, and transport services do not significantly affect the growth of Nigerian economy. The findings, although counterintuitive, underscores the challenges facing the Nigerian transport system and business environment in stimulating economic growth. The research further conducted post estimation tests to confirm that validity and robustness of the research findings by confirming the absence of autocorrelation, multicollinearity, and heteroscedasticity.

Meanwhile, the findings and conclusions of this study provides significant implications for transport experts, policymakers, and researchers alike. While the Nigerian case, according to the findings of this research, may differ from the expected results, the study underscored the importance of transport infrastructure in stimulating economic growth. Although there are peculiar challenges Nigeria faces, such as inadequacies, corruption, among others, that may impede the positive impact of transport infrastructure on economic growth. This study highlighted deliberate and targeted policy and infrastructural interventions to resolve issues of transport infrastructure, encourage private investments, and strengthen institutional capacity. By prioritising transport infrastructure and other relevant economic stimulants, as well as promoting public-private partnerships and investment in sustainable development in the transport sector,

Nigeria can enhance its economy, promote access to trade and other economic opportunities, and enhance competitiveness on the broader global economy.

Conclusively, the study offers a significant contribution to the existing literature on the intricate connection between transport infrastructure and economic growth in Nigeria. While the findings of this research provide useful information and value-added insights, coupled with policy implications and actionable recommendations, there is, however, a need for future studies to address the gaps identified in this study. Hence, by leveraging the research results as basis to understand the Nigerian transport system in relation to the economy and consistent private and public investment in transport infrastructure, there are better possibilities that Nigeria can maintain a sustainable economic growth for years to come.

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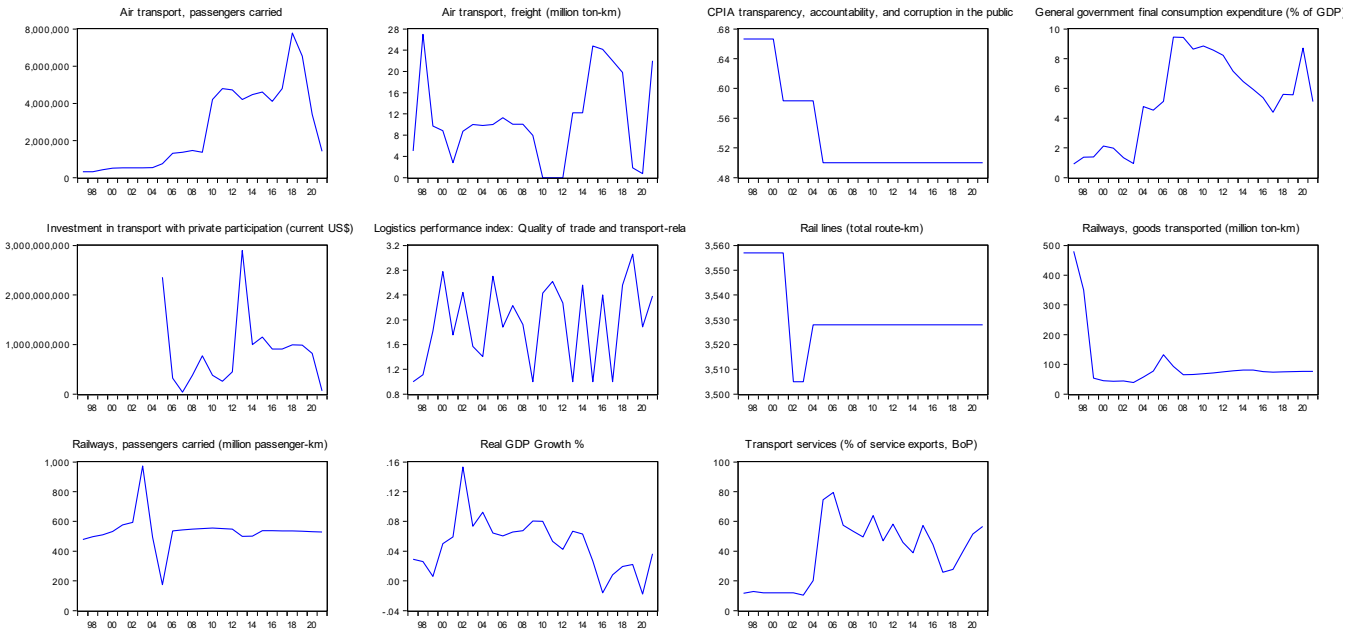
Appendices


Air transport, passengers carried
Air transport, freight (million ton-km)
CPIA transparency, accountability, and corruption in the public
General government final consumption expenditure (% of GDP
Investment in transport with private participation (current US$)
Logistics performance index: Quality of trade and transport-rela
Rail lines (total route-km)
Railways, goods transported (million ton-km)
Railways, passengers carried (million passenger-km)
Real GDP Growth %
Transport services (% of service exports, BoP)


Real GDP Growth %
.16
.12
.08
.04
.00
-.04
98
00
02
04
06
08
10
12
14
16
18
20

	REAL_GDP_GROWTH__	TRANSPORT_SERVICES____OF	AIR_TRANSPORT__FREIGHT__	AIR_TRANSPORT__PASSENGER	CPIA_TRANSPARENCY__ACCOU	GENERAL_GOVERNMENT_FINAL	INVESTMENT_IN_TRANSPORT_
Mean	0.04249470540113722	51.24364537147829	11.12186545974695	3604503.03516903	0.5	6.893308601764706	864753749.4875658
Median	0.05307924203666415	51.41510479932408	10.036	4197375	0.5	6.464486129	818491582.7525746
Maximum	0.08036925101896841	79.47318293173954	24.80196393392246	7786143.99416227	0.5	9.448340036	2900000000
Minimum	-0.01794253082335917	25.85296750786619	0	747648	0.5	4.403315163	40000000
Std. Dev.	0.03110985177308069	14.23738065669221	8.838883753748071	2027800.97006929	0	1.813487374547273	755294813.7005389
Skewness	-0.6680845361395275	0.1061870185678014	0.1796776939574748	0.2088419012378629		0.1142638007476752	1.498986966515255
Kurtosis	2.321610418223131	2.805538036163072	1.769802317833764	2.263425284995462		1.415671239142702	4.760516934212102
Jarque-Bera	1.590605151851413	0.058733715811191739	1.163453531014979	0.5078764659911736		1.814978428380095	8.561814534961505
Probability	0.451444617981945	0.971060158017551978	0.558932387627895578	0.7757397156851622		0.403536145971522 8	0.013830108780475921
Sum	0.7224099918193326	871.1419713151315131	189.0717128156982	61276551.59781735	8.5	117.1862462338	14700813741.2 38862
Sum Sq. Dev.	0.01548516603748883	3243.248127416856	1250.013856196345	6579162838742 3.25	0	52.61978332227778	9.127524089647 6906e+18
Observations	17	17	17	17	17	17	17

REAL_GDP_G TRANSPORT_ AIR_TRANSPO AIR_TRANSPO CPIA_TRANSP GENERAL_GO INVESTMENT_ILOC

	ROWTH__	SERVICES____OF	RT__FREIGHT__	RT__PASSENGER	ARENCY__ACCOU	VERNMENT_FINAL	N_TRANSPORT_	RFC
REAL_GDP_GROWTH__	1	0.44036600165 45661	-0.33794856986 00331	-0.44249329593 3956		0.37971810546 33386	0.02309600123 918661	0.04
TRANSPORT_SERVICES___OF	0.44036600165 45661	1	0.26699612793 16002	0.69716839836 96888		0.11682830036 78609	0.08102323211 524865	0.08
AIR_TRANSPORT__FREIGHT__	-0.33794856986 00331	-0.26699612793 16002	1	0.01600518926 332963		-0.62855008609 79074	-0.14819694121 51083	-0.3
AIR_TRANSPORT__PASSENGER	-0.44249329593 3956	-0.69716839836 96888	-0.01600518926 332963	1		-0.17526039404 31052	-0.12125910578 77826	-0.18
CPIA_TRANSPARENCY__ACCOU								
GENERAL_GOVERNMENT_FINAL	-0.37971810546 33386	-0.11682830036 78609	-0.62855008609 79074	-0.17526039404 31052		1	-0.34347016641 13411	-0.00
INVESTMENT_IN_TRANSPORT_	-0.02309600123 918661	-0.08102323211 524865	-0.14819694121 51083	-0.12125910578 77826		-0.34347016641 13411	1	-0.24
LOGISTICS_PERFORMANCE_IN	-0.04287893831 501485	-0.08168381422 252121	-0.33533475455 29282	-0.18158463294 75675		-0.06355141800 601854	-0.24867874109 31933	
RAIL_LINES__TOTAL_ROUTE_								
RAILWAYS__GOODS_TRANSPOR	-0.09286555479 879542	-0.49156711658 33493	-0.10459057444 70564	-0.28307687377 85991		-0.28055192901 86691	-0.13207281150 51224	-0.02
RAILWAYS__PASSENGERS_CAR	-0.16411966755 40452	-0.37175289040 61638	-0.01853327041 991641	-0.33046537767 97183		-0.39189688707 14866	-0.60162033394 68769	-0.23

Null Hypothesis: D(REAL_GDP_GROWTH__) has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on SIC, maxlag=5)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-6.532068	0.0001
Test critical values:	1% level	-4.416345	
	5% level	-3.622033	
	10% level	-3.248592	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(REAL_GDP_GROWTH__,2)
Method: Least Squares
Date: 08/06/23 Time: 13:42
Sample (adjusted): 1999 2021
Included observations: 23 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(REAL_GDP_GROWTH__(-1))	-1.436751	0.219953	-6.532068	0.0000
C	0.011012	0.016089	0.684451	0.5015
@TREND("1997")	-0.000880	0.001112	-0.791111	0.4382

R-squared	0.682396	Mean dependent var	0.002504
Adjusted R-squared	0.650636	S.D. dependent var	0.058614
S.E. of regression	0.034645	Akaike info criterion	-3.766225
Sum squared resid	0.024005	Schwarz criterion	-3.618117
Log likelihood	46.31158	Hannan-Quinn criter.	-3.728976
F-statistic	21.48575	Durbin-Watson stat	1.917753
Prob(F-statistic)	0.000010		

Null Hypothesis: D(TRANSPORT_SERVICES____OF) has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on SIC, maxlag=5)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-4.301643	0.0127
Test critical values:	1% level	-4.416345	
	5% level	-3.622033	
	10% level	-3.248592	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(TRANSPORT_SERVICES____OF,2)
Method: Least Squares
Date: 08/06/23 Time: 13:45
Sample (adjusted): 1999 2021
Included observations: 23 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(TRANSPORT_SERVICES____OF(-1))	-0.963033	0.223876	-4.301643	0.0003
C	3.422772	7.638925	0.448070	0.6589
@TREND("1997")	-0.121792	0.521363	-0.233603	0.8177

R-squared	0.480628	Mean dependent var	0.170255
Adjusted R-squared	0.428690	S.D. dependent var	21.89100
S.E. of regression	16.54632	Akaike info criterion	8.571312
Sum squared resid	5475.615	Schwarz criterion	8.719420
Log likelihood	-95.57009	Hannan-Quinn criter.	8.608561
F-statistic	9.254006	Durbin-Watson stat	1.974988
Prob(F-statistic)	0.001428		

Null Hypothesis: LOGISTICS_PERFORMANCE_IN has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on SIC, maxlag=5)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-6.071960	0.0003
Test critical values:	1% level	-4.394309	
	5% level	-3.612199	
	10% level	-3.243079	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LOGISTICS_PERFORMANCE_IN)
Method: Least Squares
Date: 08/06/23 Time: 13:46
Sample (adjusted): 1998 2021
Included observations: 24 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LOGISTICS_PERFORMANCE_IN(-1)	-1.246272	0.205250	-6.071960	0.0000
C	2.241180	0.441096	5.080933	0.0000
@TREND("1997")	0.018054	0.019363	0.932436	0.3617

R-squared	0.637659	Mean dependent var	0.057727
Adjusted R-squared	0.603150	S.D. dependent var	1.020969
S.E. of regression	0.643170	Akaike info criterion	2.071653
Sum squared resid	8.687018	Schwarz criterion	2.218910
Log likelihood	-21.85984	Hannan-Quinn criter.	2.110720
F-statistic	18.47823	Durbin-Watson stat	2.102039
Prob(F-statistic)	0.000023		

Null Hypothesis: D(AIR_TRANSPORT__FREIGHT__) has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on SIC, maxlag=5)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-5.584462	0.0008
Test critical values:	1% level	-4.416345	
	5% level	-3.622033	
	10% level	-3.248592	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(AIR_TRANSPORT__FREIGHT__,2)
Method: Least Squares
Date: 08/06/23 Time: 13:48
Sample (adjusted): 1999 2021
Included observations: 23 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(AIR_TRANSPORT__FREIGHT__(-1))	-1.184204	0.212053	-5.584462	0.0000

C	-3.963016	3.839763	-1.032099	0.3143
@TREND("1997")	0.285503	0.263984	1.081516	0.2923

R-squared	0.634993	Mean dependent var	-0.031917
Adjusted R-squared	0.598493	S.D. dependent var	13.11712
S.E. of regression	8.311608	Akaike info criterion	7.194291
Sum squared resid	1381.656	Schwarz criterion	7.342399
Log likelihood	-79.73434	Hannan-Quinn criter.	7.231539
F-statistic	17.39677	Durbin-Watson stat	1.364153
Prob(F-statistic)	0.000042		

Null Hypothesis: D(AIR_TRANSPORT__PASSENGER) has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 1 (Automatic - based on SIC, maxlag=5)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-3.688539	0.0450
Test critical values:	1% level	-4.440739	
	5% level	-3.632896	
	10% level	-3.254671	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(AIR_TRANSPORT__PASSENGER,2)
Method: Least Squares
Date: 08/06/23 Time: 13:50
Sample (adjusted): 2000 2021
Included observations: 22 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(AIR_TRANSPORT__PASSENGER(-1))	-1.207909	0.327476	-3.688539	0.0017
D(AIR_TRANSPORT__PASSENGER(-1),2)	0.546489	0.274040	1.994192	0.0615
C	549323.0	590032.0	0.931006	0.3642
@TREND("1997")	-29419.27	39841.05	-0.738416	0.4698

R-squared	0.462831	Mean dependent var	-95198.42
Adjusted R-squared	0.373302	S.D. dependent var	1466271.
S.E. of regression	1160762.	Akaike info criterion	30.93002
Sum squared resid	2.43E+13	Schwarz criterion	31.12839
Log likelihood	-336.2302	Hannan-Quinn criter.	30.97675
F-statistic	5.169663	Durbin-Watson stat	2.095746
Prob(F-statistic)	0.009422		

Null Hypothesis: INVESTMENT_IN_TRANSPORT_ has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on SIC, maxlag=3)

	t-Statistic	Prob.*

Augmented Dickey-Fuller test statistic		-4.071563	0.0281
Test critical values:	1% level	-4.667883	
	5% level	-3.733200	
	10% level	-3.310349	

*MacKinnon (1996) one-sided p-values.
Warning: Probabilities and critical values calculated for 20 observations
and may not be accurate for a sample size of 16

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(INVESTMENT_IN_TRANSPORT_)
Method: Least Squares
Date: 08/06/23 Time: 13:53
Sample (adjusted): 2006 2021
Included observations: 16 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
INVESTMENT_IN_TRANSPORT_(-1)	-0.987578	0.242555	-4.071563	0.0013
C	2.26E+08	6.72E+08	0.336918	0.7416
@TREND("1997")	32357832	38245198	0.846063	0.4128

R-squared	0.563543	Mean dependent var	-1.43E+08
Adjusted R-squared	0.496396	S.D. dependent var	9.89E+08
S.E. of regression	7.02E+08	Akaike info criterion	43.74391
Sum squared resid	6.41E+18	Schwarz criterion	43.88877
Log likelihood	-346.9512	Hannan-Quinn criter.	43.75132
F-statistic	8.392659	Durbin-Watson stat	1.717138
Prob(F-statistic)	0.004567		

Null Hypothesis: RAILWAYS__GOODS_TRANSPOR has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 5 (Automatic - based on SIC, maxlag=5)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-4.476806	0.0111
Test critical values:	1% level	-4.532598	
	5% level	-3.673616	
	10% level	-3.277364	

*MacKinnon (1996) one-sided p-values.
Warning: Probabilities and critical values calculated for 20 observations
and may not be accurate for a sample size of 19

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(RAILWAYS__GOODS_TRANSPOR)
Method: Least Squares
Date: 08/06/23 Time: 13:54
Sample (adjusted): 2003 2021
Included observations: 19 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.

RAILWAYS__GOODS_TRANSPOR(-1)	-1.662054	0.371259	-4.476806	0.0009
D(RAILWAYS__GOODS_TRANSPOR(-1))	0.803998	0.249777	3.218860	0.0082
D(RAILWAYS__GOODS_TRANSPOR(-2))	0.541126	0.240351	2.251403	0.0458
D(RAILWAYS__GOODS_TRANSPOR(-3))	0.289960	0.211819	1.368903	0.1983
D(RAILWAYS__GOODS_TRANSPOR(-4))	0.137123	0.049562	2.766713	0.0183
D(RAILWAYS__GOODS_TRANSPOR(-5))	0.127525	0.059049	2.159661	0.0537
C	126.9480	27.58181	4.602597	0.0008
@TREND("1997")	-0.023281	0.636958	-0.036550	0.9715

R-squared	0.722980	Mean dependent var	1.715601
Adjusted R-squared	0.546694	S.D. dependent var	18.44985
S.E. of regression	12.42192	Akaike info criterion	8.172363
Sum squared resid	1697.344	Schwarz criterion	8.570022
Log likelihood	-69.63745	Hannan-Quinn criter.	8.239663
F-statistic	4.101184	Durbin-Watson stat	3.056073
Prob(F-statistic)	0.018638		

Null Hypothesis: RAILWAYS__PASSENGERS_CAR has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 1 (Automatic - based on SIC, maxlag=5)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-4.844512	0.0040
Test critical values:	1% level	-4.416345	
	5% level	-3.622033	
	10% level	-3.248592	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(RAILWAYS__PASSENGERS_CAR)
Method: Least Squares
Date: 08/06/23 Time: 13:58
Sample (adjusted): 1999 2021
Included observations: 23 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
RAILWAYS__PASSENGERS_CAR(-1)	-1.333474	0.275255	-4.844512	0.0001
D(RAILWAYS__PASSENGERS_CAR(-1))	0.443403	0.202664	2.187874	0.0414
C	744.5077	160.5462	4.637342	0.0002
@TREND("1997")	-1.976984	3.699571	-0.534382	0.5993

R-squared	0.574172	Mean dependent var	1.376879
Adjusted R-squared	0.506936	S.D. dependent var	167.1480
S.E. of regression	117.3688	Akaike info criterion	12.52529
Sum squared resid	261733.3	Schwarz criterion	12.72277
Log likelihood	-140.0408	Hannan-Quinn criter.	12.57496
F-statistic	8.539666	Durbin-Watson stat	2.027528
Prob(F-statistic)	0.000851		

Dependent Variable: REAL_GDP_GROWTH__
Method: ARDL
Date: 08/06/23 Time: 18:03
Sample (adjusted): 2001 2021
Included observations: 21 after adjustments
Maximum dependent lags: 4 (Automatic selection)
Model selection method: Akaike info criterion (AIC)
Dynamic regressors (4 lags, automatic): TRANSPORT_SERVICES____OF LOGISTICS_PERFORMANCE_IN INVESTMENT_IN_TRANSPORT_
Fixed regressors: C
Number of models evalulated: 500
Selected Model: ARDL(4, 0, 4, 3)

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
REAL_GDP_GROWTH__(-1)	0.331522	0.217829	1.521936	0.1788
REAL_GDP_GROWTH__(-2)	0.215840	0.212717	1.014682	0.3494
REAL_GDP_GROWTH__(-3)	-0.568664	0.263175	-2.160785	0.0740
REAL_GDP_GROWTH__(-4)	0.598256	0.214358	2.790924	0.0315
TRANSPORT_SERVICES____OF	-7.99E-06	0.000416	-0.019206	0.9853
LOGISTICS_PERFORMANCE_IN	0.001869	0.012084	0.154693	0.8821
LOGISTICS_PERFORMANCE_IN(-1)	-0.016398	0.013149	-1.247090	0.2588
LOGISTICS_PERFORMANCE_IN(-2)	0.016378	0.010600	1.545110	0.1733
LOGISTICS_PERFORMANCE_IN(-3)	0.010666	0.012466	0.855614	0.4251
LOGISTICS_PERFORMANCE_IN(-4)	-0.013568	0.014387	-0.943083	0.3820
INVESTMENT_IN_TRANSPORT_	-1.67E-12	8.23E-12	-0.202972	0.8459
INVESTMENT_IN_TRANSPORT_(-1)	-2.03E-11	9.75E-12	-2.080397	0.0827
INVESTMENT_IN_TRANSPORT_(-2)	-5.01E-12	7.29E-12	-0.687005	0.5177
INVESTMENT_IN_TRANSPORT_(-3)	-2.12E-11	6.95E-12	-3.057859	0.0223
C	0.054504	0.091934	0.592865	0.5749

R-squared	0.912867	Mean dependent var	0.052422
Adjusted R-squared	0.709555	S.D. dependent var	0.038361
S.E. of regression	0.020674	Akaike info criterion	-4.744109
Sum squared resid	0.002564	Schwarz criterion	-3.998021
Log likelihood	64.81314	Hannan-Quinn criter.	-4.582188
F-statistic	4.489996	Durbin-Watson stat	2.386828
Prob(F-statistic)	0.037230		

*Note: p-values and any subsequent tests do not account for model selection.

ARDL Bounds Test
Date: 08/06/23 Time: 18:04
Sample: 2001 2021
Included observations: 21
Null Hypothesis: No long-run relationships exist

Test Statistic	Value	k
F-statistic	1.208724	3

Critical Value Bounds

Significance	I0 Bound	I1 Bound
10%	2.72	3.77
5%	3.23	4.35
2.5%	3.69	4.89
1%	4.29	5.61

Test Equation:
Dependent Variable: D(REAL_GDP_GROWTH__)
Method: Least Squares
Date: 08/06/23 Time: 18:04
Sample: 2001 2021
Included observations: 21

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(REAL_GDP_GROWTH__(-1))	-0.194829	0.407333	-0.478304	0.6418
D(REAL_GDP_GROWTH__(-2))	-0.022746	0.378859	-0.060039	0.9532
D(REAL_GDP_GROWTH__(-3))	-0.577709	0.302664	-1.908750	0.0827
D(LOGISTICS_PERFORMANCE_IN)	0.017268	0.014484	1.192233	0.2583
D(INVESTMENT_IN_TRANSPORT_)	2.45E-11	1.33E-11	1.835626	0.0936
C	0.071469	0.055757	1.281790	0.2263
TRANSPORT_SERVICES____OF	-0.000177	0.000564	-0.314035	0.7594
LOGISTICS_PERFORMANCE_IN	-0.015315	0.025518	-0.600156	0.5606
INVESTMENT_IN_TRANSPORT_	-2.40E-11	1.71E-11	-1.401336	0.1887
REAL_GDP_GROWTH__(-1)	-0.319350	0.341115	-0.936195	0.3693

R-squared	0.546556	Mean dependent var	-0.000652
Adjusted R-squared	0.175556	S.D. dependent var	0.036440
S.E. of regression	0.033088	Akaike info criterion	-3.673568
Sum squared resid	0.012043	Schwarz criterion	-3.176176
Log likelihood	48.57246	Hannan-Quinn criter.	-3.565621
F-statistic	1.473196	Durbin-Watson stat	1.833378
Prob(F-statistic)	0.268323		

ARDL Cointegrating And Long Run Form
Dependent Variable: REAL_GDP_GROWTH__
Selected Model: ARDL(4, 0, 4, 3)
Date: 08/06/23 Time: 18:05
Sample: 1997 2021
Included observations: 21

Cointegrating Form

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(REAL_GDP_GROWTH_ _(-1))	-0.245432	0.281844	-0.870809	0.4173
D(REAL_GDP_GROWTH_ _(-2))	-0.029592	0.295001	-0.100313	0.9234
D(REAL_GDP_GROWTH_ _(-3))	-0.598256	0.214358	-2.790924	0.0315
D(TRANSPORT_SERVICE S____OF)	-0.000008	0.000416	-0.019206	0.9853
D(LOGISTICS_PERFORM ANCE_IN)	0.001869	0.012084	0.154693	0.8821
D(LOGISTICS_PERFORM ANCE_IN)	-0.016378	0.010600	-1.545110	0.1733
D(LOGISTICS_PERFORM ANCE_IN)	-0.010666	0.012466	-0.855614	0.4251
D(LOGISTICS_PERFORM ANCE_IN)	0.013568	0.014387	0.943083	0.3820
D(INVESTMENT_IN_TRAN SPORT_)	-0.000000	0.000000	-0.202972	0.8459
D(INVESTMENT_IN_TRAN SPORT_)	0.000000	0.000000	0.687005	0.5177
D(INVESTMENT_IN_TRAN SPORT_)	0.000000	0.000000	3.057859	0.0223
CointEq(-1)	-0.423046	0.270445	-1.564259	0.1688

Cointeq = REAL_GDP_GROWTH__ - (-0.0000*TRANSPORT_SERVICES__ __OF -0.0025*LOGISTICS_PERFORMANCE_IN -0.0000 *INVESTMENT_IN_TRANSPORT_ + 0.1288)

Long Run Coefficients

Variable	Coefficient	Std. Error	t-Statistic	Prob.

TRANSPORT_SERVICES_ ___OF	-0.000019	0.000989	-0.019091	0.9854
LOGISTICS_PERFORMAN CE_IN	-0.002490	0.119734	-0.020797	0.9841
INVESTMENT_IN_TRANS PORT_	-0.000000	0.000000	-1.833987	0.1163
C	0.128838	0.208792	0.617067	0.5599

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	3.755478	Prob. F(2,4)	0.1208
Obs*R-squared	13.70260	Prob. Chi-Square(2)	0.0011

Test Equation:
Dependent Variable: RESID
Method: ARDL
Date: 08/06/23 Time: 18:05
Sample: 2001 2021
Included observations: 21
Presample missing value lagged residuals set to zero.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
REAL_GDP_GROWTH__(-1)	0.089940	0.200188	0.449277	0.6765
REAL_GDP_GROWTH__(-2)	0.215008	0.197498	1.088663	0.3375
REAL_GDP_GROWTH__(-3)	-0.072704	0.192310	-0.378055	0.7246
REAL_GDP_GROWTH__(-4)	0.016570	0.158916	0.104268	0.9220
TRANSPORT_SERVICES____OF	-0.000361	0.000379	-0.951297	0.3953
LOGISTICS_PERFORMANCE_IN	-0.011133	0.011464	-0.971198	0.3864
LOGISTICS_PERFORMANCE_IN(-1)	-0.017350	0.011686	-1.484635	0.2118
LOGISTICS_PERFORMANCE_IN(-2)	-0.008258	0.008241	-1.002054	0.3730
LOGISTICS_PERFORMANCE_IN(-3)	-0.008500	0.009836	-0.864207	0.4362
LOGISTICS_PERFORMANCE_IN(-4)	-0.012186	0.011770	-1.035369	0.3590
INVESTMENT_IN_TRANSPORT_	-5.70E-12	6.75E-12	-0.844704	0.4458
INVESTMENT_IN_TRANSPORT_(-1)	1.07E-12	7.38E-12	0.144315	0.8922
INVESTMENT_IN_TRANSPORT_(-2)	3.94E-12	5.52E-12	0.715075	0.5141
INVESTMENT_IN_TRANSPORT_(-3)	2.95E-12	5.32E-12	0.553985	0.6091
C	0.114646	0.081636	1.404358	0.2329
RESID(-1)	-0.835069	0.472380	-1.767791	0.1518
RESID(-2)	-1.455496	0.572496	-2.542370	0.0638

R-squared	0.652505	Mean dependent var	-1.07E-18

Adjusted R-squared	-0.737475	S.D. dependent var	0.011323
S.E. of regression	0.014926	Akaike info criterion	-5.610637
Sum squared resid	0.000891	Schwarz criterion	-4.765071
Log likelihood	75.91169	Hannan-Quinn criter.	-5.427128
F-statistic	0.469435	Durbin-Watson stat	2.697848
Prob(F-statistic)	0.875790		

Variance Inflation Factors
Date: 08/06/23 Time: 18:06
Sample: 1997 2021
Included observations: 21

Variable	Coefficient Variance	Uncentered VIF	Centered VIF
REAL_GDP_GROWTH_ _(-1)	0.047450	9.805813	3.238708
REAL_GDP_GROWTH_ _(-2)	0.045249	9.320481	2.787876
REAL_GDP_GROWTH_ _(-3)	0.069261	14.29559	4.230669
REAL_GDP_GROWTH_ _(-4)	0.045949	9.534683	2.742628
TRANSPORT_SERVICE S____OF	1.73E-07	19.70010	3.186709
LOGISTICS_PERFORM ANCE_IN	0.000146	31.55279	2.755525
LOGISTICS_PERFORM ANCE_IN(-1)	0.000173	38.18127	3.443078
LOGISTICS_PERFORM ANCE_IN(-2)	0.000112	24.74228	2.243565
LOGISTICS_PERFORM ANCE_IN(-3)	0.000155	31.26887	2.941669
LOGISTICS_PERFORM ANCE_IN(-4)	0.000207	38.95842	4.082743
INVESTMENT_IN_TRA NSPORT_	6.78E-23	3.463423	1.807638
INVESTMENT_IN_TRA NSPORT_(-1)	9.50E-23	4.854588	2.545828
INVESTMENT_IN_TRA NSPORT_(-2)	5.31E-23	2.629219	1.470105
INVESTMENT_IN_TRA NSPORT_(-3)	4.83E-23	2.280319	1.364104
C	0.008452	415.2788	NA

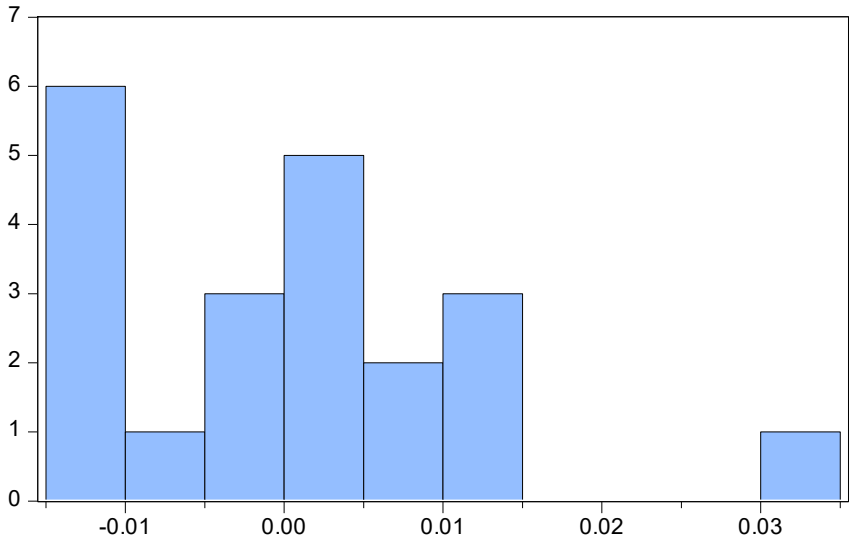
Heteroskedasticity Test: Breusch-Pagan-Godfrey

F-statistic	0.561516	Prob. F(14,6)	0.8249
Obs*R-squared	11.90989	Prob. Chi-Square(14)	0.6135
Scaled explained SS	1.589134	Prob. Chi-Square(14)	1.0000

Test Equation:
Dependent Variable: RESID^2
Method: Least Squares
Date: 08/06/23 Time: 18:06
Sample: 2001 2021
Included observations: 21

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.000656	0.001208	0.542508	0.6070
REAL_GDP_GROWTH__(-1)	0.002008	0.002863	0.701197	0.5094
REAL_GDP_GROWTH__(-2)	0.002064	0.002796	0.738115	0.4883
REAL_GDP_GROWTH__(-3)	-0.005391	0.003459	-1.558279	0.1702
REAL_GDP_GROWTH__(-4)	0.001384	0.002818	0.491089	0.6408
TRANSPORT_SERVICES____OF	-9.67E-07	5.47E-06	-0.176987	0.8653
LOGISTICS_PERFORMANCE_IN	2.30E-05	0.000159	0.144502	0.8898
LOGISTICS_PERFORMANCE_IN(-1)	-0.000139	0.000173	-0.805652	0.4512
LOGISTICS_PERFORMANCE_IN(-2)	4.18E-05	0.000139	0.300128	0.7742
LOGISTICS_PERFORMANCE_IN(-3)	-3.64E-05	0.000164	-0.222048	0.8316
LOGISTICS_PERFORMANCE_IN(-4)	-0.000131	0.000189	-0.691145	0.5153
INVESTMENT_IN_TRANSPORT_	8.89E-14	1.08E-13	0.821317	0.4429
INVESTMENT_IN_TRANSPORT_(-1)	-7.82E-14	1.28E-13	-0.609972	0.5643
INVESTMENT_IN_TRANSPORT_(-2)	1.16E-14	9.58E-14	0.121608	0.9072
INVESTMENT_IN_TRANSPORT_(-3)	-7.11E-14	9.13E-14	-0.778136	0.4661

R-squared	0.567138	Mean dependent var	0.000122
Adjusted R-squared	-0.442874	S.D. dependent var	0.000226
S.E. of regression	0.000272	Akaike info criterion	-13.40751
Sum squared resid	4.43E-07	Schwarz criterion	-12.66142
Log likelihood	155.7788	Hannan-Quinn criter.	-13.24559
F-statistic	0.561516	Durbin-Watson stat	2.502313
Prob(F-statistic)	0.824935		



Series: Residuals
Sample 2001 2021
Observations 21

Mean	-1.07e-18
Median	0.000219
Maximum	0.032599
Minimum	-0.014909
Std. Dev.	0.011323
Skewness	0.951734
Kurtosis	4.269029
Jarque-Bera	4.579422
Probability	0.101296