TAX REVENUE, INSTITUTION AND PUBLIC INFRASTRUCTURE IN NIGERIA

BY

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PG/SSC2015678

DEPARTMENT OF ECONOMICS
FACULTY OF SOCIAL SCIENCES
UNIVERSITY OF BENIN

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A PROJECT SUBMITTED TO THE DEPARTMENT OF ECONOMICS, FACULTY OF SOCIAL SCIENCES, UNIVERSITY OF BENIN, BENIN CITY, EDO STATE, NIGERIA, IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE AWARD OF MASTER OF SCIENCE (M.SC.) DEGREE IN ECONOMICS

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CERTIFICATION

We, the undersigned, hereby certify that this research work was carried out by **Jesuiga Emosioke ENEGWEA** with matriculation number **PG/SSC2015678** and approved as adequate in scope and content in partial fulfilment of the requirements for the award of Master of Science (M.SC.) Degree in Economics.

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DEDICATION

I dedicate this project work to the Almighty God. He gave me the grace to finish the work, and saw me through the entire academic programme at the University of Benin.

ACKNOWLEDGEMENTS

I am eternally grateful to God Almighty for His grace, mercies and every enablement granted to me in my academic pursuits.

The successful completion of this research project, in partial fulfilment of the requirements for the award of M. SC.[Economics] degree of the University of Benin, Benin City, Nigeria, was never a product of my personal efforts alone. Rather, I received various forms of assistance from different persons, worthy of being acknowledged and appreciated. However, the list of such acknowledgements was not necessarily done based on any particular order of importance.

Dr. Nosakhare L. Arodoye was my Project Supervisor. Despite his busy schedule as Head of the Department of Economics, he was very prompt and thorough with the supervision of the project. His comments, suggestions and encouragement were very useful towards the successful completion of the work. My profound appreciation goes to him.

I would like to note and appreciate the contributions of Mr Gbolahan Adejuwon and his amiable wife, Mrs Dotun Adejuwon. They graciously received and welcomed me into their home in the course of my programme and have since then accepted and treated me as a member of their family. May God Almighty abundantly bless them and their children.

I wish to specially, sincerely and wholeheartedly appreciate and thank my parents, John Edemho Enegwea and Mrs. Deborah Igbashobo Enegwea. Their parental, spiritual, prayer, financial, material, moral and other forms of support and care have continued to be of invaluable help to me in life. My prayer is that their investments upon my life will not be in vain. May they live long to enjoy the fruits of their labour.

For the aforementioned persons, and all others I cannot readily remember to acknowledge, I pray that God Almighty will reward their labour of love and kindness towards me.

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ABSTRACT

The study investigated the tax revenue, institution and public infrastructure in Nigeria. It aimed to examine the impact of tax revenue and institution in public infrastructure in Nigeria. To guide the study, three research questions were raised with three hypotheses tested.

The study employed both descriptive and multiple regression analysis with ordinary least squares (OLS) econometric techniques. The data for the study were collected from the Central Bank of Nigeria (CBN) Statistical Bulletin and world development indicators from year 1981 to 2021. Reliability of estimated results was determined by using the economic or 'a priori' criteria, statistical criteria and econometric criteria. Data were analysed using Augmented Dickey- Fuller (ADF) test, Johansen cointegration test and Error correction mechanism.

The result revealed that, in the long run, there was a significant relationship between tax revenue and infrastructure development in Nigeria. However, in the short run, the study revealed negative impact due to inefficiencies. Also, institutional quality, in the long run, did not have a statistically significant impact on infrastructure development. However, in the short run, there was an initial positive impact of institutional quality on infrastructure development, followed by a negative lagged effect. The results also showed that Foreign Direct Investment (FDI) had a weak and statistically insignificant positive impact on infrastructure development in Nigeria. Furthermore, public debt had a marginally significant positive impact on infrastructure development in the long run. However, in the short run, public debt had a significant negative impact. Based on these findings, it was recommended that policymakers should enhance tax revenue collection through improved tax administration and tax evasion reduction, and provide efficient funds allocation for infrastructure. It was also recommended that policymakers should strengthen fiscal transparency and institutional quality by focusing on anti-corruption in procurement. Furthermore, government should create a favourable investment climate by reducing regulatory bottlenecks and promoting public-private partnerships to attract infrastructure-focused FDI and also prioritize prudent public debt management, and balance borrowing with sustainable servicing to maintain fiscal stability. For sustainable economic growth, policymakers should adopt a comprehensive policy framework that combines fiscal discipline, institutional reforms and private sector engagement.

CHAPTER ONE

INTRODUCTION

1.1 Preamble

There has always been the increasing pressure on the various national governments as to how to cope with the diverse needs of the populace. Every government has the primary responsibility of providing public infrastructures that would impact on the welfare of the citizens. However, in Nigeria, a major challenge facing the policy makers is in the area of adequate mobilization, proper management, equitable allocation, prudent allocation, and transparent accountability of funds towards infrastructural development with Oyewumi, Otunsanya, and Adeyeye (2020) that "infrastructural development is a function of funds". Speaking along this line, Simplice (2020) noted that "it is (an) agreeable (fact) that no nation can achieve development in the absence of adequate revenue to fund its programmes and projects". However, there is the problem that the Nigeria's "total revenue has been negatively impacted due to the crash in oil prices in the world market in recent years" (Oyewumi et al 2020). Therefore, in view of the dwindling oil revenue, Nigeria should not continue to place emphasis on oil and gas business to the neglect of other key sectors which can eventually boost the nation's revenue.

Besides the crisis in oil sector, increase in population also calls for an urgent improvement in the nation's infrastructures. "Government has huge projects to pursue on yearly basis because the population is always on the increase so the expected facilities and if not properly planned there will be problems in the future" (Ariworo, Ehiorobo, & Orunmwese, 2020). It is with the above regard that we will be discussing taxes as a sure source of government revenue, and look at how it impacts on public infrastructures in Nigeria.

Taxation is a term when a taxing authority, usually the government, levies or imposes a financial obligation (taxes) on its citizens. Paying of taxes to the government has been a mainstay in civilization. It is the most common form of financing government activities. In Nigeria, all eligible individuals employed, business owners, foreigners who derive income from the country, and corporate bodies are expected to pay tax. It is the primary source of income generation in Nigeria.

Taxes are mandatory contributions levied on individuals or corporations by the government. The tax revenue generated are used to finance government activities, including public works and services such as roads, education, social security, health care services, etc. Tax i89s an enforced contribution of money, enacted pursuant to legislative authority. If there is no valid statute by which it is imposed, a charge is not a tax. Tax is assessed in accordance with some reasonable rule of appointment on persons or properly with a tax jurisdiction. Hence it is the responsibility of all taxable citizens to pay tax, it is not a voluntary payment but a compulsory pecuniary burden placed on tax payers for societal benefits, these societal benefits are known collectively as infrastructures.

Tax revenue is one of the major sources through which government generate financial resources needed to meet the constitutional needs of the citizens. The relevance of tax revenue has attained a specific role in the development and sustenance of a country's economy. Tax plays various roles in the development of a nation. It is not only used as a tool for revenue generation but also used by the government to carry out some of its fiscal policies, such as to reduce the inequalities of wealth and income of the society, to control inflation and discourage unnecessary consumption. Therefore, an effective and efficient tax system is important. (Dibia & Onwuchekwa, 2019). The provision of public

infrastructure is considered a key factor in promoting economic growth and development, also attracting foreign investors for a sustainable production and productivity.

At the same time, inadequate levels of infrastructures restrict economic growth, a situation developing countries, such as which Nigeria, finds itself in it. Public infrastructure plays an important role in the economic, social, and environmental health of a country as they boost growth, encourage investors, and create jobs. It refers to services and facilities that helps uplift economic activities and the growth of a country or region by facilitating better productivity. Therefore, physical infrastructure is important for a nation's economic and social development as it helps improve the citizens quality of life, it is the backbone of any economy. However, government investment in infrastructures tends to inadequate, uncertain, and inefficient. Be that as it may, it should be a concern to all discerning minds that increase in revenue generation alone, tax revenue inclusive does not automatically translate into a boost in public infrastructures. There must be an institutional factor of government which could be summed up as the all-encompassing activities of the government in power to ensure that the revenues generated are properly managed, equitably allocated, prudently utilized, and transparently accounted for. The above background therefore forms the basis for our endeavour to research into 'Tax revenue, institution and public infrastructure in Nigeria'.

1.2 Statement of the Research Problem

Nigeria, as a developing nation, is plagued with so many problems, some of which are in the area of provision of public infrastructure. While the existing infrastructures in terms of roads, power, transportation, water supply, just to mention a few- are said to be not enough to cope with the continued rise in population, improvement on them has tended to be at a slow pace. Sometimes, some of the infrastructures are neglected and abandoned. This is

why “the neglected project(s) such as road(s) and power supply have led to the end of many industries in Nigeria, as was aptly asserted in earlier research (Enegwea, 2019). Evidence abounds of companies and industries that have ended their operations and left Nigeria on account of neglected and poor infrastructure. Examples include Michelin Tyre Services Company Limited, which ended their operations in Nigeria in 2007, and Dunlop Nigeria PLC whose operations ended in the country in 2008. A report in the Daily Post Nigeria of 31st March, 2016 "attributed the folding up of Michelin and Dunlop tyre companies as a result of epileptic power being experienced over the years in the country". In the airline industry, the Punch Newspapers of 22nd January, 2020 reported the suspension of daily flight on 30th June, 2016 from Lagos to Houston-Texas by the United Airlines. Similarly, the Spanish carrier, Iberia, on 12th May, 2016, ended its flights from Nigeria to Madrid. Reasons given include "high cost and scarcity of aviation fuel, poor navigational and landing aids ... (and) obsolete infrastructure", all of which revolve around poor infrastructure.

Nigeria’s infrastructure deficit, amounts to 30% of its gross domestic product (GDP), which falls short of the international benchmark of 70% set by the World Bank, with Nigeria’s population growing at a rate of over 2.5% per year and an expected population of 400 million people by 2050. It is worrisome that the current infrastructure in the country is likely to be overwhelmed. The 2019 Global Competitive Index Report ranked Nigeria 130th out of 141 economies surveyed for quality infrastructure facilities. With a score of 48.33 out of 100 total points, the country still has over 50% infrastructure deficit. Also, Nigeria was ranked 24th out of 54 African countries in the Africa Infrastructure Development Index (AIDI), 2020. With a total score of 23.26, Nigeria lags behind Egypt at 2nd place with 88.3 points, and Libya at 3rd with 82.9 points.

For a nation to achieve development, there has to be necessary revenue to provide basic infrastructures, which is where tax comes to play. Another challenge in Nigeria is generation of tax revenue from the citizens and how government makes use of the revenue generated. There is always a problem of the level of transparency between the government and the citizens. Efficiency in tax collection must be balanced with efficiency in tax utilization. There is a need to motivate citizens to pay taxes in the correct amount on due dates. To do this, there has to be an increase in the level of transparency from the government. The citizens tend to not to trust the government as to how the revenue generated from taxing them is used. There have been consistent failures by the government in transparently accounting for revenue and executing programmes and projects that will improve the standard of living of the people. Also, the level of tax compliance is dreadfully low such that the revenue generated cannot properly fund infrastructural development.

According to Muhammed Nami, the chairman of the Federal Inland Revenue Service FIRS (2021), only 41 million citizens pay taxes in Nigeria out of the over 200 million population in the country. He also mentioned the Nigeria custom service generate about NGN4.2 trillion, from this amount, oil related taxes accounted for only 22% which is NGN950 billion, the non-oil taxes generated was about NGN3.3 trillion (September 30th, 2021). This is not encouraging for a country desiring development. The total tax revenue ratio to GDP was 10.86% of GDP as of 2021, and according to the world Bank, for there to be economic growth and poverty reduction, the tax revenue of a country has to be above 15% of its GDP. The active number of tax payer should be geared up. Part of the reasons for this is high practice of tax evasion, which is punishable by the law in Nigeria.

Critical to Nigeria's economic development and social well-being, is the nexus between institutional governance and infrastructure. Government effectiveness, political stability, regulatory quality, rule of law, and absence of corruption are necessary in grappling with the numerous challenges, and in accelerating the nation's infrastructure development. Robust infrastructure provision tends to support governance by way of improving access to essential services. However, issues of corruption and inefficiency have been a plague in Nigeria, such that the nation is ranked 150th out of 180 countries on the Corruption Perception Index, according to Transparency International (2022). Corruption tends to negatively impact resource allocation for infrastructure projects, prompting the Nigeria Extractive Industries Transparency Initiative (NEITI, 2021) to reveal that an estimated 30% of public procurement budgets is lost through corruption.

To address and tackle the above challenging issues, Public-Private Partnerships (PPP)and citizen engagement, as forms of participatory governance models, present viable solutions (Ebohon & Agunwamba, 2020; and Akanbi & Mba, 2021). Other solutions include strengthening the nation's institutions to enforce accountability and transparency (Ezeani, 2017), engagement of e-governance initiatives to track project progress and expenditures in order to improve transparency and reduce corruption (Chukwuma, 2020), and investing in capacity building for government officials and stakeholders in project management and governance (Igbokwe-Ibeto and Igbokwe, 2018). Based on a report by the National Bureau of Statistics in June 2023, showed there has been a fluctuation in the total tax revenue between 2010 and 2021. As at 2010, the total tax revenue was at 8,344.55 billion Naira which was 15.28% of the GDP, it increased to 12,586.14 billion Naira in 2011 which was 19.98% of the GDP. Then there was a decrease for six consecutive years from 2012 to 2017. At 2017, the total tax revenue was 10,262.44 billion Naira which was 9.02% of the GDP, before an increase in 2018 of the total tax revenue of 13,239.47 billion Naira

which was 10.36% of the GDP, then in 2021, the total tax revenue amount to 18,851.06 billion Naira which was 10.86% of GDP. Between 2018 and 2021, there was a slight fluctuation in tax revenue as percentage of GDP.

Despite the challenges in the nation's infrastructures, Nigeria has continued to seek ways of boosting the revenues required for infrastructural improvements. While tax becomes a dependable source of revenue for the nation, an interplay with governmental institutions is required to guarantee a positive impact in terms of improvement of public infrastructures. Some of the effort by the government to boost and conserve more revenue for infrastructure includes: the introduction of the Integrated Payroll and Personnel Information System (IPSS) in 2012, which was designed to ensure effective budgeting of payroll costs based on actual verified numbers and not estimate. The system enables the government to save more money for infrastructural development; the establishment of the Sovereign Wealth Fund (SWF)in 2012, as a potential financing mechanism for addressing the infrastructure deficits in Nigeria; and lastly, the removal of fuel subsidy, as a bold decision taken on the 29th May, 2023 at the inception of the administration of President Bola Ahmed Tinubu, designed to free up financial resources for other sectors of the economy and channel funds for the development of critical public infrastructure. (Ozili and Obiorah, 2023). As a guarantee, an earlier recommendation by Anazodo, Ezenwile and Chukwurah (2014) that "proceeds from the removal of subsidy on petroleum products should be monitored so as to ensure that they are invested in critical infrastructures" should be implemented.

1.3 Research Questions

The following questions form the pivot upon which the research gained relevance, and they include:

i. Are there significant impacts of aggregate tax revenue on public infrastructure in Nigeria?
ii. To what extent does institutional factors influence public infrastructure in Nigeria?
iii. Are there interactive effects of tax revenue and institution on public infrastructure in Nigeria?

1.4 Objectives of the Study

The main objective of this study is to examine the impact of tax revenue and institution on public infrastructure in Nigeria. Other specific objectives include to:

i. investigate the impact of aggregate tax revenue on public infrastructure in Nigeria
ii. assess the extent to which institutional factors influence public infrastructure in Nigeria.
iii. analyze the interactive effects of tax revenue and institution on public infrastructure

1.5 Hypotheses of the Study

In line with the specific objectives of this study, the hypotheses of the study are stated in null form as follows:

i. tax revenue does not significantly affect public infrastructure in Nigeria.
ii. institutional factors do not significantly influence public infrastructure in Nigeria.
iii. there is no significant interactive effects of tax revenue and institution on public infrastructure in Nigeria.

1.6 Significance of the Study

Government and other stakeholders in Nigeria have always been burdened with level and state of public infrastructures in the nation. Despite the various efforts and attempts made over the years, this study will shed more light on how governmental institutions can use tax revenue to impact positively on infrastructures in Nigeria. Notwithstanding, this study on tax revenue, institution and public infrastructure in Nigeria is very significant in so many ways. Not only does it contribute to the existing pool of knowledge, but it also serves as a basis for further research endeavors. Equally, the research findings will aid the government in the formulation of the right policies that would enhance further growth and revival in public infrastructural development. Finally, the research outcome will aid the Nigerian government on how to curb wastages and mismanagement in the course of provision development of the nation's infrastructure.

1.7 Scope of the Study

Using Nigeria as a case study, this research seeks to identify the impact of tax revenue and institutions on infrastructure. Secondary data collected for the period 1981 to 2021 were used in this analysis. Importantly, as part of the period, was the nation's oil boom of 1983 with its attendant economic prosperity. Therefore, there is a need to analyze and establish the impact of such on the nation's tax revenue, institutions and public infrastructure. Statistical Bulletins, and World Development Indicators were consulted for the data. The study is limited to Nigeria's tax revenue and selected infrastructural facilities in the country in order to enable a realistic concise conclusion.

1.8 Limitations of the Study

It is evident that this research project cannot be completed without facing various challenges which can have an impact of this research. Such limitations include: time constraints, financial constraint and availability of reliable data.

Time constraints: the factor of time is crucial when sourcing for data, modeling and computation. This study was conducted in addition to other academic work with a given timeline.

Another limitation was financial constraint. Money is an important factor for conducting adequate research. This result from the need of sourcing materials, performing data analysis, typing the document and binding it.

Availability of reliable data obtained from secondary sources can sometimes pose a serious challenge as they can be erroneous, which limits the study's scope and this can affect the performance of regression analysis for this study.

1.9 Organization of the Study

This study is divided into six chapters. Chapter one which is the introduction which covers the preamble, statement of the problem, research questions, objectives of the study, hypotheses of the study, significance of the study, scope of the study, limitations of the study and organization of the study. Chapter two focuses on the background to the study. Chapter three focuses on the review of related literature while chapter four dwells on theoretical framework, model specification and methodology. Chapter five dwells on presentation and analysis of data and also interpretation of results and discussion of findings, while chapter six presents the summary of the findings, conclusions and recommendations.

CHAPTER TWO

BACKGROUND TO THE STUDY

2.1 Introduction

This chapter reviews the trends of tax revenue and good governance as an institutional factor and how they affect the public infrastructure in Nigeria.

2.2 Tax Revenue Generation in Nigeria

Tax revenue generation in Nigeria is a crucial aspect of the country's fiscal policy and economic development. The Nigerian government relies heavily on tax revenue to fund public infrastructure, provide essential services, and implement various development programs.

Types of Taxes in Nigeria

Companies Income Tax, Education Tax, Stamp Duties, Custom Duties, Excise Duties, Withholding Tax, and Value Added Tax are the principal taxes administered by the Federal Inland Revenue Service; Personal Income Tax and Withholding Tax are principally administered by the State Board of Internal Revenue; and Levies are principally administered by Local Government Revenue Committees. There are several taxes and levies imposed by the Nigerian government to generate revenue. Some of the key taxes in Nigeria include:

i. Companies Income Tax (CIT): This tax is imposed on the profits of companies operating in Nigeria. The current rate for CIT is 30% for companies in the oil and gas sector, and 20% for other companies.

ii. Personal Income Tax (PIT): PIT is imposed on the income of individuals, including employees, self-employed individuals, and professionals. The rates for PIT vary across different income brackets, with higher-income earners paying higher rates.

iii. Value Added Tax (VAT): VAT is a consumption tax imposed on the value added at each stage of the production and distribution chain. The standard rate for VAT in Nigeria is 7.5%, although there are exemptions for certain goods and services.

iv. Petroleum Profit Tax (PPT): PPT is imposed on companies engaged in upstream petroleum operations. The rate for PPT varies depending on the profitability of the company and ranges from 50% to 85%.

v. Customs and Excise Duties: These are taxes imposed on imported goods and certain locally manufactured goods. The rates for customs and excise duties vary, depending on the type of goods.

vi. Stamp Duties: Stamp duties are imposed on various types of transactions, such as legal documents, bank transfers, and financial transactions. The rates for stamp duties vary depending on the nature and value of the transaction.

vii. Capital Gains Tax (CGT): CGT is imposed on the profits derived from the sale or disposal of capital assets, such as real estate, stocks, and bonds. The rate for CGT is 10%.

The Federal Inland Revenue Service (FIRS) is the primary tax authority responsible for the administration and collection of taxes in Nigeria. State governments also have their respective tax authorities that collect certain taxes within their jurisdictions. However, despite the existence of various taxes, tax revenue generation in Nigeria faces challenges such as low tax compliance, tax evasion, and a large informal economy. The government has been implementing measures to improve tax administration, increase tax compliance,

and expand the tax base to enhance revenue generation. Tax reforms and initiatives, such as the introduction of the Tax Identification Number (TIN) system and the Voluntary Assets and Income Declaration Scheme (VAIDS), have been introduced to address these challenges and boost tax revenue in the country.

Tax Administration in Nigeria

In Nigeria, taxation is regulated by law. Implicitly, the passing of the applicable statute is required to make such a tax a legal obligation (Acts, By-law and decree among others). The administrative body is established by the tax code, which also defines its tax jurisdiction. According to tax regulations, some types of incomes, profits, gains, and transaction values of taxable people are subject to tax at a predetermined rate. The current economic climate, the complexity of financial transactions, welfare demands, and social needs are taken into consideration while making changes to these regulations.

The body in charge of collecting and administering federal taxes is called the Federal Inland Revenue Service (FIRS). Taxes that are owed to state governments are handled by the several State Boards of Internal Revenue, whereas taxes owed to local governments are handled by local government revenue committees. However, there is the Joint Tax Board which offers advice, harmonizes double taxes, and suggests change. Tax statutes, the cornerstone of tax administration, set taxes. These tax statutes typically list the tax rate, payment deadline, method of assessment, offences, and penalties for the cited taxes.

Tax administration entails the registration, assessment, returns, collection, compliance monitoring, compliance enforcement, sanction, taxpayer education and awareness, as well as any other action that might increase the efficacy and efficiency of taxation.

i. Registration of Taxpayer: Taxpayer registration is done by submitting relevant information as required by the relevant tax authority. Taxpayer registration usually precedes tax assessment, collection, compliance monitoring and enforcement. Federal Inland Revenue Service (FIRS) and State Board of Internal Revenue register taxpayers for taxes within their jurisdiction.

ii. Assessment of Taxpayers: Tax authorities assess taxpayers on taxes administered by them and they can also reassess tax returns rendered by taxpayers. The basis of assessing tax (tax rate, basis period, and tax deduction) are stipulated in tax statutes.

iii. Returns: Tax authorities usually require taxpayers to file information as required by relevant tax statutes and as further required with them. This is usually on a periodic basis (annually or monthly) or as the need arises.

iv. Tax Collection: Tax collection is the next step after assessment. Either the taxpayer self-assess himself or is assessed/reassessed by tax authority. Mode of tax remittance is usually determined by the relevant tax authority.

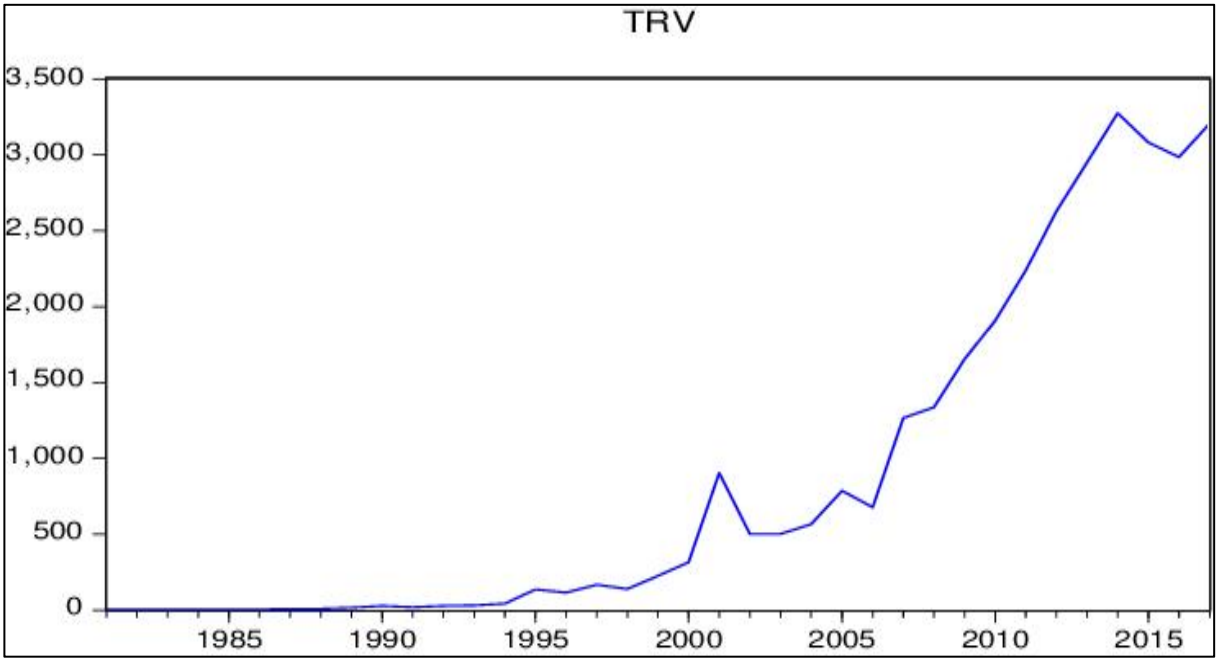
v. Compliance Monitoring: Tax authorities usually monitor tax compliance of taxpayers by assessing their adherence to the provisions of relevant tax statute. This is usually done by tax authorities at their respective offices by checking the taxpayer's file and/or visiting the taxpayer to obtain further relevant information to complement information at their disposal to assess the taxpayer's compliance with the provision of the relevant tax statute.

vi. Compliance Enforcement: Tax authorities' compliance can be enforced on taxpayers.

Trends of Tax Revenue in Nigeria

Despite the challenges associated with tax revenue collection and its negative influence on an economy, it has been proved to be a good source of government revenue that is absolutely certain in collection. Tax revenue in Nigeria from 1981 to 2017 are shown in Figure 1 below. The vertical axis depicts the tax revenue in billions of Naira while the horizontal area indicates the time on a yearly basis.

Figure 1: Tax Revenue (TRV) in Nigeria: 1981 - 2017



Source: Adapted from ResearchGate, 2019.

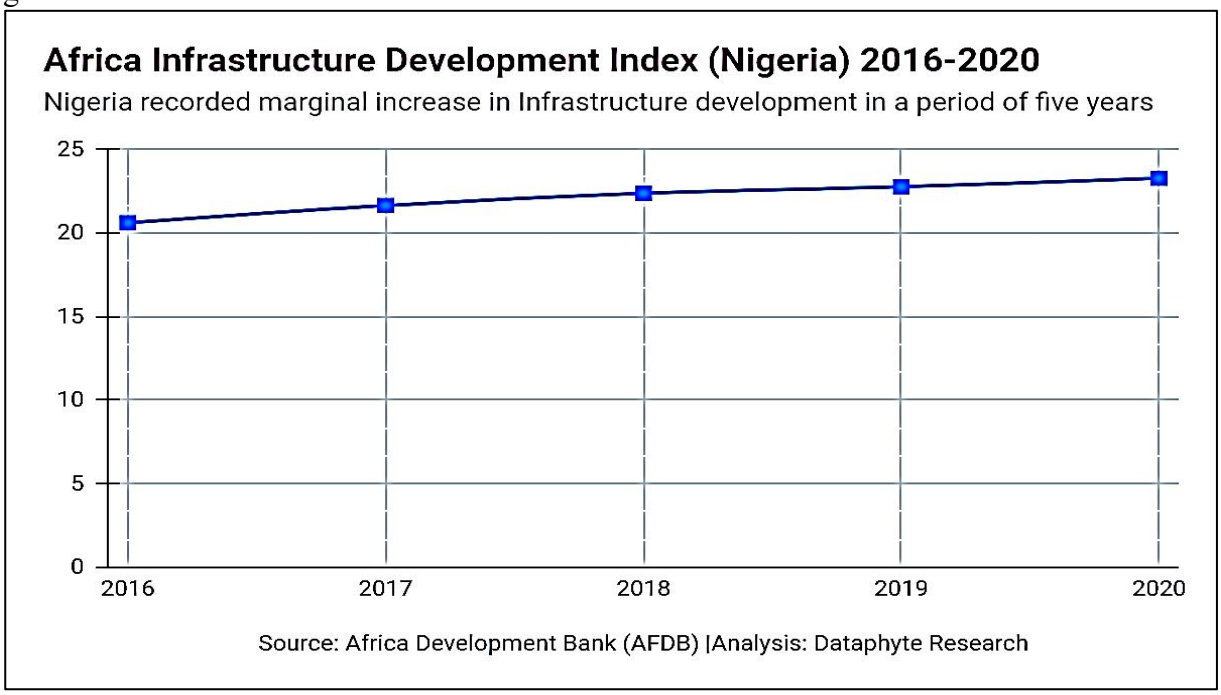
Figure 1 shows the flow of revenue from all taxes except petroleum profit tax. The attention given to tax revenue driven by the government in recent times in Nigeria has led to an increase in tax revenue as can be witnessed in 2011 from Figure 1 above. Though there was a little drop between 2014 and 2015, a sudden rise occurred between 2016 and 2017, thereby giving credence to government's effort to exploit tax revenue sources due to the dwindling oil revenue.

2.3 Infrastructural Development in Nigeria

Nigeria's infrastructure deficit, amounting to 30% of its gross domestic product (GDP), falls short of the international benchmark of 70% set by the World Bank, the International Trade Office of the US Department of Commerce observed. With Nigeria's population growing at a rate of over 2.5% per year and an expected population of 400 million people by 2050, the US agency worries that the current infrastructure in the country is likely to be overwhelmed. The World Bank has projected that Nigeria will need to invest $3 trillion to reduce its infrastructure deficit. The 2019 Global Competitive Index Report ranked Nigeria 130th out of 141 economies surveyed for quality infrastructure facilities. With a score of 48.33 out of 100 total points, the country still has over 50% infrastructure deficit. Also, Nigeria was ranked 24th out of 54 African countries in the Africa Infrastructure Development Index (AIDI), 2020. With a total score of 23.26, Nigeria lags behind Egypt at 2nd place with 88.3 points, and Libya at 3rd with 82.9 points.

Over five years, from 2016~2020, though slowly, Nigeria has recorded a marginal increase in infrastructure development across selected components, namely: transport, power, ICT, and water and sanitation. Despite obvious improvement, there is still need for further drive and acceleration in the country's infrastructural development.

Figure 2:



Infrastructures are essential social services that not only aid economic activities but also stabilize the economy. Thus, Infrastructure Development (ID) is pivotal to national economic growth. In simple terms, it is the improvement of the quality of the different components of the infrastructure — transport system, power, ICT, water and sanitation, and others. Inadequate infrastructure facilities have been identified as one of the factors militating against sustainable economic growth in Nigeria. Despite the government's various efforts to bridge infrastructure gaps, the journey seems prolonged with recurring rural-urban migration and an increase in annual population growth that further strains existing facilities.

Table 1: DEBT MANAGEMENT OFFICE

NIGERIA

LOANS OBTAINED FROM CHINA EXIM AS AT SEPTEMBER 30TH 2021

AMOUNTS IN MILLIONS

S/N	Project Description	Loan currency	Loan amount	Agreement date	Terms and conditions				Amount disbursed		Payment		Amount outstanding
					Interest rate (P.A)	Grace period	Maturity date	Tenor	Amount	Percentage	Principal	Interest	
									A	B	C	D	E
1.	Nigerian-Communications-Satellite	USD	200.00	12-Jan-06	3.00%	5 years	29-Jun-18	12 years	200.00	100.00%	200.00	40.02	0.00
2.	Nigerian National Public Security Communication System Project	USD	399.50	20-Dec-10	2.50%	7 years	21-Sep-30	20 years	399.50	100.00%	122.92	96.63	276.58
3.	Nigerian Railway Modernization Project (Idu-Kaduna Section)	USD	500.00	20-Dec-10	2.50%	7 years	21-Sep-30	20 years	500.22	100.00%	153.85	89.18	346.15
4.	Abuja Light Rail Project	USD	500.00	7-Nov-12	2.50%	7 years	21-Mar-33	20 years	500.00	100.00%	76.92	78.23	423.08
5.	Nigerian ICT Infrastructure	USD	100.00	5-Jan-13	2.50%	7 years	21-Mar-33	20 years	100.00	100.00%	11.54	13.04	88.46
6.	Nigerian Four Airport Terminal	USD	500.00	10-Jul-13	2.50%	7 years	21-Mar-35	20 years	499.44	100.00%	0.00	59.09	499.99

	Expansion Project (Abuja, Kano, Lagos & Port Harcourt												
7.	Nigerian Zungoru Hydroelectric Power Project	USD	984.32	28-Sept-13	2.50%	7 years	21-Sep-36	20 years	597.42	60.69%	0.00	41.10	597.42
8.	Nigerian 40 Parbioled Rice processing Plants Project (Fed. Min. of Agric. & Rural Dev.)	USD	325.67	26-April-16	2.50%	7 years	21-Sep-36	20 years	0.00	0.00%	0.00	0.00	0.00
9.	Nigerian Railway Modernization Project (Lagos-Ibadan Section)	USD	1,267.32	18-Aug-17	2.50%	7 years	21-Mar-36	20 years	1042.70	82.23%	0.00	53.89	1,042.70
10.	Nigeria Rehabilitation & Upgrading of Abuja-Keffi-Markurdi Road project**	USD	460.82	29-May-18	2.50%	7 years	21-Sep-37	20 years	187.79	40.75%	0.00	6.14	187.79
11.	Nigerian Supply of Rolling Stocks and Depot Equipment for	USD	157.00	29-May-18	2.50%	7 years	21-Sep-37	20 years	0.00	0.00%	0.00	0.00	0.00

	Abuja Light Rail Project.												
12.	Nigeria Greater Abuja Water Supply Project	USD	379.00	29-May-18	2.50%	7 years	21-Mar-38	20 years	56.95	15.00%	0.00	0.66	56.95
13.	Nigerian Four Airport Terminal Expansion Project Ancillary Project**	USD	183.62	27-Dec-19	2.75%	7 years	21-Mar-38	20 years	0.00	0.00%	0.00	0.00	0.00
14.	Nigerian Four Airport Terminal Expansion Project Incremental Project**	USD	208.90	27-Dec-19	2.75%	7 years	21-Sep-39	20 years	0.00	0.00%	0.00	0.00	0.00
			Total (USD)						4,084.35		565.23	477.98	3,519.12
15.	Nigerian ICT Infrastructure Backbone Phase II Project***	CNY	2,300.00	5-Sep-18	2.50%	7 years	21-Sep-39	20 years	480.40	20.89%	0.00	0.00	480.40
			TOTAL (CNY)						480.40		-	-	480.40

Source: Debt Management Office

Note: *Loan fully repaid as at June 29, 2015

** and *** are additional loans for Nigeria Four Airport Expansion Project and Nigerian ICT Infrastructure Backbone Project respectively CNY

(Chinese Renmimbi Yuan)

Part of the mechanisms deployed by the government to fix the country's infrastructure deficits is the establishment of the Economic Recovery and Growth Plan (ERGP) and the National Integrated Infrastructure Master Plan - a framework for building a resilient economy and a roadmap for building world-class infrastructures. Both, identify and elaborate on effective strategies for the successful implementation of the programs in line with the current economic realities.

Transport Infrastructure

Another visible headway in infrastructure development (majorly directed towards the transportation system) in Nigeria is the popular Chinese project-tied loans that have had a significant impact on the country's infrastructure development. The total loan obtained from China as of September 30, 2021, was $6.17 billion with USD3.519 billion disbursed. In addition, there is another Chinese Renmimbi Yuan-denominated loan of CNY2.300 billion of which CNY480.40 million was disbursed.

The projects fifteen – (15) in number as of March 31, 2020, include:

- Nigerian-Communications Satellite;
- The Nigerian National Public Security Communication System Project;
- the Nigerian Railway Modernization Project (Idu-Kaduna section);
- the Abuja Light Rail Project;
- the Nigerian Four Airport Terminals Expansion Project (Abuja, Kano, Lagos, and Port Harcourt);
- The Nigeria ICT Infrastructure Backbone project;
- Nigerian Zungeru Hydroelectric Power Project;
- Nigerian 40 Parboiled Rice Processing Plants Project;
- Nigerian Railway Modernization Project (Lagos-Ibadan section);
- Rehabilitation and upgrading of Abuja – Keffi- Makurdi Road Project and others;

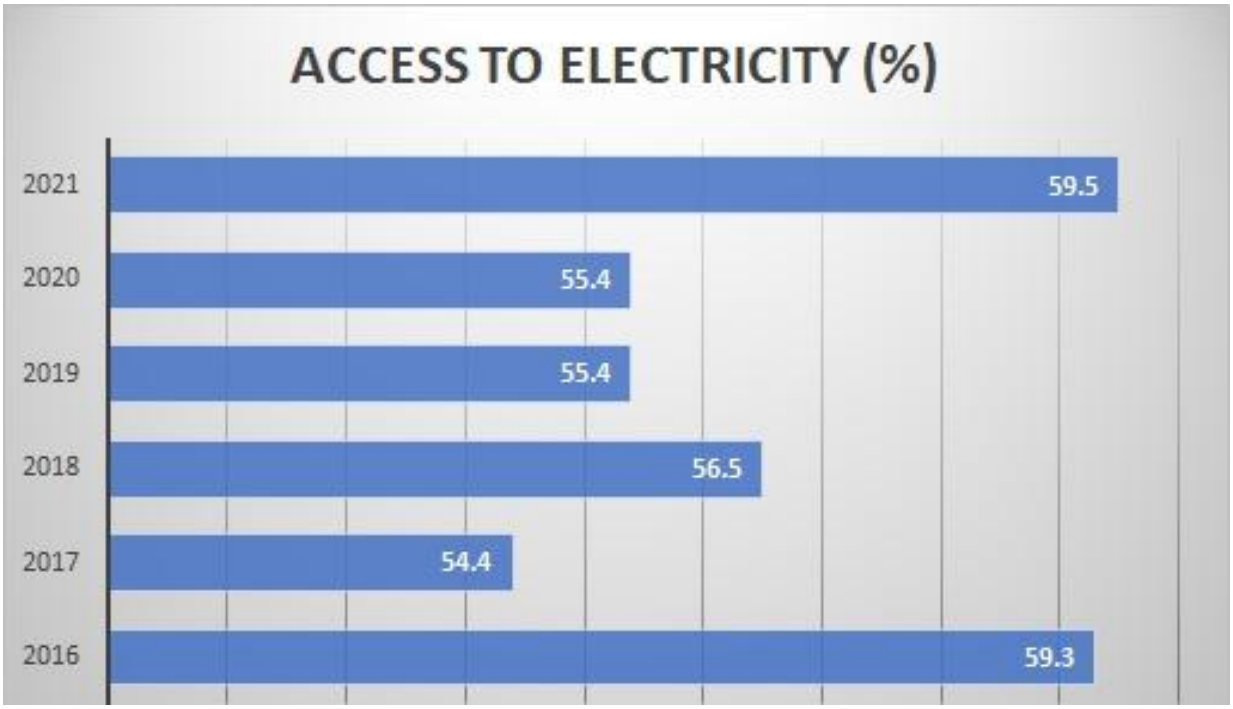
- Nigeria Supply of Rolling Stocks and Depot Equipment for Abuja Light Rail Project;
- Nigeria Greater Abuja Water Supply Project;
- Nigerian Four Airport Terminal Expansion Project Ancillary Project;
- Nigerian Four Airport Terminal Expansion Project Incremental Project;
- Nigerian ICT Infrastructure Backbone Phase II Project.

Power Infrastructure

On the AIDI's Electricity index to measure the total electricity production of a given county, Nigeria scored 2.721 over 100, ranking 29th out of 54 African countries. In a similar survey by the World Bank to evaluate electricity access for countries in Sub-Saharan Africa across different years, Nigeria got a score of 55.4%. Though a significant feat, about half of its population—majorly people in the rural areas still live without basic access to electricity.

Figure 3: Percentage of Nigerians that have access to electricity between 2016 -2021

Despite significant progress in ensuring that its over 200 millions population have access to electricity, about half if the population still live without basic electricity supply.



ICT, Water and Sanitation

The 2020 ICT Index to measure the availability of quality ICT infrastructure also saw Nigeria perform low with 17.8 points out of 100. On the other hand, in 2019, a state of emergency was declared on Nigeria's Water, Sanitation, and Hygiene (WASH) project owing to inadequate lack of infrastructure, insufficient human capital, poor investment, and others. In a featured story on World Bank News, 60 million Nigerians have no access to basic drinking water, 80 million lack access to advanced sanitation facilities, and 167 million have no access to basic hand washing facilities. Overall, the fundamentals of any national economy are its stock of infrastructure. Efficient transport and port systems ease the costs of transportation and aid production processes.

Sophisticated ICT infrastructure enhances communication flow, and stable electricity increases economic productivity, and strengthens businesses. Water supply and sanitation improve citizens' health and reduce water-borne related diseases. The condition of a nation's social infrastructure determines its level of economic growth, its people's well-

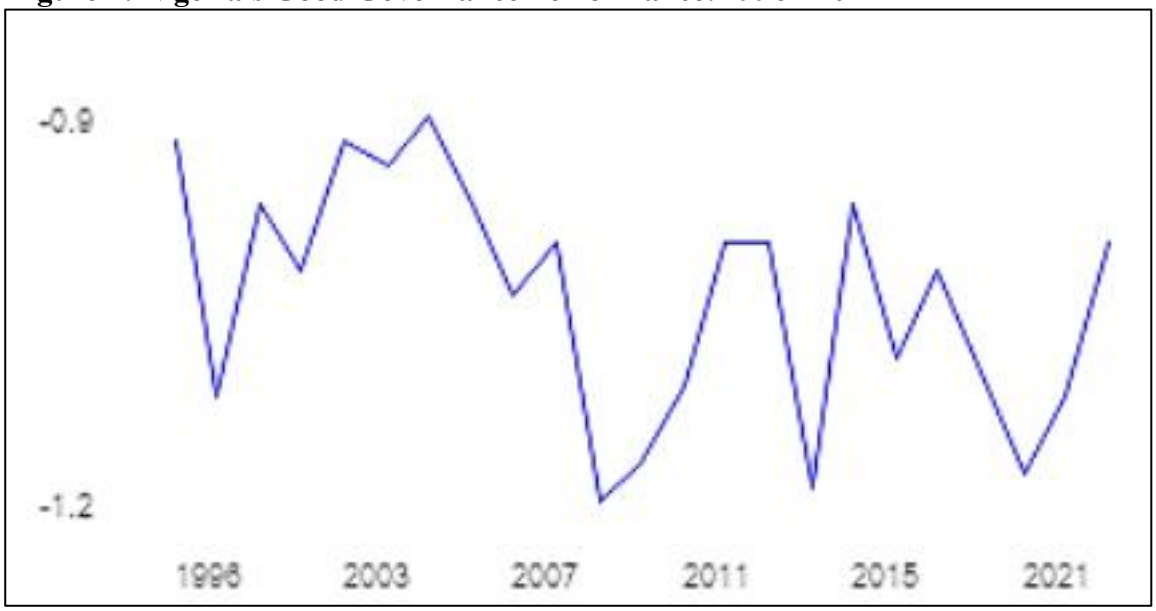
being, employment opportunities, the cost of doing business, and foreign and local investors' confidence in the viability of their business endeavours. Hence, closing Nigeria's vast infrastructure deficit in power, transport, ICT, and water and sanitation remains a policy path to be prioritised.

2.4 Good Governance in Nigeria

Good governance means that processes and institutions produce results that meet the needs of society while making the best use of resources at their disposal. A common index used to measure the effectiveness of government in delivering good governance is the World Governance Index (WDI) which ranges from -2.5 to +2.5, with higher values corresponding to better governance.

Figure 4 below graphically shows the performance of the government in delivering good governance from 1996 to 2021. The average value for Nigeria during that period was -1.04 points with a minimum of -1.2 points in 2009 and a maximum of -0.9 points in 2005. The latest value from 2021 is -1 points. For comparison, the world average in 2021 based on 192 countries is -0.02 points.

Figure 4: Nigeria's Good Governance Performance: 1996 - 2021



Source: Adapted from Global Economic Outlook, 2023.

From figure 4 above, it can be seen that Nigeria seems to experience the best in good governance around 2004-2005. During this era, leadership was under the Obasanjo's administration, which marked a turnaround in governance. This period represented Nigeria's postmilitary democratic governance. Strong leadership, bold reforms such as establishment of Economic Financial Crimes Commission (EFCC), Independent Corrupt Practices and Other Related Offences Commission (ICPC), and the launch of the National Economic Empowerment and Development Strategy (NEEDS), debt relief and relatively stable political environment led to a surge in global confidence and improvement in governance.

The worse experience around 2008-2009 in the nations governance was during the civilian regime of President Umaru Musa Yar'Adua. This period was marked by political uncertainties, a near-vacuum experience in leadership due to the poor state of health of the President, rise in corruption, oil sector and Niger Delta crisis and deterioration in public service delivery. Between 2015 and 2021, Nigeria's governance showed initial promise, especially in anti-corruption and counter insurgency, but deteriorated in key areas such as security, rule of law, civil liberties and economic management. This period ended with public trust in governance significantly weakened, especially after the #EndSARS protest and economic hardships caused by the pandemic (COVID 19).

CHAPTER THREE

LITERATURE REVIEW

3.1 Conceptual Review

Three major conceptual issues important to us in this study are tax revenue, institution and public infrastructure.

3.1.1 Concept of Tax Revenue

Government is charged with performance of certain functions and responsibilities for the benefit of those it governs (Ade & Festus, 2020). In the nations of the world, including Nigeria, the extent to which government is able to go in providing such benefits depends on the amount of revenues at its disposal, as well as proper deployment and use of such revenues. There are various revenues available to government, and tax revenue is one of them.

What is tax revenue? Before delving into the definition of the term, 'tax revenue', we need to understand that there are other synonyms of the concept as 'taxation' and 'tax' as which we will be coming across in the course of the research exercise. Various scholars have given their own definitions of the concept of taxation. Though we do not intend to dwell on so many of such examples, the general consensus among them is that taxation involves compulsory monetary contributions by individuals and corporate bodies to the government to fund its operations and provide various services to the entire citizenry.

Dibia and Onwuchekwa (2019) defined "tax as a compulsory levy made by all concerned to the government of a country from which essential services are rendered, without necessarily offering an explanation on how the money generated is spent or equating the

services with money collected". Perhaps, a more expanded definition as contained in the work of Uche (2017) has helped to identify the "all concerned" entities expressed above. According to him, taxation "is a required payment imposed by the government on the income, profit or wealth of individuals, group of persons, and corporate organizations". The revenue derived from this source (taxation) is the tax revenue. The definition by StudySmarter UK is concise and on point. It says "taxation is a system where individuals and businesses pay money to the government to fund its operations and services. The financial fuel keeps public infrastructure running".

Arising from the above therefore, the fact is obvious that both governments, on one hand, and individuals and corporate bodies, on the other hand, have their own obligations and responsibilities when it comes to taxation. The government collects tax revenue(s) from individuals and corporate bodies and utilize same to provide public infrastructure and other services for the benefit of the people. In summary, "funding public expenditure … is one of the reasons why government collect taxes. The government uses the collected revenue to achieve certain economic goals... A government also uses taxation for the redistribution of income in an attempt to lower inequality and create a more equitable society" (StudySmaster UK).

What is the role of taxation as an instrument of fiscal policy? Aboyade (1983) has identified four of such roles as follows:

i. "It helps to allocate resources from private to public needs by contributing substantially to the financing of such communal services as defence, law and order, education, health and social security;
ii. "Taxation can be used as part of the general public policy amoury to control deflation and contain inflation;

iii. “There is the pursuit of economic growth, which is particularly of social concern to the underdeveloped countries; and

iv. “There is the role of taxation in promoting social equity by helping to redistribute economic wealth and income”.

Of the above roles of taxation as instrument of fiscal policy, the first has direct bearing and relevance to the focus of this study. Nonetheless, the three other roles of taxation are valid. What are the different types of taxes? Basing their classification on the works of other researchers, Oyebolu and Usifoh (2020) stated that “tax can be classified based on its incidence into direct and indirect taxes. A direct tax is a tax on income that is borne directly by tax payers… Examples of direct tax are personal income tax, capital gain tax and petroleum profit tax. While indirect tax are taxes initially suffered by the tax payer but whose ultimate burden is borne by the final consumer of the goods and services; excise duties, customs duties, stamp duties and value added tax. This category of tax is borne by a person other than the one from whom the tax is collected”.

What are the tax legislations in Nigeria? Oftentimes, the government comes up with various legislations to guide and regulate the tax systems in Nigeria. Uche (2017), in noting some examples of such legislations, said that “these legislations are the Personal Income Tax Amendment Act 2011, Companies Income Profit Tax Amendment Act 2007, (and) the Petroleum Profit Tax Amendment Act 2004. Others are the Capital Gains Tax Amendment Act 2004, the value Added Tax Amendment Act 2007 and Education Tax Amendment Act 2004. The agency of the federal government in charge of the administration and collection of these taxes, (except customs/excise duties) up to April 2007 was the Federal Board of Inland Revenue (FBIR). In 2007, the board was scrapped and replaced by the Federal Inland Revenue Service (FIRS)”.

By and large, tax revenue plays a crucial role in funding public infrastructure development in Nigeria. The government is now placing more emphasis on it, especially in the current era of dwindling revenues, occasioned by the adverse economic impact of covid-19 pandemic; fluctuation in oil revenue; the fall of the Nigerian currency (the Naira) in exchange of the United States currency (the Dollar); the depletion in the Nigeria's foreign reserves; and so on. The government relies heavily on the tax revenues to finance public services, such as building roads, schools, hospitals and other infrastructural projects that are essential for economic growth and development.

3.1.2 Concept of Institution

The meaning of the word' institution' depends on the subject and field of study. Therefore, the word should not be used loosely. For the purpose of our research, it refers to "an organization, establishment, foundation, society, or the like, devoted to the promotion of a particular cause or program(me)" (Dictionary.com). With this understanding, there is the need to identify and qualify from the onset that government is the institution under consideration here.

Government as an Institution

Government is the first institution ever known and established in any human society. Without it, such a society would remain in a state of nature, with its brutish tendencies and characteristics. Government as an institution is in charge of affairs any nation or society. As such, it decides, initiates, supervises, controls and regulates all matters, issues, programmes, projects and activities of such a nation or society. Such an all-embracing role of government extends to matters of tax revenue and public infrastructure development. There are three arms of government in Nigeria as in other nations. These are the executive, the legislature and the judicial arms, all charged with their defined constitutional roles in

the affairs of the nation. The ability to effectively and efficiently perform and play such roles brings about good governance. On the contrary, when and where lapses and corruptions abound, bad governance becomes the other of the day.

Tax Institutions and Authorities

However, for government impacts to be deployed and felt at different levels, sections, nooks and crannies, there are other sub-institutions or authorities established to represent government in playing such defined, specific and relevant roles in accordance with the mandates of the respective institutions. Usually, the nomenclatures of such institutions are in consonant with their assigned mandates. Hence in the matters of a nation's tax administration, tax institutions are established to take charge. 'Tax institutions', interchangeably referred to as 'tax authorities', are institutions, organizations, establishments, agencies and authorities of government in charge of tax matters and administration.

Tax Institutions and Authorities in Nigeria

In line with the nation's federating units, the following are the major tax institutions and authorities in Nigeria:

Federal Inland Revenue Service (FIRS), responsible for the administration of taxes due to the federal government.

a. **State Board of Internal Revenue (SBIR)**, which administers taxes that are due to each state government. Taxes administered at this level are mainly personal income tax, and withholding tax.
b. **Local Government Revenue Committee (LGRC)**, which administers taxes that are due to each local government. However, it should be noted that in practice, the

state governments and their SBIR have tended to usurp the powers and roles of the local governments and their LGRC in tax revenue collection. Only a very little fraction of what is collected is given to each local government to run its affairs. Hence the LGRC is only left to collect levies, rates and fines for each local government.

c. **Joint Tax Board (JTB)**, which is expected to act as an effective supervisory and advisory body on the shared activities of state and federal authorities.

Tax Institutions and Authorities and Challenges of Tax Administration in Nigeria

At this juncture, we are discussing the challenging issues facing, and associated with, the tax institutions and authorities and the general tax administration in Nigeria. Such challenges are numerous. However, we can glean, summarize and highlight few of such challenges from the works of Nwede, Joseph Okwesili; Nwali, Teben Benz; and Orga, Josephine (2013); Okeke, Martin Ifeaniyi; and Eme, Okechukwu Innocent (2013); Musa, Phillip; and Ajibade, Olalekan Eyitayo (2016); and Ibe, Ikenna U. (2017) as follows:

i. Problem of weak enforcement of taxes occasioned by arbitrary use of force in tax collection which gives rise to civil and criminal liabilities.
ii. Problem of corruption whereby tax "evaders prefer to bribe (tax) officials than pay taxes" (Ibe, 2017).
iii. Ibe (2017) also noted that "the use of tax consultants has equally compounded the issue of corruption in tax collection. They print different types of receipts, maintain different account(s) for the sole aim of diverting taxes collected to their private pockets".
iv. Lack of resource control by the nine oil producing states of Akwa-Ibom, Cross River, Rivers, Bayelsa, Delta, Edo, Ondo, Abia and Imo States has robbed the host

state and local governments of getting adequate benefits from oil taxes and other revenues. This has continued to portend a problem as some youth of those areas sometimes kidnap oil workers for ransom as a way of pressing home their demand for resource control by the oil producing states.

v. The practice of state and local government joint allocation has tended to reduce the various local governments to mere administrative and fiscal appendages of states, under the whims and caprices of the State Governors who reduce, and deny them of, their full fiscal allocations. This has tended to plunge the local governments into serious financial challenges, especially when they are not in full charge of tax matters in their domains.

vi. Also, as a fallout of poor practice and operation of fiscal federalism in Nigeria, the local governments are manipulated out of tax control and revenue gains in their domains. Officials of the SBIR collect the taxes at the local government areas (LGA) into the state coffers, while a little fraction is left for the respective local governments to run their affairs. In fact, the task of the LGRC and staff has been reduced to that of mere collection of levies, rates and fines. This does not augur well for the continued administrative and fiscal sustenance of the local government system in Nigeria.

Governance and Institutional Performance

In every community or association of people, governance is what is required to set, regulate, and enforce the rules of engagement, as well as measure performance. Therefore, governance is the actual work or duty of a nation's government with its executive, legislative and judicial arms and other institutions. Amplifying the view of other scholars, Ubi and Udah (2019) stated that "governance is simply policy making and policy

execution regulated by systems of laws and guidelines which are separated into specific operations to achieve national objectives". In simple terms, governance is the process of overseeing and managing the affairs and activities of people in a given domain, such as a country, or institutions within a country. There are two concepts of governance which, according to Uyannah, John and Eyibio (2021), "depend on the level of attained development of the society in question among other factors". There is the concept of 'good or effective governance', and the other concept of 'bad or poor governance'. The issue of good or effective governance in institutional performance is very key to boosting a nation's revenues and public infrastructural development, in views of its relevant indicators, as we shall see.

What is good or effective governance? Jerome and Tella (2022) "defined (it) as the well-performance of government output, including provision of economic and political goods …. With good governance, corruption which is a major obstacle to effective development efforts in many ways is at the minimal level". Perhaps, an earlier position by Ubi and Udah (2019) gives us a clearer view and explanation of the concept. According to them, "good or effective governance is achieved by means of good public policies with clear cut objectives, targeted programmes and willingness to anticipate and re-assess outcomes if and when necessary. That is why the provision of an effective legal and institutional framework that guarantees the availability of a range of public goods and services is inherent in good governance".

At this juncture, we may ask, what are the indicators of good or effective governance? In other words, how do we measure good or effective governance? Ubi and Udah (2019) further highlighted the World Bank's "six indicators of good governance as follows:

i. "Voice and accountability;

ii. “Political stability;

iii. “Government effectiveness;

iv. “Regulatory quality;

v. “Rule of law; and

vi. “Control of corruption”.

Bad or poor governance is the opposite of good or effective governance. It is a situation when governing entities refuse to listen to the voices of those they manage and are not willing to take responsibility for their conducts. Ubi and Udah(2019) have listed the main characteristics of bad governance, as identified the World Bank, as follows:

i. “Failure to properly distinguish between what is public and what is private, thus, leading to private appropriation of otherwise public resources;

ii. “Inability to establish a predictable framework for law and government behavior in a manner conducive to development;

iii. “Excessive rules, regulations etc., which impede the functioning of markets and encourage rent seeking behaviour;

iv. “Priorities that are inconsistent with development, thereby resulting in misallocation of national resources and

v. “Excessive narrow base for, or non-transparent, decision making”.

3.1.3 Concept of Public Infrastructure

‘Infrastructure’, ‘public infrastructure’, ‘infrastructure development’, and ‘infrastructural development’ are concepts that will be closely and interchangeably used for the purpose of this research.

Oyewumi, Otunsanya and Adeyeye (2020) reiterated the definition of some previous authors "that infrastructural development is the totality of facilities and social amenities provided by government for the purpose of enhancing the quality of living standard of her citizens". In identifying such facilities and social amenities, they listed them as "adequate and good educational facilities, availability of pipe-borne water, qualitative and befitting health care centers, provision of good roads, suitable and qualified teachers and teaching facilities"

The fact cannot be over-emphasized that the hallmark for a nation's overall economic growth and development lies in its public infrastructure. Hence the fact should be agreed with that "infrastructural provisions and availability of resources to meet such needs has been the major point of concern to government in all the states of the (Nigerian) federation" (Ade and Festus, 2020).

By simple classification, Denomme and Garland (2023) have identified three categories and examples of infrastructures, which has further deepened our understanding of the concept as follows:

i. "Hard infrastructure: physical systems needed for operation, such as transportation, energy, telecommunications, and waste removal.
ii. "Soft infrastructure institutions needed for operation, such as education, government, health services, and emergency services.
iii. "Critical infrastructure: the minimal systems that are necessary to operations, such as access to food and water, heat, and shelter".

There are challenges associated with infrastructural development, especially in Nigeria and in other developing nations of the world. Oyedele (2016) has discussed such challenges, some of which are hereby identified, summarized and highlighted below, as:

dearth (scarcity) of visionary leaders as agents of positive change; paucity of funds; lack of maintenance culture; corruption; high cost of governance with little left to fund infrastructures; high cost of public projects; lack of continuity in government projects; and lack of (proper) planning.

Our discussion on infrastructural development will not be complete without looking at its benefits to a nation. What are the benefits? The work of Presents serves as a very good reference, and from it we summarize the benefits of infrastructural development which are hereby presented below:

i. Improved infrastructures promote economic activities and job creation;
ii. Road and telecommunication infrastructures enhance regional connectivity, and foster trade and collaboration.
iii. Effective infrastructures lead to increase in businesses, high productivity and competitiveness.
iv. Such infrastructures like health care, education and utilities help to improve the quality of life.
v. Modern infrastructures support the adoption of new technologies and innovations.
vi. Environmental sustainability is guaranteed through modern infrastructures.
vii. Robust infrastructures help to equip various communities to withstand and recover from natural disaster and other challenges.
viii. Provision of essential infrastructures enables the various segments of society to benefit from essential services and opportunities.

Infrastructural development is very key to the overall development of a nation. The benefit derived from infrastructural provisions are very far reaching, and constitute the engine that drives all other sectors of the nation.

3.2 Theoretical Literature Review

Four theories considered and discussed in this study were: (i) The Benefit Theory of Taxation; (ii) The Faculty Theory of Taxation; (iii) The Wagner's Law of Increasing State Activity: and (iv) The Theory of structural Functionalism. The theories were discussed in a manner to establish, as much as possible, how tax revenue and institutions (the independent variables) influence the development of public infrastructure (the dependent variable).

3.2.1 The Benefit Theory of Taxation

The works of Eyo (2016), Nwankwo (2016), and Uche (2017) have given an understanding of the benefit theory of taxation. The theory is anchored on the presumed relationship between the state (represented by the government) and taxpayers, whereby the state is obligated to provide certain goods and services to the members of the society in compensation for tax paid for such supplies. Some authors, like Samuelson and Nordhaus, (2010), choose to refer to it as 'the benefit principle', which succinctly "holds that individual should be taxed in proportion to the benefit they receive from government programs(programmes) "

For the purpose of this study therefore, such services include the various public infrastructure projects developed and provided by the state. The implication is that the more infrastructural provisions and benefits derived, the more public taxes are expected from the taxpayers, and that continues as a vicious circle.

3.2.2 The Faculty Theory of Taxation

The faculty theory of taxation is what is often referred to as the 'theory of ability-to-pay' in some literatures. In the work of Ade and Festus (2020), the theory is premised on the

fact that taxation should be levied according to each individual's ability to pay. It means the individual "faculty" to bear the tax burden. This is derived from Adam smith's "canon of equity: (which is) based on the principle of justice and ability to pay. It tells that people should pay taxes according to their respective abilities" (Lokanathan,2015). It means that payment of tax should come from "him that hath", instead of "him that hath not". Essentially, the theory suggests that those with higher ability to pay should contribute more in taxes compared to those with lower ability to pay. Hence, the position of Samuelson and Nordhaus, (2010) was apt that "usually tax systems organized on the ability-to-pay principles are also redistributive, meaning that the raised funds from higher-income people to increase the incomes and consumption of poorer groups". The implication of this is that the taxpayer makes sacrifice and pays to fund the infrastructural projects of the state for his own benefit, as well as the benefits of all other stakeholders. By so doing, the taxpayer subsidizes the payment for the nation's infrastructures.

3.2.3 The Wagner's Law of Increasing State Activity

'The Wagner's law', also known as 'the law of increasing state activity', is so named after Adolph Wagner (1835-1917) who was a German political economist. His proposition was an empirical law to analyze and explain trend in the growth of public expenditure. His argument was that there was a functional, cause and effect relationship existing between the growth of public sector. Thus, Wagner postulated "a fundamental connection between economic growth and public expenditure". As he observed, "increases in public spending are an inevitable consequence of economic growth. This means that share amount of public spending rises with an increase in the rate of output growth" (Olayiwola; Kum; and Bakare-Aremu, 2021).

The Wagner's law was derived from the historical experience of the continental Europe, with particular reference to Germany at the early stages of industrialization. The three postulations in Wagner's law, as listed in Emerenini and Ihugba (2014)'s research work, are as follows, that:

a. "the extension of the functions of the state(s) leads to an increase in public expenditure on administration and regulation of the economy
b. "the development of modern industrial society would give rise to increasing political pressure for social progress and call for increased allowance for social consideration in the conduct of industry; and
c. "the rise in public expenditure will be more than proportional increase in the national income (elastic wants) and will thus result in a relative expansion of the public sector".

Anoke, Odo, Chukwu, and Agabi (2016), in their review of Wagner's law, stressed that "thus, as nations become more advanced the member and degree of market failures would make the state to become more regulatory in nature, thereby increasing its role and this would inexorably involve more government spending…. As income rises, society would demand more education, entertainment, a more equitable distribution of wealth and generally more public services". Simply, in the explanation of Wagner's law, government spending is endogenous (or external) factor and a consequence of economic growth, rather than the cause it.

3.2.4 The Theory of Structural Functionalism

The *Encyclopedia Britannica* (2024) contains a detailed documentation of 'structural functionalism'. It has to do with how each of the institutions, relationships, roles, and norms which together constitute a society serves a purpose, and each is indispensable for

the continued existence of the others and of society as a whole. It is a sociological "theory (which) posits that the society is a system with interdependent parts that work together for the stability of the whole. It assumes that all parts must work together for the proper functioning of the whole" (Uyanah, John and Eyibio, 2021). Therefore, what is at play in such a scenario of interactions is for the "Interdependent parts" to "work together" for the proper functioning of the whole". The implication for the Nigerian nation, from the aforesaid, is that the executive, legislative and judiciary institutions of government must carry other parts and entities – including the non-governmental institutions – along, and work together, in the planning, execution and maintenance of infrastructural development projects. Projects should be undertaken based on the felt needs of the people. People in various communities should learn to take ownership of such infrastructures - such as roads, health, education, housing, transportation, telecommunication, and so on – and see to it that they are protected, maintained and preserved in order to derive the maximum benefits intended. The tax authorities of the various tiers of government must be well organized and strengthened through tax education so as to ensure a boost in tax revenue. As a corresponding effect, that would translate into building, development and maintenance of more public infrastructure. However, appropriate laws should be strengthened and applied where necessary so as to discourage and check corruption in the tax sector.

3.3 Empirical Review

Quite a number of works abound with reference to our topic of 'Tax Revenue, Institution and Public infrastructure in Nigeria'. Of course, the focus of the various researchers and the results of their works vary from one study to another. We will briefly discuss the results of such related works here.

Dibia and Onwuchekwa, (2019) based their work on '*Taxation and Economic Growth in Nigeria'*, and examined the linkages among company income tax (CIT), petroleum profit tax (PPT) and the economic growth of Nigeria as reflected in real Gross Domestic Production (RGDP) using time series data from 1981 to 2016. The tool employed was the Ex post-facto research design. The findings reveal that PPT and CIT have positive and significant on the RGDP in Nigeria. The study made some recommendations for the Nigerian government to act upon as follows: "put in place fiscal policies that will enhances investments in real sectors and create employment opportunities; endeavor to provide social amenities to all nooks and crannies of the country as this will boost the level of tax compliances in Nigeria; (and) create an enabling environment for entrepreneurship and innovation to enhance income generated from tax proceeds"

Okonkwo, Ikeotuonye Victor; and Chukwu, Kenechukwu Origin (2019) did a study on "*Government Tax Revenue and Economic Development in Nigeria*: *1996 – 2017'.* Vector Autoregressive Estimate was used in estimating the model in the analysis of data sourced from the Central Bank of Nigeria Statistical bulletin, United Nations Development Programme, and Federal Inland Revenue Service from 1998 to 2017. The research finding revealed that tax revenue has insignificant effect on human development index in Nigeria. As recommendations, there was the need for government to improve on tax collection rate by encouraging training of tax personnel enforcing tax laws. At the same time, tax revenue should be transparently and judiciously utilized in such manners that would accelerate economic development in wealth creation.

Okolie, (2021) researched into *'Administration of Local Government Revenue in Nigeria: Prospects and Challenges'.* He disclosed the problematic nature of administration of Local Government revenues which is as a result of corruption, overdependence on federal

allocation, incompetence, lack of diversification of internal sources of revenues, among others. In order to proffer solutions, the study did a historical background of Local Governments in Nigeria, reviewed the many sources of internal revenue available to the Local Government Councils and recommended that deliberate actions should be taken to intensify efforts in increasing internally generated revenue since revenue from Federal Account is declining by the day as a result of the volatility in crude oil prices.

Musa, Phillip and Ajibade, Olalekan Eyitayo (2016)'s study was on *'Local Government and Challenges of Revenue Allocation in Nigeria (A Study of Yewa South Local Government, Ogun State)'.* They noted that the Local Government exists primarily to provide services that make life worth living. Furthermore, as a third level of government, it is created to bring government closer to the people at the grassroot and to transform lives and the rural level. The purpose of the study was to examine local government and the challenges of revenue allocation in Nigeria, using Yewa South Local Government of Ogun State as a case study and to probe issues with revenue allocation among the three levels of government, with focus on the third level. The study employed both primary and secondary method of data collection. It was then concluded and recommended that the state joint local government account should be abolished as it gives state governments absolute control over the local governments.

Ibe, Ikenna U. (2017) did *'An Appraisal of the Legal and Administrative Framework for Taxation in Nigeria'.* He stressed the fact the taxation has become globally acknowledged as the most constant and the most reliable source of public revenue and finance. As a revenue source, tax is usually not subject to the vagaries of extraneous factors like the price of crude oil in international market. Therefore, as a chief source of internal revenue, tax provides stable base for budgetary projection. The utility of tax goes beyond its

revenue potential as it symbolizes the financial commitment of the electorates to the government they voluntarily and democratically elected. In line with the tax laws and the primary essence of tax, administrative agencies have been put in place to administer these taxes in Nigeria. The study looked at the legal and administrative framework for taxation in Nigeria. It was discovered, among other things, that tax agencies exist at each tier of government in Nigeria and they carry out the duties imposed on them by the law. However, the agencies are faced with some challenges which have in a way limited them from carrying out their duties. The study concluded that no matter how structurally beautiful a tax system may be, a corrupt and inept tax administrative machinery will make nonsense of its laudable provision. Hence the importance of an effective administrative structure that will ensure average compliance.

Ubi, and Udah, (2019) studied the *'Impact of Governance and Road Infrastructure on Industrial Growth in Nigeria'.* They tried to establish if there was any predicable relationship existing between industrial growth and infrastructure (governance and road) in Nigeria, using data from the period from 1980-2015. Using the vector Autogressive (VAR) model for the analysis, the estimated result showed that infrastructure (governance and road) has an important but restrictive role to play in driving industrial growth. The study recommended for appropriate governance frame work (good institutional and corruption free framework) to institutionalize best practices in policy formulation and implementation. Another recommendation was for government to allow for public-private participation in the construction, rehabilitation and maintenance of roads in other to fast track the nation's industrialization process.

Oyewumi, Otusanya and Adeyeye, (2020) researched on '*Infrastructural Development and Tax Compliance of Small and Medium Enterprises Owners in Lagos State*, *Nigeria'*.

It was survey research involving the use of primary data gathered by means of a well-structured likert linear scale questionnaire. Pearson correlation and multiple regression tools were adopted to text one hypothesis formulated for the study. The result showed that infrastructural development has a significant and positive influence on tax compliance of Small and Medium Enterprises (SME) owners. The study recommended that the Lagos State Government should make adequate and concerted efforts to develop the basis infrastructures in order to boost and increase tax compliance. It was imperative for the Government to monitor the execution of various capital projects to ensure that they were well delivered and enhance value for money.

Meagher, Kate (2018), researched on '*Taxing Times: Taxation, Divided Societies and the Informal Economy in Northern Nigeria'*, and challenged the nation that taxing the informal economy was a mechanism for political visibility and rebuilding of the social contract. With the fieldwork experience in northern Nigeria, the research showed that history, gender, wealth and ethno-religious identity were factors in shaping governance outcomes. With such inverse relationship between informal economy, taxation and political voice, there was a risk that would deepen and worsen social divisions rather than rebuild the social contract.

Igbodo, Atu, and Josiah, (2020), did a work on '*Using Tax Audit and Investigation to Boost Revenue Generation in Nigeria'*. The study adopted a theoretical approach to analyse, support and advocate the need for Government to explore the use of tax audit and investigation as sure way of boosting revenue generation, instead of too much reliance on borrowing and oil revenue, to fund infrastructural development. The study therefore recommended the following: (i) an urgent need for the government to enforce tax audit and investigation; (ii) the use of tax audit and tax investigation should be a regular

exercise, not adhoc; and (iii) strengthening of the capacity of the Federal Inland Revenue Service (FIRS) staff.

Aminu, and Mlanga, (2020) gave an '*Analysis of the Impact of Fiscal Policy on Economic Growth in Nigeria*: *1985 – 2019'*. The scholars assessed some fiscal policy variables on Nigeria's economic growth for the period from 1985 to 2019, utilizing ordinary least square regression method. The study revealed and confirmed a positive and significant effect of long term relationship between economic growth and government expenditure on economic/administrative services. Also, while there was significant relationship between economic growth and rate of inflation, effective fiscal policy framework was essential in aiding governments at boosting the economy represented by higher levels of GDP and lower level of rate of inflation. To boost the GDP and the overall performance of the economy, the following were recommended: Federal government to tilt the level of annual budgetary allocation in favour of economic services; productive government expenditure in conjunction with private sector investment plans should always outweigh expenditure on consumption and luxury items; and effective control of inflation rate as part and parcel of federal government's medium- and long-term expenditure frameworks.

Iormbagah, Eke, Ihendinihu, Nwaorgu, and Oti, (2020) titled their study on '*Informal Taxation and Economic Development in Nigeria'*. The study posited that informal taxation was the most effective way of self-governance and raising funds to confront the economic development challenges faced by the rural communities on account of government negligence. The study adopted a research survey which focused on rural communities. 200 questionnaires were administered randomly online using a 5 likert's scale of which 48 questionnaires were duly filled and returned to form the sample size analyzed. Inferential statistics (averages) and percentages were used for analysis of responses and data collected

from the questionnaires returned. The discovery was that funds mobilized through informal taxation mechanism contributed to infrastructural development in Nigeria except for health delivery. On the other hand, there was poor level of accountability in informal taxation process occasioned by poor awareness of the process and absence of accountability mechanisms put in place by community members. It was therefore recommended that government should assist community members to improve the informal taxation mechanisms by way of engaging public auditors to assess the process to ensure accountability. Also, government should partner communities who engage in informed taxation by way of financial assistance towards timely completion of projects, and to guarantee rapid economic development of the rural communities, especially in the area of health care delivery.

Aminu, (2020) investigated into the '*Impact of Education Tax and Investment in Human Capital on Economic Growth in Nigeria*'. He utilized the Non-Linear Autoregressive Distributed Lag Model of cointegration covering the period from 1995 to 2019. The findings showed that education tax and investment in human capital have positive and significant effect on the growth of the Nigerian economy over the sampled period. The following recommendations were therefore put forward: the need to provide a suitable environment to ensure macro-economic stability that would in turn encourage increase investment in the public sector education; collaboration and shared responsibility among the government, beneficiaries (students and parents), employers of labor and other stakeholders towards financing primary, secondary tertiary education in other to guarantee solid foundation for human capital formation for the country. Also, the federal government should continue to fund the operations of TETFUND (Tertiary Education Trust Fund) through education tax.

Omotosho, and Olaoye, (2020)'s research was on '*Government Budget Variables and Economic Growth in Nigeria (1981-2019)'.* Employing the use of Autoregressive distributive Lag, the research examined government budget variables and economic growth in Nigeria from 1981 to 2019 period. Budget variables were disaggregated into oil revenue, capital expenditure and recurrent expenditure, while economic growth was poxied with real GDP, using data sourced from the central Bank of Nigeria (CBN) statistical Bulletin (2019). Expo-factor research design was adopted. The discovery was that oil revenue and capital expenditure exerted a positive and significant pact on economic growth in Nigeria, while non-oil revenue and recurrent expenditure had a positive, but insignificant impact on the economic growth. It was then recommended for the government to focus on judicious public spending and diversification of the economy.

Oyedele, (2016) researched into '*Infrastructure Provision, Good Governance and Sustainable Development in Developing Nations'*. He stated that the essence of good governance is infrastructure provision. Inclusive governance enhances infrastructure success. Infrastructures are the goods and services in human habitats that ensure better standard of living for the people. The aim of infrastructures is to provide food, income, employment, shelter, security, education, transportation, communication, electricity, recreation, good health, and so on. Sustainable development of infrastructure involves carrying out needs assessment through survey to familiarize with the infrastructural requirements of the people in any area. This paper adopted the literature review methodology to assess the methods, challenges and motives for infrastructure provision in developing nations.

CHAPTER FOUR

THEORETICAL FRAMEWORK, MODEL SPECIFICATION AND METHODOLOGY

4.1 Theoretical Framework

This study is based on Wagner's theory. Wagner's theory, also known as Wagner's Law of Increasing State Activity, posits that as societies progress and expand economically, the role and activities of the state grow in response to the increasing needs and demands of the population. This theory can be used as a basis for studying the impact of tax revenue and institutional factors on public infrastructure. Wagner argued that as the economy develops, the government's responsibilities increase, leading to a larger public sector and higher public expenditure. This expenditure is financed through tax revenue, among other sources. In the context of infrastructural development, tax revenue plays a crucial role in funding public investment in infrastructure projects such as roads, bridges, schools, hospitals, and other public utilities.

The availability of tax revenue is influenced by various factors, including tax policies, economic growth, and tax compliance. Good governance factors, such as transparency, accountability, and efficiency in public administration, can also impact tax revenue generation and allocation towards infrastructure development. When good governance practices are in place, it enhances the effectiveness and efficiency of tax collection and utilization, leading to better infrastructure outcomes.

4.2 Model Specification

Infrastructural development model for Nigeria can be specified in a functional form as:

INFD = F (TREV, GGF, FDI, TPD) …….…… (1)

The econometric form of the model above is stated as follows:

$$INFD_t = \propto_0 + \propto_1 TREV_t + \propto_2 GGF_t + \propto_3 FDI_t + \propto_4 TPD_t + U_t \ldots\ldots\ldots\ldots (2)$$

Where:

INFD = Infrastructural development

TREV = Tax revenue

GGF = Good governance factors

FDI = Foreign direct investment

TPD= Total public debt

U = Stochastic error term

t = Time trend

$\propto_0, \propto_1, \propto_2, \propto_3, \propto_4,$ are parameters to be estimated.

Infrastructure development is proxied by gross fixed capital formation while good governance factors are proxied by a good governance index. In log linear, the model (equation 10) becomes:

$$LnINFD_t = \propto_0 + \propto_1 LnTREV_t + \propto_2 LnGGF_t + \propto_3 LnFDI_t + \propto_4 LnTPD_t + U_t \ldots (4)$$

Also, the error correction mechanism (ECM) is the main estimation technique for this study. Therefore, the ECM model for this study is stated as follows:

$$\Delta INFD_t = \propto_0 + \propto_1 lnTREV_t + \propto_2 lnGGF_t + \propto_3 lnFDI_t + \propto_4 lnTPD_t + \varepsilon ECM_{t-1} + U_t \ldots (5)$$

The coefficient of error correction term (ε) is expected to be negative ($\varepsilon < 0$) and significant as this is required to ensure the existence of a long run relationship and adjusted disequilibrium in the model (Narayan, 2005). In the same vein, the ECM_{t-1} indicates the one period lagged error correction term. It measures the effectiveness of the adjustment mechanism in stabilizing disequilibrium in the model. The numerical value of its coefficient indicates the speed of adjustment to equilibrium from the short run disequilibrium in the model.

Determining the Reliability of Estimated Results

In determining whether the estimates of the parameters are theoretically meaningful and statistically satisfactory, this study will make use of various criteria which may be classified into three groups. Firstly, economic or a priori criteria, which are determined by economic theory. Secondly, statistical criteria, determined by statistical theory. Thirdly, econometric criteria, determined by econometric theory (Koutsoyiannis, 1977).

Economic 'A priori' Criteria

These are determined by the principles of economic theory and refer to the sign and the size of the parameters of economic relationships (Koutsoyiannis, 1977). The economic criterion check is aimed at determining whether the signs and sizes of the estimated results are in conformity with economic theory. That is, it is concerned with ascertaining the consistency of parameter estimates with the signs and sizes postulated by theory. To this end, it is expected that the parameters estimate of this study conform with the theoretical postulation in terms of signs and sizes. Thus, the a priori expectations of this study are stated as follows:

$$\propto_0 > 0, \propto_1 > 0, \propto_2 > 0, \propto_3 > 0, \propto_4 > 0.$$

Where:

$\propto_0$ = Constant term

$\propto_1$ = Coefficient of tax revenue

$\propto_2$ = Coefficient of good governance factors

$\propto_3$ = Coefficient of foreign direct investment

$\propto_4$ = Coefficient of total public debt

Statistical Criteria (First-Order Tests)

These are determined by statistical theory and aim at the evaluation of the statistical reliability of the estimates of the parameters of the model (Koutsoyannis, 1977). The most commonly used statistical criteria are the correlation coefficient and the standard deviation (or standard error) of the estimates. The estimates of the parameters of the model are obtained from a sample of observations of the variables included in the relationship. The sampling theory of statistics prescribes some tests for finding out how accurate these estimates are.

It should be noted that the statistical criteria are secondary only to the a priori theoretical criteria. The estimates of the parameters should be rejected in general if they happen to have the 'wrong' sign (or size) even though the correlation coefficient is high, or the standard errors suggest that the estimates are statistically significant. In such cases, the parameters, though statistically satisfactory, are theoretically implausible, that is to say they make no sense on the basis of the a priori theoretical economic criteria (Koutsoyannis, 1977). In order to determine the statistical reliability of parameter estimates, there is the

need to carry out tests of significance. According to Gujarati (2004), a test of significance is a procedure by which a sample result is used to verify the truth or falsify a null hypothesis. It involves the following tests:

a. **Standard Error Test:** This test becomes imperative owing to the fact that sampling errors are inevitable in all estimates obtained from a given set of observations. Thus, it is necessary to measure the size or magnitude of the error and thereafter determine the degree of confidence in the validity of the estimates obtained (Koutsoyannis, 1977). This test helps us to decide whether the estimates are significantly different from zero i.e. whether the sample from which they have been estimated might have come from a population whose true parameters are zero (Koutsoyannis, 1977).

b. **The T-test:** This test is employed in determining the significance of the individual parameter estimates in the regression model. It will be used in testing the statistical significance of each regression coefficient at a given level of significance with n-k degrees of freedom and in this case, we will use a 5% level of significance. It is given as; $t_{\propto/2(n-k)}$, where; $t_{\propto/2(n-k)}$ = t-critical, $\propto$ = level of significance, n = sample size, k= total number of estimated parameters. Decision Rule: if $t_{cal} < t_{\propto/2(n-k)}$ at a given level of significance, we accept Ho and reject Hi but if $+t_{cal} > +t_{\propto/2(n-k)}$ We reject Ho and accept Hi. On the contrary, if $-t_{cal} < -t_{\propto/2(n-k)}$ at a given level of significance, we reject Ho and accept Hi but if $-t_{cal} > -t_{\propto/2(n-k)}$, we accept Ho and reject Hi.

c. F-test: This entails testing the overall significance of the regression model. That is, testing the significance of the regression result as against individual significance of the regressors. Therefore, the test can be said to be a joint hypothesis test employing the analysis of variance (ANOVA). Decision rule: if the computed

(calculated) F-value is greater than the critical (theoretical) value of F ($f_{\propto(k-1)(N-K)}$), then we say it is significant otherwise. It is not significant. The test aims at finding out whether the explanatory variables do actually have any significant influence on the dependent variable. Formally the test of the overall significance of the regression implies testing the null hypothesis (Koutsoyiannis, 1977).

d. R^2 and adjusted R^2 tests: When the explanatory variables are more than one we talk of multiple correlation (as is the case with this study). The square of the correlation coefficient is called the coefficient of multiple determination or squared multiple correlation coefficient. The coefficient of multiple determination is denoted by capital R^2 (Koutsoyiannis, 1977). The R^2 shows the percentage of the total variation in the dependent variable explained by the independent variables. The higher the value of R^2 the greater the percentage of the variation of the dependent variable explained by the regression plane, that is, the better the 'goodness of fit' of the regression plane to the sample observations. The closer the value of R^2 to zero, the worse the fit. According to Gujarati (2004) it is advisable to treat $\underline{R}^2$ as another summary statistic. The $\underline{R}^2$ is reported by most statistical packages along with the conventional R^2. The adjusted R^2 ($\underline{R}^2$) is meant to correct the defect that would arise from the addition of new regressor by taking into account the degrees of freedom, which clearly decrease as new regressors are introduced in the function (Koutsoyiannis, 1977). The $\underline{R}^2$ is reported as the multiple coefficients of determination adjusted to take into account the degree of freedom associated with the sums of squares. If n is large $\underline{R}^2$ and R^2 will not differ much. But with small samples, if the number of regressors is large in relation to the sample observations,

$\underline{R}^2$ will be much smaller than R^2 and can even assume negative values, in which case $\underline{R}^2$ should be interpreted as being equal to zero (Koutsoyiannis, 1977).

Econometric Criteria (Second-Order Test)

It is important to note that the statistical tests discussed above are valid only if the assumptions of the econometric method (ordinary least squares) employed are satisfied. If the U's do not have the assumed pattern for their behaviour the evidence provided by statistical tests is invalidated. Thus, in order to attach importance to R^2 or to the standard errors (or the t and f statistics) we should first make sure that the basic assumptions of classical least squares are satisfied in any particular case. In general, if the assumptions of an econometric method are violated in any application the estimates obtained from this method do not possess some or all of their optimal properties and/or their standard errors (and related t and f statistics) become unreliable criteria.

When the assumptions of an econometric technique are not satisfied it is customary to respecify the model (e.g. introduce new variables or omit some others, transform the original variables, etc) so as to produce a new form which meets the assumptions of the econometric theory. We then proceed with re-estimation of the new model and with re-application of all the tests. This process of re-specification of the model and re-estimation will continue until the results pass all the economic, statistical and econometric tests (Koutsoyannis, 1977).

Since we are dealing with time series, this study will conduct the following econometrics tests:

Autocorrelation test: This test is employed to check if the error terms corresponding to different observation are uncorrelated; testing for the randomness of the error term. Therefore, the Durbin-Watson (DW) method was utilized for this test.

Stability test: This test is used to ascertain whether or not the variables adopted for this study were stable over time at 5% level of significance. The CUSUM test is employed for this purpose.

Normality test: This test is carried out to check if the stochastic error term is normally distributed. The stochastic error term is normally distributed if it has a mean value of zero and a constant variance, that is:

$U = N\ (O, \sigma_i^2)$

4.3 Methodology

This study employs a multiple regression analysis with ordinary least squares (OLS) econometric technique. To prevent any difficulty that may arise from using a non-stationary time-series data to perform regression thereby leading to spurious regression, the study therefore employed Augmented Dickey-Fuller (ADF) test for unit root in order to achieve stationarity. The study also employed the Johansen cointegration test to assess the long run relationship between the variables adopted for the study. In addition, Error Correction Mechanism (ECM) is utilized to correct any form of disequilibrium in the short run. These methods of testing employed in this study are further explained as follows:

4.3.1 The Unit Root Test

The unit root test is the first formal pre-test to be conducted. It involves testing the stationarity of variables, and then the order of integration of the individual series under

consideration. Researchers have developed several procedures for the test of order of integration. The most common one is the Augmented Dickey-Fuller (ADF) test after Dickey and Fuller (1979, 1981). The Augmented Dickey-Fuller test depends on rejecting a null hypothesis of unit root (the series are non-stationary) in favour of the alternate hypothesis of stationarity. The test is conducted with and without a deterministic trend (t) for each of the series. Primarily, this test involves testing for the order of integration of each time series (variable). A series is considered to be integrated of order 1(1) if it needs to be differenced once to become stationary. The holds for an order 1(2) series which will need to be differenced twice to become stationary. Likewise, a stationary series is integrated in order of degree 1(0) if no differencing is required.

4.3.2 The Cointegration Test

Cointegration test is the second formal pre-test to be conducted. It involves testing for the presence or otherwise of cointegration between the series of the same order of integration. The basic idea behind co-integration is that if, in the long-run, two or more series move closely together, even though the series themselves are trended, the difference between them is constant. Therefore, it is possible to regard these series as defining a long-run equilibrium relationship. The absence of co-integration suggests that such variables have no long-run relationship, that is, they can wander arbitrarily far away from each other. The study employs the maximum – likelihood test procedure established by Johansen and Juselius (1990) and Johansen (1991). In order to determine the number of cointegration vectors, Johansen (1988, 1989) and Johansen and Juselius (1990) suggested two statistical tests. The first one is the trace test (trace). It tests the null hypothesis that the number of distinct cointegration vectors is less than or equal to q against a general unrestricted alternative.

4.3.3 The Error Correction Model

After ascertaining the existence of cointegration among the series, then an Error Correction Mechanism is constructed to correct for any disequilibrium in the short-run. The ECM adopted was first used by Sargan (1964) and later popularized by Engel and Granger (1969). In an ECM, the dynamics of both short-run (changes) and long-run (levels) adjustment processes are modeled simultaneously, thereby offering the possibility of revealing information about both the short-run and long-run relationship.

4.4 Sources of Data

The data for the study were culled from the Central Bank of Nigeria (CBN) statistical bulletin and world Development Indicators (WDI). All the variables were secondary data and measured in millions.

CHAPTER FIVE

PRESENTATION OF RESULTS AND DISCUSSION OF FINDINGS

5.0 Introduction

This chapter essentially covers the presentation and interpretation of results from pre-estimation tests, model estimation, diagnostic tests results, summary of the diagnostic test results, discussion of findings and policy implications of the results. The section starts with the descriptive statistics, followed by the statistical significance of the variables and then the unit root test, co-integration test, the autoregressive distributed lag (ARDL) model estimation and of course the diagnostics tests results and its summary of results. The chapter is concluded with discussion of findings as well as the policy implications of the results.

5.1 Pre-Estimation Tests

In this section, the descriptive statistics is first of all carried out showing coefficient that summarizes the variables. Then the variables are rigorously tested for their stationarity using the Augmented-Dickey Fuller (ADF) and the Philips-Perron (PP) tests. They were further tested to check the existence of long run relationship using the Johansen Co-integration test and the ARDL bounds test. Finally, the ARDL model was estimated to determine the relationship between the variables of the study. The various analyses alongside their results are what follows.

5.1.1 Descriptive Statistics

Descriptive statistics basically gives descriptive coefficients that summarizes a given set of variables. It includes measures of central tendency and measures of variability (spread).

Measures of central tendency include the mean, median, and mode while measures of variability include standard deviation, variance, minimum and maximum variables, kurtosis and skewness. The table below shows the summary statistics for the variable of this study:

Table 5.1: Summary of Descriptive Statistics

Measures	LNINFD	LNTREV	LNGGI	LNFDI	LNTPD
Mean	9.040667	6.001240	4.637325	4.217595	7.420503
Median	9.017509	6.120957	4.597138	4.884996	8.123315
Maximum	9.667111	8.764053	4.991992	7.222566	10.58547
Minimum	8.642745	2.395164	4.320922	-1.106181	2.604451
Std. Dev.	0.214403	2.197047	0.200854	2.902988	2.152686
Skewness	0.484126	-0.325590	0.281877	-0.645125	-0.641234
Kurtosis	3.426267	1.698870	1.751555	1.943460	2.465887
Jarque-Berra	1.911995	3.616499	3.205573	4.750912	3.297085
Probability	0.384429	0.163941	0.201335	0.092972	0.192330
Observations	41	41	41	41	41

Source: Researcher's Computation (2025) Using EViews 10.0

Table 5.1 presents the descriptive statistics for five variables: the log of infrastructural development (LNINFD), the log of total tax revenue (LNTREV), the log of good governance index (LNGGI), the log of foreign direct investment (LNFDI), and the log of total public debt (LNTBD), each measured across 41 observations.

For LNINFD, the average log value is 9.040667, with a median of 9.017509, suggesting a relatively symmetrical distribution. The values range from a minimum of 8.642745 to a maximum of 9.667111. The standard deviation is 0.214403, indicating that the values are clustered closely around the mean. The distribution exhibits a slight positive skewness of 0.484126 and a kurtosis of 3.426267, suggesting heavier tails and a sharper peak than a normal distribution. The Jarque-bera test statistic is 1.911995, with a probability of 0.384429, indicating that we fail to reject the null hypothesis of normality.

LTREV has a mean of 6.001240 and a median of 6.120957, implying a slight left skew. The values vary significantly, ranging from 2.395164 to 8.764053, with a standard

deviation of 2.197047. The skewness is -0.325590, the kurtosis is 1.698870, suggesting a platykurtic distribution. The Jarque-bera statistic is 3.616499, with a probability of 0.163941, again failing to reject normality.

LNGGI shows a mean of 4.637325 and a median of 4.597135, with values ranging from 4.320922 to 4.991792. The standard deviation is 0.200854, indicating low variability. The skewness is 0.281877, and the kurtosis is 1.751555, suggesting a platykurtic distribution. The Jarque-bera statistic is 3.205573, with a probability of 0.201335, indicating normality.

LNFDI has a mean of 4.217595 and a median of 4.884996, suggesting a left skew. The values range widely from -1.106181 to 7.222566, with a high standard deviation of 2.902988. The skewness is -0.645125, and the kurtosis is 1.943460, indicating a platykurtic distribution. The Jarque-bera statistic is 4.750912, with a probability of 0.092972, failing to reject normality.

LNTPD has a mean of 7.420503 and a median of 8.123315, indicating a left skew. The values range from 2.604451 to 10.58547, with a standard deviation of 2.152686. The skewness is -0.641234, and the kurtosis is 2.465887, suggesting a platykurtic distribution. The Jarque-bera statistic is 3.297085, with a probability of 0.192330, again failing to reject normality.

In summary, all five variables appear to be normally distributed based on the Jarque-bera statistic. LNTREV, LNFDI, and LNTPD exhibit higher variability and left skewness, while LNINFD and LNGGI show lower variability and slight right skewness. All variables have platykurtic distributions except LNINFD which is leptokurtic.

Table 5.2: Statistical Significance of Intercept and Trend for Each Variable

Variable	Term	t-Statistic	p-Value	Significance
LNINFD	Intercept	144.3110	0.0000	*
	Trend	2.533380	0.0154	*
LNTREV	Intercept	16.89732	0.0000	*
	Trend	29.16631	0.0000	*
LNGGI	Intercept	385.1902	0.0000	*
	Trend	34.27830	0.0000	*
LNFDI	Intercept	-1.242982	0.2213	*
	Trend	18.13302	0.0000	*
LNTPD	Intercept	20.53309	0.0000	*
	Trend	20.61417	0.0000	*

Source: Researcher's Computation (2025) Using EVIEWS 10.0
Where * indicates significance at 5% level

The tests results in Table 5.2 reveals that the trend is to be included when carrying out the unit root tests for the variables in the study as the probability values for all the variables are less than 0.05 at the 5% level of significance.

Lag Length Selection for Unit Root Test

In time series econometrics, accurately determining the appropriate lag length is crucial for effective unit root testing, which is fundamental for assessing the stationarity of the series. Lag length selection plays a vital role in the robustness of the unit root tests, influencing both the test's power and its ability to detect the correct number of lags. In unit root testing, the choice of lag length affects the test's ability to capture the true dynamics of the series. An insufficient number of lags can lead to autocorrelation of the residuals, while excessive lags can reduce test power and result in overfitting. To determine the optimal lag length, several criteria are employed which include sequential modified Likelihood Ratio test statistic (LR), Final Prediction Error (FPE), Akaike Information Criteria (AIC), Schwarz Information Criterion (SIC), and Hannan-Quin Information Criterion (HIQ). The results of these tests for this study are presented in the Table 4 below:

Table 5.3: Lag Length Selection Results for Unit Root Test

Lag Length	LR	FPE	AIC	SC	HQ
0	NA	6.98e-06	2.316393	2.534085	2.393140
1	338.6413	4.93e-10	-7.256167	-5.950018*	-6.795689
2	33.47554	5.68e-10	-7.192337	-4.797729	-6.348126
3	39.03199	4.23e-10	-7.699652	-4.216586	-6.471708
4	44.72100*	1.58e-10*	-9.143363*	-4.571839	-7.531687*

Source: Researcher's Computation (2025) Using EViews 10.

Where * indicates lag order selected by the criterion

Table 5.3 reveals that the optimal lag length according to LR, FPE, AIC and HQ is 4 while the optimal lag length according to SC is 1. However, the Schwarz Criterion (SC) is known to be more conservative and penalizes the inclusion of additional lags more heavily than the AIC, especially with smaller sample sizes. Given the sample size of 37, the SC might be more reliable in this case.\

5.1.3 Unit Root Tests (Test for Stationarity)

In econometrics, testing for stationarity is a crucial step in analyzing time series data. Stationarity implies that the statistical properties of a time series, such as mean and variance, remain constant over time. Stationarity tests help ensure that the underlying time series are suitable for further econometric modeling, such as cointegration analysis or time series regression models. The two major tests for checking stationarity in time series data are the Augmented Dickey-Fuller (ADF) and the Phillips-Perron (PP) tests.

Conducting these tests helps determine whether differencing or other transformations are necessary to achieve stationarity, ensuring the reliability and validity of subsequent econometric analyses. For the purpose of this study, the Augmented Dickey-Fuller (ADF) and the Phillips-Perron (PP) tests were conducted. The tables below illustrate the categorization of variables into either stationary or non-stationary, as well as the determination of their order of integration.

The table showing the results of the stationarity tests (ADF and PP) at both levels and first differences for each variable. The table includes the t-statistic, p-value, and conclusion regarding the stationarity for each test:

Table 5.4: Unit Root Tests Results (ADF & PP) at Level and First Difference

Variable	Test	Level/First Difference	t-Statistic	Critical	p-Value	Stationary
LNINFD	**ADF**	Level	-5.008449	-3.526609	0.0012	Yes
	PP	Level	-5.160547	-3.526609	0.0008	Yes
LNTRV	**ADF**	Level	-1.701126	-3.526609	0.7322	No
		First Difference	-6.938435	-3.529758	0.0000	Yes
	PP	Level	-1.701126	-3.526609	0.7322	No
		First Difference	-7.989456	-3.529758	0.0000	Yes
LNGGI	**ADF**	Level	-1.611756	-3.529758	0.7700	No
		First Difference	-3.630426	-3.529758	0.0400	Yes
	PP	Level	-1.410348	-3.526609	0.8426	No
		First Difference	-3.589323	-3.529758	0.043	Yes
LNFDI	**ADF**	Level	-0.557730	-3.526609	0.9762	No
		First Difference	-6.073515	-3.529758	0.0001	Yes
	PP	Level	-0.297198	-3.526609	0.9880	No
		First Difference	-6.529137	-3.529758	0.0000	Yes
LNTPD	ADF	Level	-2.359358	-3.526609	0.3941	No
		First Difference	-5.772298	-3.529758	0.0001	Yes
	PP	Level	-2.359934	-3.526609	0.3939	No
		First Difference	-5.773082	-3.529758	0.0148	Yes

Source: Researcher's Computation (2025) Using E-Views 10.0

Table 5.4 shows the results of the stationarity tests (ADF and PP) at both levels and first differences for each variable. The table includes the t-statistic, critical values, p-values, and conclusion regarding the stationarity for each test. At level, all the variables except LNINFD were non-stationary using the ADF test as the test fail to reject the null hypothesis of a unit root in the variables at the 5% level of significance. Also, using the PP test, all the variables were non-stationary except LNINFD at the same level of significance (5%). However, at first difference, all the variables were stationary using both the ADF and PP tests as the tests strongly reject the null hypothesis of a unit root in the variables at the 5% level of significance.

5.1.4 Cointegration Tests Results

In this subsection, we are to ascertain if there is a long-run relationship between LNINFD and the other variables (LNTREV, LNGGI, LFDI, and LTPD) using both the Johansen Cointegration and ARDL bounds tests. Table 6 presents the results of the tests:

Table 5.5a: Johansen Cointegration Test Results

Rank	Test Statistics	Trace Statistics	Critical Value (5%)	Max Eigen Statistics	Critical Value (5%)	P-Value (Trace)	P-Value (Max Eigen)
None*	R_1	128.3586	69.81889	57.46430	33.87687	0.0000	0.0000
At most 1*	R_2	70.89432	47.85613	36.07469	27.58434	0.0001	0.0032
At most 2*	R_3	34.81963	29.79707	22.81396	21.13162	0.0121	0.0287
At most 3	R_4	12.00567	15.49471	11.08316	14.26460	0.1567	0.1501
At most 4	R_5	0.922508	3.841466	0.922508	3.841466	0.3368	0.3368

Source: Researcher's Computation (2025) Using E-Views 10.0

Where * denotes the rejection of the null hypothesis at the 0.05 level of significance

From Table 5.5a, we reject the null hypothesis of no cointegration between the LNINFD and the other variables, which are LNTREV, LNGGI, LNFDI, and LNTPD at the 5% level of significance. It can be seen that both the trace statistics and max-eigen statistics indicate that there are three co-integrating equations at the 0.05 significance level implying a long run relationship among the variables utilized in this study. The finding of cointegration suggests that these variables move together in the long run, even though they may deviate from each other in the short run. These results are significant as they indicate that the variables are related in the long run.

Bounds Cointegration Test

In addition to the Johansen cointegration test, we shall also carry out the bounds test to confirm the existence of long run relationships among the variables in the model. The bounds test is essentially used to determine the existence of long run relationship between the variables in an ARDL model. The results of this test are presented below:

Table 5.5b: Bounds Cointegration Test Results

F-Statistic	Number of Regressors (K)	Significance Level	Lower Bound	Upper Bound	Remark
6.468564	4	10%	3.03	4.06	****
		5%	3.47	4.57	***
		2.5%	3.89	5.07	**
		1%	4.4	5.72	*

Source: Researcher's Computation (2025) Using E-Views 12.0

Where ****, ***, **, and * indicate 10%, 5%, 2.5%, and 1% significance level respectively.

Table 5.5b shows the results of the bounds testing carried out to determine the cointegration among the variables of the study. The bounds test entails comparing the F-Statistic of the model at a 5% significance level with both the lower and upper bound tests also at the 5% level of significance. The F-Statistic value of 6.468564 in the Table 7 exceeds both the lower and upper bound values of 3.47 and 4.57 respectively. This result indicates the presence of a long run relationship among the variables of the study. Hence, the null hypothesis, suggesting no cointegration among the variables of the study is rejected. Instead, the alternate hypothesis, which suggests cointegration among the variables under consideration is accepted.

Table 5.6: Lag Length Selection Criteria Results for the ARDL Model

Lag Length	LR	FPE	AIC	SC	HQ
0	NA	8.50e-06	2.513844	2.729315	2.590507
1	353.5793	5.10e-10	-7.219720	-5.926888*	-6.759740*
2	36.76057	5.24e-10	-7.265433	-4.895242	-6.507251
3	39.25284*	3.98e-10*	-7.733863*	-4.286314	-6.507251

Source: Researcher's Computation (2025) Using EViews 12.0

Where * indicates lag order selected by the criterion

Table 5.6 indicates that the optimal lag length according to LR, FPE, and AIC is 3 while SC and HQ suggest lag length 1. Since majority of the criteria recommends lag length 3, we therefore use lag length 3 as the optimal lag length for our ARDL model.

5.2 Model Estimation

In this section, we shall estimate the long run and short run autoregressive models. We begin by presenting the long run ARDL model as follows:

The Long Run ARDL Model Estimation

Dependent Variable: LNINFD

Method: Autoregressive Distributed Lag

Table 5.7: ARDL Long Run Estimation Result

Variable	Coefficient	Std. Error	t-Statistic	P-Value
LNTREV	0.347789	0.106911	3.253079	0.0038
LNGGI	-0.657788	1.461162	-0.450182	0.6572
LNFDI	0.026228	0.037761	0.694564	0.4949
LNTPD	0.128820	0.074267	1.734566	0.0975
…	…	…	…	…
Diagnostic Tests				
R-Squared	0.748369			
Adjusted R-Squared	0.568633			
F-Statistic	4.163711			
Prob. (F-Statistic)	0.001514			
Durbin-Watson (DW) Statistic	2.028761			

Source: Researcher's Computation (2025) Using E-Views 10.0

Table 5.7 presents the long-run estimation results from an Autoregressive Distributed Lag (ARDL) model, analyzing the factors influencing infrastructural development. The dependent variable is the natural logarithm of infrastructural development (LNINFD), and the independent variables are the natural logarithms of tax revenue (LNTREV), good governance index (LNGGI), foreign direct investment (LNFDI), and total public debt (LNTPD). The result reveals a statistically significant positive long-run relationship between tax revenue and infrastructural development. Specifically, a 1% increase in tax revenue is associated with a 0.3478% increase in infrastructural development, as indicated by the coefficient of 0.347789 and a p-value of 0.0038.

However, good governance index exhibits a negative long-run relationship with infrastructural development, with a coefficient of -0.657788, suggesting that 1% increase

in good governance index is associated with a 0.6578% decrease in infrastructural development. Nevertheless, this result is not statistically significant, as indicated by the p-value of 0.6572.

Similarly, foreign direct investment shows a positive long-run relationship with infrastructural development, with a coefficient of 0.026228, suggesting that a 1% increase in foreign direct investment is associated with a 0.0262% increase in infrastructural development. However, this result is also not statistically significant, with a p-value of 04949. Total public debt exhibits a marginally significant positive long-run relationship with infrastructural development, with a coefficient of 0.128820 and a p-value of 0.0975, suggesting that a 1% increase in total public debt is associated with a 0.1288% increase in infrastructural development.'

The model's overall fit is reasonably good, with an R-squared value of 0.748369, indicating that approximately 74.84% of the variation in infrastructural development is explained by the independent variables. The adjusted R-squared is 0.568633, providing a more conservative measure of the model's fit. The F-statistic of 4.163711, with a corresponding p-value of 0.001514, indicates that the model as a whole is statistically significant. The Durbin-Watson statistic of 2.02876 suggests the absence of significant autocorrelation in the residuals.

In a nutshell, the analysis indicates that tax revenue plays a crucial role in the long-run development of infrastructure, while the effects of good governance, foreign direct investment, and total public debt are either statistically insignificant or marginally significant.

The Short Run ARDL Model Estimation

Dependent Variable: D (LRGDP)

Table 5.8: ARDL Short Run Estimation Result

Variable	Coefficient	Std. Error	t-Statistic	P-Value
C	-0.183815	0.049350	-3.724742	0.0013
DLNINFD (-1)	0.249666	0.147800	1.689217	0.1060
DLNINFD (-2)	-0.371109	0.094897	-3.910633	0.0008
DLNTREV	0.022386	0.036810	0.608147	0.5496
DLNTREV (-1)	-0.293693	0.062610	-4.690838	0.0001
DLNTREV (-2)	-0.135236	0.042485	-3.183161	0.0045
DLNGGI	3.083711	1.511300	2.040436	0.0541
DLNGGI (-1)	0.672651	1.377608	0.488274	0.6304
DLNGGI (-2)	-3.602475	1.458058	-2.470735	0.0221
DLNTPD	-0.124870	0.060303	-2.070701	0.0509
CointEq (-1)	-1.251117	0.201627	-6.205107	0.0000
…	…	…	…	…
Diagnostic Tests				
R-Squared	0.902570			
Adjusted R-Squared	0.859700			
F-Statistic	21.05398			
Prob. (F-Statistic)	0.0000			
Durbin-Watson (DW) Statistic	2.028761			

Source: Researcher's Computation (2025) Using E-Views 10.0

The results of the short run ARDL model in Table 5.8 shows the short run dynamics of infrastructural development (DLNIFD), revealing several significant relationships. The constant term (C) has a negative coefficient of -183815, which is statistically significant at the 5% level with a p-value of 0.0225, indicating that in the absence of other influencing factors, the dependent variable has a negative starting point. Examining the lagged effects of infrastructural, the immediate past change (one period lag) does not significantly impact the current change in infrastructural development. However, a significant negative impact is observed from the change in infrastructural development two periods ago, with a coefficient of -0.371109, implying potential overcorrection or cyclical behaviour.

Tax revenue also shows a significant lagged effect. An increase in tax revenue in the previous period significantly decreases current infrastructural development, with a

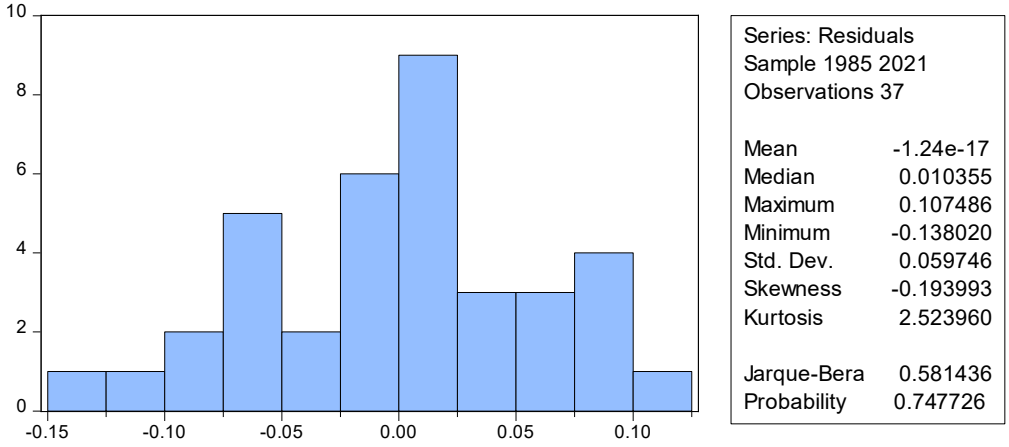
coefficient of -0.293693. Similarly, an increase in tax revenue two periods ago also negatively affects current infrastructural development, though to a lesser extent (-0.135236). Good governance index (LNGGI), a proxy for public institutions, has a complex relationship with infrastructural development. An immediate improvement in good governance significantly increases infrastructural development, with a coefficient of 3.083711. However, a lagged effect two periods ago shows a significant negative impact (-3.602475), suggesting that the influence of institutions may involve intricate dynamics over time. Total public debt (LNTPD) negatively impacts infrastructural development in the short run. An increase in public debt significantly decreases infrastructural development, with a coefficient of -0.124870.

The R-squared value of 0.902570 indicates that approximately 90.26% of the variation in infrastructural development is explained by the model. The adjusted R-squared of 0.859700 accounts for the number of predictors in the model and remains high, suggesting a good model fit. The slight difference between R-squared and adjusted R-squared shows that the model is well fitted. The F-statistic value of 21.05398 with its probability value of 0.0000 indicates that the model is highly statistically significant, meaning that the predictors, as a whole, significantly explain the variation in infrastructural development. The Durbin-Watson statistic of 2.028761 suggests that there is no major autocorrelation issue.

5.3 Diagnostic Tests

Diagnostic tests are tests conducted to check for the normality of the model, the stability of the model, and also to check for serial correlation, heteroscedasticity and multi-collinearity. This is to ensure that the model passes the econometric criteria. The test results are summarized in the table below.

Figure 5.1: Normality Test Result



Source: Researcher's Computation (2025) Using E-Views 10.0

Table 5.9: Serial Correlation Test Result

Test Statistics	Value	DF	P-Value	Conclusion
Breusch-Godfrey F-Statistic	1.228881	3	0.3382	No evidence of serial correlation

Source: Researcher's Computation (2025) Using E-Views 10.0

Table 5.10: Heteroskedasticity Test Result

Test Statistics	Value	DF	P-Value	Conclusion
Breusch-Pagan-Godfrey F-Statistic	0.493353	6	0.9176	No evidence of heteroskedasticity

Source: Researcher's Computation (2025) Using E-Views 10.0

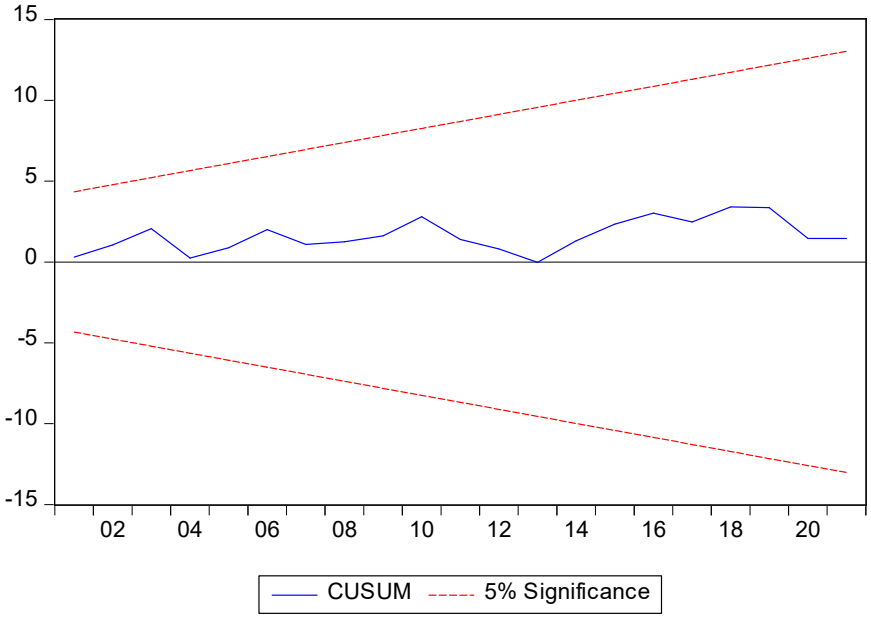
Table 5.11: Multicollinearity (VIF) Test Results

Variable	VIF Value	Conclusion
LNINFD (-1)	2.333981	No multicollinearity
LNINFD (-2)	1.893824	No multicollinearity
LNINFD (-3)	1.574120	No multicollinearity
LNTREV	1.644597	No multicollinearity
LNTREV (-1)	1.938760	No multicollinearity
LNTREV (-2)	1.862885	No multicollinearity
LNTREV (-3)	1.773997	No multicollinearity
LNGGI	2.599317	No multicollinearity
LNGGI (-1)	3.429562	No multicollinearity
LNGGI (-2)	2.223342	No multicollinearity
LNGGI (-3)	2.502399	No multicollinearity
LNFDI	1.670670	No multicollinearity
LNTPD	2.651399	No multicollinearity
LNTPD (-1)	2.626411	No multicollinearity

Source: Researcher's Computation (2025) Using E-Views 10.0

Stability Test Result

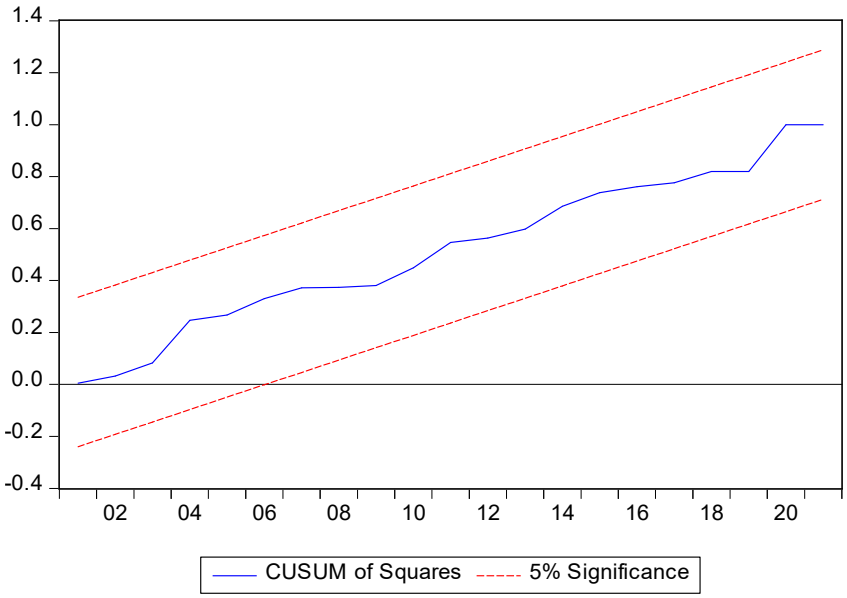
Figure 5.2a: CUSUM Test



Source: Researcher's (2025) Using E-Views 10.0

Figure 5.2ashows that the parameters of the model are stable over the sampled period since the cumulative sum of residuals (CUSUM) plot (the blue line) stays within the confidence band (the red lines).

Figure 5.2b: CUSUM of Squares Test



Source: Researcher's (2025) Using E-Views 10.0

Figure 5.2b shows that the parameters of the model are stable over the sampled period since the cumulative sum of squares of residuals (CUSUM) plot (the blue line) stays within the confidence band (the red lines). This confirms the result in Figure 6.

Table 5.12: Summary of the Diagnostic Tests Results

Test	Method	Prob. Value	Conclusion
Normality	Histogram Normality Test	0.747726	Normally Distributed
Serial Correlation	Breusch-Godfrey Serial Correlation LM Test	0.3382	No serial correlation
Heteroskedasticity	Breusch-Pagan-Godfrey Heteroskedasticity Test	0.9176	Homoscedastic (equal spread)
Multicollinearity	Variance Inflation Factor	1.645 to 3.430	No multicollinearity
Stability	CUSUM test and CUSUM of Squares	Blue line within red lines	Stable

Source: Researcher's Compilation (2025)

Having performed the diagnostic tests, the results are compiled in the Table 5.12 and fully shown in appendix VIII. The Histogram normality test shows that the distribution is normally distributed. The Breusch-Godfrey Serial Correlation LM test was used to test for autocorrelation in the model and with a probability result greater than 0.05, it implies the absence of autocorrelation. This reaffirms the Durbin-Watson statistics test already carried out earlier. The results of the Breusch-Pagan-Godfrey Heteroskedasticity test indicates the absence of heteroscedasticity in the model. There is also stability of parameters in the model as seen in the CUSUM test and CUSUM of squares test.

5.4 Discussion of Findings

This study examines the impact of tax revenue and institutional quality on public infrastructure development in Nigeria using an ARDL model. The findings reveal that tax revenue plays a significant role in driving infrastructure development in the long run, while institutional quality, foreign direct investment (FDI), and public debt exhibit varying effects across different time horizons. The results indicate that tax revenue has a

statistically significant positive effect on infrastructure development in the long run, with a coefficient of 0.3478. This suggests that an increase in tax revenue leads to a corresponding increase in infrastructure investment. This finding aligns with the work of Ogbonna and Appah (2016), who argued that tax revenue enhances government spending on infrastructure in Nigeria. Similarly, Owolabi and Okwu (2011) found that tax revenue significantly contributes to public investment, particularly in transportation and energy projects. However, the short-run analysis presents a contrasting result, showing that previous periods' tax revenue negatively impacts infrastructure development. This may indicate inefficiencies in fiscal management, delays in project execution, or misallocation of funds, as noted by Egbulonu and Amadi (2020), who highlighted that while tax revenue is essential for infrastructure financing, short-term leakages and bureaucratic inefficiencies can limit its immediate benefits.

The study also finds that institutional quality, as measured by the good governance index (GGI), has a negative but statistically insignificant long-run effect on infrastructure development. This contradicts the findings of Acemoglu and Robinson (2012), who emphasized that strong institutions foster economic development, including infrastructure expansion. However, the short-run results show a more complex relationship, where an immediate improvement in governance significantly enhances infrastructure development, but the lagged effect suggests a negative impact. This implies that while governance reforms may initially facilitate infrastructure projects, delays in implementation, policy reversals, or political instability may offset these gains over time. Akinlo (2019) similarly observed that governance improvements in Nigeria often suffer from inconsistencies, leading to mixed impacts on public investment.

The role of FDI in infrastructure development appears to be weak in this study. The long-run results show a positive but statistically insignificant effect, indicating that foreign investments do not significantly drive infrastructure expansion. This is consistent with Asiedu (2006), who found that FDI inflows to Africa often target extractive industries rather than infrastructure. In contrast, studies such as Adegbite and Olayemi (2021) suggest that in countries with strong institutional frameworks, FDI plays a more significant role in infrastructure financing. The findings suggest that Nigeria's institutional challenges may be limiting the effectiveness of FDI in infrastructure development, highlighting the need for policy reforms that attract infrastructure-oriented foreign investment.

Public debt is another key factor examined in the study, with the results showing a marginally significant positive long-run relationship with infrastructure development. The coefficient of 0.1288 suggests that an increase in public debt is associated with increased infrastructure investment. This finding supports Iyoha (1999), who argued that public debt, when effectively managed, can contribute positively to infrastructure financing. However, the short-run analysis paints a different picture, as public debt has a significant negative effect on infrastructure development. This suggests that excessive debt servicing costs may be crowding out public investment in the short term, a concern also raised by Ajayi and Oke (2012), who emphasized that Nigeria's rising debt burden reduces fiscal space for infrastructure spending.

The error correction term (-1.2511) is highly significant, indicating a strong long-run equilibrium relationship among the variables. This suggests that any short-term shocks to infrastructure development are quickly corrected, reinforcing the importance of stable macroeconomic policies. The model also demonstrates a good fit, with an R-squared of

0.748 in the long run and 0.902 in the short run, indicating that a substantial portion of the variation in infrastructure development is explained by the independent variables. Additionally, the Durbin-Watson statistic of 2.03 suggests no major autocorrelation issues, further supporting the robustness of the results.

In a nutshell, this study provides evidence that tax revenue is a crucial driver of infrastructure development in Nigeria, highlighting the need for enhanced tax administration and efficient public spending. However, the inconsistent impact of institutional quality suggests that governance reforms must be sustained and effectively implemented to improve infrastructure outcomes. The weak influence of FDI underscores the need for policy efforts to create an investment-friendly environment that attracts infrastructure-oriented foreign capital. Finally, while public debt contributes to infrastructure financing in the long run, its short-run negative effect highlights the need for prudent debt management to avoid excessive fiscal pressure. These findings contribute to the ongoing discourse on public infrastructure financing in Nigeria and provide empirical support for policies that strengthen tax collection, institutional governance, and strategic debt management.

5.5 Policy Implications of Findings

The findings of this study provide several critical policy implications for improving public infrastructure development in Nigeria. The results indicate that tax revenue is a significant driver of infrastructure development in the long run. This underscores the need for policymakers to enhance tax collection mechanisms and ensure efficient allocation of tax revenue towards infrastructure projects. Tax reforms aimed at expanding the tax base, reducing tax evasion, and improving compliance could significantly enhance government revenue and its capacity to finance infrastructure. Additionally, strengthening fiscal

transparency and accountability in the utilization of tax revenue would ensure that funds are effectively directed towards critical infrastructure needs rather than being misallocated or lost to corruption.

The mixed impact of institutional quality suggests that while governance improvements can positively influence infrastructure development, the effectiveness of these improvements depends on sustained and consistent implementation. Policymakers should focus on strengthening institutional frameworks by promoting transparency, reducing bureaucratic inefficiencies, and enhancing the rule of law. This would create a stable environment for infrastructure investments and improve public confidence in government projects. Strengthening anti-corruption measures within infrastructure procurement and project execution is essential to ensure that governance improvements translate into tangible infrastructure outcomes. The weak and statistically insignificant impact of foreign direct investment (FDI) on infrastructure development suggests that Nigeria has not been able to attract sufficient infrastructure-targeted foreign investments. This calls for policies that enhance the investment climate by reducing regulatory bottlenecks, improving legal protections for investors, and offering incentives for private sector participation in infrastructure financing. Public-private partnerships (PPPs) should be promoted as a viable strategy for mobilizing private investment in infrastructure projects. Additionally, ensuring macroeconomic stability, strengthening institutional quality, and reducing political risk would help attract long-term FDI in infrastructure sectors.

The findings on public debt indicate that while debt contributes to infrastructure financing in the long run, it negatively impacts infrastructure development in the short run. This highlights the need for prudent debt management policies that balance borrowing for infrastructure development with sustainable debt servicing. Policymakers should prioritize

concessional loans and external borrowing with favorable terms to avoid excessive debt burdens. Moreover, debt-financed infrastructure projects should be carefully evaluated to ensure their long-term economic viability and ability to generate returns that can offset debt servicing costs. Fiscal discipline and transparency in debt management are crucial to preventing debt crises that could undermine infrastructure development efforts.

Finally, the significant and negative error correction term suggests that deviations from equilibrium in infrastructure development are quickly corrected. This implies that policymakers should focus on maintaining a stable macroeconomic environment and implementing long-term infrastructure plans that can withstand short-term shocks. Strategic infrastructure planning, backed by consistent funding and institutional support, would ensure that infrastructure development remains a priority in Nigeria's economic agenda.

In sum, the study highlights the importance of enhancing tax revenue collection, strengthening institutional quality, attracting infrastructure-focused FDI, and managing public debt effectively to improve public infrastructure development in Nigeria. A coordinated policy approach that integrates fiscal discipline, institutional reforms, and private sector participation is necessary to address Nigeria's infrastructure deficits and promote sustainable economic growth.

CHAPTER SIX

SUMMARY OF FINDINGS, CONCLUSION AND RECOMMENDATIONS

6.1 Introduction

This chapter begins with the summary of findings of the analyses carried out in the previous chapter. Based on the findings, the entire study is concluded. Thereafter, recommendations are made for policy implementation and further studies.

6.2 Summary of Findings

This study reveals a significant long-run relationship between tax revenue and infrastructure development in Nigeria, suggesting that increased tax revenue effectively drives infrastructure investment. However, short-run analysis indicates potential inefficiencies in fiscal management, as previous periods' tax revenue shows a negative impact. Institutional quality presents a complex picture; while its long-run effect is statistically insignificant, short-run analysis demonstrates an initial positive impact followed by a negative lagged effect, highlighting implementation challenges. Foreign Direct Investment (FDI) exhibits a weak, statistically insignificant positive impact, suggesting Nigeria struggles to attract infrastructure-focused foreign capital. Public debt shows a marginally significant positive long-run relationship, but a significant negative short-run effect, indicating that debt servicing may crowd out infrastructure spending in the immediate term. Notably, the error correction term signifies a strong long-run equilibrium among the variables, implying rapid correction of short-term shocks. The model demonstrates a good fit, with high R-squared values and no major autocorrelation issues, confirming the robustness of these findings.

6.3 Conclusion

In conclusion, this study underscores the critical role of tax revenue in driving infrastructure development in Nigeria, emphasizing the need for enhanced tax administration and efficient public spending. The inconsistent impact of institutional quality highlights the necessity for sustained and effective governance reforms to improve infrastructure outcomes. The weak influence of FDI points to the need for policies that create an investment-friendly environment for infrastructure-oriented foreign capital. While public debt contributes to infrastructure financing in the long run, its short-run negative effect necessitates prudent debt management to avoid excessive fiscal pressure. Overall, the study emphasizes the importance of enhancing tax revenue collection, strengthening institutional quality, attracting infrastructure-focused FDI, and managing public debt effectively to improve public infrastructure development in Nigeria.

6.4 Recommendations

6.4.1 Policy Recommendations

As a way of addressing the findings of this study, policymakers should prioritize enhancing tax revenue collection through improved tax administration, expanded tax bases, and reduced evasion, ensuring efficient allocation of funds to infrastructure projects. Strengthening fiscal transparency and accountability is also crucial. Concurrently, institutional quality must be improved by promoting transparency, reducing bureaucratic inefficiencies, and enhancing the rule of law, with a focus on anti-corruption measures in infrastructure procurement and project execution. To attract infrastructure-focused FDI, Nigeria should create a more favorable investment climate by reducing regulatory bottlenecks, offering incentives, and promoting public-private partnerships, while ensuring macroeconomic stability. Prudent public debt management is essential, balancing

borrowing for infrastructure with sustainable debt servicing, prioritizing concessional loans, and carefully evaluating debt-financed projects. Finally, maintaining macroeconomic stability and implementing long-term infrastructure plans are vital to withstand short-term shocks. A coordinated policy approach that integrates fiscal discipline, institutional reforms, and private sector participation is necessary to address Nigeria's infrastructure deficits and promote sustainable economic growth.

6.4.2 Recommendations for Further Studies

Future studies should focus on:

i. Disaggregated Tax Revenue Analysis: Future research could examine the impact of different types of tax revenue on infrastructural development. This would help policymakers understand which tax sources contribute most effectively to infrastructure financing.
ii. Sector-Specific Infrastructure Development: While this study assesses infrastructure development broadly, future studies could analyze sectors such as transportation, energy, or telecommunications to determine which areas benefit most from tax revenue and public spending.
iii. Comparative Studies across African Countries: A comparative study between Nigeria and other African countries with similar economic structures could provide insights into best practices for enhancing infrastructure financing through tax revenue and foreign direct investment.
iv. Institutional Quality and Infrastructure Performance: Given the mixed findings on institutional quality, future research could focus on specific governance factors such as corruption, perception, bureaucratic efficiency, and regulatory quality to identify the precise roles in infrastructure development.

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Appendix I

Data Collected

YEAR	INFD	TREV	GGI	FDI	TPD
1981	15,789.67	11.43	75.258	0.33082	13.5238
1982	12,893.80	11.35	76.983	0.35685	23.827
1983	10,198.26	10.97	78.708	0.37136	32.7991
1984	7,121.28	11.68	80.433	0.38382	40.4808
1985	6,032.26	14.98	82.158	0.43217	45.2497
1986	6,045.46	12.27	83.883	0.94924	69.8911
1987	5,668.87	25.38	85.608	1.83	137.5782
1988	6,047.75	27.59	87.333	2.01	180.9859
1989	6,441.90	54.42	**89.058**	3.18	287.4433
1990	7,331.16	60.27	89.058	4.73	382.7075
1991	7,240.29	81.04	89.058	6.08	444.6525
1992	7,277.43	122.23	89.058	11.09	722.2258
1993	7,825.69	71.619	89.058	14.79	906.9808
1994	7,633.27	82.444	89.058	15.38	1056.396
1995	7,126.18	181.96	89.058	17.45	1194.599
1996	7,610.32	233.217	89.058	88	1037.296
1997	8,055.21	292.998	89.058	109.09	1097.683
1998	8,167.45	247.169	89.058	109.72	1193.847
1999	8,385.96	227.4	94.4	97.9	3372.181
2000	8,996.91	455.3	96.8	116.41	3995.638
2001	6,860.44	586.6	99.2	132.29	4193.265
2002	7,559.73	433.9	101.6	191.71	5098.886
2003	9,178.17	703.1	104	259.61	5808.009
2004	7,348.34	1194	106.4	451.23	6260.595
2005	7,520.47	1740	108.8	658.15	4220.979
2006	10,557.89	1870	111.2	757.73	3177.409
2007	8,246.21	1850	113.6	761.73	4559.053
2008	8,031.72	2970	116	977.59	2813.49
2009	8,828.81	2197	118.4	906.4	3808.471
2010	9,183.06	2840	120.8	906.41	5241.668
2011	8,425.76	4630	123.2	1370	6519.6
2012	8,640.77	5000	125.6	1110	7554.258
2013	9,320.35	4810	128	886.17	10044.2
2014	10,570.47	4710	130.4	774.83	11243.12
2015	10,432.23	3740	132.8	589.87	12603.71
2016	9,927.26	3310	135.2	1130	16296.71
2017	9,631.70	4030	137.6	1070	20373.43
2018	10,569.60	5320	140	1020	24387.07
2019	11,445.86	5260	142.4	1200	27401.38
2020	9,761.50	4950	144.8	910.59	32915.52
2021	10,216.82	6400	147.2	1360	39556.03

Sources: World Development Indicators (WDI, 2024), Central Bank of Nigeria Statistical Bulletin (CBN, 2024), National Bureau of Statistics Statistical Bulletin (NBS, 2024), Federal Inland Revenue Service (2024).

Note: All data are in billions of naira.

Appendix II

Descriptive Statistics

	LNINFD	LNTREV	LNGGI	LNFDI	LNTPD
Mean	9.040667	6.001240	4.637325	4.217595	7.420503
Median	9.017509	6.120957	4.597138	4.884996	8.123315
Maximum	9.667111	8.764053	4.991792	7.222566	10.58547
Minimum	8.642745	2.395164	4.320922	-1.106181	2.604451
Std. Dev.	0.214403	2.197047	0.200854	2.902988	2.152686
Skewness	0.484126	-0.325590	0.281877	-0.645125	-0.641234
Kurtosis	3.426267	1.698870	1.751555	1.943460	2.465887
Jarque-Bera	1.911995	3.616499	3.205573	4.750912	3.297085
Probability	0.384429	0.163941	0.201335	0.092972	0.192330
Sum	370.6673	246.0508	190.1303	172.9214	304.2406
Sum Sq. Dev.	1.838752	193.0807	1.613693	337.0936	185.3623
Observations	41	41	41	41	41

Statistical Significance of Variables for Unit Root Testing

Dependent Variable: LNINFD
Method: Least Squares
Date: 03/24/25 Time: 07:12
Sample: 1981 2021
Included observations: 41

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	8.906105	0.061715	144.3110	0.0000
@TREND	0.006728	0.002656	2.533380	0.0154

R-squared	0.141310	Mean dependent var	9.040667
Adjusted R-squared	0.119292	S.D. dependent var	0.214403
S.E. of regression	0.201209	Akaike info criterion	-0.3213

			94
Sum squared resid	1.578918	Schwarz criterion	-0.237805
Log likelihood	8.588576	Hannan-Quinn criter.	-0.290956
F-statistic	6.418013	Durbin-Watson stat	0.473047
Prob(F-statistic)	0.015429		

Dependent Variable: LNTREV
Method: Least Squares
Date: 03/24/25 Time: 07:18
Sample: 1981 2021
Included observations: 41

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	2.414420	0.142888	16.89732	0.0000
@TREND	0.179341	0.006149	29.16631	0.0000

R-squared	0.956164	Mean dependent var	6.001240
Adjusted R-squared	0.955040	S.D. dependent var	2.197047
S.E. of regression	0.465858	Akaike info criterion	1.357681
Sum squared resid	8.463941	Schwarz criterion	1.441270
Log likelihood	-25.83246	Hannan-Quinn criter.	1.388119
F-statistic	850.6738	Durbin-Watson stat	0.431032
Prob(F-statistic)	0.000000		

Dependent Variable: LNGGI
Method: Least Squares
Date: 03/24/25 Time: 07:20
Sample: 1981 2021

Included observations: 41

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	4.307416	0.011183	385.1902	0.0000
@TREND	0.016495	0.000481	34.27830	0.0000

R-squared	0.967875	Mean dependent var	4.637325
Adjusted R-squared	0.967051	S.D. dependent var	0.200854
S.E. of regression	0.036459	Akaike info criterion	-3.737725
Sum squared resid	0.051840	Schwarz criterion	-3.654136
Log likelihood	78.62336	Hannan-Quinn criter.	-3.707286
F-statistic	1175.002	Durbin-Watson stat	0.092891
Prob(F-statistic)	0.000000		

Dependent Variable: LNFDI
Method: Least Squares
Date: 03/24/25 Time: 07:23
Sample: 1981 2021
Included observations: 41

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.364982	0.293634	-1.242982	0.2213
@TREND	0.229129	0.012636	18.13302	0.0000

R-squared	0.893966	Mean dependent var	4.217595
Adjusted R-squared	0.891247	S.D. dependent var	2.902988

S.E. of regression	0.957339	Akaike info criterion	2.798232
Sum squared resid	35.74341	Schwarz criterion	2.881821
Log likelihood	-55.36375	Hannan-Quinn criter.	2.828670
F-statistic	328.8063	Durbin-Watson stat	0.134262
Prob(F-statistic)	0.000000		

Dependent Variable: LNTPD
Method: Least Squares
Date: 03/24/25 Time: 07:26
Sample: 1981 2021
Included observations: 41

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	3.980825	0.193874	20.53309	0.0000
@TREND	0.171984	0.008343	20.61417	0.0000

R-squared	0.915938	Mean dependent var	7.420503
Adjusted R-squared	0.913783	S.D. dependent var	2.152686
S.E. of regression	0.632088	Akaike info criterion	1.967976
Sum squared resid	15.58189	Schwarz criterion	2.051565
Log likelihood	-38.34350	Hannan-Quinn criter.	1.998414
F-statistic	424.9441	Durbin-Watson stat	0.172202
Prob(F-statistic)	0.000000		

Lag Length Selection Criterion

VAR Lag Order Selection Criteria
Endogenous variables: LNINFD LNTREV LNGGI LNFDI LNTPD
Exogenous variables: C

Date: 03/24/25 Time: 07:39
Sample: 1981 2021
Included observations: 37

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-37.85328	NA	6.98e-06	2.316393	2.534085	2.393140
1	164.2391	338.6413	4.93e-10	-7.256167	-5.950018*	-6.795689
2	188.0582	33.47554	5.68e-10	-7.192337	-4.797729	-6.348126
3	222.4436	39.03199	4.23e-10	-7.699652	-4.216586	-6.471708
4	274.1522	44.72100*	1.58e-10*	-9.143363*	-4.571839	-7.531687*

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion

Unit Root Tests with ADF
At Level
Null Hypothesis: LNINFD has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on SIC, maxlag=1)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-5.008449	0.0012
Test critical values:	1% level	-4.205004	
	5% level	-3.526609	
	10% level	-3.194611	

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

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LNINFD)
Method: Least Squares
Date: 03/24/25 Time: 08:08
Sample (adjusted): 1982 2021
Included observations: 40 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNINFD(-1)	-0.418162	0.083491	-5.008449	0.0000
C	3.647311	0.744042	4.902023	0.0000
@TREND("1981")	0.005867	0.001535	3.822441	0.0005

R-squared	0.446801	Mean dependent var	-0.010883
Adjusted R-squared	0.416898	S.D. dependent var	0.137234
S.E. of regression	0.104794	Akaike info criterion	-1.601608
Sum squared resid	0.406323	Schwarz criterion	-1.474942
Log likelihood	35.03217	Hannan-Quinn criter.	-1.555810
F-statistic	14.94182	Durbin-Watson stat	2.197753
Prob(F-statistic)	0.000018		

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

	t-Statistic	Prob.*

Augmented Dickey-Fuller test statistic		-1.611756	0.7700
Test critical values:	1% level	-4.211868	
	5% level	-3.529758	
	10% level	-3.196411	

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

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LNGGI)
Method: Least Squares
Date: 03/24/25 Time: 08:22
Sample (adjusted): 1983 2021
Included observations: 39 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNGGI(-1)	-0.070593	0.043799	-1.611756	0.1160
D(LNGGI(-1))	0.512104	0.144489	3.544255	0.0011
C	0.308828	0.187639	1.645861	0.1087
@TREND("1981")	0.001262	0.000730	1.727666	0.0929

R-squared	0.304365	Mean dependent var	0.016621
Adjusted R-squared	0.244739	S.D. dependent var	0.011212
S.E. of regression	0.009744	Akaike info criterion	-6.327461
Sum squared resid	0.003323	Schwarz criterion	-6.156839
Log likelihood	127.3855	Hannan-Quinn criter.	-6.266243
F-statistic	5.104580	Durbin-Watson stat	2.289055
Prob(F-statistic)	0.004912		

Null Hypothesis: LNFDI has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on SIC, maxlag=1)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-0.557730	0.9762
Test critical values:	1% level	-4.205004	
	5% level	-3.526609	
	10% level	-3.194611	

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

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LNFDI)
Method: Least Squares
Date: 03/24/25 Time: 08:25
Sample (adjusted): 1982 2021
Included observations: 40 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNFDI(-1)	-0.033183	0.059496	-0.557730	0.5804
C	0.368896	0.117278	3.145491	0.0033
@TREND("1981")	-0.001141	0.014757	-0.077336	0.9388

R-squared	0.096823	Mean dependent var	0.208036
Adjusted R-squared	0.048003	S.D. dependent var	0.350135
S.E. of regression	0.341628	Akaike info criterion	0.761850
Sum squared resid	4.318261	Schwarz criterion	0.888516
Log likelihood	-12.23701	Hannan-Quinn criter.	0.807649
F-statistic	1.983260	Durbin-Watson stat	1.929948
Prob(F-statistic)	0.151980		

3

Null Hypothesis: LNTPD has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on SIC, maxlag=1)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.359358	0.3941
Test critical values:	1% level	-4.205004	
	5% level	-3.526609	
	10% level	-3.194611	

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

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LNTPD)
Method: Least Squares
Date: 03/24/25 Time: 08:29
Sample (adjusted): 1982 2021
Included observations: 40 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNTPD(-1)	-0.143425	0.060790	-2.359358	0.0237
C	0.873870	0.243193	3.593324	0.0009
@TREND("1981")	0.018468	0.011018	1.676165	0.1021

R-squared	0.201199	Mean dependent var	0.199526
Adjusted R-squared	0.158020	S.D. dependent var	0.260812
S.E. of regression	0.239320	Akaike info criterion	0.050007
Sum squared resid	2.119137	Schwarz criterion	0.176673
Log likelihood	1.999860	Hannan-Quinn	0.095858

	7	criter.	05
	4.65970		1.8624
F-statistic	3	Durbin-Watson stat	67
	0.01567		
Prob(F-statistic)	2		

At First Difference
Null Hypothesis: D(LNTREV) has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on SIC, maxlag=1)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-6.938435	0.0000
Test critical values:	1% level	-4.211868	
	5% level	-3.529758	
	10% level	-3.196411	

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

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LNTREV,2)
Method: Least Squares
Date: 03/24/25 Time: 08:32
Sample (adjusted): 1983 2021
Included observations: 39 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LNTREV(-1))	-1.140307	0.164346	-6.938435	0.0000
C	0.279213	0.111812	2.497153	0.0172
@TREND("1981")	-0.004521	0.004449	-1.016151	0.3163

	0.57217	Mean dependent	0.0067
R-squared	0	var	68
Adjusted R-	0.54840		0.4608
squared	2	S.D. dependent var	94
	0.30972	Akaike info	0.5675
S.E. of regression	5	criterion	42

Sum squared resid	3.453472	Schwarz criterion	0.695508
Log likelihood	-8.067064	Hannan-Quinn criter.	0.613455
F-statistic	24.07280	Durbin-Watson stat	2.083713
Prob(F-statistic)	0.000000		

Null Hypothesis: D(LNGGI) has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on SIC, maxlag=1)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-3.630426	0.0400
Test critical values:	1% level	-4.211868	
	5% level	-3.529758	
	10% level	-3.196411	

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

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LNGGI,2)
Method: Least Squares
Date: 03/24/25 Time: 08:35
Sample (adjusted): 1983 2021
Included observations: 39 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LNGGI(-1))	-0.528043	0.145449	-3.630426	0.0009
C	0.006462	0.003900	1.656809	0.1062
@TREND("1981")	0.000107	0.000144	0.742700	0.4625

R-squared	0.268370	Mean dependent var	-0.000160
Adjusted R-	0.22772	S.D. dependent var	0.0113

squared	4		31
S.E. of regression	0.009958	Akaike info criterion	-6.307146
Sum squared resid	0.003570	Schwarz criterion	-6.179180
Log likelihood	125.9894	Hannan-Quinn criter.	-6.261233
F-statistic	6.602609	Durbin-Watson stat	2.173761
Prob(F-statistic)	0.003608		

Null Hypothesis: D(LNFDI) has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on SIC, maxlag=1)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-6.073515	0.0001
Test critical values:	1% level	-4.211868	
	5% level	-3.529758	
	10% level	-3.196411	

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

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LNFDI,2)
Method: Least Squares
Date: 03/24/25 Time: 08:38
Sample (adjusted): 1983 2021
Included observations: 39 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LNFDI(-1))	-1.017545	0.167538	-6.073515	0.0000
C	0.432796	0.136261	3.176229	0.0031
@TREND("1981"	-	0.005191	-	0.0533

)	0.010372	1.997902	

R-squared	0.506106	Mean dependent var	0.008344
Adjusted R-squared	0.478667	S.D. dependent var	0.475819
S.E. of regression	0.343557	Akaike info criterion	0.774878
Sum squared resid	4.249140	Schwarz criterion	0.902844
Log likelihood	-12.11012	Hannan-Quinn criter.	0.820791
F-statistic	18.44506	Durbin-Watson stat	1.999233
Prob(F-statistic)	0.000003		

Null Hypothesis: D(LNTPD) has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on SIC, maxlag=1)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-5.772298	0.0001
Test critical values:	1% level	-4.211868	
	5% level	-3.529758	
	10% level	-3.196411	

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

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LNTPD,2)
Method: Least Squares
Date: 03/24/25 Time: 08:40
Sample (adjusted): 1983 2021
Included observations: 39 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LNTPD(-1))	-0.950397	0.164648	-5.772298	0.0000

C	0.285827	0.103605	2.758826	0.0091
@TREND("1981")	-0.005030	0.003815	-1.318302	0.1957

R-squared	0.481800	Mean dependent var	-0.009810
Adjusted R-squared	0.453011	S.D. dependent var	0.346677
S.E. of regression	0.256398	Akaike info criterion	0.189633
Sum squared resid	2.366639	Schwarz criterion	0.317599
Log likelihood	-0.697835	Hannan-Quinn criter.	0.235546
F-statistic	16.73563	Durbin-Watson stat	2.000432
Prob(F-statistic)	0.000007		

Unit Root Tests with PP
At Level

Null Hypothesis: LNINFD has a unit root
Exogenous: Constant, Linear Trend
Bandwidth: 1 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-5.160547	0.0008
Test critical values:	1% level	-4.205004	
	5% level	-3.526609	
	10% level	-3.194611	

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

Residual variance (no correction)	0.010158
HAC corrected variance (Bartlett kernel)	0.008718

Phillips-Perron Test Equation
Dependent Variable: D(LNINFD)
Method: Least Squares
Date: 03/24/25 Time: 08:45
Sample (adjusted): 1982 2021
Included observations: 40 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNINFD(-1)	-0.418162	0.083491	-5.008449	0.0000
C	3.647311	0.744042	4.902023	0.0000
@TREND("1981")	0.005867	0.001535	3.822441	0.0005

R-squared	0.446801	Mean dependent var	-0.010883
Adjusted R-squared	0.416898	S.D. dependent var	0.137234
S.E. of regression	0.104794	Akaike info criterion	-1.601608
Sum squared resid	0.406323	Schwarz criterion	-1.474942
Log likelihood	35.03217	Hannan-Quinn criter.	-1.555810
F-statistic	14.94182	Durbin-Watson stat	2.197753
Prob(F-statistic)	0.000018		

Null Hypothesis: LNTREV has a unit root
Exogenous: Constant, Linear Trend
Bandwidth: 0 (Newey-West automatic) using Bartlett kernel

	Adj. t-Stat	Prob.*
Phillips-Perron test statistic	-	0.7322

		1.701126
Test critical values:	1% level	-4.205004
	5% level	-3.526609
	10% level	-3.194611

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

Residual variance (no correction)	0.082999
HAC corrected variance (Bartlett kernel)	0.082999

Phillips-Perron Test Equation
Dependent Variable: D(LNTREV)
Method: Least Squares
Date: 03/24/25 Time: 08:50
Sample (adjusted): 1982 2021
Included observations: 40 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNTREV(-1)	-0.183463	0.107848	-1.701126	0.0973
C	0.623359	0.255222	2.442414	0.0195
@TREND("1981")	0.030399	0.020106	1.511881	0.1391

R-squared	0.085500	Mean dependent var	0.158195
Adjusted R-squared	0.036068	S.D. dependent var	0.305099
S.E. of regression	0.299547	Akaike info criterion	0.498946
Sum squared resid	3.319946	Schwarz criterion	0.625612
Log likelihood	-6.978921	Hannan-Quinn criter.	0.544744
F-statistic	1.729644	Durbin-Watson stat	2.021311
Prob(F-statistic)	0.191379		

Null Hypothesis: LNGGI has a unit root
Exogenous: Constant, Linear Trend
Bandwidth: 4 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-1.410348	0.8426
Test critical values:	1% level	-4.205004	
	5% level	-3.526609	
	10% level	-3.194611	

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

Residual variance (no correction)	0.000115
HAC corrected variance (Bartlett kernel)	0.000281

Phillips-Perron Test Equation
Dependent Variable: D(LNGGI)
Method: Least Squares
Date: 03/24/25 Time: 08:54
Sample (adjusted): 1982 2021
Included observations: 40 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNGGI(-1)	-0.041367	0.049346	-0.838297	0.4072
C	0.191326	0.211836	0.903182	0.3723
@TREND("1981")	0.000825	0.000824	1.001470	0.3231

R-squared	0.041934	Mean dependent var	0.016772
Adjusted R-	-	S.D. dependent var	0.011111

squared	0.009853		08
S.E. of regression	0.011163	Akaike info criterion	-6.080392
Sum squared resid	0.004611	Schwarz criterion	-5.953726
Log likelihood	124.6078	Hannan-Quinn criter.	-6.034594
F-statistic	0.809735	Durbin-Watson stat	1.016600
Prob(F-statistic)	0.452705		

Null Hypothesis: LNFDI has a unit root
Exogenous: Constant, Linear Trend
Bandwidth: 5 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-0.297198	0.9880
Test critical values:	1% level	-4.205004	
	5% level	-3.526609	
	10% level	-3.194611	

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

Residual variance (no correction)	0.107957
HAC corrected variance (Bartlett kernel)	0.079386

Phillips-Perron Test Equation
Dependent Variable: D(LNFDI)

Method: Least Squares
Date: 03/24/25 Time: 08:57
Sample (adjusted): 1982 2021
Included observations: 40 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNFDI(-1)	-0.033183	0.059496	-0.557730	0.5804
C	0.368896	0.117278	3.145491	0.0033
@TREND("1981")	-0.001141	0.014757	-0.077336	0.9388

R-squared	0.096823	Mean dependent var	0.208036
Adjusted R-squared	0.048003	S.D. dependent var	0.350135
S.E. of regression	0.341628	Akaike info criterion	0.761850
Sum squared resid	4.318261	Schwarz criterion	0.888516
Log likelihood	-12.23701	Hannan-Quinn criter.	0.807649
F-statistic	1.983260	Durbin-Watson stat	1.929948
Prob(F-statistic)	0.151983		

Null Hypothesis: LNTPD has a unit root
Exogenous: Constant, Linear Trend
Bandwidth: 1 (Newey-West automatic) using Bartlett kernel

	Adj. t-Stat	Prob.*
Phillips-Perron test statistic	-	0.3939

		2.359934
Test critical values:	1% level	-4.205004
	5% level	-3.526609
	10% level	-3.194611

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

Residual variance (no correction)	0.052978
HAC corrected variance (Bartlett kernel)	0.056544

Phillips-Perron Test Equation
Dependent Variable: D(LNTPD)
Method: Least Squares
Date: 03/24/25 Time: 08:59
Sample (adjusted): 1982 2021
Included observations: 40 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNTPD(-1)	-0.143425	0.060790	-2.359358	0.0237
C	0.873870	0.243193	3.593324	0.0009
@TREND("1981")	0.018468	0.011018	1.676165	0.1021

R-squared	0.201199	Mean dependent var	0.199526
Adjusted R-squared	0.158020	S.D. dependent var	0.260812
S.E. of regression	0.239320	Akaike info criterion	0.050007
Sum squared resid	2.119137	Schwarz criterion	0.176673
Log likelihood	1.999867	Hannan-Quinn criter.	0.095805
F-statistic	4.659703	Durbin-Watson stat	1.862467
Prob(F-statistic)	0.015672		

At First Difference

Null Hypothesis: D(LNTREV) has a unit root
Exogenous: Constant, Linear Trend
Bandwidth: 10 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-7.989456	0.0000
Test critical values:	1% level	-4.211868	
	5% level	-3.529758	
	10% level	-3.196411	

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

Residual variance (no correction)	0.088551
HAC corrected variance (Bartlett kernel)	0.036476

Phillips-Perron Test Equation
Dependent Variable: D(LNTREV,2)
Method: Least Squares
Date: 03/24/25 Time: 09:02
Sample (adjusted): 1983 2021
Included observations: 39 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.

D(LNTREV(-1))	-1.140307	0.164346	-6.938435	0.0000
C	0.279213	0.111812	2.497153	0.0172
@TREND("1981")	-0.004521	0.004449	-1.016151	0.3163

R-squared	0.572170	Mean dependent var	0.006768
Adjusted R-squared	0.548402	S.D. dependent var	0.460894
S.E. of regression	0.309725	Akaike info criterion	0.567542
Sum squared resid	3.453472	Schwarz criterion	0.695508
Log likelihood	-8.067064	Hannan-Quinn criter.	0.613455
F-statistic	24.07280	Durbin-Watson stat	2.083713
Prob(F-statistic)	0.000000		

Null Hypothesis: D(LNGGI) has a unit root
Exogenous: Constant, Linear Trend
Bandwidth: 2 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-3.589323	0.0439
Test critical values:	1% level	-4.211868	
	5% level	-3.529758	
	10% level	-3.196411	

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

Residual variance (no correction)	9.15E-05
HAC corrected variance (Bartlett kernel)	8.74E-05

Phillips-Perron Test Equation
Dependent Variable: D(LNGGI,2)
Method: Least Squares
Date: 03/24/25 Time: 09:05
Sample (adjusted): 1983 2021
Included observations: 39 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LNGGI(-1))	-0.528043	0.145449	-3.630426	0.0009
C	0.006462	0.003900	1.656809	0.1062
@TREND("1981")	0.000107	0.000144	0.742700	0.4625

R-squared	0.268370	Mean dependent var	-0.000160
Adjusted R-squared	0.227724	S.D. dependent var	0.011331
S.E. of regression	0.009958	Akaike info criterion	-6.307146
Sum squared resid	0.003570	Schwarz criterion	-6.179180
Log likelihood	125.9894	Hannan-Quinn criter.	-6.261233
F-statistic	6.602609	Durbin-Watson stat	2.173761
Prob(F-statistic)	0.003608		

Null Hypothesis: D(LNFDI) has a unit root
Exogenous: Constant, Linear Trend
Bandwidth: 11 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-6.529137	0.0000
Test critical values:	1% level	-4.211868	
	5% level	-3.529758	
	10% level	-3.196411	

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

Residual variance (no correction)	0.108952
HAC corrected variance (Bartlett kernel)	0.047024

Phillips-Perron Test Equation
Dependent Variable: D(LNFDI,2)
Method: Least Squares
Date: 03/24/25 Time: 09:07
Sample (adjusted): 1983 2021
Included observations: 39 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LNFDI(-1))	-1.01754	0.167538	-6.073515	0.0000

C	0.432796	0.136261	3.176229	0.0031
@TREND("1981")	-0.010372	0.005191	-1.997902	0.0533

R-squared	0.506106	Mean dependent var	0.008344
Adjusted R-squared	0.478667	S.D. dependent var	0.475819
S.E. of regression	0.343557	Akaike info criterion	0.774878
Sum squared resid	4.249140	Schwarz criterion	0.902844
Log likelihood	-12.11012	Hannan-Quinn criter.	0.820791
F-statistic	18.44506	Durbin-Watson stat	1.999233
Prob(F-statistic)	0.000003		

Null Hypothesis: D(LNTPD) has a unit root
Exogenous: Constant, Linear Trend
Bandwidth: 2 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-5.773082	0.0001
Test critical values:	1% level	-4.211868	
	5% level	-3.529758	
	10% level	-3.196411	

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

Residual variance (no correction)	0.060683
HAC corrected variance (Bartlett kernel)	0.060920

Phillips-Perron Test Equation
Dependent Variable: D(LNTPD,2)
Method: Least Squares
Date: 03/24/25 Time: 09:10
Sample (adjusted): 1983 2021
Included observations: 39 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LNTPD(-1))	-0.950397	0.164648	-5.772298	0.0000
C	0.285827	0.103605	2.758826	0.0091
@TREND("1981")	-0.005030	0.003815	-1.318302	0.1957

R-squared	0.481800	Mean dependent var	-0.009810
Adjusted R-squared	0.453011	S.D. dependent var	0.346677
S.E. of regression	0.256398	Akaike info criterion	0.189633
Sum squared resid	2.366639	Schwarz criterion	0.317599
Log likelihood	-0.697835	Hannan-Quinn criter.	0.235546
F-statistic	16.73563	Durbin-Watson stat	2.000432
Prob(F-statistic)	0.000007		

Cointegration Test

Date: 03/24/25 Time: 14:16

Sample (adjusted): 1984 2021
Included observations: 38 after adjustments
Trend assumption: Linear deterministic trend
Series: LNINFD LNTREV LNGGI LNFDI LNTPD
Lags interval (in first differences): 1 to 2

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.779580	128.3586	69.81889	0.0000
At most 1 *	0.613001	70.89432	47.85613	0.0001
At most 2 *	0.451390	34.81963	29.79707	0.0121
At most 3	0.252979	12.00567	15.49471	0.1567
At most 4	0.023984	0.922508	3.841466	0.3368

Trace test indicates 3 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.779580	57.46430	33.87687	0.0000
At most 1 *	0.613001	36.07469	27.58434	0.0032

At most 2 *	0.451390	22.81396	21.13162	0.0287
At most 3	0.252979	11.08316	14.26460	0.1501
At most 4	0.023984	0.922508	3.841466	0.3368

Max-eigenvalue test indicates 3 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level

**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegrating Coefficients (normalized by b'*S11*b=I):

LNINFD	LNTREV	LNGGI	LNFDI	LNTPD
-9.372968	1.001150	-0.194070	-0.627951	0.590391
0.713546	7.505995	-27.58857	-4.515748	1.068812
2.280387	-1.351060	1.882571	1.984793	-0.934912
1.261697	0.345751	-14.56495	-0.638677	1.852521
4.639781	-4.521838	23.05931	1.597470	0.516180

Unrestricted Adjustment Coefficients (alpha):

D(LNINFD)	0.090972	0.009629	0.021196	0.002972	0.000286
D(LNTREV)	0.031545	-0.148819	-0.040218	0.028948	0.024494
D(LNGGI)	-0.000537	-0.003950	0.002673	0.000343	-0.000930
D(LNFDI)	0.043933	-0.058111	-0.165669	0.084697	-0.000436
D(LNTPD)	-0.003348	-0.074425	-0.026873	-0.062586	-0.021953

1 Cointegrating Equation(s):		Log likelihood	191.4962

Normalized cointegrating coefficients (standard error in parentheses)

LNINFD	LNTREV	LNGGI	LNFDI	LNTPD
1.000000	-0.106813	0.020705	0.066996	-0.062989
	(0.09518)	(0.42516)	(0.05679)	(0.02730)

Adjustment coefficients (standard error in parentheses)

D(LNINFD)	-0.852680
	(0.10913)

D(LNTREV)	-0.295668
	(0.48047)
D(LNGGI)	0.005036
	(0.01622)
D(LNFDI)	-0.411783
	(0.56723)
D(LNTPD)	0.031381
	(0.39517)

2 Equation(s):	Cointegrating	Log likelihood	209.5336

Normalized cointegrating coefficients (standard error in parentheses)

LNINFD	LNTREV	LNGGI	LNFDI	LNTPD
1.000000	0.000000	-0.368150	0.002708	-0.047299
		(0.16638)	(0.01830)	(0.02566)
0.000000	1.000000	-3.640540	-0.601876	0.146891
		(0.30486)	(0.03354)	(0.04701)

Adjustment coefficients (standard error in parentheses)

D(LNINFD)	-0.845809	0.163353
	(0.10800)	(0.08700)
D(LNTREV)	-0.401858	-1.085453
	(0.39613)	(0.31911)
D(LNGGI)	0.002218	-0.030184
	(0.01455)	(0.01172)
D(LNFDI)	-0.453248	-0.392195
	(0.55870)	(0.45007)
D(LNTPD)	-0.021725	-0.561986
	(0.37181)	(0.29952)

3 Equation(s):	Cointegrating	Log likelihood	220.9406

Normalized cointegrating coefficients (standard error in parentheses)

LNINFD	LNTREV	LNGGI	LNFDI	LNTPD
1.000000	0.000000	0.000000	-0.192630	0.058058

			(0.06304)	(0.08265)
0.000000	1.000000	0.000000	-2.533527	1.188743
			(0.57763)	(0.75730)
0.000000	0.000000	1.000000	-0.530594	0.286181
			(0.15941)	(0.20899)

Adjustment coefficients (standard error in parentheses)

D(LNINFD)	-0.797475	0.134717	-0.243408
	(0.10360)	(0.08239)	(0.29620)
D(LNTREV)	-0.493571	-1.031115	4.023865
	(0.40042)	(0.31842)	(1.14476)
D(LNGGI)	0.008313	-0.033795	0.114101
	(0.01409)	(0.01120)	(0.04027)
D(LNFDI)	-0.831038	-0.168365	1.282779
	(0.48140)	(0.38282)	(1.37627)
D(LNTPD)	-0.083004	-0.525680	2.003341
	(0.37918)	(0.30154)	(1.08405)

---

4 Equation(s):	Cointegrating	Log likelihood	226.4821

Normalized cointegrating coefficients (standard error in parentheses)

LNINFD	LNTREV	LNGGI	LNFDI	LNTPD
1.000000	0.000000	0.000000	0.000000	-0.089089
				(0.01189)
0.000000	1.000000	0.000000	0.000000	-0.746587
				(0.11655)
0.000000	0.000000	1.000000	0.000000	-0.119134
				(0.01999)
0.000000	0.000000	0.000000	1.000000	-0.763888
				(0.14359)

Adjustment coefficients (standard error in parentheses)

D(LNINFD)	-0.793725	0.135745	-0.286698	-0.060439
	(0.10433)	(0.08235)	(0.33427)	(0.05362)
D(LNTREV)	-0.457048	-1.021107	3.602239	0.553906
	(0.40000)	(0.31573)	(1.28161)	(0.20557)
D(LNGGI)	0.008745	-0.033677	0.109109	0.023259
	(0.01419)	(0.01120)	(0.04547)	(0.00729)

D(LNFDI)	-0.724176	-0.139081	0.049177	-0.148088
	(0.45764)	(0.36124)	(1.46630)	(0.23520)
D(LNTPD)	-0.161968	-0.547319	2.914897	0.324823
	(0.36317)	(0.28667)	(1.16362)	(0.18665)

Lag Length Criterion for ARDL Model

VAR Lag Order Selection Criteria
Endogenous variables: LNINFD LNTREV LNGGI LNFDI LNTPD
Exogenous variables: C
Date: 03/25/25 Time: 06:19
Sample: 1981 2021
Included observations: 38

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-42.76303	NA	8.50e-06	2.513844	2.729315	2.590507
1	167.1747	353.5793	5.10e-10	-7.219720	-5.926888*	-6.759740*
2	193.0432	36.76057	5.24e-10	-7.265433	-4.895242	-6.422137
3	226.9434	39.25284*	3.98e-10*	-7.733863*	-4.286314	-6.507251

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

Static ARDL Model

Dependent Variable: DLNINFD
Method: ARDL

Date: 03/25/25 Time: 06:27
Sample (adjusted): 1985 2021
Included observations: 37 after adjustments
Maximum dependent lags: 3 (Automatic selection)
Model selection method: Akaike info criterion (AIC)
Dynamic regressors (3 lags, automatic): DLNTREV DLNGGI DLNFDI

DLNTPD
Fixed regressors: C @TREND
Number of models evalulated: 768
Selected Model: ARDL(3, 3, 3, 0, 1)

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
DLNINFD(-1)	-0.001451	0.149263	-0.009723	0.9923
DLNINFD(-2)	-0.620775	0.131479	-4.721472	0.0001
DLNINFD(-3)	0.371109	0.117212	3.166140	0.0047
DLNTREV	0.022386	0.053233	0.420529	0.6784
DLNTREV(-1)	0.119046	0.057772	2.060610	0.0519
DLNTREV(-2)	0.158456	0.056721	2.793599	0.0109
DLNTREV(-3)	0.135236	0.055363	2.442707	0.0235
DLNGGI	3.083711	1.836203	1.679396	0.1079
DLNGGI(-1)	-3.234030	2.102972	-1.537838	0.1390
DLNGGI(-2)	-4.275125	1.687652	-2.533180	0.0193
DLNGGI(-3)	3.602475	1.783823	2.019525	0.0564
DLNFDI	0.032814	0.046645	0.703478	0.4895
DLNTPD	-	0.080606	-	0.1363

	0.124870		1.549131	
DLNTPD(-1)	0.286039	0.080216	3.565841	0.0018
C	-0.183815	0.074645	-2.462538	0.0225
@TREND	0.004522	0.002160	2.093019	0.0487

R-squared	0.748369	Mean dependent var	0.009755
Adjusted R-squared	0.568633	S.D. dependent var	0.119104
S.E. of regression	0.078226	Akaike info criterion	-1.959972
Sum squared resid	0.128504	Schwarz criterion	-1.263359
Log likelihood	52.25948	Hannan-Quinn criter.	-1.714383
F-statistic	4.163711	Durbin-Watson stat	2.028761
Prob(F-statistic)	0.001514		

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

ARDL Long Run Form and Bounds Test

ARDL Long Run Form and Bounds Test
Dependent Variable: D(DLNINFD)
Selected Model: ARDL(3, 3, 3, 0, 1)
Case 5: Unrestricted Constant and Unrestricted Trend
Date: 03/25/25 Time: 06:28
Sample: 1981 2021
Included observations: 37

Conditional Error Correction Regression

Variable	Coefficient	Std. Error	t-Statistic	Prob.

C	-0.183815	0.074645	-2.462538	0.0225
@TREND	0.004522	0.002160	2.093019	0.0487
DLNINFD(-1)*	-1.251117	0.246973	-5.065805	0.0001
DLNTREV(-1)	0.435125	0.152538	2.852558	0.0095
DLNGGI(-1)	-0.822970	1.902658	-0.432537	0.6698
DLNFDI**	0.032814	0.046645	0.703478	0.4895
DLNTPD(-1)	0.161169	0.094040	1.713834	0.1013
D(DLNINFD(-1))	0.249666	0.175440	1.423083	0.1694
D(DLNINFD(-2))	-0.371109	0.117212	-3.166140	0.0047
D(DLNTREV)	0.022386	0.053233	0.420529	0.6784
D(DLNTREV(-1))	-0.293693	0.094285	-3.114957	0.0052
D(DLNTREV(-2))	-0.135236	0.055363	-2.442707	0.0235
D(DLNGGI)	3.083711	1.836203	1.679396	0.1079
D(DLNGGI(-1))	0.672651	1.901199	0.353803	0.7270
D(DLNGGI(-2))	-3.602475	1.783823	-2.019525	0.0564
D(DLNTPD)	-0.124870	0.080606	-1.549131	0.1363

* p-value incompatible with t-Bounds distribution.
** Variable interpreted as Z = Z(-1) + D(Z).

Levels Equation

Case 5: Unrestricted Constant and Unrestricted Trend

Variable	Coefficient	Std. Error	t-Statistic	Prob.
DLNTREV	0.347789	0.106911	3.253079	0.0038
DLNGGI	-0.657788	1.461162	-0.450182	0.6572
DLNFDI	0.026228	0.037761	0.694564	0.4949
DLNTPD	0.128820	0.074267	1.734566	0.0975

EC = DLNINFD - (0.3478*DLNTREV -0.6578*DLNGGI + 0.0262*DLNFDI +
0.1288*DLNTPD)

F-Bounds Test		Null Hypothesis: No levels relationship		
Test Statistic	Value	Signif.	I(0)	I(1)
			Asymptotic: n=1000	
F-statistic	6.468564	10%	3.03	4.06
K	4	5%	3.47	4.57
		2.5%	3.89	5.07
		1%	4.4	5.72
			Finite Sample: n=40	
Actual Sample Size	37	10%	3.334	4.438
		5%	3.958	5.226
		1%	5.376	7.092
			Finite Sample: n=35	
		10%	3.374	4.512

5%	4.036	5.304
1%	5.604	7.172

t-Bounds Test		Null Hypothesis: No levels relationship		
Test Statistic	Value	Signif.	I(0)	I(1)
t-statistic	-5.065805	10%	-3.13	-4.04
		5%	-3.41	-4.36
		2.5%	-3.65	-4.62
		1%	-3.96	-4.96

ARDL Error Correction Regression

ARDL Error Correction Regression
Dependent Variable: D(DLNINFD)
Selected Model: ARDL(3, 3, 3, 0, 1)
Case 5: Unrestricted Constant and Unrestricted Trend
Date: 03/25/25 Time: 06:31
Sample: 1981 2021
Included observations: 37

ECM Regression
Case 5: Unrestricted Constant and Unrestricted Trend

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.183815	0.049350	-3.724742	0.0013
@TREND	0.004522	0.001590	2.843100	0.0097
D(DLNINFD(-1))	0.249666	0.147800	1.689217	0.1060
D(DLNINFD(-2))	-0.371109	0.094897	-3.910633	0.0008

D(DLNTREV)	0.022386	0.036810	0.608147	0.5496
D(DLNTREV(-1))	-0.293693	0.062610	-4.690838	0.0001
D(DLNTREV(-2))	-0.135236	0.042485	-3.183161	0.0045
D(DLNGGI)	3.083711	1.511300	2.040436	0.0541
D(DLNGGI(-1))	0.672651	1.377608	0.488274	0.6304
D(DLNGGI(-2))	-3.602475	1.458058	-2.470735	0.0221
D(DLNTPD)	-0.124870	0.060303	-2.070701	0.0509
CointEq(-1)*	-1.251117	0.201627	-6.205107	0.0000

R-squared	0.902570	Mean dependent var	0.010938
Adjusted R-squared	0.859700	S.D. dependent var	0.191408
S.E. of regression	0.071695	Akaike info criterion	-2.176188
Sum squared resid	0.128504	Schwarz criterion	-1.653728
Log likelihood	52.25948	Hannan-Quinn criter.	-1.991996
F-statistic	21.05398	Durbin-Watson stat	2.028761
Prob(F-statistic)	0.000000		

* p-value incompatible with t-Bounds distribution.

F-Bounds Test	Null Hypothesis: No levels relationship

Test Statistic	Value	Signif.	I(0)	I(1)
F-statistic	6.468564	10%	3.03	4.06
K	4	5%	3.47	4.57
		2.5%	3.89	5.07
		1%	4.4	5.72

t-Bounds Test		Null Hypothesis: No levels relationship		
Test Statistic	Value	Signif.	I(0)	I(1)
t-statistic	-6.205107	10%	-3.13	-4.04
		5%	-3.41	-4.36
		2.5%	-3.65	-4.62
		1%	-3.96	-4.96

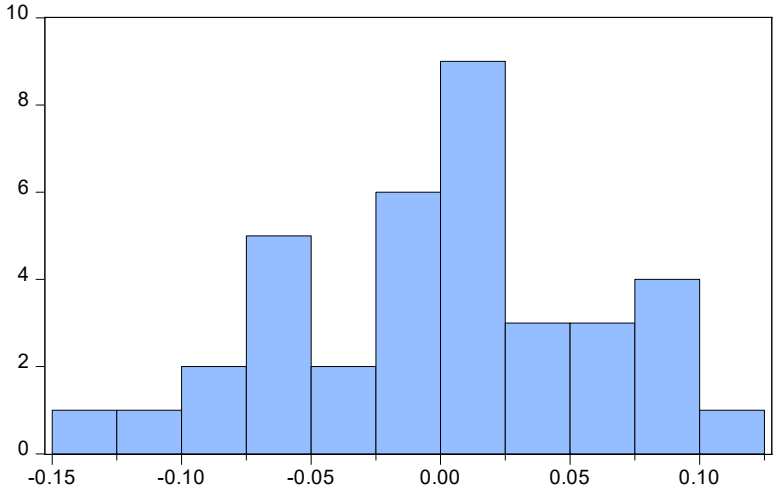
Appendix IV

Multicollinearity Test Result (Variance Inflation Factor)

Variance Inflation Factors
Date: 03/25/25 Time: 06:35
Sample: 1981 2021
Included observations: 37

Variable	Coefficient Variance	Uncentered VIF	Centered VIF
DLNINFD(-1)	0.022279	2.334170	2.333981
DLNINFD(-2)	0.017287	1.894907	1.893824
DLNINFD(-3)	0.013739	1.583895	1.574120
DLNTREV	0.002834	2.142319	1.644597
DLNTREV(-1)	0.003338	2.489445	1.938760
DLNTREV(-2)	0.003217	2.398362	1.862885
DLNTREV(-3)	0.003065	2.284860	1.773997
DLNGGI	3.371641	8.038641	2.599317
DLNGGI(-1)	4.422492	10.68846	3.429562
DLNGGI(-2)	2.848168	6.982117	2.223342
DLNGGI(-3)	3.182024	7.917373	2.502399
DLNFDI	0.002176	2.312558	1.670670
DLNTPD	0.006497	4.011596	2.651399
DLNTPD(-1)	0.006435	3.983932	2.626411
C	0.005572	33.69013	NA
@TREND	4.67E-06	16.87450	3.216877

Normality Test Result



Series: Residuals
Sample 1985 2021
Observations 37

Mean	-1.24e-17
Median	0.010355
Maximum	0.107486
Minimum	-0.138020
Std. Dev.	0.059746
Skewness	-0.193993
Kurtosis	2.523960
Jarque-Bera	0.581436
Probability	0.747726

Serial Correlation Test Result
Breusch-Godfrey Serial Correlation LM Test:

F-statistic	1.228881	Prob. F(3,18)	0.3282
Obs*R-squared	6.289853	Prob. Chi-Square(3)	0.0983

Test Equation:
Dependent Variable: RESID
Method: ARDL
Date: 03/25/25 Time: 06:57
Sample: 1985 2021
Included observations: 37
Presample missing value lagged residuals set to zero.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
DLNINFD(-1)	-0.075050	0.186175	-0.403114	0.6916
DLNINFD(-2)	0.037086	0.136542	0.271607	0.7890
DLNINFD(-3)	0.086245	0.126657	0.680934	0.5046
DLNTREV	0.016245	0.053376	0.304348	0.7644
DLNTREV(-1)	0.022859	0.058862	0.388345	0.7023
DLNTREV(-2)	0.016612	0.058872	0.282162	0.7810
DLNTREV(-3)	0.005022	0.057514	0.087315	0.9314
DLNGGI	-1.649744	2.021599	-0.816059	0.4251
DLNGGI(-1)	0.277309	2.076800	0.133527	0.8953
DLNGGI(-2)	0.700863	1.722375	0.406916	0.6889
DLNGGI(-3)	-0.203050	1.867729	-0.108715	0.9146

DLNFDI	-0.004619	0.046475	-0.099383	0.9219
DLNTPD	0.084167	0.092006	0.914798	0.3724
DLNTPD(-1)	0.010519	0.079190	0.132827	0.8958
C	-0.035200	0.077628	-0.453443	0.6556
@TREND	0.001204	0.002327	0.517358	0.6112
RESID(-1)	-0.149224	0.267638	-0.557560	0.5840
RESID(-2)	-0.324360	0.272870	-1.188697	0.2500
RESID(-3)	-0.520944	0.310044	-1.680229	0.1102

R-squared	0.169996	Mean dependent var	-1.24E-17
Adjusted R-squared	-0.660008	S.D. dependent var	0.059746
S.E. of regression	0.076977	Akaike info criterion	-1.984134
Sum squared resid	0.106659	Schwarz criterion	-1.156906
Log likelihood	55.70649	Hannan-Quinn criter.	-1.692498
F-statistic	0.204814	Durbin-Watson stat	1.883490
Prob(F-statistic)	0.999229		

Heteroscedasticity Test Result
Heteroskedasticity Test: Breusch-Pagan-Godfrey

F-statistic	0.493353	Prob. F(15,21)	0.9176
Obs*R-squared	9.641128	Prob. Chi-Square(15)	0.8417

Scaled explained SS	2.366500	Prob. Chi-Square(15)	0.9999

Test Equation:
Dependent Variable: RESID^2

Method: Least Squares
Date: 03/25/25 Time: 06:59
Sample: 1985 2021
Included observations: 37

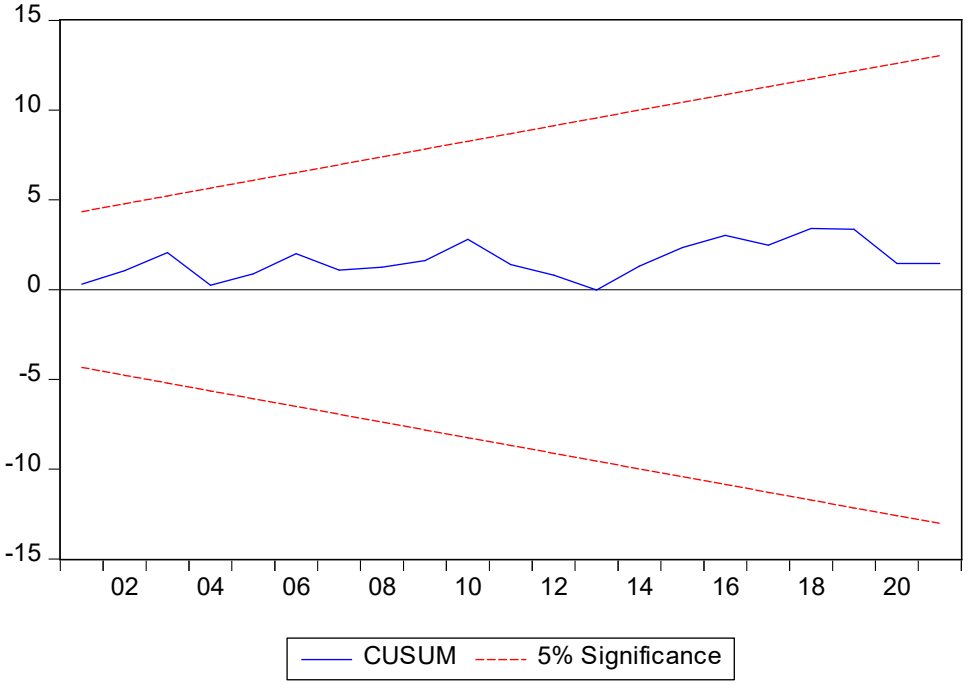
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.001504	0.004670	0.322180	0.7505
DLNINFD(-1)	0.002021	0.009338	0.216397	0.8308
DLNINFD(-2)	-0.005832	0.008225	-0.709023	0.4861
DLNINFD(-3)	-0.009202	0.007333	-1.254891	0.2233
DLNTREV	-0.000720	0.003330	-0.216339	0.8308
DLNTREV(-1)	0.001043	0.003614	0.288529	0.7758
DLNTREV(-2)	-0.000463	0.003548	-0.130403	0.8975
DLNTREV(-3)	0.002594	0.003463	0.748968	0.4622
DLNGGI	-0.043597	0.114872	-0.379527	0.7081
DLNGGI(-1)	-0.024015	0.131561	-0.182540	0.8569
DLNGGI(-2)	0.008039	0.105578	0.076147	0.9400
DLNGGI(-3)	0.058363	0.111595	0.522988	0.6065
DLNFDI	-0.002790	0.002918	-0.956036	0.3499
DLNTPD	-0.00166	0.005043	-0.329292	0.7452

DLNTPD(-1)	1 0.001814	0.005018	0.361462	0.7214
@TREND	9.23E-05	0.000135	0.682906	0.5021

R-squared	0.260571	Mean dependent var	0.003473
Adjusted R-squared	-0.267593	S.D. dependent var	0.004347
S.E. of regression	0.004894	Akaike info criterion	-7.503250
Sum squared resid	0.000503	Schwarz criterion	-6.806637
Log likelihood	154.8101	Hannan-Quinn criter.	-7.257662
F-statistic	0.493353	Durbin-Watson stat	2.332808
Prob(F-statistic)	0.917647		

Stability Tests

a) CUSUM Test



b) CUSUM of Squares Test