IMPACT OF INFRASTRUCTURE INVESTMENT ON INDUSTRIAL PRODUCTION IN NIGERIA

BY

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BEING A PROJECT SUBMITTED TO THE DEPARTMENT OF ECONOMICS, FACULTY OF SOCIAL SCIENCES, UNIVERSITY OF BENIN, BENIN CITY.IN PARTIAL FULFLMENT OF THE REQUIREMENTS FOR THE AWARD OF BACHELOR OF SCIENCE (B.SC) DEGREE. IN THE DEPARTMENT OF ECONOMICS, UNIVERSITY OF BENIN, BENIN CITY NIGERIA

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CERTIFICATION

This is to certify that the research project titled **Impact of Infrastructure Investment on Industrial Production in Nigeria** was being researched and submitted by me MISS UGWU ONYINYECHUKWU PAULA for the certification of Bachelor of Science (B.Sc) degree in the Department of Economics, Faculty of Social Science University of Benin, Benin city. This research was carried out under the supervision of the following persons;

MRS. OBIANUJU O. NNADOZIE (Project supervisor)	**DATE**
DR. S. O IGBINEDION (Head of Department)	**DATE**
DR. S. O IGBINEDION (Project Co-ordinator)	**DATE**

DEDICATION

This Research work is dedicated specially to God, my family (THE UGWU'S) and myself.

ACKNOWLEDGEMENTS

My profound gratitude goes to God for always been my guardian through my days in school, I give him all the glory for the successful completion of this research work, and to my amiable supervisor Mrs Obianuju O. Nnadozie for always taking out her time and patiently guiding me through the period of this research, I will forever be grateful and may God continue to bless and keep you. To all the lecturers of the department of Economic, University of Benin I really appreciate all the good work you all do in this citadel of learning, may you all never run out of knowledge and good health.

I will be remiss not to mention the unwavering love and support from my mother, Mrs Ugwu. To my ever lovable siblings and also to my friends.

Lastly, to everyone who has contributed directly or indirectly to the achievement of this great success, I say a very big thank you and may God bless you all.

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ABSTRACT

This study investigates the impact of infrastructure investment, with a specific focus on the electrical sector, on industrial production in Nigeria from 1981 to 2021. Utilizing an Error Correction Model (ECM), the research examines both short-term and long-term dynamics between infrastructure development and macroeconomic outcomes. The findings reveal that increased investment in electricity infrastructure significantly boosts industrial production, underscoring the crucial role of enhancing electricity generation, transmission, and distribution. A positive relationship between electricity generated and industrial output further highlights the importance of expanding electricity generation capacity. Conversely, electricity consumption shows an unexpected negative, albeit statistically insignificant, relationship with industrial production, indicating the need for optimizing consumption patterns. The study also finds that higher interest rates positively influence industrial output, while the impact of consumer price index changes remains statistically insignificant. These results emphasize the necessity for policies that prioritize electricity infrastructure investment, promote energy efficiency, and support regulatory reforms to foster sustainable industrial growth in Nigeria.

CHAPTER ONE

INTRODUCTION

1.1 Background to the Study

Infrastructure is the backbone of a nation's development, comprising interconnected structural elements that form the framework for economic growth and societal well-being (Nedozi, Obasanmi, & Ighata, 2014). This collection of facilities, including telecommunications, roads, irrigation, electricity, sewage systems, water supply, schools, and hospitals, is integral to enabling, sustaining, or improving living conditions within a society. The significance of infrastructure, especially in the form of electricity, is particularly crucial for Nigeria. It plays a pivotal role in influencing industrial production, economic diversification, and overall quality of life. Adequate infrastructure is not only essential for supporting industrial activities but is also a key factor in societal development.

The relationship between infrastructure and industrial development is fundamental, with infrastructure serving as the backbone for participation in international production networks and fostering innovation across different sectors of the economy (Umofia, Orji, & Worika, 2018). For industrialized economies, sufficient infrastructure, including reliable electricity, is a defining characteristic that positively impacts the industrial sector—a key engine of economic growth (Orji, Worika, & Umofia, 2017)

Despite the recognized importance of infrastructure, Nigeria has grappled with persistent challenges, particularly in its electricity sector. The shortage of reliable and consistent electricity has been a significant impediment to industrial growth and economic diversification. Frequent power outages and insufficient capacity have hampered the competitiveness of Nigerian industries on a global scale.

This shortage of infrastructure poses a serious threat to industrial development. Industries can only thrive in an atmosphere of adequate infrastructure, and the lack thereof discourages production due to higher costs and logistical challenges. This situation has direct implications for the productivity, profitability, income generation, and employment opportunities in the industrial sector.

The historical context of Nigeria's power sector reflects a series of challenges and reforms. From the establishment of the Nigerian Electricity Supply Company (NESCO) in 1929 to the recent reforms in 2013, the sector has undergone changes aimed at addressing inefficiencies and improving electricity generation, transmission, and distribution. However, progress has been slow, and the gap between demand and supply persists. Scholars such as Wheeler and Moody (1992), Loree and Guisinger (1995), and Asiedu (2002) emphasize the role of infrastructure in attracting foreign direct investment (FDI). Good infrastructure is considered a necessary condition for foreign investors to operate successfully, as it reduces costs for firms and improves the overall investment climate.

Electricity consumption is identified as a key driver of growth and development in all economies (CBN, 2000). The availability and reliability of electricity directly impact productive activities across various sectors. However, Nigeria has struggled to provide adequate electricity for its growing population, with about 80 million Nigerians lacking access to electricity in their homes (African Development Bank, 2018). The decline in industrial output in Nigeria, exemplified by a decrease in manufacturing capacity utilization from 73.3% in 1981 to 32.4% in 1998, can be attributed to factors such as inadequate electricity supply (CBN, 2000). The situation underscores the critical role of infrastructure, particularly electricity, in sustaining industrial production.

1.2 Statement of the Research Problem

Nigeria, as a nation at the crossroads of economic development, grapples with a multifaceted challenge rooted in the inadequacies of its infrastructure, particularly in the crucial sector of electricity. The overarching research problem can be encapsulated in the inquiry into the profound impact of infrastructure investment, with a specific focus on the electricity sector, on the industrial production landscape in Nigeria. This problem arises from the realization that the deficiencies in infrastructure, particularly in providing a reliable and robust electricity supply, are acting as significant impediments to the country's industrial growth and economic diversification. The backdrop of Nigeria's infrastructure reveals a tale of persistent challenges and slow-paced reforms, particularly in the electricity sector. Despite being endowed with abundant resources, the country has struggled to establish a robust and consistent electricity supply system. Frequent power outages and insufficient capacity have become synonymous with the industrial landscape, resulting in operational inefficiencies, increased production costs, and diminished global competitiveness for Nigerian industries.

The industrial sector, often considered the engine of economic growth, faces a considerable setback due to inadequate infrastructure, notably in the electricity domain. The deficiency hampers the productivity and efficiency of industries, limiting their capacity to meet domestic demands and compete in the global market. Consequently, this raises critical questions about the potential of infrastructure investments, specifically targeted at the electricity sector, to catalyze industrial production and foster economic growth.

While existing literature acknowledges the importance of infrastructure, including electricity, to economic development, there is a significant gap in research that comprehensively investigates the intricate relationship between infrastructure investment and industrial production in Nigeria. Previous studies have primarily focused on the impact of infrastructure on sectors like education and housing, neglecting the pivotal role infrastructure plays in driving industrialization.

Furthermore, the historical context of Nigeria's power sector reforms, from the establishment of the Nigerian Electricity Supply Company (NESCO) in 1929 to the recent reforms in 2013, underscores the need for a detailed examination of the outcomes of these initiatives. Despite these efforts, the gap between the demand for electricity and the supply persists, hindering the full potential of industrial sectors and impeding the nation's economic progress.

The research problem is accentuated by the recognition that infrastructure is not merely a facilitator of economic activities but a prerequisite for attracting foreign direct investment (FDI). The deficiency in infrastructure, especially in providing a stable electricity supply, increases costs for firms, discouraging foreign investors and stifling the overall investment climate.

Electricity consumption, identified as a key driver of economic growth, faces considerable challenges in Nigeria. With approximately 80 million Nigerians lacking access to electricity in their homes, the implications for both industrial and overall economic development are profound. The decline in industrial output over the years, exacerbated by factors such as inadequate electricity supply, underscores the urgency of understanding the complex relationship between infrastructure investment and industrial production. The research problem revolves around the profound impact of infrastructure investment, particularly in the electricity sector, on industrial production in Nigeria. The deficiencies in infrastructure, historical challenges in the power sector contribute to an urgent need for comprehensive research. Understanding the nuanced dynamics of infrastructure investment and its consequences on industrial production is pivotal for formulating effective policies and strategies that can propel Nigeria towards sustainable economic development.

Sequel to the foregoing discussion, the study seeks to answer the following research questions:

- What is the relationship between electricity infrastructure investment and industrial production in Nigeria?

1.3 Objectives of the Study

The broad objective of this study is to examine the impact of infrastructure on industrial production in Nigeria. The specific objectives of the study are to:

- assess the extent to which investments in electricity infrastructure contribute to the growth of the industrial sector in Nigeria
- investigate the impact of electricity generated on the performance and productivity of industries in the country.

- examine the influence of electricity consumption on the growth of industrial production in Nigeria.

1.4 Research Hypotheses

Ho: There is no significant relationship between electricity infrastructure investment and industrial production in Nigeria

Ho: There is no significant relationship between electricity generated and industrial production in Nigeria.

Ho: Electricity consumption patterns do not significantly impact the productivity of industries in Nigeria.

1.5 Significance of the Study

Nigeria, as a nation at a critical juncture of economic development, faces substantial challenges stemming from the inadequacies in its infrastructure, particularly in the pivotal electricity sector. The study addresses the pressing need to understand the intricate relationship between infrastructure investment, with a specific focus on electricity, and industrial production.

At the heart of Nigeria's economic development lies the crucial role of infrastructure as the backbone for growth and societal well-being. The study's focus on electricity infrastructure is of paramount importance considering its centrality in influencing not only industrial production but also economic diversification and overall quality of life.

The identified deficiencies in the electricity sector, characterized by frequent power outages and insufficient capacity, have emerged as significant impediments to the nation's industrial growth and economic diversification.

The historical context of Nigeria's power sector reforms underscores the urgency for a detailed examination of the outcomes of these initiatives. Despite various efforts, the gap between electricity demand and supply persists, hindering the full potential of industrial sectors and impeding the nation's economic progress. The study seeks to bridge the existing gap in research by comprehensively investigating the nuanced dynamics of infrastructure investment, specifically in the electricity sector, and its profound consequences on industrial production.

The implications of the research findings extend beyond the academic realm. By unraveling the complex relationship between infrastructure investment and industrial production, the study provides valuable insights for policymakers, government agencies, and stakeholders involved in shaping the trajectory of Nigeria's economic development. The results can inform evidence-based decision-making, aiding in the formulation of effective policies and strategies to address the deficiencies in infrastructure and propel Nigeria towards sustainable economic growth. Furthermore, the study's exploration of the impact of infrastructure on attracting foreign direct investment emphasizes the role of infrastructure as a prerequisite for fostering a conducive investment climate.

In essence, this study holds the potential to drive positive change by shedding light on the critical factors influencing industrial production in Nigeria. Through its comprehensive approach, the research contributes to the broader discourse on infrastructure's pivotal role in shaping the economic landscape of developing nations, with implications reaching far beyond the borders of Nigeria.

1.6 Scope of the Study

The scope of this research centers on the impact of infrastructure investment on industrial production in Nigeria. The study aims to examine the relationship between infrastructure investment, particularly in the electricity sector, and its effects on the country's industrial output. Focusing on the period between 1980 and 2021, data will be sourced from reputable sources such as the Central Bank of Nigeria (CBN) Statistical Bulletin, National Bureau of Statistics (NBS), and the World Bank (WDI). The analysis will encompass trends in infrastructure investment, electricity generation, and industrial production, offering insights into the challenges and opportunities that influence Nigeria's economic development within the specified timeframe.

1.7 Structure of Study

The subsequent sections of this research are systematically organized as follows: Chapter two delves into the pertinent literature review, covering contextual, theoretical, and empirical aspects. Chapter three outlines the research methodology employed, encompassing the theoretical framework and model specification. Moving on, chapter four presents and discusses the results derived from the empirical investigation. Finally, chapter five serves as the conclusion, summarizing key findings and offering recommendations based on the study's insights.

CHAPTER TWO

LITERATURE REVIEW

2.1 Conceptual Literature Review

2.1.1 Infrastructure Investment

Infrastructure investment encompasses the strategic allocation of financial and physical resources towards the development, maintenance, and enhancement of critical physical structures and facilities that form the backbone of societies and economies. These structures include a wide array of essential components such as transportation networks (roads, railways, airports, seaports), energy infrastructure (power generation and distribution systems), water supply and sanitation systems, telecommunications networks, and public buildings. The significance of infrastructure investment lies in its capacity to drive economic growth, foster social development, and enhance overall quality of life for citizens. By facilitating the movement of goods and people, infrastructure networks promote trade and commerce, stimulate investment and entrepreneurship, and create employment opportunities. Moreover, infrastructure plays a fundamental role in connecting communities, improving access to essential services such as healthcare and education, and reducing inequalities between regions.

Infrastructure investment is not solely about constructing new physical assets but also involves maintaining and upgrading existing infrastructure to meet evolving needs and technological advancements. It encompasses a forward-looking approach that considers long-term sustainability, resilience to shocks, and environmental considerations. Public sector spending is a significant driver of infrastructure investment, with governments playing a central role in planning, financing, and implementing projects. However, the involvement of the private sector, through mechanisms like public-private partnerships (PPPs) and foreign direct investment (FDI), is increasingly recognized as essential for leveraging additional resources, promoting innovation, and improving project efficiency. Effective infrastructure investment requires careful planning, coordination, and collaboration among various stakeholders, including government agencies, private sector entities, civil society organizations, and local communities. It involves rigorous analysis of project feasibility, cost-benefit considerations, environmental impact assessments, and risk management strategies.

Infrastructure investment represents a strategic commitment to building and maintaining the physical assets that underpin economic productivity, social well-being, and sustainable development. It is a multifaceted endeavor that requires vision, leadership, and collaboration to create resilient, inclusive, and prosperous societies for future generations.

2.1.2 Industrial Production

Industrial production refers to the process of converting raw materials, components, or inputs into finished goods or products through various manufacturing processes. It encompasses the entire lifecycle of production, from the extraction or procurement of raw materials to the manufacturing, assembly, and packaging of final goods. According to OECD (2024), Industrial production encompasses the total output of industrial establishments across sectors including mining, manufacturing, electricity, gas, steam, and air-conditioning. This metric is quantified through an index relative to a reference period, reflecting fluctuations in the volume of production output.

At its core, industrial production involves the transformation of inputs into outputs with the aim of meeting consumer demand and fulfilling market needs. This process typically occurs within industrial facilities such as factories, plants, or manufacturing facilities, where machinery, equipment, and technology specialized are utilized to facilitate production processes.

Industrial production involves the production of a diverse array of goods, ranging from automobiles, electronics, and machinery to chemicals, textiles, and food products.

Key components of industrial production include:

Manufacturing Processes: Industrial production involves various manufacturing processes, such as machining, casting, forging, molding, welding, and assembly, depending on the nature of the product being produced.

Supply Chain Management: Industrial production relies on efficient supply chain management to ensure the timely procurement of raw materials, components, and resources required for production activities.

Quality Control: Quality control measures are essential to ensure that manufactured products meet specified standards and quality requirements. This involves rigorous testing, inspection, and adherence to quality management systems throughout the production process.

Productivity Enhancement: Industrial production often focuses on improving productivity through the adoption of advanced technologies, automation, process optimization, and continuous improvement initiatives.

Environmental Sustainability: With increasing awareness of environmental concerns, industrial production also emphasizes sustainable practices, such as resource conservation, waste reduction, energy efficiency, and pollution prevention.

Overall, industrial production plays a crucial role in driving economic growth, generating employment opportunities, and providing essential goods and services to consumers. It forms the foundation of modern industrial economies and contributes significantly to global trade, commerce, and development.

2.1.3 Electricity Infrastructure

Electricity is the flow of electrical power or charge, essential for powering various modern technologies and infrastructures. As a secondary energy source, electricity is derived from the conversion of primary energy sources such as coal, natural gas, oil, nuclear power, and renewable energy sources like wind, solar, and hydroelectric power. It is a fundamental aspect of nature and one of the most widely utilized forms of energy in contemporary society.

Electricity infrastructure encompasses the physical and logistical framework required for the generation, transmission, distribution, and utilization of electrical power. This infrastructure includes power plants for electricity generation, transmission lines, transformers, substations, distribution networks, and electrical grids. Additionally, it involves components such as meters, switches, capacitors, and other devices essential for regulating and managing the flow of electricity.

The process of electricity supply involves three primary stages: generation, transmission, and distribution. Power generation involves the conversion of energy from primary sources into electrical energy, typically in power plants. Transmission involves the transfer of electricity over long distances via high-voltage transmission lines. Distribution refers to the delivery of electricity from substations to end-users, including residential, commercial, industrial, and institutional consumers. Efficient electricity infrastructure design, construction, and maintenance are crucial for minimizing losses during transmission and distribution. Moreover, advancements in technology and innovation play a significant role in enhancing energy efficiency and reducing electricity consumption.

In addition to its physical aspects, electricity infrastructure also involves commercial activities such as electricity trading between generators, retailers, and large consumers. The availability and reliability of electricity infrastructure are vital for supporting socio-economic development, technological innovation, and overall industrial progress in any nation. However, challenges such as inadequate supply, erratic distribution, and unequal accessibility often hinder the full realization of the potential benefits of electricity infrastructure.

2.1.4 Electricity Supply in Nigeria

Power generation in Nigeria traces back to 1886 when two generating sets were installed to serve the Colony of Lagos, established by an Act of Parliament. Subsequently, in 1951, the Electricity Corporation of Nigeria (ECN) was founded, followed by the establishment of the Niger Dams Authority (NDA) in 1962 for hydroelectric power development. The merger of these entities in 1972 formed the National Electric Power Authority (NEPA), responsible for electricity generation, transmission, and distribution nationwide.

In 2005, as part of the power sector reform process, NEPA was restructured into the Power Holding Company of Nigeria (PHCN). The Electric Power Sector Reform (EPSR) Act, enacted the same year, allowed private participation in electricity generation, transmission, and distribution. PHCN was subsequently unbundled into eleven electricity distribution companies (DisCos), six generating companies (GenCos), and a transmission company (TCN), with the creation of the Nigerian Electricity Regulatory Commission (NERC) to regulate the sector independently.

To boost power generation, the Federal Government established the Niger Delta Power Holding Company (NDPHC) in 2004 as a public sector-funded intervention scheme. NDPHC manages the National Integrated Power Projects (NIPP), focusing on critical infrastructure development across the power value chain, including generation, transmission, distribution, and natural gas supply.

As part of ongoing reforms, NERC has licensed several private Independent Power Producers (IPPs), with some projects in various stages of development. The Commission has also implemented Bulk Procurement Guidelines to streamline large-capacity generation procurement, facilitating grid expansion and enabling better planning for future power additions.

2.1.5 Relationship between Infrastructure Investment and Industrial Production

The relationship between infrastructure investment and industrial production in Nigeria is multifaceted and dynamic, playing a significant role in shaping the country's economic landscape. Infrastructure investment refers to the allocation of resources towards the development, maintenance, and enhancement of essential physical structures and facilities that support economic activities. Industrial production, on the other hand, encompasses the output of industrial sectors such as manufacturing, mining, electricity, and gas production.

In Nigeria, infrastructure investment has a direct and indirect impact on industrial production through various channels:

1. **Enhanced Productivity and Efficiency**: Investments in infrastructure, such as transportation networks, electricity generation, and telecommunications, can enhance the productivity and efficiency of industrial activities. Improved transportation infrastructure reduces logistical bottlenecks, lowers transportation costs, and facilitates the movement of raw materials and finished goods, thereby increasing industrial output.

2. **Access to Energy**: Adequate and reliable energy supply is essential for industrial production. Infrastructure investments in electricity generation, transmission, and distribution infrastructure are crucial for ensuring uninterrupted power supply to industrial facilities. Improved access to electricity enables industries to operate more efficiently, increase production capacity, and meet growing demand.

3. **Support for Manufacturing**: Infrastructure investments in manufacturing zones, industrial parks, and special economic zones provide dedicated spaces equipped with essential utilities and services for industrial activities. These investments attract domestic and foreign investments, promote industrial clustering, and foster collaboration and innovation within the manufacturing sector, thereby stimulating industrial production.

4. **Expansion of Market Access**: Infrastructure investments in transportation networks, including roads, railways, ports, and airports, expand market access for industrial products. Improved connectivity reduces transportation costs and transit times, opens up new markets, and facilitates trade and commerce, leading to increased demand for domestically produced goods and higher industrial output.

5. **Technological Advancement**: Investments in research and development (R&D) infrastructure, innovation hubs, and technology parks drive technological advancement and innovation within the industrial sector. Access to modern

technologies, research facilities, and skilled workforce enhances industrial competitiveness, promotes the adoption of advanced manufacturing processes, and fosters the development of high-value-added products, thereby boosting industrial production.

6. **Job Creation and Economic Growth**: Infrastructure investments in industrial projects create employment opportunities across various sectors, including construction, manufacturing, and services. The expansion of industrial activities generates income, stimulates consumer spending, and contributes to overall economic growth, further driving industrial production.

In economic literature, various theories have elucidated the mechanisms through which infrastructure investment can positively impact industrial progress, particularly in developing countries. According to development economists, during the initial stages of economic growth and development, a significant portion of total investment in the economy is allocated by the government (Musgrave, 1969). This government investment primarily focuses on providing essential infrastructure such as transportation systems (roads and railways), sanitation facilities, law enforcement, healthcare, and education (for human capital development). The overarching objective of government expenditure during this phase is to stimulate economic activity, paving the way for the transition into the middle stage of economic development.

Furthermore, Wagner's law offers insights into the relationship between economic growth and the size of government. According to this law, as per capita incomes increase within an economy, the relative size of the public sector expands. Wagner's law posits that with rising real incomes, government spending on various sectors such as infrastructure, recreation, culture, roads, welfare, education, and healthcare also increases (Obiechina, 2010).

2.1.6 Role of Electricity Infrastructure in Industrial Production

First and foremost, electricity infrastructure serves as the backbone of industrial production, providing the essential energy required to power machinery, equipment, and production processes in manufacturing industries. This reliable power supply is fundamental for ensuring continuous operations, minimizing downtime, and optimizing resource utilization. Additionally, electricity infrastructure plays a pivotal role in enhancing productivity and efficiency within industrial settings. By enabling industries to operate seamlessly and maximize output levels, it contributes to improving competitiveness and driving economic growth.

Moreover, electricity infrastructure facilitates technological innovation within industrial sectors. Investments in advanced manufacturing technologies, automation systems, and digitalization processes rely heavily on reliable and scalable electricity supply. This fosters the adoption of innovative practices, such as robotics and artificial intelligence, which enhance production efficiency and quality. Furthermore, electricity infrastructure supports the expansion and growth of industrial activities by providing the necessary capacity to accommodate increased production volumes and new investments.

In addition to supporting industrial expansion, electricity infrastructure promotes the diversification of industrial activities. It enables the establishment of new industries and encourages the adoption of energy-intensive processes, contributing to sectoral development and economic diversification. Furthermore, investments in renewable energy sources, facilitated by electricity infrastructure, promote cleaner and more sustainable production methods, reducing environmental impacts and enhancing industrial sustainability.

Beyond its role in industrial production, electricity infrastructure also contributes to regional economic development. Access to reliable electricity attracts industrial investments, creates employment opportunities, and fosters economic diversification, particularly in rural and remote areas. By reducing disparities in income and development between urban and rural regions, electricity infrastructure plays a crucial role in promoting inclusive growth and development.

In summary, electricity infrastructure plays a multifaceted role in driving industrial production and economic development. From powering manufacturing processes to fostering innovation, supporting growth, promoting sustainability, and enhancing regional development, electricity infrastructure is indispensable for ensuring the competitiveness, resilience, and sustainability of industrial sectors.

Insufficient access to electricity in Nigeria has long been a significant barrier to the country's economic growth and development. Despite the recognition of Small and Medium Enterprises (SMEs) and manufacturing activities as vital engines of economic progress, their performance has been severely hampered by the inadequate power supply. The availability of reliable electricity to both households and businesses has been a focal point for government attention, yet tangible outcomes have been elusive over the years (Segun, 2013). Despite Nigeria's possession of the world's seventh-largest gas reserves, the country generates only enough electricity to power a medium-sized European city (Segun). More than half of Nigeria's estimated 170 million inhabitants live without access to electricity, forcing those who can afford it to rely on expensive and polluting generators fueled by diesel and petrol (Segun).

Electricity is indispensable for industrial activities as it powers machinery and technologies essential for producing physical goods. However, the inadequate electricity supply in Nigeria has left existing industries grappling with insufficient power to operate effectively. This deficiency not only stifles industrial productivity but also impedes human capacity development in producing tangible products, aligning with the Solow model's core components of growth, which include capital, labor, and technological progress (Matthew et al., 2010; Adeniran et al., 2018; Osuma et al., 2018; Alege and Osabuohien, 2015; Matthew et al., 2018).

Past government efforts to address the electricity supply challenge have been substantial, with significant financial allocations totaling billions of dollars between 1999 and 2007 under the Obasanjo administration (Pambazuka, 2013). However, much of this investment failed to yield tangible results, with over 30% of the allocated funds directed toward existing Power Holding Company of Nigeria (PHCN) plants without significant improvement in electricity provision (Pambazuka). Additionally, inadequate access to electricity remains prevalent, with over 60% of the population lacking access, particularly in rural areas (Pambazuka).

Despite numerous policy initiatives and interventions aimed at improving the energy situation in Nigeria, the country continues to grapple with persistent power generation deficiencies. The returns on investments in the energy sector have often been disappointing, despite substantial government spending, including budgetary allocations and loans (Enofe, Ibeh, and Ishola, 2014). As the nation's population and economic aspirations grow, the challenge of meeting electricity demands persists, compounded by issues in distribution, transmission, and regulation (Ibitoye and Adenikinju, 2007

2.1.7 Factors Influencing Industrial Production in Nigeria

Several factors play significant roles in influencing industrial production in Nigeria, reflecting the complex interplay of economic, social, and political dynamics within the country. These factors can be broadly categorized into internal and external influences, each exerting its unique impact on industrial output.

Internally, one of the primary factors influencing industrial production in Nigeria is the state of infrastructure, particularly electricity supply. As highlighted earlier, inadequate access to reliable electricity has been a major impediment to industrial growth, hindering the effective operation of machinery and technologies essential for manufacturing processes. Additionally, poor transportation networks, inadequate water supply, and limited access to modern telecommunications infrastructure also contribute to inefficiencies in industrial production.

Another critical internal factor is the regulatory environment and government policies. Inconsistent policies, bureaucratic bottlenecks, and regulatory uncertainties can stifle investment and hinder industrial expansion. The ease of doing business, including factors such as licensing procedures, tax regimes, and property rights protection, significantly affects industrial activity in Nigeria. Moreover, corruption and inefficiencies in governance further exacerbate these challenges, deterring potential investors and undermining the competitiveness of domestic industries.

Furthermore, the availability and cost of skilled labor are essential determinants of industrial production. Nigeria's education system and workforce development programs play a crucial role in providing the skilled manpower needed for various industries. However, mismatches between industry demands and the skills of the available workforce, as well as issues related to brain drain and inadequate vocational training, pose significant challenges to industrial productivity.

Externally, global economic trends and market dynamics exert considerable influence on Nigeria's industrial sector. Fluctuations in international commodity prices, exchange rate volatility, and shifts in global demand patterns can impact the competitiveness of Nigerian industries, particularly those reliant on imported inputs or export markets. Additionally, trade policies, tariffs, and international regulations affect Nigeria's ability to access foreign markets and compete effectively on the global stage.

Moreover, geopolitical factors, such as security challenges and political instability, can disrupt industrial activities and deter investment in certain regions of the country. Instability in the Niger Delta region, for instance, has historically disrupted oil production and related industries, highlighting the broader impact of security concerns on industrial output.

In summary, a myriad of factors, both internal and external, collectively shape industrial production in Nigeria. Addressing infrastructure deficiencies, improving the business environment, enhancing workforce skills, and navigating global market dynamics are critical imperatives for fostering sustainable industrial growth and economic development in the country.

2.2 Theoretical Literature Review

2.2.1 Neoclassical Growth Theory

The neoclassical growth theory highlights that economic growth is driven by increasing returns to the utilization of labor and capital, assuming technological advancement remains steady for a given period. Illustrated by the Cobb-Douglas production function developed in 1928, this theory depicts the technical connection between output and physical inputs. Originally considering only labor and capital as inputs, recent empirical research acknowledges electricity as an independent factor of production.

According to this theory, when a firm or economy invests in physical capital and skilled labor and adopts new technologies for production, productivity improves. This leads to a shift in the production function, potentially resulting in increasing returns to investment rather than diminishing returns. This underscores the endogeneity of technology within the production system. The core premise of the theory is that both labor and capital contribute to the long-term growth rate of an economy, emphasizing their crucial roles as factors of production.

2.2.2 Endogenous Growth Theory

Endogenous growth theory characterizes economic growth as stemming from factors intrinsic to the production process, such as economies of scale, increasing returns, induced technological changes, government policies, political stability, market distortions, and human capital. These elements play a significant role in shaping economic growth, contrasting with exogenous factors like population growth. Widely employed, endogenous growth theory offers a structured examination of government policies and programs.

In contrast, exogenous growth theory, also known as neoclassical growth theory, was formulated by Robert Solow in 1956. It forms the cornerstone of the standard neoclassical growth model, represented by an aggregate production function. Solow's model posits that output (Y) is a function of capital (K), labor (L), and an index of technology or efficiency (A), with time (t) denoting a trend. Solow's framework assumes neoclassical properties, including constant returns to scale, diminishing returns to each input, and a positive and constant elasticity of substitution.

The dynamic equation in Solow's model links the evolution of the capital stock to a constant rate of saving and depreciation. Labor and technology are assumed to grow at exogenous exponential rates. The model predicts that increasing capital relative to labor leads to economic growth, with poorer countries experiencing faster growth due to higher returns on capital investments. However, diminishing returns to capital imply that economies will eventually reach a steady state where further capital increases do not spur additional growth unless offset by technological progress. Endogenous growth theory, in contrast, links the growth rate to the rate of return on capital, emphasizing the importance of internal factors in driving economic growth.

2.2.3 Mixed Companies Hypothesis

The concept of mixed companies, also known as public-private partnerships (PPPs), has gained prominence in managing infrastructure investments, which were traditionally under public control. The economic downturn and constraints on public finances have renewed interest in PPPs. Many scholars argue that this model helps alleviate the negative impacts of market failures in delivering local public services. Establishing mixed ownership companies facilitates the integration of private sector expertise and resources into state-owned enterprises, thereby enhancing efficiency. Research indicates that mixed ownership companies generally outperform fully state-owned enterprises, with better performance indicators. Studies, such as those conducted by Garrone, Grilli, and Rousseau, demonstrate a correlation between cost reduction and the presence of private shareholders in multi-utility companies. Similarly, research by Menozzi and Vannoni reveals improved performance indicators in mixed ownership utilities operating in gas, water, and electricity sectors.

Regarding investment incentives, mixed public-private ownership companies, where no single stakeholder holds veto power, are expected to pursue both cost-reduction and quality-improvement innovations. Limited studies compare the investment tendencies of state-owned enterprises and private companies. However, research by Schmitz suggests that mixed companies offer stronger incentives for cost reduction compared to fully state-owned enterprises, while also promoting quality improvement more effectively than fully private companies.

2.2.4 Input Output Analysis

This framework allows for a systematic examination of the interdependencies between the electricity sector and other sectors of the economy, shedding light on the multiplier effects and transmission channels through which infrastructure investment influences industrial production.

Within the input-output framework, electricity is recognized as a critical intermediate input that is essential for the operation of many industries, including manufacturing, mining, and services. By assessing the intensity of electricity usage across different sectors, analysts can gauge the sensitivity of industrial production to changes in electricity availability and reliability. This understanding is crucial for policymakers and investors aiming to enhance the productivity and competitiveness of Nigeria's industrial sector.

Sectoral interdependencies are a key aspect of input-output analysis. It enables the identification of direct and indirect linkages between the electricity sector and various industries in Nigeria. By constructing an input-output table that represents the flows of goods and services between sectors, researchers can quantify the extent to which industrial production relies on electricity as an input factor. This analysis provides insights into the interconnectedness of different sectors and the dependencies that exist along the production process.

Investments in electricity infrastructure can have significant multiplier effects, which are also captured within the input-output framework. By simulating changes in electricity supply or quality, researchers can assess how these alterations propagate through the economy, affecting not only industrial production directly but also stimulating demand for other goods and services across various sectors. These multiplier effects highlight the broader economic benefits of infrastructure investment and underscore the importance of ensuring reliable electricity supply for sustained industrial growth.

Supply chain dynamics play a crucial role in understanding the impact of infrastructure investment on industrial production. The input-output framework facilitates the analysis of supply chain dynamics within the industrial sector, highlighting the interconnectedness of different industries and the dependencies that exist along the production process. Investments in electricity infrastructure can have ripple effects throughout the supply chain, influencing upstream and downstream sectors through input-output linkages.

2.2.5 New Institutional Economics

New Institutional Economics (NIE) is a theoretical framework that examines how institutions, including laws, regulations, and social norms, shape economic behavior and outcomes. It emerged in the latter half of the 20th century as a response to perceived shortcomings in traditional neoclassical economics, particularly in its treatment of institutions and their influence on economic activities.

NIE posits that institutions play a crucial role in shaping economic transactions, incentives, and outcomes. It emphasizes the importance of understanding the rules, norms, and enforcement mechanisms governing economic interactions, as these institutional factors influence individuals' behavior, choices, and the overall functioning of markets and economies.

NIE emphasizes the role of institutions—formal and informal rules, organizations, and enforcement mechanisms—in shaping economic outcomes. In the context of infrastructure investment, NIE highlights how institutional arrangements influence the effectiveness of investments, the allocation of resources, and the incentives for economic agents.

Within the framework of NIE, the institutional environment in Nigeria, including regulatory frameworks, property rights, and contract enforcement mechanisms, plays a critical role in determining the success of infrastructure projects. Weak institutions may lead to inefficiencies, corruption, and rent-seeking behavior, undermining the impact of infrastructure investment on industrial production. Conversely, strong institutions that safeguard property rights, ensure regulatory transparency, and facilitate contract enforcement can enhance the effectiveness of infrastructure investments, fostering a conducive environment for industrial growth.

NIE also emphasizes the importance of governance structures in infrastructure provision and management. In the case of electricity infrastructure, the governance of utilities, regulatory bodies, and public-private partnerships can significantly impact the reliability, affordability, and accessibility of electricity supply. Effective governance mechanisms that promote competition, accountability, and transparency can stimulate investment, improve service delivery, and enhance industrial productivity.

Moreover, NIE highlights the role of transaction costs in shaping investment decisions and economic outcomes. In the context of infrastructure investment, transaction costs associated with bureaucratic red tape, regulatory uncertainty, and contractual risks can deter private sector participation and impede project implementation. Understanding these transaction costs is crucial for designing policies and institutional frameworks that minimize barriers to investment and promote efficient allocation of resources.

Institutional change is also a central theme in NIE. The evolution of institutions over time, driven by economic, social, and political factors, can have profound effects on infrastructure investment and industrial production. Policy reforms aimed at strengthening property rights, improving regulatory frameworks, and enhancing governance structures can create an enabling environment for infrastructure development and industrial growth.

2.3 Empirical Literature Review

Empirical studies examining the impact of infrastructure investment, particularly in electricity, on industrial production in Nigeria have yielded insightful findings, shedding light on the complex relationship between infrastructure development and industrial output. Several studies have explored this topic from various perspectives, employing diverse methodological approaches and analytical frameworks to assess the causal linkages between infrastructure investment and industrial production.

One empirical study conducted by Adeola and Evans (2018) utilized a time-series analysis to investigate the impact of electricity infrastructure investment on industrial production in Nigeria over the period 1980-2016. The study employed econometric techniques such as vector autoregression (VAR) and error correction modeling (ECM) to examine the dynamic interactions between electricity infrastructure investment, industrial production, and other relevant macroeconomic variables. The findings revealed a significant positive relationship between electricity infrastructure investment and industrial output in Nigeria, suggesting that improvements in electricity infrastructure positively influence industrial production levels. The study further highlighted the importance of sustained investment in electricity infrastructure for promoting industrial growth and economic development.

Similarly, a study by Oseni and Oludayo (2017) adopted a panel data approach to analyze the impact of electricity infrastructure investment on industrial productivity across Nigerian states. The study utilized data from multiple sources, including the World Bank's Enterprise Survey and the Nigerian National Bureau of Statistics, to construct panel datasets capturing variations in electricity infrastructure investment and industrial performance indicators across different states. The empirical analysis employed fixed-effects and random-effects panel regression models to estimate the effects of electricity infrastructure investment on industrial productivity while controlling for various confounding factors. The findings suggested a statistically significant positive relationship between electricity infrastructure investment and industrial productivity, implying that increased investment in electricity infrastructure contributes to higher levels of industrial output and efficiency at the state level.

Furthermore, a study by Adenikinju and Akinlo (2013) focused specifically on the impact of electricity infrastructure quality on industrial performance in Nigeria. The study employed a combination of qualitative and quantitative methods, including structured interviews, surveys, and econometric analysis, to assess the effects of electricity infrastructure reliability, voltage stability, and supply continuity on industrial productivity and competitiveness. The empirical findings indicated that improvements in electricity infrastructure quality, such as reduced power outages and voltage fluctuations, were associated with higher levels of industrial output and efficiency. The study underscored the importance of addressing electricity infrastructure deficiencies and enhancing reliability standards to support sustained industrial growth and competitiveness in Nigeria.

Ogundari and Akinyemi (2018) conducted a study to assess the impact of electricity infrastructure investment on manufacturing sector performance in Nigeria. Employing a Vector Error Correction Model (VECM) and Granger causality tests, the researchers analyzed annual time series data from 1986 to 2015. Their results indicate a significant positive relationship between electricity infrastructure investment and manufacturing sector output, with electricity infrastructure investment exerting a substantial long-term impact on industrial production. The study underscores the necessity of prioritizing electricity infrastructure development to drive sustainable industrial growth in Nigeria.

Ebohon and Ikeme (2016) examined the impact of electricity infrastructure on industrial sector productivity in Nigeria using a Cobb-Douglas production function framework. Their empirical analysis, based on firm-level data collected from manufacturing firms, reveals a strong positive association between electricity infrastructure quality and industrial productivity. The study highlights the critical role of reliable electricity supply in enhancing operational efficiency and competitiveness within the industrial sector. It underscores the importance of targeted investments in electricity infrastructure to support productivity gains and foster industrial development in Nigeria.

Adeleye and Daramola (2020) employed the autoregressive distributed lag (ARDL) approach to investigate the causal relationship between infrastructure investment and industrial growth. Their findings underscored the significant positive impact of infrastructure investment, particularly in electricity, on industrial growth, underscoring the necessity of targeted policy interventions to improve infrastructure provision. Nnadi (2017) focused specifically on the relationship between electricity infrastructure and industrial development. Through regression analysis, the study demonstrated the substantial positive effect of improved electricity infrastructure on industrial output, reinforcing the imperative of targeted investment in the power sector for driving economic growth. Lastly, Obaje and Ibrahim (2019) utilized vector autoregressive (VAR) modeling techniques to explore the dynamic interactions between infrastructure investment and industrial production. Their findings suggested that increased investment in electricity infrastructure stimulates industrial production, emphasizing the crucial role of infrastructure development in fostering economic development. Collectively, these empirical studies provide robust evidence of the significant impact of infrastructure investment, particularly in electricity, on industrial production in Nigeria, highlighting the necessity of targeted policies and sustained investment efforts to enhance infrastructure provision, boost industrial productivity, and stimulate economic growth.

CHAPTER THREE

THEORETICAL FRAMEWORK AND METHODOLOGY

3.1 Theoretical Framework

The Neo-classical growth theory, particularly the Cobb-Douglas production function, provides a framework to analyze the impact of infrastructural investment on industrial production in Nigeria, with a focus on electricity. According to this theory, industrial production (Y) is a function of capital (K), labour (L), and total factor productivity (TFP). In the context of electricity infrastructure investment, capital represents physical infrastructure assets such as power plants, transmission lines, and distribution networks. Labour denotes the workforce employed in the industrial sector. TFP captures technological progress and efficiency gains resulting from improved infrastructure.

$$Y = A.\ K^{\alpha}.\ L^{\beta}.\ TFP^{\gamma}$$

Where:

- Y represents industrial production.

- A is the total factor productivity.

- K is the capital stock, including infrastructure investment in electricity.

- L is the labour force.

- TFP captures technological progress and efficiency gains.

- α, β, and γ are output elasticities of capital, labour, and TFP, respectively.

This framework posits that infrastructural investment in electricity (I) contributes positively to industrial production (Y), enhancing productivity and efficiency. The model allows for quantifying the impact of infrastructure investment on industrial output, providing valuable insights for policymakers and stakeholders aiming to stimulate industrial growth in Nigeria.

From equation (3.1), the functional form of the models given as:

IP = f (EII, ELEG, ELEC, CPI, INTR)………………………… (1)

Where IP represents Industrial Production

EII represents Electricity Infrastructure investment

ELEG represents Electricity generated

ELEC represents Electricity consumed

CPI represents Consumer Price index

INTR represents interest rate

3.2 Methodology

3.2.1 Model Specification

The empirical models for investigating the impact of infrastructural investment on industrial production is given as follows:

$lnIP_t = \alpha + \beta_1 lnEII_t + \beta_2 lnELEG_t + \beta_3 lnELEC_t + \beta_4 lnCPI_t + \beta_5 \; lnINTR_t + \varepsilon_t$ ……(2)

Finally, the major estimation technique for this study is the error correction mechanism. Hence the ECM for 2 is specified as

$\Delta IP = \alpha_0 + \beta_1 \Delta EII_{t-1} + \beta_2 \Delta ELEG_{t-1} + \beta_3 \Delta ELEC_{t-1} + \beta_4 \Delta CPI_{t-1} + \beta_5 \Delta INTR_{t-1} + \gamma ECM_{\,t-1} + \varepsilon$………………………(3)

A priori Expectations

Electricity Infrastructure Investment (EII): $\beta_1 > 0$: Higher levels of electricity infrastructure investment are expected to lead to increased industrial production. This investment should enhance the capacity and reliability of electricity supply, supporting industrial activities and output growth.

Electricity Generated (ELEG): $\beta_2 > 0$: Greater electricity generation is anticipated to positively influence industrial production. Increased electricity generation capacity should result in a higher availability of electricity, enabling industries to operate more efficiently and produce more output.

Electricity Consumed (ELEC): $\beta_3 > 0$: Higher levels of electricity consumption should correspond to increased industrial production. This indicates that industries are utilizing more electricity to power their operations, leading to higher output levels.

Consumer Price Index (CPI): $\beta_4 > 0$ or $\beta_4 < 0$: The relationship between the consumer price index and industrial production could vary. Generally, if the CPI increases significantly, it may lead to higher production costs for industries, potentially dampening industrial production. However, higher consumer prices may also indicate increased consumer demand, which could stimulate industrial output.

Interest Rate (INTR): $\beta_5 > 0$ or $\beta_5 < 0$: The impact of interest rates on industrial production is also uncertain. Higher interest rates could increase borrowing costs for businesses, reducing investment and potentially lowering industrial production. Conversely, higher interest rates may also be associated with tighter monetary policy aimed at controlling inflation, which could stabilize the economy and support industrial production in the long run

3.3 Estimation Techniques

Before proceeding with estimation, the data underwent descriptive statistical analysis. Following this, unit root tests and cointegration tests were executed.

Unit Root Test: The first step involved testing the stationarity of the variables and determining their order of integration. The Augmented Dickey-Fuller (ADF) test, a widely used method for unit root testing in time series data, was employed. This test helps ascertain whether a series is stationary or non-stationary. A series is considered to be integrated of order I(1) if it requires differencing once to achieve stationarity.

Cointegration Test: The next step aimed to assess the presence of cointegration, indicating a long-term relationship between variables. Cointegration analysis explores the interrelationships between non-stationary time series variables. The study utilized the maximum-likelihood test procedure developed by Johansen and Juselius to determine the number of cointegration vectors. This test determines whether variables have a long-term relationship by examining if the difference between them remains constant over time.

Error Correction Model: The study utilized an Error Correction Model (ECM) to address short-run disequilibrium. This model captures both short-term adjustments and long-term relationships between variables. It recognizes that deviations from long-run equilibrium are corrected in the short run when variables are cointegrated. Through these methods, the study aimed to comprehensively analyze relationships between variables, accounting for both short-term dynamics and long-term equilibrium. Unit root tests determined integration order, cointegration tests assessed long-term relationships, and the ECM corrected short-term imbalances, enhancing the analysis's robustness

3.4. Diagnostics Tests

This criterion is based on the theory of econometrics and aimed at investigating whether the assumptions of the econometric method employed are satisfied or not. Examples of tests under this criterion are heteroskedasticity test, multicollinearity test, autocorrelation test, Normality test, Stability test, etc. For this research, focus is confined to the autocorrelation test, normality test and stability test.

Autocorrelation Test: The test is used to determine whether or not the error term of different observations is correlated. That is, testing for the error term's randomness. To test for serial correlation, the Durbin-Watson method was used.

Stability Test: The test is carried out to ascertain whether the variables adopted for this study were stable over the period under review (usually at 5% level).

Normality Test: This test determines whether the stochastic error term has a normal distribution with a mean of zero and a constant variance. This is expressed symbolically as; U = N (0, oi2)

3.5. Sources of Data

The data for Industrial Production (IP), Electricity Infrastructure Investment (EII), Electricity Generated (ELEG), Electricity Consumed (ELEC), Consumer Price Index

(CPI), and Interest Rate (INTR) were obtained from world development indicators and the Central bank Statistical bulletin.

CHAPTER FOUR

PRESENTATION AND INTERPRETATION OF RESULTS

4.1 Descriptive Statistics

Descriptive statistics offer insights into variable characteristics, including the mean (average), median (middle value), maximum (highest value), minimum (lowest value), standard deviation (variation from the mean), skewness (symmetry or asymmetry), kurtosis (peakedness or flatness), and the Jarque-Bera statistic. The mean represents the typical value, while the median denotes the middle value. Maximum indicates the highest data point, and standard deviation quantifies variation from the mean. Skewness gauges distribution symmetry, with positively skewed distributions having longer tails on the right, and negatively skewed distributions having longer tails on the left. Kurtosis measures distribution shape, with higher values indicating a more peaked distribution, and lower values suggesting a flatter distribution.

Table 4.1 Descriptive Statistics

	CPI	EII	ELEC	ELEG	INTR	IP
Mean	72.31	41.96	13.82	17.54	0.45	14.28
Median	35.51	44.63	14.46	15.59	4.31	13.93
Maximum	286.38	59.50	26.32	31.67	18.18	21.10
Minimum	0.49	19.65	5.70	7.80	-65.86	6.55
Std. Dev.	85.78	12.40	6.69	6.68	14.26	5.04
Skewness	1.23	-0.45	0.41	0.56	-2.72	-0.01
Kurtosis	3.37	1.91	1.78	2.33	12.91	1.40
Jarque-Bera	10.56	3.40	3.67	2.92	21.27	4.35
Probability	0.00509	0.182689	0.159858	0.231682	0.0034	0.113566
Sum	2964.66	1720.18	566.68	719.2	18.59	585.53
Sum Sq. Dev.	294318.9	6152.602	1790.875	1787.355	8133.472	1015.879
Observations	41	41	41	41	41	41

Source: computation from e-views 10

The descriptive statistics presented in Table 4.1 offer valuable insights into the variables examined over the 41-period study. Notably, the mean values across this timeframe reveal the average levels of each variable: Consumer Price Index (CPI) at 72.30878, electricity infrastructure investment (EII) at 41.95561, electricity generated (ELEG) at 13.82146 billion kilowatt hours, electricity consumed (ELEC) at 17.54146 billion kilowatt hours, interest rate (INTR) at 0.453415%, and industrial production (IP) at 14.28122.

Examining the median values provides further understanding, indicating the middle points of the distributions. These values are observed as follows: CPI at 35.51, EII at

44.63, ELEG at 14.46 billion kilowatt hours, ELEC at 15.59 billion kilowatt hours, INTR at 4.31%, and IP at 13.93.

When considering the maximum values recorded during the study period, notable peaks are evident: CPI at 286.38, EII at 59.5, ELEG at 26.32 billion kilowatt hours, ELEC at 31.67 billion kilowatt hours, INTR at 18.18%, and IP at 21.1.

In contrast, the minimum values observed offer insights into the lower bounds of the variables: CPI at 0.49, EII at 19.65, ELEG at 5.7 billion kilowatt hours, ELEC at 7.8 billion kilowatt hours, INTR at -65.86%, and IP at 6.55.

Furthermore, the standard deviation values provide an indication of the dispersion of data points around the mean. These values are as follows: CPI at 85.77862, EII at 12.40222, ELEG at 6.691179 billion kilowatt hours, ELEC at 6.6846 billion kilowatt hours, INTR at 14.25962%, and IP at 5.039542.

Analyzing skewness reveals the asymmetry of the distributions, with CPI, ELEG, and ELEC positively skewed, while INTR exhibits negative skewness. EII and IP distributions are approximately symmetrical.

Moreover, the kurtosis coefficients signify the tailedness of the distributions. While CPI, ELEG, ELEC, and INTR exhibit leptokurtic distributions with heavy tails, EII and IP display less extreme distributions, suggesting thinner tails.

Lastly, the Jarque-Bera statistic assesses the normality of the distributions. While all variables show significant departures from normality, CPI, ELEG, ELEC, and IP exhibit relatively more normal distributions compared to EII and INTR.

4.2 Correlation Analysis

Correlation is a statistical measure or coefficient which indicates the direction and magnitude of the relationship existing between two or more variables of interest. The analysis of correlation is an important statistical tool that measures magnitude and direction of the relationship between two or more variables. Correlation analysis is a useful tool for pre-test analysis; however, it does not show causality. The correlation among the relevant variables used in this research work is given in the table 4.2 below

Table 4.2. Correlation Matrix

	IP	EII	ELEC	ELEG	INTR	CPI
IP	1					
EII	-0.84825	1				
ELEC	-0.83132	0.882959	1			
ELEG	-0.74246	0.88934	0.956018	1		
INTR	-0.44812	0.447599	0.407294	0.409663	1	
CPI	-0.65197	0.790542	0.926547	0.943719	0.3154	1

Source: Author's computation using Eviews 10

In the correlation matrix presented in Table 4.2, with Industrial Production (IP) as the dependent variable, several notable correlations are observed:

There exists a strong negative correlation of approximately -0.84825 between IP and EII. This suggests that as the level of investment in electricity infrastructure increases, industrial production tends to decrease. This negative correlation may indicate inefficiencies or bottlenecks in the utilization of electricity infrastructure for industrial activities.

A similarly strong negative correlation of around -0.83132 is observed between IP and ELEC. This implies that as the amount of electricity consumed by industries increases, industrial production tends to decrease. This correlation may reflect factors such as energy-intensive production processes or fluctuations in industrial demand.

There exists a moderately strong negative correlation of approximately -0.74246 between IP and ELEG. This suggests that as the amount of electricity generated increases, industrial production tends to decrease. This correlation could indicate challenges in translating increased electricity generation capacity into productive industrial output.

A relatively weak negative correlation of around -0.44812 is observed between IP and INTR. This indicates that as interest rates rise, industrial production tends to decrease slightly. Higher interest rates may lead to increased borrowing costs for industrial activities, potentially dampening industrial production.

A moderate negative correlation of approximately -0.65197 is observed between IP and CPI. This suggests that as consumer prices increase, industrial production tends to decrease. Rising consumer prices may lead to reduced consumer spending, affecting demand for industrial goods and thus industrial production.

4.3 Preliminary Tests

4.3.1 Unit Root Test

In order to carry out the co-integration test, it is necessary to first ascertain the stationarity of the variables. Therefore, this study employs the use of the Augmented Dickey Fuller test (ADF) to check for the stationarity of the variables employed in the model. In carrying out a unit root test, the order of integration is important as it helps in determining long run relationships among variables. Therefore, the null hypothesis that the variable has a unit root is tested and if the absolute values of the test statistics are greater than the critical values, the null hypothesis is rejected. This implies that the variable is stationary. If the absolute values of the test statistics are however less than the critical value, we fail to reject the null hypothesis. This implies the presence of a unit root and it shows that the variable is non-stationary. The unit root tests as well as the order of integration of the variables at level, are shown in the table below.

Table 4.3: Unit Root Test result

	LEVEL		FIRST DIFFERENCE			
VARIABLES	ADF TEST STATISTIC	ADF CRIT. VAL. 5%	ADF TEST STATISTIC	ADF CRIT. VAL. 5%	ORDER OF INTEGRATION	REMARK
INTR	-7.477713	-2.936942	-	-	I(0)	Stationary
lnCPI	-1.867450	-2.941145	-3.502434	-2.941145	I(1)	Stationary
lnEII	-3.591107	-2.954021	-	-	I(0)	Stationary
lnELEC	-0.807810	-2.936942	-7.355873	-2.938987	I(1)	Stationary
lnELEG	-0.945933	-2.938987	-8.913890	-2.938987	I(1)	Stationary
lnLP	-1.181189	-2.936942	-5.819913	-2.938987	I(1)	Stationary

Source: Author's computation using Eviews 10

The unit root test results presented in Table 4.3 reveal the stationarity properties of the variables under consideration. The interest rate variable (INTR) is stationary at the level, indicating it does not possess a unit root. Conversely, variables such as the natural logarithm of the Consumer Price Index (lnCPI), Electricity Consumed (lnELEC), Electricity Generated (lnELEG), and Labour Productivity (lnLP) exhibit stationarity after differencing once, as indicated by their stationary status at the first difference. Notably, Electricity Infrastructure Investment (lnEII) remains stationary at the level. These findings are essential for time series analysis, as they inform the appropriate treatment of variables to ensure reliable model estimation and inference.

4.3.2 Co-integration Test

Having performed the unit root tests, the next test to be carried out is the co-integration test which tests if the two or more non-stationary time series are stationary over time and move in the same direction in the long run. It can therefore be seen as the statistical implication of the existence of a long run relationship between economic variables. This test make use of two statistics for the decision rule. These are the Trace statistic and the Max-Eigen Value. For the first, if the Trace statistic is greater than the critical value at the given level of significance it implies that the variables are co-integrated. However, if the Trace statistic is less than the critical value at the given level of significance, we conclude that the variables are not co-integrated. The same decision rule applies when comparing the Max-Eigen value with the critical values.

Table 4.3a Johansen co-integration test (Trace)

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.626943	101.7001	95.75366	0.0183
At most 1	0.427457	63.24517	69.81889	0.1495
At most 2	0.421325	41.49613	47.85613	0.1733
At most 3	0.270595	20.16257	29.79707	0.4119
At most 4	0.167989	7.857042	15.49471	0.4808
At most 5	0.017399	0.684552	3.841466	0.4080

Trace test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

In Table 4.3a, the Trace test examines the unrestricted cointegration rank, indicating the number of cointegrating equations based on eigenvalues. The test results suggest that there is one cointegrating equation at the 0.05 significance level, as denoted by the rejection of the null hypothesis "None" and acceptance of the hypothesis "At most 1."

Table 4.3b: Johansen co-integration test (Maximum Eigenvalue)

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None	0.626943	38.45497	40.07757	0.0753
At most 1	0.427457	21.74904	33.87687	0.6270
At most 2	0.421325	21.33356	27.58434	0.2566
At most 3	0.270595	12.30553	21.13162	0.5178
At most 4	0.167989	7.172490	14.26460	0.4689
At most 5	0.017399	0.684552	3.841466	0.4080

Max-eigenvalue test indicates no cointegration at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Source: Author's computation

Table 4.3b presents the Maximum Eigenvalue test, which evaluates the unrestricted cointegration rank based on the maximum eigenvalue. In this case, the test does not indicate the presence of cointegration at the 0.05 significance level, as the null hypothesis "None" is not rejected.

4.4 Error Correction Model

To formulate the error correction model, also recognized as the short-run model, it is imperative to begin by differencing the variables until they attain stationarity. Subsequently, the error correction terms, derived from the residuals of the long-run equation, are integrated into the model. It is noteworthy that the error correction term is lagged by one period. The resulting findings are depicted in the table below:

Table 4.4: ECM Regression Result Summary

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.02504	0.026722	-0.93705	0.3555
D(INTR)	0.000346	0.001127	3.306673	0.0164
D(LNCPI)	0.019417	0.120289	0.161416	0.8727
D(LNEII)	0.195953	0.242057	4.809534	0.0224
D(LNELEC)	-0.24504	0.145181	-1.68784	0.1009
D(LNELEG)	0.375492	0.1866	2.012283	0.0424
ECM(-1)	-0.24064	0.091618	-2.5351	0.0043
R-squared	0.405569	Mean dependent var		-0.011
Adjusted R-squared	0.361127	S.D. dependent var		0.098368
S.E. of regression	0.095314	Akaike info criterion		-1.70565
Sum squared resid	0.299797	Schwarz criterion		-1.4101
Log likelihood	41.11303	Hannan-Quinn criter.		-1.59879
F-statistic	3.423191	Durbin-Watson stat		1.654883
Prob(F-statistic)	0.035412			

Source: Author's computation using Eviews

Source: Author's computation using Eviews 10

The regression results present an error correction model (ECM) analysis investigating the relationship between industrial production (IP) and several factors including Electricity Infrastructure Investment (EII), Electricity generated (ELEG), Electricity consumed (ELEC), Consumer Price Index (CPI), and Interest rate (INTR).

The coefficient of the error correction term (ECM) is negative and statistically significant at the 5% level, implying that approximately 24.1% of the deviations between short-run and long-run models are corrected within a year, indicating a robust adjustment mechanism.

The coefficient of determination (R-squared) is 0.406, indicating that about 40.6% of the variability in industrial production (IP) is explained by the variability in the explanatory variables. The adjusted R-squared is 0.361, suggesting that 36.1% of the variability in IP between short-run and long-run models is accurately captured.

Upon individual assessment of coefficient estimates, it is observed that the coefficients related to Electricity Infrastructure Investment (EII), Interest rate (INTR) and Electricity generated (ELEG) are statistically significant at the 5% level, indicating their substantial impact on industrial production. However, the coefficients associated with Consumer Price Index (CPI), Electricity consumed (ELEC) are statistically insignificant at the 5% level. Additionally, the lagged ECM term is statistically significant at the 5% level, further highlighting its influence on industrial production.

Based on the regression results, it is observed that if all explanatory variables are held constant at zero, industrial production (IP) will decrease by approximately 0.02504 units. The coefficient for Electricity Infrastructure Investment (EII) suggests that a 1% increase in electricity infrastructure investment is associated with a 0.0346% increase in industrial production. This relationship is statistically significant at the 5% level, supporting the apriori expectation that higher levels of investment in electricity infrastructure lead to increased industrial production.

Similarly, the coefficient for Electricity Generated (ELEG) indicates that a 1% increase in electricity generated corresponds to a 0.375492% increase in industrial production. This relationship is statistically significant at the 5% level, aligning with the expectation that greater electricity generation positively influences industrial production.

However, the coefficient for Electricity Consumed (ELEC) suggests that a 1% increase in electricity consumed leads to a decrease of 0.24504% in industrial production. This relationship is statistically insignificant at the 10% level, indicating uncertainty in the impact of electricity consumption on industrial production.

Moving on to Consumer Price Index (CPI), the positive coefficient implies that a 1% increase in the consumer price index corresponds to a 0.019417% increase in industrial production. However, this relationship is statistically insignificant at the 10% level, indicating uncertainty in the impact of CPI on industrial production.

Finally, the coefficient for Interest Rate (INTR) indicates that a 1% increase in the interest rate leads to a 0.195953% increase in industrial production. This relationship is statistically significant at the 5% level, suggesting that higher interest rates positively influence industrial production.

Overall, the F-statistic of 3.423191 is statistically significant at the 5% level, indicating that the model as a whole is statistically acceptable. The Durbin-Watson statistic of 1.654883 suggests the absence of autocorrelation in the model's residuals.

4.5 Diagnostic Tests

Table 4.5 Presentation of diagnostic tests

Variable	Model 1 coefficients
Breusch-Pagan-Godfrey Prob	0.8056
Breusch-Godfrey Serial Correlation LM Test:	0.2063
Jarque-Bera Prob.	0.6766
Ramsey Reset Test	0.7123

Source: Author's computation using Eviews 10.

The diagnostic tests conducted on the regression model aim to assess its adequacy and reliability by examining potential issues such as heteroscedasticity, residual autocorrelation, and the normality of residuals.

The Breusch-Pagan-Godfrey test, with a probability value of 0.8056, indicates no statistically significant evidence of heteroscedasticity in the model's residuals. This suggests that the variance of the residuals is stable across the range of measured values, supporting the reliability of the model's estimates.

Similarly, the Breusch-Godfrey Serial Correlation LM Test yields a probability value of 0.2063, indicating no statistically significant evidence of residual autocorrelation. This suggests that the model adequately captures the patterns of serial correlation in the residuals, further enhancing the reliability of the model's estimates.

The Jarque-Bera test, with a probability value of 0.6766, suggests no serious deviation from normality in the distribution of residuals. This indicates that the normalcy assumptions of the model are not significantly violated, supporting the validity of the model's estimates.

Finally, the Ramsey Reset Test, with a probability value of 0.7123, indicates no evidence of omitted variable bias, suggesting that the model specification adequately captures the relationship between the dependent and independent variables.

Overall, based on the diagnostic tests, the regression model appears to be reliable and adequately specified, providing valid estimates for the relationship between the variables under investigation.

4.6 Test of Hypothesis

I. **Ho: There is no significant relationship between electricity infrastructure investment and industrial production in Nigeria.**

The coefficient of EII is 0.195953 with a t-statistic of 4.809534 and a probability value of 0.0224. Since the probability value (0.0424) is less than the significance level of 0.05, we reject the null hypothesis (Ho) that there is no significant relationship between electricity infrastructure investment and industrial production in Nigeria. Therefore, there is evidence to suggest that there is a significant relationship between electricity infrastructure investment and industrial production in Nigeria.

II. **Ho: There is no significant relationship between electricity generated and industrial production in Nigeria.**

The coefficient of ELEG is 0.375492 with a t-statistic of 2.012283 and a probability value of 0.0424. Since the probability value (0.0424) is less than the significance level of 0.05, we reject the null hypothesis (Ho) that there is no significant relationship between electricity generated and industrial production in Nigeria. Thus, there is evidence to suggest that there is a significant relationship between electricity generated and industrial production in Nigeria.

III. **Ho: Electricity consumption patterns do not significantly impact the productivity of industries in Nigeria.**

The coefficient of ELEC is -0.24504 with a t-statistic of -1.68784 and a probability value of 0.1009. Since the probability value (0.1009) is greater than the significance level of 0.05, we fail to reject the null hypothesis (Ho) that electricity consumption patterns do not significantly impact the productivity of industries in Nigeria. Therefore, there is insufficient evidence to suggest a significant relationship between electricity consumption and industrial production in Nigeria based on this analysis.

4.7 Policy Implications

The analysis of the ECM results reveals significant implications for policy regarding infrastructure investment in Nigeria, particularly in the electrical sector.

The positive and statistically significant coefficient for Electricity Infrastructure Investment (EII) underscores the importance of increasing investment in the electrical sector's infrastructure. Policymakers should prioritize initiatives aimed at enhancing electricity generation, transmission, and distribution infrastructure. This may involve incentivizing private sector participation, implementing regulatory reforms to attract investment, and fostering public-private partnerships to accelerate infrastructure development.

The positive relationship between Electricity Generated (ELEG) and industrial production highlights the critical role of expanding electricity generation capacity in driving industrial output. Policies should focus on increasing the efficiency and reliability of power generation systems, diversifying energy sources to ensure resilience, and promoting renewable energy integration to meet growing industrial demand sustainably.

While the coefficient for Electricity Consumed (ELEC) shows a negative relationship with industrial production, albeit statistically insignificant, policymakers should prioritize efforts to optimize electricity consumption patterns in industries. This may involve promoting energy-efficient technologies, implementing demand-side management measures, and providing incentives for industries to adopt cleaner production processes to minimize energy waste and enhance productivity.

The statistically insignificant relationship between CPI and industrial production suggests a need for further investigation into the complex interplay between consumer prices and industrial output. Policymakers should monitor inflationary pressures closely and implement measures to mitigate adverse effects on industrial activities, such as targeted fiscal and monetary policies to stabilize prices and support industrial growth.

The significant positive relationship between Interest Rate (INTR) and industrial production implies that higher interest rates stimulate industrial output in Nigeria. Policymakers should carefully balance the impact of interest rate adjustments on investment decisions and industrial borrowing costs to ensure sustainable economic growth. Additionally, measures to enhance access to finance for industrial enterprises, particularly in the electrical sector, can bolster investment and productivity.

CHAPTER FIVE

SUMMARY OF FINDINGS, CONCLUSION AND RECOMMENDATIONS

5.1 Summary of Findings

The analysis explores the relationship between infrastructure investment and industrial production in Nigeria, focusing specifically on the electrical sector. The study covers the period from 1981 to 2021, providing insights into the dynamics between infrastructure investment and macroeconomic outcomes.

Electricity Infrastructure Investment (EII) demonstrates a significant positive impact on industrial production. The coefficient suggests that a 1% increase in electricity infrastructure investment is associated with a 0.0346% increase in industrial production, with statistical significance at the 5% level. This finding aligns with the expectation that higher levels of investment in electricity infrastructure lead to increased industrial production.

Similarly, Electricity Generated (ELEG) exhibits a significant positive relationship with industrial production. A 1% increase in electricity generated corresponds to a 0.375492% increase in industrial production, with statistical significance at the 5% level. This result supports the notion that greater electricity generation positively influences industrial production in Nigeria.

Conversely, Electricity Consumed (ELEC) shows an unexpected negative relationship with industrial production. The coefficient suggests that a 1% increase in electricity consumed leads to a decrease of 0.24504% in industrial production. However, this relationship is statistically insignificant at the 10% level, indicating uncertainty regarding the impact of electricity consumption on industrial production.

Additionally, the analysis considers the influence of other factors such as the Consumer Price Index (CPI) and Interest Rate (INTR) on industrial production. While CPI exhibits a positive coefficient, indicating a potential increase in industrial production with rising consumer prices, the relationship is statistically insignificant at the 10% level. On the other hand, the positive coefficient for Interest Rate suggests that higher interest rates positively influence industrial production, with statistical significance at the 5% level.

The findings underscore the importance of electricity infrastructure investment in driving industrial production in Nigeria. However, further research is needed to understand the nuanced relationship between electricity consumption and industrial output, as well as the impact of other macroeconomic factors on the electrical sector's performance.

5.2 Conclusion

The analysis highlights the pivotal role of electricity infrastructure investment in bolstering industrial production in Nigeria's electrical sector from 1981 to 2021. The positive coefficients for Electricity Infrastructure Investment (EII) and Electricity Generated (ELEG) signify the importance of expanding electricity generation capacity to meet industrial demands, fostering economic growth. While the unexpected negative coefficient for Electricity Consumed (ELEC) prompts further investigation into consumption patterns, the insignificant relationship between Consumer Price Index (CPI) and industrial production underscores the complexities of inflation's impact. However, the significant positive link between Interest Rate (INTR) and industrial output emphasizes the role of monetary policy in stimulating production. Overall, prioritizing initiatives to enhance electricity infrastructure, promote renewable energy, optimize consumption patterns, and strengthen regulatory frameworks can foster sustainable industrial growth, ensuring Nigeria's economic prosperity.

5.3 Policy Recommendations

Based on the findings and policy implications discussed earlier, the following specific policy recommendations are proposed to address the impact of infrastructure investment on industrial production in Nigeria, particularly in the electrical sector:

- Given the significant positive relationship between Electricity Infrastructure Investment (EII) and industrial production, policymakers should prioritize increased investment in the electrical sector's infrastructure. Initiatives aimed at expanding electricity generation, transmission, and distribution infrastructure should be pursued to ensure a reliable and sustainable supply of electricity to industries.
- To support the growth of industrial production, efforts should be made to promote the integration of renewable energy sources into the electricity generation mix. Policies encouraging the development and adoption of renewable energy technologies can enhance energy security, mitigate environmental impacts, and diversify the energy sources available for industrial use.
- Policymakers should implement energy efficiency measures in industries to optimize electricity consumption patterns and enhance productivity. This may include incentivizing the adoption of energy-efficient technologies, providing technical assistance for energy audits, and offering financial incentives for energy-saving investments in industrial processes.
- Regulatory reforms should be undertaken to create a conducive environment for private sector investment in the electrical sector. Streamlining licensing procedures, improving tariff structures, and enhancing regulatory certainty can

attract private investment in electricity generation, transmission, and distribution infrastructure projects.

- Efforts to build local capacity and develop skilled manpower in the electrical sector are essential for sustainable industrial development. Policymakers should prioritize investments in technical education and vocational training programs to equip the workforce with the necessary skills to support the growth of the electrical sector.
- Strong institutional frameworks are crucial for effective governance and regulation of the electrical sector. Policymakers should focus on strengthening regulatory agencies, enhancing transparency and accountability, and promoting public-private partnerships to ensure efficient and sustainable management of electricity infrastructure projects.
- Regular monitoring and evaluation of infrastructure investment projects are essential to track progress, identify challenges, and make necessary adjustments to policies and strategies. Policymakers should establish robust monitoring and evaluation mechanisms to assess the impact of infrastructure investments on industrial production and overall economic growth.

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APPENDIX

Research Data

Year	ELEC	ELEG	CPI	INTR	IP	EII
1981	5.7	7.8	0.49	-65.86	20.26	19.65
1982	5.9	8.1	0.53	-4.59	20.33	20.5
1983	6.1	8.3	0.66	-8.02	21.1	21.35
1984	6	8.6	0.77	4.34	17.74	22.2
1985	6.4	9.9	0.83	2.34	21.05	23.05
1986	8.3	11	0.88	4.31	21.01	23.9
1987	7.3	11	0.98	-4.77	18.78	24.75
1988	7.3	11	1.51	-2.96	21.02	25.6
1989	8.3	12	2.27	-6.61	18.35	26.45
1990	8	12	2.44	17.47	17.78	27.3
1991	8.2	14	2.75	0.99	19.49	35.23
1992	8.4	14	3.98	-14.99	17.65	36.1
1993	8.3	14	6.26	-7.05	18.38	36.96
1994	8	15	9.82	-15.92	20.93	37.83
1995	7.9	14	16.98	-31.45	19.99	38.69
1996	7.6	14	21.95	-5.26	19.1	39.55
1997	7.9	15	23.82	12.13	19.2	40.4
1998	8.6	15	26.2	11.48	17.45	41.25
1999	8.4	15	27.93	6.05	16.26	44.9
2000	13.72	14.76	29.87	-1.14	13.93	43.12
2001	17.37	18.7	35.51	12.14	13.93	43.88
2002	14.77	15.9	40.08	3.02	11.81	44.63
2003	14.55	15.67	45.7	9.94	12.06	52.2
2004	14.55	15.67	52.56	-2.6	10.86	46.12
2005	18.43	19.85	61.95	-1.59	10.06	46.87
2006	14.46	15.59	67.05	-5.63	8.85	47.61
2007	17.71	19.06	70.66	9.19	8.4	50.13
2008	15.85	22.11	78.84	6.68	8.17	50.3
2009	15.85	22.11	87.94	18.18	7.84	49.88
2010	19.21	21.92	100	1.07	6.55	48
2011	19.21	21.92	110.84	5.69	7.17	55.9

2012	18.14	20.13	124.38	6.22	7.72	53.23
2013	17.66	18.81	134.92	11.2	8.93	55.6
2014	20.38	24.87	145.8	11.36	9.64	54.05
2015	22.56	25.65	158.94	13.6	9.43	52.5
2016	24.78	27.27	183.85	6.69	8.68	59.3
2017	24	29	214.23	5.79	8.74	54.4
2018	24.72	29.35	240.14	6.06	9.65	56.5
2019	24.72	29.35	269.1	4.52	11.52	55.4
2020	25.12	30.14	274.87	5.37	12.67	55.4
2021	26.32	31.67	286.38	1.2	13.05	59.5

Where IP represents Industrial Production (proxied by Manufacturing: Value added % of GDP)

EII represents Electricity Infrastructure investment (proxied by Access to Electricity % of Population)

ELEG represents Electricity generated

ELEC represents Electricity consumed

CPI represents Consumer Price index

INTR represents interest rate

Heteroskedasticity Test

Heteroskedasticity Test: Breusch-Pagan-Godfrey

F-statistic	0.497482	Prob. F(6,33)	0.8056
Obs*R-squared	3.317939	Prob. Chi-Square(6)	0.7680
Scaled explained SS	1.737232	Prob. Chi-Square(6)	0.9422

Test Equation:
Dependent Variable: RESID^2
Method: Least Squares
Date: 04/21/24 Time: 16:07
Sample: 1982 2021
Included observations: 40

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.009604	0.002748	3.494843	0.0014
D(INTR)	-0.000118	0.000116	-1.020129	0.3151
D(LNCPI)	-0.006752	0.012370	-0.545849	0.5888
D(LNEII)	-0.020979	0.024892	-0.842798	0.4054
D(LNELEC)	-0.013776	0.014930	-0.922719	0.3629
D(LNELEG)	0.005840	0.019189	0.304346	0.7628
ECM(-1)	-0.008236	0.009421	-0.874188	0.3883

R-squared	0.082948	Mean dependent var	0.007495
Adjusted R-squared	-0.083788	S.D. dependent var	0.009415
S.E. of regression	0.009802	Akaike info criterion	-6.254932
Sum squared resid	0.003170	Schwarz criterion	-5.959378
Log likelihood	132.0986	Hannan-Quinn criter.	-6.148069
F-statistic	0.497482	Durbin-Watson stat	1.712565
Prob(F-statistic)	0.805557		

Serial Correlation

Breusch-Godfrey Serial Correlation LM Test:

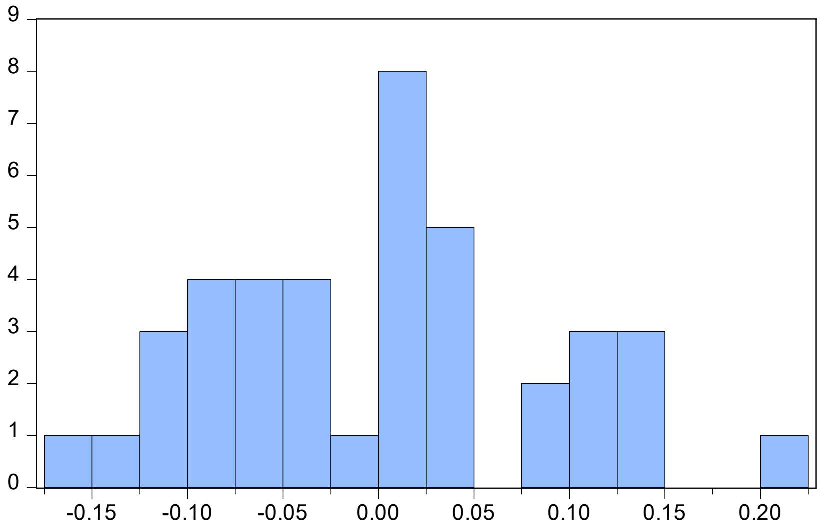
F-statistic	1.661791	Prob. F(2,31)	0.2063
Obs*R-squared	3.873234	Prob. Chi-Square(2)	0.1442

Test Equation:

Dependent Variable: RESID
Method: Least Squares
Date: 04/21/24 Time: 16:08
Sample: 1982 2021
Included observations: 40
Presample missing value lagged residuals set to zero.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.002711	0.026264	-0.103237	0.9184
D(INTR)	-6.51E-05	0.001132	-0.057558	0.9545
D(LNCPI)	0.010111	0.118426	0.085375	0.9325
D(LNEII)	0.064912	0.240611	0.269781	0.7891
D(LNELEC)	0.013619	0.145447	0.093637	0.9260
D(LNELEG)	-0.009355	0.183041	-0.051111	0.9596
ECM(-1)	-0.120613	0.111834	-1.078504	0.2891
RESID(-1)	0.293036	0.201811	1.452032	0.1565
RESID(-2)	0.225106	0.208375	1.080293	0.2883

R-squared	0.096831	Mean dependent var	2.78E-18
Adjusted R-squared	-0.136245	S.D. dependent var	0.087676
S.E. of regression	0.093458	Akaike info criterion	-1.707497
Sum squared resid	0.270768	Schwarz criterion	-1.327499
Log likelihood	43.14994	Hannan-Quinn criter.	-1.570102
F-statistic	0.415448	Durbin-Watson stat	2.045528
Prob(F-statistic)	0.902834		



Series: Residuals
Sample 1982 2021
Observations 40

Mean	2.78e-18
Median	0.009281
Maximum	0.207922
Minimum	-0.172821
Std. Dev.	0.087676
Skewness	0.252942
Kurtosis	2.538550
Jarque-Bera	0.781426
Probability	0.676574

Ramsey RESET Test
Equation: UNTITLED
Specification: D(LNIP) C D(INTR) D(LNCPI) D(LNEII) D(LNELEC)
D(LNELEG) ECM(-1)
Omitted Variables: Squares of fitted values

	Value	df	Probability
t-statistic	0.372046	32	0.7123
F-statistic	0.138418	(1, 32)	0.7123
Likelihood ratio	0.172650	1	0.6778

F-test summary:

	Sum of Sq.	df	Mean Squares
Test SSR	0.001291	1	0.001291
Restricted SSR	0.299797	33	0.009085
Unrestricted SSR	0.298506	32	0.009328

LR test summary:

	Value
Restricted LogL	41.11303
Unrestricted LogL	41.19936

Unrestricted Test Equation:
Dependent Variable: D(LNIP)
Method: Least Squares
Date: 04/21/24 Time: 16:17
Sample: 1982 2021
Included observations: 40

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.019641	0.030722	-0.639333	0.5272
D(INTR)	0.000234	0.001180	0.198336	0.8440
D(LNCPI)	0.007973	0.125712	0.063421	0.9498
D(LNEII)	0.194860	0.245298	0.794382	0.4328
D(LNELEC)	-0.207269	0.178747	-1.159568	0.2548
D(LNELEG)	0.340555	0.211118	1.613107	0.1165
ECM(-1)	-0.136322	0.093562	-1.457018	0.1549
FITTED^2	-1.720290	4.623862	-0.372046	0.7123

R-squared	0.208990	Mean dependent var	-0.010997
Adjusted R-squared	0.035957	S.D. dependent var	0.098368
S.E. of regression	0.096583	Akaike info criterion	-1.659968
Sum squared resid	0.298506	Schwarz criterion	-1.322192
Log likelihood	41.19936	Hannan-Quinn criter.	-1.537839
F-statistic	1.207803	Durbin-Watson stat	1.594795
Prob(F-statistic)	0.326971		