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INFRASTRUCTURE DEVELOPMENT AND INDUSTRIALISATION IN NIGERIA

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Abstract

This study examines the impact of infrastructure development on industrialization in Nigeria from 1996 to 2023. Key infrastructure indicators—access to electricity, internet penetration rate, and government capital expenditure—were employed, while government effectiveness served as a control variable. Manufacturing value added was used as a proxy for industrialization. Data were sourced from the Central Bank of Nigeria (CBN) Statistical Bulletin and the World Bank's World Development Indicators (WDI). The analysis employed the Augmented Dickey-Fuller (ADF) Unit Root Test to assess stationarity, while the Autoregressive Distributed Lag (ARDL) model was used to estimate both short-run and long-run relationships. Findings from the bounds test confirmed the existence of a long-run relationship between infrastructure development and industrialization in Nigeria. Specifically, access to electricity showed a strong and positive impact on manufacturing value added in both the short and long run. Government capital expenditure exhibited a significant long-run effect, while government effectiveness was positively associated with industrialization in the short run. Interestingly, internet penetration did not show a significant impact on manufacturing value added during the period under review. The study concludes that infrastructure development plays a pivotal role in advancing Nigeria's industrial growth. Accordingly, it is recommended that the Federal Ministry of Power intensify efforts toward nationwide electrification—particularly in rural and industrial zones—to unlock the full potential of Nigeria's manufacturing sector.

***Keywords**: Infrastructure, Development, Industrialisation, Nigeria.*

Introduction

Industrialisation remains a cornerstone for economic transformation and structural change in developing economies, including Nigeria. In this study, industrialisation is perceived as the process through which Nigeria transitions from an economy largely dependent on agriculture and crude oil to one with a thriving manufacturing base and productive industrial sectors. According to Njoku, et al. (2014), industrialisation involves the expansion and increased output of industries, measured by indicators such as the index of industrial production. Similarly, Nwachukwu and Odigie (2017) emphasized that industrialisation drives technological innovation, job creation, and structural diversification—outcomes that are essential for Nigeria's long-term economic resilience. In Nigeria, industrialisation has played a pivotal role in contributing to GDP, promoting value addition, creating employment, and fostering backward and forward linkages across sectors. However, the pace and quality of industrial growth have been significantly constrained by infrastructural deficiencies.

Therefore, this study perceives infrastructure development as the strategic investment in foundational services such as electricity, internet connectivity, transportation, and effective governance systems. According to Isukul and Ozuzu (2021), government capital expenditure directed at infrastructure development—particularly the power sector—can reduce production costs and enhance industrial competitiveness. Similarly, Okoh and Uche (2020) argue that access to efficient infrastructure accelerates productivity in manufacturing and facilitates economic modernization. Statistical evidence reveals that Nigeria's access to electricity remains grossly inadequate, serving only a fraction of its over 218 million population. The power sector, plagued by frequent grid collapses, generates less than a third of its 13,500 MW installed capacity, resulting in an estimated $29 billion annual loss to the economy (Reuters, 2023). Despite this, internet penetration has surged from just 3% in 2004 to 73.82% by 2021, creating digital opportunities for modern industrial operations (New Telegraph, 2021). Between 2010 and 2024, Nigeria's federal government invested over ₦25.7 trillion in capital projects, with a sharp rise in spending since 2020—reflecting renewed attention to infrastructure as a lever for industrial recovery (Intelpoint, 2024). Furthermore, effective governance remains a crucial driver. As Isukul and Ozuzu (2021) emphasized, sound fiscal policies, transparent institutions, and strategic governance foster an enabling environment where infrastructure investments translate into meaningful industrial development. Thus, the study posits that infrastructure development—measured through access to electricity, internet penetration, government capital expenditure, and government effectiveness—is a critical determinant of industrialisation in Nigeria.

Despite Nigeria's ambitious industrialisation agenda, the country's manufacturing sector remains underdeveloped, contributing only about 13% to GDP as of 2023 (NBS, 2023), far below its potential compared to peer economies. One of the most persistent constraints is inadequate infrastructure. For instance, only 55.4% of Nigerians had access to electricity in 2021, with frequent power outages resulting in an estimated $29 billion annual economic loss (World Bank, 2021; Reuters, 2023). Additionally, while internet penetration has improved, rising to 73.82% by 2021 (New Telegraph, 2021), its industrial application remains limited due to high costs and poor broadband quality. Although government capital expenditure has increased—reaching over ₦5.9 trillion in 2023 alone (CBN, 2023)—the efficiency of spending and infrastructure quality remains a concern. Moreover, Nigeria's government effectiveness percentile rank stood at 14.9 out of 100 in 2022 (World Bank, 2023), indicating weak institutional capacity to implement and maintain infrastructure projects. These persistent gaps have hindered manufacturing growth, job creation, and economic diversification. Thus, this study is motivated by the need to empirically investigate how infrastructure—particularly electricity access, internet penetration, capital investment, and governance—impacts industrialisation in Nigeria, providing evidence to guide infrastructure policy for sustainable industrial growth.

Literature Review

Theoretical Literature

Endogenous Growth Theory

This study is underpinned by the Endogenous Growth Theory, propounded by Paul Romer (1990) and Robert Lucas (1988).

The theory emerged as a critique of the neoclassical growth model by incorporating internal (endogenous) factors such as human capital, innovation, and public infrastructure as key drivers of long-term economic growth. The central assumptions of the theory include: (i) returns to investment in infrastructure and knowledge are not subject to diminishing returns; (ii) public policy and institutional quality play pivotal roles in stimulating growth; and (iii) technological progress is a result of deliberate investment decisions rather than an external factor. Proponents of the theory, such as Romer (1990) and Barro (1991), argue that government investment in infrastructure and education can lead to sustainable economic growth through increased productivity and industrial expansion. Lucas (1988) also emphasized the role of human capital and spillover effects in enhancing innovation and output. On the contrary, opponents such as Solow (1956) and Mankiw (1995) critique the theory for overestimating the ability of public policy to sustain growth, contending that factors like technology progress remain largely exogenous and that real-world policy impacts are often constrained by inefficiencies and corruption. Despite such critiques, the relevance of the Endogenous Growth Theory to this study is both direct and compelling. By examining how infrastructure—represented by access to electricity, internet penetration rate, and government capital expenditure—affects industrialisation (measured by manufacturing value added) the study aligns with the theory's position that internal investments significantly influence economic development. Additionally, the inclusion of government effectiveness as a control variable reflects the theory's emphasis on the importance of institutions in translating infrastructure investment into industrial outcomes. The Endogenous Growth Theory thus validates the empirical direction of this research and strengthens its policy implications.

Structural Change Theory

The Structural Change Theory was popularized by Lewis (1954) and later expanded by Chenery (1979). The theory explains economic development as a transformation process from a traditional, agrarian-based economy to a modern, industrialized one. According to this perspective, development entails reallocating labor and resources from low-productivity sectors like agriculture to high-productivity sectors such as manufacturing and industry. The key assumptions of Structural Change Theory include: (i) surplus labor exists in the agricultural sector which can be transferred to industry without loss in agricultural output; (ii) industrialization leads to capital accumulation and economic diversification; and (iii) government plays a strategic role in facilitating the structural transition through policy and infrastructure. Proponents like Chenery and Syrquin (1975) emphasize the role of industrial policy and infrastructure in creating enabling environments for industrial growth, asserting that government investment in roads, electricity, and communication is crucial for structural transformation.

Conversely, opponents such as Bauer (1984) and Lal (1983) argue that structuralist approaches tend to overestimate the state's ability to engineer economic transformation and often neglect market mechanisms and entrepreneurial dynamism. The relevance of the Structural Change Theory to this study lies in its focus on industrialization as the engine of economic growth and the recognition of infrastructure as a critical enabler in this transformation. By focusing on access to electricity, internet penetration, government capital expenditure, and government effectiveness, this study aligns with the theory's emphasis on transitioning to a productive industrial sector through infrastructural investments and institutional efficiency. Structural Change Theory thus offers a solid theoretical framework for analyzing the impact of infrastructure on Nigeria's journey toward industrialization.

Review of Related Empirical Studies

Several empirical studies have examined the impact of infrastructural development on industrialization in Nigeria, focusing on various dimensions. For instance, Ifoghere and Olele (2024) examined the impact of government infrastructural development on Transportation (IFDT), road (IFDR), water (IFDW) and telecommunication (ITEL) as they influence the growth process of the Nigerian economy, proxy by real GDP (RGDP), from 1990 to 2023. Descriptive statistics and econometric methods of Auto-Regressive Distributive Lag (ARDL) model and Granger causality estimation tests were conducted to examine the long run relationship of the series. The analysis revealed that infrastructure development on transport services (IFDT) was positive and significant in explaining changes in real GDP of Nigeria. However, Infrastructure development on road (IFDR), water (IFDW) and telecommunication (ITEL) were negative and not significant in explaining changes in Nigeria's real GDP within the study period. On this basis therefore, the study concludes that there is no long run relationship between the dependent variable (RGDP) and the explanatory variables (IFDT, IFDR, IFDW and ITEL).

Similarly, Nexon (2024) assess the effect of infrastructure development on industrialization in Nigeria. Findings showed that education plays a pivotal role in driving technological innovation and fostering economic growth. Through education, individuals acquire the knowledge, skills, and expertise necessary to develop new technologies and drive innovation across various sectors. A well-educated workforce is crucial for advancing technological advancements, as it enables individuals to engage in research, development, and application of new ideas. Moreover, education fosters critical thinking, creativity, and problem-solving abilities, which are essential for addressing complex challenges and driving innovation forward. Additionally, education enhances the adaptability of the workforce, enabling individuals to keep pace with rapidly evolving technological advancements. Furthermore, investments in education contribute to economic growth by increasing productivity, stimulating entrepreneurship, and fostering a competitive workforce in the global market. Also, Yusuf (2023) investigates the relationship between infrastructural development and manufacturing sector performance in Nigeria: the moderating role of institutional quality. To accomplish this objective, the study employs an Autoregressive distributed lag (ARDL) from (2002–2021). The results show that institutional quality in Nigeria has a negative impact on manufacturing sector performance both in the short run and long run. The study reveals that productive infrastructure development is positively and significantly improving manufacturing sector performance in Nigeria.

Correspondingly, Ojediran (2023) for over 40 years, studied the influence of infrastructure development on Nigeria's economic growth (1981-2019). An infrastructure-modeling Cobb-Douglas production function is given. To test for stationarity, long-run connection, causal link, and short and long-run equilibrium, the research utilized the unit root test, Johansen co-integration test, Granger causality test, and Ordinary Least Square (OLS) approaches. The study's findings found that Nigeria's economic development may be attributed to factors including infrastructure, currency, and inflation. Except for the labour force, all of the study's factors were statistically significant in explaining Nigeria's economic development. Furthermore, Bennee et al (2021) examined the relationship between Infrastructure Development Expenditure and Economic Growth of Nigeria for twenty one (21) years period ranging from 2000-2020. The study adopted Longitudinal (Ex-post facto) research design via E-Views 10.0. The result revealed that a significant and positive relationship exist between infrastructure development expenditure and RGDP.

Still, Kani and Avinash (2020) examines the relationship between the level of infrastructure facilities provision and industrial growth and consequent linkages to regional development in Nigeria. Industrial performance is influenced by infrastructural facilities available in a country which are classified into two; economic (roads, water, electricity, communication) and social (schools, hospitals, housing, sewage management). Adequate provision of infrastructural facilities with required efficiency leads to higher productivity leading to industrial growth and regional development and vice vasa. Poor provision of the required facilities necessitates enterprises to provide them which costs a lot out of revenue thereby limiting the industrial growth prospects and becomes a major threat to star-ups. In areas where the facilities are not sufficiently supplied, economic activities such as supply of goods and services, provision of employment, revenue, marketing, improvement of people's lives, regional development etc. were negatively affected. Being a conceptual paper, secondary data was used in the collection of data for this study and results was analyzed using a content analysis. More, so Azolibe and Okonkwo (2020) examine whether the state of infrastructure development in Sub-Saharan Africa actually stimulates industrial sector productivity, using a panel data set of 17 countries spanning from 2003 to 2018. Design/methodology/approach – The study used panel least square estimation technique to examine the relationship between the variables. The result of the study indicates that the major factor that influences industrial sector productivity in Sub-Saharan Africa is their quantity and quality of telecommunication infrastructure. Analysis shows that the relatively low level of industrial sector productivity in Sub-Saharan Africa is largely due to their poor electricity and transport infrastructure and underutilization of water supply and sanitation infrastructure.

Taofik (2019) examines the influence of infrastructure on industrialization in Nigeria from 1981 to 2015. It synthesizes the production function and growth approaches to estimate the industrial output elasticity of infrastructure development using the dynamic ordinary least squares (DOLS) estimation technique that accounts for present and past effects of infrastructural development on industrialization. The Toda-Yamamoto modified Wald (MWALD)-based causality test that arbitrage between the results with and without structural breaks was used to define the direction of causality between infrastructure and industrial output. The unit root tests that account for break and without break were employed to ascertain the stationarity of the data, while the residual-based cointegration test with a structural break was employed to determine the cointegrating relationship among the variables. Findings suggest that all proxy of infrastructure except telephone density impacted positively on industrial output when structural breaks were not accounted for. Telephone density and energy consumption impacted on industrial output in the presence of structural breaks, while capital expenditure in transport and communication did not impact on industrial output. This suggests that fluctuations in infrastructural development, to a large extent, affected the magnitude of the impact of infrastructure on industrialization in Nigeria.

Ogbaro and Omotoso (2017) examines the role of infrastructure development in promoting economic growth in Nigeria over the period 1980-2015. A Cobb-Douglas production function which models infrastructure as a stock variable is specified and estimated using the ordinary least squares method. The study finds positive and significant effects of total air transport infrastructure, communication infrastructure, power infrastructure and total rail lines on economic growth Additionally, Abdul and Vashma (2014) explored the relationship between Infrastructure development and economic growth in Pakistan. For this purpose we used time series data for the period from 1971 to 2013. Auto Regressive Distributed Lags Model (ARDL) has been applied to examine the short run as well as long run relationship between infrastructure development and economic growth. Infrastructure Development Index (LINDI) is constructed to examine the impact of infrastructure development on economic growth. The empirical findings show a positive relationship between physical infrastructure and economic growth. The results showed that infrastructure development plays a key role to sustain to accelerate the process of economic growth and sustain it in the long-run.

Gaps and Value Addition

The reviewed empirical literature demonstrates that significant scholarly attention has been given to understanding how infrastructural development influences economic growth and industrialization in Nigeria and other developing regions. Studies such as Ifoghere and Olele (2024) examined various infrastructure components, including transportation, roads, water, and telecommunications, showing that while transport infrastructure had a positive and significant impact on real GDP, other components were negative or insignificant, suggesting that infrastructure effects are not uniform across sectors. Similarly, Yusuf (2023) highlighted the importance of productive infrastructure in boosting manufacturing performance, although institutional quality was found to exert a negative influence, pointing to the role of governance and policy in mediating infrastructure effectiveness. Ojediran (2023) and Bennee et al. (2021) reinforced the positive association between infrastructure development and economic growth using different econometric methods and time periods, while Ogbaro and Omotoso (2017) demonstrated the relevance of specific infrastructure types such as air transport and power in driving economic performance. Other studies, including Taofik (2019), further underscored that the impact of infrastructure on industrialization is sensitive to structural breaks and fluctuating investment patterns, with certain components such as telephone density and energy consumption becoming significant only when accounting for such dynamics.

Meanwhile, Azolibe and Okonkwo (2020) expanded the focus to Sub-Saharan Africa, emphasizing the critical role of telecommunications infrastructure in stimulating industrial productivity but also highlighting the persistent challenges of poor electricity and transport networks. While this body of evidence provides useful insights into the links between infrastructure and broader economic outcomes, important gaps remain. Many studies primarily focus on aggregate economic growth (measured by real GDP) rather than directly modeling industrialization as a distinct outcome variable, and often do not comprehensively compare the relative contributions of traditional infrastructure like roads and electricity with modern infrastructure such as ICT within the same empirical framework. Additionally, despite some attention to institutional quality, there is limited integration of governance and policy factors as moderators of infrastructure effectiveness. The literature also tends to rely on national-level time series data over long periods without adequately capturing regional disparities in infrastructure provision across Nigeria's diverse geopolitical zones or accounting for the evolving role of digital infrastructure in driving contemporary industrial development. This suggests that future research can contribute by jointly examining disaggregated infrastructure components, explicitly targeting industrialization outcomes, incorporating institutional and policy dimensions, and adopting methodologies capable of capturing regional heterogeneity and recent shifts toward knowledge-based infrastructure investments.

Methodology

This study basically relied on secondary data which was obtained from World Banks, world Development Indicator (WDI). Access to Electricity (EAC), Internet Penetration Rate (IPR), Government Capital Expenditure (GCE), and Government Effectiveness (GOE) were used to proxy the explanatory variables while, Manufacturing Value Added (HDI), was adopted to capture "Industrialization". The formulated model was subjected to unit root test using Augmented Dickey Fuller (ADF) approach. Based on the outcome of the ADF, the study employed both the Auto-regressive Distributive Lag (ARDL) Model.

Model Specification

This study is based on the modification of Yusuf (2023) when investigating the Nexus between Infrastructure Development and Manufacturing Sector Performance in Nigeria. Thus the model was;

MVA =f (INFR, INSQ, GFCF, HDI)

Where: MVA represents manufacturing value added, INFR depicts infrastructural development, INSQ is the institutional quality, GFCF is the gross fixed capital formation, HDI describes human development index.

The model was modified by introducing access to electricity, internet penetration rate government effectiveness. The model is specified as follows:

$$MVA = f(AEC, IPR, GCE, GOE) \qquad (1)$$

The mathematical model could be symbolically expressed as;

$$MVA = \beta_0 + \beta_1 AEC + \beta_2 IPR + \beta_3 GCE + \beta_4 GOE \qquad (2)$$

Equation (2) above is transformed into an econometric model by incorporating the disturbance term (ε) as follows:

$$MVA = \beta_0 + \beta_1 AEC + \beta_2\ IPR + \beta_3\ GCE + \beta_4\ GOE + e \qquad (3)$$

Logarithmic transformation are also a convenient means of transforming a highly skewed variable into one that is more approximately normal (Kenneth 2011)

The modified version of the model adopted for this study now take the form of

$$LMVA = \beta_0 + \beta_1\ AEC + \beta_2\ IPR + \beta_3\ LGCE + \beta_4\ GOE + e \qquad (4)$$

Where:

MVA = Manufacturing Value Added, AEC = Access to Electricity, IPR = Internet Penetration Rate, GCE = Government Capital Expenditure, GOE = Government Effectiveness, f = functional relationship β_0 = Intercept of relationship in the model/constant B_1-B_4 = Coefficients of each independent or explanatory variable e= Stochastic or Error term.

Description of Variables in the Model

Manufacturing Value Added (MVA): This refers to the net output of the manufacturing sector after adding up all outputs and subtracting intermediate inputs. Manufacturing value added is used to proxy industrialization and was measured in US$.

Access to Electricity (**AEC**): This means the ability of households, businesses, and industries to reliably connect to and use electricity for their activities. It involves not just physical connection to the grid but also having a stable, affordable, and continuous power supply. When electricity is reliable and affordable, it reduces production costs, since manufacturers spend less on backup generators or alternative energy. Thereby enhancing manufacturing value. Accordingly, this paper expects that access to electricity will have a positive relationship with manufacturing value added. Access to electricity is used in this paper as a surrogate to infrastructural development and is measured in % of population. Hence, $\beta 1>0$.

Internet Penetration Rate (**IPR**): This refers to the percentage of the population or businesses that have access to and actively use the Internet. High Internet penetration significantly benefits manufacturing by streamlining production and supply chains, facilitating the adoption of modern technologies such as automation, data analytics, and smart manufacturing systems, and expanding market access through online platforms. Therefore, this study hypotheses that internet penetration will be positively related with manufacturing value added. Interment penetration is used as a stand-in for infrastructural development and is measured in % of population. Thus, $\beta 2>0$.

Government Capital Expenditure (**GCE**): This refers to public spending on long-term assets such as roads, power infrastructure, water systems, and industrial facilities. When government capital expenditure is high and effectively implemented, manufacturers benefit from better transportation networks that lower logistics costs, more reliable electricity that reduces production interruptions, and improved industrial zones that attract investment and support expansion. Consequently, this study believed that government capital expenditure will be positively related with manufacturing value added. Government capital expenditure is used in this paper as a proxy for infrastructural development and would be expressed as billions of naira annually. Thus, $\beta 3>0$.

Government Effectiveness (**GOE**): This refers to the quality of public institutions, policies, and services, including how well governments design and implement regulations, deliver infrastructure, and support businesses. When government effectiveness is high, manufacturers operate in an environment with clear policies, efficient bureaucracy, and reliable public services, which reduces uncertainty and lowers the cost of doing business. It is expected that government effectiveness is positively related to manufacturing value added. Government effectiveness is used to proxy infrastructural development and is measured in percentile rank. Thus, β4>0.

Descriptive Statistics

Table 1: Descriptive Statistics Test Result

	MVA	AEC	IPR	GCE	GOE
Mean	33.37250	48.61071	14.07143	1065.664	14.71429
Median	33.98500	50.20000	10.50000	800.7350	15.00000
Maximum	64.90000	60.50000	39.00000	4486.210	21.00000
Minimum	9.620000	0.000000	0.000000	212.9300	9.000000
Std. Dev.	17.19293	11.23620	13.40516	989.9732	3.494516
Skewness	0.249619	-2.934218	0.467469	1.938145	0.068290
Kurtosis	1.962527	13.64638	1.833773	6.613643	2.604511
Jarque-Bera	1.546519	172.4145	2.606561	32.76471	1.177927
Probability	0.461506	0.000000	0.271639	0.000000	0.554902
Sum	934.4300	1361.100	394.0000	29838.59	412.0000
Sum Sq. Dev.	7981.113	3408.807	4851.857	26461268	329.7143
Observations	28	28	28	28	28

Source: Author Computation 2025

Table 1 presents a detailed summary of the descriptive statistics for the variables analyzed in this study, comprising 28 observations covering one dependent variable and four independent variables. The Manufacturing Value Added (MVA) recorded a mean value of 33.37250 with a minimum of 64.90000 a maximum of 64.90000, and a standard deviation of 17.19293, indicating moderate variability. Access to electricity reported a mean of 48.61071, with a minimum of 0.000000, a maximum of 60.50000, and a standard deviation of 11.23620. Internet penetration rate (IPR) had a mean of 14.07143, ranging from 0.000000 to 39.00000, with a standard deviation of 14.94, while Government capital expenditure (GCE) recorded a mean of 1065.664, a minimum of 212.9300, a maximum of 41.86, and a standard deviation of 4486.210. Government Effectiveness (GOE) averaged 14.71429, with values ranging from 9.000000 to 21.00000 and a standard deviation of 0.068290.

The skewness results revealed that manufacturing value added, internet penetration, and government effectiveness were moderately skewed, with coefficients of 0.24, 0.46 and 0.06, respectively. However, access to electricity and government capital expenditure are highly skewed. The kurtosis results showed that government effectiveness is mesokurtic, with values close to 3, while access to electricity, and government capital expenditure were leptokurtic, having a coefficient greater than 3. However, manufacturing value added and internet penetration rate are leptykurtic because their coefficient is less than 3. The Jarque-Bera test indicated that manufacturing value added, internet penetration rate and government effectiveness were normally distributed, with p-values greater than 0.05. Based on these results, the variables were deemed appropriate for further analysis and subjected to unit root tests to determine stationarity.

Unit Root Test

The study employed the Augmented Dickey Fuller (ADF) unit root test to identify the order of integration of the variables under study to select appropriate methodology in order to avoid spurious regression.

Table 2: Unit Root Test Using Augmented Dickey Fuller (ADF)

Variables	Levels		First Difference		Order of Integration	P-value
	T. Statistics	5% Critical Value	T. Statistics	5% Critical Value		
LMVA	-1.288205	-2.986225	-3.366476	-2.986225	I(1)	0.0223
AEC	-0.859941	-1.953858	-2.363603	-1.954414	I(1)	0.0000
IPR	3.277050	-2.976263			I(0)	0.0000
LGCE	-0.527616	-2.976263	-7.016292	-2.981038	I(1)	0.0000
GOE	-3.287539	-2.976263			I(0)	0.0256

Source: Extracts from E-view 13. * Level of significance at 5%

The variables included in the study were put through Augmented Dickey Fuller (ADF) Tests to assess if they are stationary series or non-stationary series, according to the results from table 2 above. The stationarity test results show that LMVA, and LGCE were stationary at initial difference I(1), whereas IPR and GOE was stationary at level I(0). The variables exhibit mixed order of integration or stationarity of level and first differences, according to assessments of the variables' stationarity. For the data analysis, the Autoregressive Distributive Lag (ARDL) method, which can handle both stationary at level I(0) and first difference I(1), was used. The ARDL test, which takes into account both short- and long-term trends when examining the connection between the dependent and independent variables, is therefore the most appropriate analytical technique.

Table 3: ARDL Bound Test

Test Statistics	Value	K
F-statistics	14.241454	4
Significance	**I (0)**	**1(1)**
10%	2.75	3.99
5%	3.35	4.77
2.5%	3.25	4.49
1%	4.78	6.67

Source: *Authors computation 2025*

Table 3 presents the results of the bound test, which compared the F-statistics with the critical bound values. The value of the F-statistic is 14.241454. The outcome demonstrated that, at a significance level of 0.05, the F-statistic is bigger than the lower bound but less than upper bound of the critical values, which are 3.35 and 4.77 respectively. It follows that there is no degree of co-integration between energy poverty and economic development in Nigeria. As a consequence, the study estimated the sort-run Auto-Regressive Distributive Lag (ARDL) below;

Short and Long-Run Estimation Results for LMVA

The results of the short and long-run dynamics association of model one are presented in table 4 below:

Table 4: ARDL Short and Long-run Result for LMVA

Short Run Coefficient				
Variable	Coefficient	Std. Error	t-Statistics	Prob
D(AEC)	0.010405	0.002352	4.423089	0.0010
D(IPR(-1)	0.038505	0.032929	1.169347	0.2670
DLOG(GCE)	0.029517	0.074908	0.394045	0.7011
D(GOE)	0.025310	0.007489	3.379807	0.0061
ECM(-1)	-0.682327	0.064503	-10.57814	0.0000
Long Run Coefficient				
Variable	Coefficient	Std. Error	t-Statistics	Prob
(AEC)	0.182460	0.061935	2.945966	0.0052
(IPR(-1)	-0.026576	0.028641	-0.927914	0.3640
LOG(GCE)	0.852127	0.327037	2.605601	0.0033
(GOE)	0.032554	0.029752	1.094200	0.2863
C	-4.459713	0.405037	-11.01064	0.0000
R^2 =0.961923; Adj R^2 =0.916923: F- Stat, = 21.37596 (0.000006); DW =2.333653				

Source: *Authors computation using E-view 13 2025*

The coefficient estimate for the error correction term, ECM (-1) has a negative value and is significant at the 0.05 level. It suggests that the model will reach long-run equilibrium at a rate of 0.68% every year. This means that a yearly adjustment speed of 0.68% may fix the mistake from the previous year. The independent variables (AEC, IPR, LGCE, & GOE) explain 92% of the total variance in the dependent variable (LMVA), according to the adjusted R-Square (R2) value. As a whole, the model is noteworthy since the F-statistic is significant at the 5% level of significance. Without serial correlation, the model would not work, according to the Durbin-Watson statistics of 2.333653, which is close to 2.

Table 4 displays the model's short-and long run outcome. The coefficient of access to electricity (AEC); and government effectiveness (GOE) has a significant positive effect on the logarithm value of manufacturing value added (LMVA). However, the coefficient of internet penetration (IPR) and the logarithm value of government capital expenditure (LGCE) had a positive but insignificant effect on the logarithm value of manufacturing value added (LMVA) in the short-run. Table 4 shows the outcome of the long-run result that the coefficient of access to electricity (AEC); and the log value of government capital expenditure (LGCE) has a significant positive effect on the logarithm value of manufacturing value added (LMVA), while government effectiveness (GOE) exhibited a positive but insignificant effect on the logarithm value of manufacturing value added (LMVA). However, internet penetration rate (IPR) reported a negative and insignificant effect on the logarithm value of manufacturing value added (LMVA) in the long-run.

Diagnostic Test

Table 5: Ramsey Reset Test, Serial Correlation LM Test and Homoscedasticity Test Results

	F-Statistic	Prob-Value
Ramsey Reset Test	1.661859	0.2448
Breusch-Godfrey Serial Correlation LM Test	1.467506	0.3274
Breusch-Pagan-Godfrey Heteroskedasticity Test	1.339544	0.3627

Source: Authors computation 2025

From Table 5, the results of the diagnostic test show that the linearity test using Ramsey Reset test indicates that the f-statistic (1.661859) with computed p-value of 0.2448 which is greater than 5 percent (0.05) critical value, hence the study reject the null hypothesis and conclude that the model is correctly specified. The result of the Serial or Autocorrelation Test using Breusch-Godfrey Serial Correlation LM Test shows that the f-statistic is 1.467506, with a Chi-Square probability value is 0.3274. This indicates that the probability value of about 33 percent (0.3274) is greater than 5 percent (0.05) critical value; hence the study confirms no serial correlation in the model. The result of the heteroscedasticity test using Breusch-Pegan-Godfrey test shows that the f-statistic is 1.339544 with a Chi-Square probability value of 0.3627 The result suggests that there is no evidence of heteroskedasticity in the model since the probability Chi-square value is more than 5 percent (P >0.05). So, residuals do have constant variance which is desirable in regression meaning that residuals are Homoscedastic.

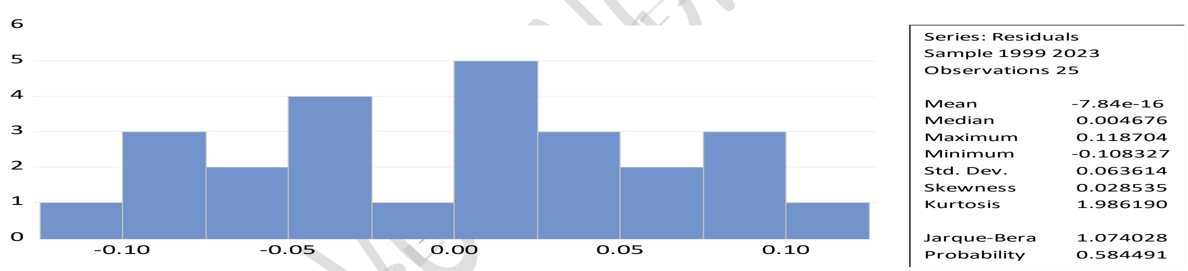

Figure 1: Normality Test

Figure 1, shows summary of the normality test with Jarque-Bara value of 1.074028 and a corresponding probability value of 0.534491 more than 0.05 level of significance, indicating that the residuals are normally distributed.

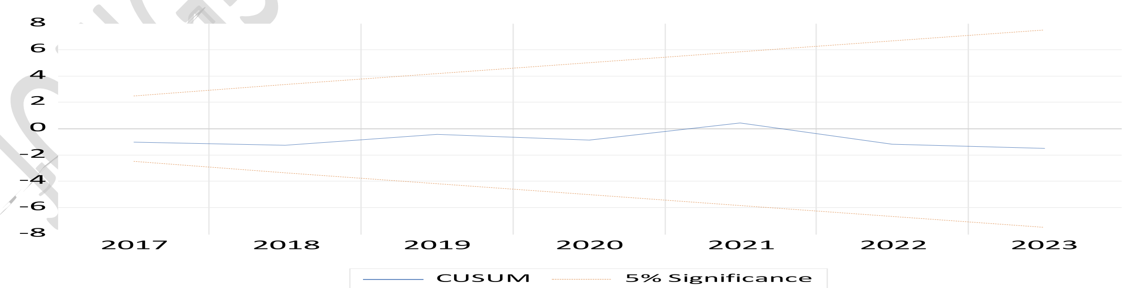

Figure 2: Stability Test

A description of the stability test is shown in Figure 2, and the results indicate that the model is stable. The fact that the blue line falls between the two red (-5 & +5) lines, or below the 0.05 level of significance, makes this clear.

Discussion of Findings

(i) Access to Electricity and Manufacturing Value Added in Nigeria

In the long-run, the results of the regression analysis using the Auto-Regressive Distributive Lag (ARDL) method showed that access to electricity (EAC) has a positive association with manufacturing value added (MVA) as a stand-in for industrialization. It does supports economic theory. It was expected that when electricity is reliable and affordable, it reduces production costs, since manufacturers spend less on backup generators or alternative energy. Also, the result from the p-value shows that access to electricity (EAC) has a statistically significant impact on manufacturing value added. Therefore, the analysis concludes that the null hypothesis that EAC and MVA are not significantly related is incorrect. The results of this study are in line with those of earlier research by Kani and Avinash (2020).

(ii) Internet Penetration Rate and Manufacturing Value Added in Nigeria

A positive association between internet penetration rate (IPR) and manufacturing value added (MVA) was inferred in the long-run using regression analysis. It is not consistent with economic theory that high Internet penetration significantly benefits manufacturing by streamlining production and supply chains, facilitating the adoption of modern technologies such as automation, data analytics, and smart manufacturing systems, and expanding market access through online platforms. Internet penetration rate (IPR) has a statistically significant impact on manufacturing value added (MVA), according to the p-value of the finding. Therefore, the analysis concludes that the null hypothesis that internet penetration rate (IPR) and manufacturing value added (MVA) do not have a significant link is true. The results of this study are in line with those of earlier research by Ifoghere and Olele (2024).

(iii) Government Capital Expenditure and Manufacturing Value Added in Nigeria

Also, in the long-run years' worth of data, we see that the link between government capital expenditure (GCE) and manufacturing value added (MVA) is positive. Economists' predictions about a positive correlation between government capital expenditure (GCE) and manufacturing value added (MVA) are spot on. The anticipated rise in government capital expenditure will provide better transportation networks that lower logistics costs, more reliable electricity that reduces production interruptions, and improved industrial zones that attract investment and support expansion. The result's p-value, however, suggests that government capital expenditure (GCE) has a statistically significant impact on manufacturing value added (MVA). Accordingly, the study's results reject the null hypothesis that the correlation between the GCE and MVA is not statistically insignificant. The results of this study are in line with those of earlier research by Nexon (2024) and Bennee et al. (2021).

(iv) Government Effectiveness and Manufacturing Value Added in Nigeria

From what we can see, in the long-run, there is a positive link between government effectiveness (GOE) and manufacturing value added (MVA). Economic theory predicts this outcome between GCO and MVA. It is believed that when government effectiveness is high, manufacturers operate in an environment with clear policies, efficient bureaucracy, and reliable public services, which reduces uncertainty and lowers the cost of doing business. Government effectiveness (GOE) have a statistically insignificant impact on manufacturing value added (MVA), according to the p-value of the outcome. Since the research found an insignificant link between government effectiveness (GOE) and manufacturing value added (MVA), the null hypothesis that there is no relationship between the two is not true.

Conclusion and Recommendations

Conclusion

This research discourse utilised the Augmented Dickey fuller unit root (ADF), Auto-Regressive Distributive Lag (ARDL) bound test Model to investigate the impact of infrastructural development on industrialization in Nigeria for 34 observation (1990 to 2023). Access to electricity, internet penetration rate, government capital expenditure and government effectiveness, were used to proxy the explanatory variables while manufacturing value added captured industrialization as the dependent variable. Based on the findings, it is consequently concluded that access to electricity and government capital expenditure had positive and significant impact on manufacturing value added. However, the relationship between internet penetration rate and government effectiveness reported an insignificant impact on manufacturing value added. Thus, based on the f-statistics it concludes that infrastructural development had substantial impact on industrialization in Nigeria.

Recommendations

Based on the findings, the following recommendation were made below;

i. The Federal Ministry of Power intensify efforts toward nationwide electrification—particularly in rural and industrial zones—to unlock the full potential of Nigeria's manufacturing sector.

ii. The Nigerian Communications Commission and NITDA should provide affordable high-speed internet to industrial areas and train manufacturers on using digital tools to improve productivity.

iii. The Federal Ministry of Finance and the Ministry of Industry, Trade and Investment should sustain and increase capital spending on infrastructure projects that directly support manufacturing growth.

iv. The Bureau of Public Service Reforms and the OSGF should strengthen policy implementation, reduce bureaucratic delays, and improve regulatory efficiency to make government interventions more impactful for manufacturers.

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