International Journal of Multidisciplinary Research and Growth Evaluation.

The Effect of Infrastructure Development on Poverty Alleviation in a Developing Economy: An Empirical Study from Nigeria

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Article Info

ISSN (online): 2582-7138
Volume: 05
Issue: 05
September-October 2024
Received: 26-07-2024
Accepted: 31-08-2024
Page No: 321-328

Abstract
The study examines the effect of infrastructure development on poverty alleviation in Nigeria from 1999 to 2022, focussing on key infrastructure facilities such as transportation, energy, water, sanitation, and telecommunications. The objective of this study was to empirically ascertain the influence of these indicators in reducing poverty level in Nigeria using statistical and econometric methods such as Pearson correlation and ordinary least squares (OLS) regression. In addition, the researchers carried out a robust check on the outcomes of the study using the ARDL model, considering the principal components factor (PCA) of transport, energy, water and sanitation, and telecommunications infrastructure as a proxy for infrastructure development. The results indicate that infrastructure development has not helped in reducing poverty in Nigeria within the period of study. Specifically, the outcomes of the OLS revealed mixed results on both the direction and magnitude of the effect of infrastructure development on poverty alleviation. While the robust test validated the position that infrastructure development has not contributed to poverty reduction in Nigeria, signifying that a 0.58% increase in poverty level is associated with infrastructure development in Nigeria. The study concluded that infrastructure development in Nigeria has not effectively reduced poverty, primarily due to challenges faced by SMEs and negatively impacting living conditions across the nation. The study highlights the practical policy implications of these findings, requiring that Nigeria undertake a strategic and long-term perspective in her investment activities, similar to what has been done by successful developing countries to propel business productivity and poverty reduction.

DOI: https://doi.org/10.54660/.IJMRGE.2024.5.5.321-328

Keywords: poverty alleviation, infrastructure development, economic growth, living standard, developing economy

1. Introduction

Investment in infrastructure development is a crucial aspect for expanding economies, and this has been behind different developmental strategies geared to infrastructure, particularly in emerging economies, to boost economic growth and eliminate poverty. Adeniran *et al*. (2021) [3] claim that infrastructure development in Nigeria has been impacted by national development plans and other development programs. Infrastructure development is the bedrock of a viable economic landscape in emerging economies because it ensures increases in productivity, attracts investments, creates jobs, and reduces poverty. Infrastructure development plays a vital role in alleviating poverty through enhancing economic growth. An expanding economy will attract investment, provide jobs, and create an enabling climate for sustainable economic growth that will help reduce poverty levels.

Novitasari *et al*. (2020) [14] posit that infrastructure development is the bedrock for relevant development activities such as socioeconomics, welfare, and prosperity.

The creation of infrastructure facilitates corporate operations and can lower production costs for commercial and industrial endeavours. For example, better transportation infrastructure means better access to markets for labour and goods by saving expenses and travel time. This connectivity can now enable the rural population to access employment opportunities available in cities easily and also market their products more profitably. According to Fagbemi *et al*. (2022) [8], this investment in water and sanitation tends to improve the health conditions of the people, reducing occurrences of diseases, improving productivity, and enhancing general well-being, thereby mitigating the levels of poverty. Arfanita *et al*. (2023) [4] confirm that this kind of infrastructure is needed for the long run and also for sustainable poverty reduction since investments in health facilities and education contribute to growing human capital, develop better opportunities of employment, and improve the standard of living. Investment in water and sanitation improves health conditions, reduces diseases, enhances productivity and general well-being, and reduces poverty (Fagbemi *et al*., 2022; Arfanita *et al*., 2023) [8, 4]. Wu *et al*. (2024) [20] state that infrastructure development will help boost economic growth and reduce poverty.

Small and medium-scale enterprises (SMEs) are primarily responsible for the majority of the economic growth in Nigeria, the country with the greatest population and economy on the African continent. SMEs account for almost 48% of the nation's GDP and 96% of all commercial activity. Over 84 percent of Nigerian workers are employed by SMEs, which are mostly in the industrial, services, and agricultural sectors. In Nigeria, these industries have played a significant role in both economic expansion and the decline of poverty. Nigeria's own infrastructure development is notably lacking, which limits the country's ability to support the strong and steady expansion of SMEs. Even with the contributions made by SMEs, over 50% of them fail in the first year of business due to inadequate infrastructure (Moniepoint, 2024) [12].

Inadequate transportation facilities, erratic power sources, inadequate water and sanitation facilities, subpar telecommunication services, and so forth are examples of poorly developed infrastructure. This hinders the flow of goods and services as well as increasing operating costs, which can negatively impact SMEs' profit margins and growth potential in a variety of ways (Gumel, 2017) [9]. The self-provision of utilities, mostly generators, adds 40% to SMEs' production costs, making infrastructure extremely expensive for them and preventing them from offering competitive pricing or turning a profit in that industry (Obokoh and Goldman, 2016; Okafor *et al*., 2023) [15, 16]. Claim that poor infrastructure may be responsible for the low productivity and industrial capacity. This reduces the accessibility of SMEs to suppliers and customers residing in rural areas, decreasing market share and its eventual expansion.

Investments in infrastructure are impacted by the growing demand for infrastructure development brought about by shifts in sociocultural society and economic activities. Novitasari *et al*. (2020) [14] assert that the growing population demands new facilities and infrastructure, reorganising new facilities and infrastructure as necessary to meet the needs of the community and global market. However, Nigeria has limited resources from both the public and private sectors to make significant investments in infrastructure that will meet the needs of its growing population and global market. Okosun *et al*. (2023) [17] assert that infrastructure development essential to sustaining the lives of the populous living in Nigerian rural areas is severely neglected. The rural areas are frequently marginalised in favour of urban development, contributing to restricted access to basic services, which lowers the standard of living for those domiciled in the areas.

Nigeria is confronted with various obstacles concerning its water infrastructure, including inadequate funding, structural defects, and inadequate water supply. Inefficiencies and sustainability problems are a result of the neglect of water supply projects, which leads to inadequate management of standpipes and dams (Adeniran *et al*., 2021) [3]. Abiru (2020) [2] claims that financial dependence on federal appropriations exacerbates the issue and restricts the development of major infrastructure. Inadequate regulations also make it difficult for state governments to take the lead in providing their own infrastructure projects and stifle local initiatives. According to Okosun *et al*. (2023) [17], Nigeria's existing inadequate infrastructure is to blame for several problems affecting businesses, including gridlock, erratic power outages, impassable roads, poor telecommunications, and contaminated drinking water. Popoola *et al*. (2024) [18] proclaim that poor infrastructure in Nigeria's higher institutions hinders research and development (R&D), which produces subpar scientific research results that are crucial for innovation and socioeconomic growth.

Although some initiatives were taken by various governments to bring about infrastructural change and development in this country, it has remained sporadic and slow. Thus, it can be identified that political instability, corruption, and misgovernance have restricted multiple initiatives and frequent efforts. According to Mallek *et al*. (2024) [11], the rate of poverty increased in African countries while it decreased in other regions, such as Asia, despite their effort in infrastructure development, giving them greater access to energy, water, and sanitation, transportation, and telecommunication than before. The research established the effect of infrastructure development on poverty alleviation in Nigeria for the period of 1999 to 2022. The year 1999 was chosen as the base year for study because it marked a turning point when the Nigerian government handed over power from a military to a democratic government.

Therefore, these objectives were achieved by answering various relevant questions: How does transport infrastructure impact poverty reduction in Nigeria? How does energy infrastructure help reduce poverty in Nigeria? How does water and sanitation infrastructure influence poverty reduction in Nigeria? To what extent does telecommunications infrastructure help in reducing poverty in Nigeria? On that note, this study employed statistical and econometric methods with data sourced from relevant sources to establish how these infrastructure development indicators have influenced poverty reduction in Nigeria. The outcomes of the study offered valuable insights that informed policy implications in resolving infrastructure development challenges in Nigeria.

2. Literature Review

Infrastructure developments have the potential to stimulate the growth of new and existing industries and enterprises,

boosting employment and economic growth with a spillover effect and reducing poverty. Hartwig and Nguyen (2023) [10] proclaim that the growing investment in infrastructure, such as telecommunications and transportation, in developing nations is an effort to reduce poverty. Infrastructure development can stimulate industry growth, boost employment, and reduce poverty. Affirms that sensible infrastructure expenditures can contribute to economic growth and a decrease in poverty. There are several existing empirical studies on the effect of infrastructure development on poverty alleviation in other developing economies. These studies have recorded a significant effect of infrastructure development on poverty alleviation, demonstrating the fundamental role that infrastructure development plays in improving economic growth and reducing poverty. For example, Chotia and Rao (2017) [6] found that infrastructure development has a positive effect on economic growth and poverty alleviation in BRICS countries, demonstrating that infrastructure development supports steady economic growth, which is necessary to reduce poverty over the long run. Abdullahi and Sieng (2023) [1] revealed that infrastructure increases the marginal productivity of private capital and reduces production costs, which significantly influence economic growth and improve many people's quality of life by raising the value of consumption, raising labour productivity, and creating jobs. Sayvaya and Phommason (2023) [19] established that road infrastructure has a significant influence on economic growth, promoting poverty alleviation in rural areas, given the observed positive relationship between road access during the rainy season and real expenditure per capita in Lao PDR. Investments in these crucial areas contribute significantly to growth by increasing productivity and people's quality of life. Recorded a reciprocal relationship between infrastructure development and economic growth, whereby infrastructure development can be financed in turn by economic growth, resulting in a positive feedback loop that raises living standards.

Infrastructure development helps to reduce poverty by improving access to markets, lowering the cost of products and services, and generating employment opportunities, which is an indication that infrastructure offers necessary services that raise the living standards of a nation. According to Fagbemi *et al*. (2022) [8], improvements in infrastructure in the areas of transportation and water and sanitation enhance access to necessary services and resources, which reduces the prevalence of disease, enhances health outcomes, and ultimately results in a significant decline in poverty. Infrastructure development initiatives have the potential to generate employment possibilities, hence augmenting the need for labour force and indicating that enhanced infrastructure fosters diverse economic activities that can pull families out of poverty (Chotia & Rao, 2017) [7].

Investments in infrastructure projects in developing economies are a significant developmental plan to improve the living standards of people. Mallek *et al*. (2024) [11] found that infrastructure development reduces poverty in 40 African economies, following the argument that improving SSA's infrastructure will increase the benefits of employment, education, and a healthy environment that reduces poverty. Infrastructure projects are large developmental plans that put investment into developing economies for better living standards. Wu *et al*. (2024) [21], studying the relationship between infrastructure investment and multidimensional poverty among rural migrant workers in China, found that infrastructure investment will reduce poverty, and infrastructure investment in telecommunications and transport reduces poverty more significantly. Zhang *et al*. (2023) [22] revealed that infrastructure projects in China significantly reduce local poverty by improving living standards and employment stability, particularly in self-dependent recipients and rural areas. Found that infrastructure development increased the number of health facilities, which has a beneficial impact on rural poverty. Fagbemi *et al*. (2022) [8] established that sustainable infrastructure development is related to significant poverty reduction in Nigeria, but further observation showed a reciprocal causal relationship between infrastructure development and poverty reduction. This is an indication that reducing poverty may lead to improved public sector performance and more effective and efficient use of resources for the development of large-scale infrastructure.

The improvement in the living standards of people will help increase productivity and, in turn, boost infrastructure development and maintenance of existing facilities. Chotia and Rao (2017) [6] recorded a positive and unidirectional causality between infrastructure development and poverty reduction; the results also indicate that infrastructural development contributing to short- and long-term economic growth leads to poverty reduction. Wu *et al*. (2024) [20], studying the influence of the high-speed railway (HSR) project on the efforts to reduce poverty in China, found that HSR facilitates both rural accessibility and the reduction of poverty. Established that the Community-Based Rural Development Program (CBRDP), in the form of providing economic and social infrastructure, contributes to improving livelihoods but does not guarantee sustainability. Cateia *et al*. (2023) [5] found that debt financing infrastructure projects will contribute positively to macro- and micro-level spillovers that improve growth and well-being for all household types in both urban and rural areas, in turn reducing inequality. Chotia and Rao (2017) [7] affirm that both infrastructure development and economic growth contribute to the decline in poverty rates in BRICS countries, but income inequality between rural and urban areas is not helping poverty reduction.

3. Method of Analysis

The study employed an empirical method to examine the impact of infrastructure development on poverty alleviation in Nigeria. This methodology involved collecting and analysing data on infrastructure development indicators and poverty alleviation variables, spanning the period from 1999 to 2022. The infrastructure development indicators as independent variables are transport, energy, water and sanitation, and telecommunications infrastructure. The proxies for these are: transport infrastructure is transport services as a percentage of commercial service exports and imports; energy infrastructure is access to electricity as a percentage of population; water and sanitation is people using safely managed drinking water services as a percentage of population; and telecommunications infrastructure is individuals using the internet as a percentage of population. Indicators that moderate the effect of infrastructure development on economic growth and poverty alleviation were taken into consideration in the study. These moderators are employed as control variables, which are investment in healthcare measured by current health expenditure as a percentage of GDP, political stability measured by political

stability, and the absence of violence or terrorism as a percentile rank. The dependent variable is poverty alleviation, and this is measured by the poverty headcount ratio at the societal poverty line as a percentage of the population. The data for these variables were collected from the World Development Indicators.

The descriptive statistics were employed in the description of the trend of the dataset over the period of study, while the Pearson correlation coefficient was used to highlight the relationship between these variables. The study employed econometric models such as ordinary least squares (OLS) regression to examine the effect of infrastructure development on poverty alleviation in Nigeria.

The OLS model is formulated below

$$POVA_t = \beta_0 + \beta_1 TRIN_t + \beta_2 ENIN_t + \beta_3 WSIN_t + \beta_4 TEIN_t + \beta_5 HELI_t + \beta_6 POST_t + \quad (1)$$

Where: $POVA_t$ is Poverty Alleviation in year t

$TRIN_t$ is Transport Infrastructure in year t

$ENIN_t$ is Energy Infrastructure in year t

$WSIN_t$ is Water and Sanitation Infrastructure in year t

$TEIN_t$ is Telecommunications Infrastructure in year t

$HEIN_t$ is Healthcare Investment in year t

$POST_t$ is Political Stability in year t

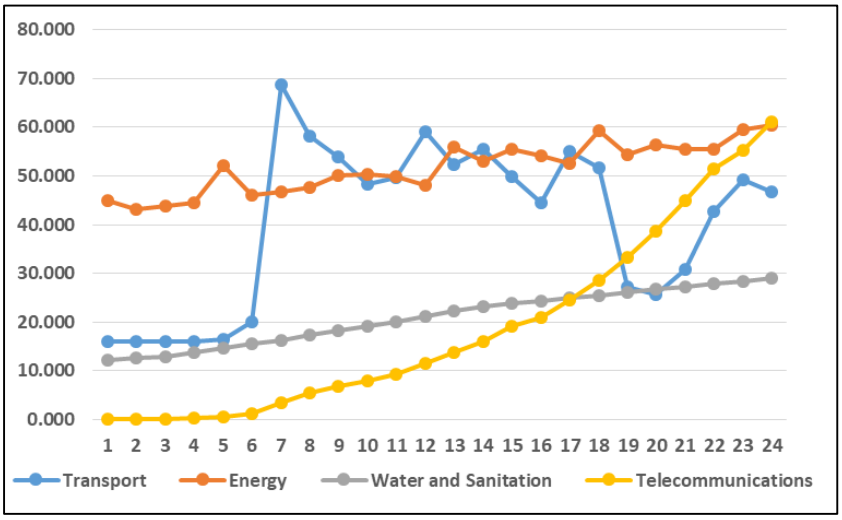
β_0 is intercept, $\beta_1 - \beta_6$ is the coefficient estimation, and ε_t denotes the error term.

4. Analysis of Results

4.1. Graphic Representation of Infrastructure Development in Nigeria

Nigeria's infrastructure development trajectory from 1999 to 2022 is depicted in Figure 1. The data for transportation infrastructure trends show that the values are somewhat erratic, ranging from a low of 15.93 in 1999 to a high of 68.72 in 2005. This suggests that 2005 was either a year of significant investments or, more likely, significant transportation changes. Investment in transport infrastructure has not increased significantly over time, as evidenced by the index's rapid fall, which peaked in 2018 at 25.57. This trend is an indication of inconsistent investment in transport infrastructure due to both intense development and negligence or bad policy direction. The trend revealed the need for investment in transportation infrastructure, which is still poorly developed, demanding more consistent and long-term planning for stabilisation to ensure significant infrastructure improvement. Access to electricity increased from 44.9% in 1999 to 60.5% in 2022, indicating consistent growth and continuous attempts to improve power generation and distribution in Nigeria through energy infrastructure investment. Though Nigeria continues to face ongoing obstacles, including poor investment, technical inefficiencies, and governance issues, the country's limited access to electricity when compared to other emerging nations remains concerning.

Nigeria has made minimal investments in water and sanitation, but there has been some progress; in 1999, 12.30% of the population used securely managed drinking water services; by 2022, that number had increased to 28.98%, indicating large gaps in the infrastructure. These gaps can be attributed to poor investment funding, population growth, and logistical challenges in extending services to rural and underserved urban areas, posing health challenges to the people.



***Source*:** World Development Indicators (2024)

Fig 1: Infrastructure Development in Nigeria

The investments in this infrastructure and strong government policies can help in reducing waterborne diseases and improving hygiene, with the broader goals of poverty reduction. The investment in telecommunications infrastructure showed the increase between years 1999 and 2022, involving an increase from 4.10 to 61.14 in the percentage of the population using the internet. The outcome is an indication of the widespread adoption of mobile technology and the internet, improving communication and access to information. The development of telecommunications infrastructure can be attributed to the liberalisation of the telecommunications industry, which contributed to increased public-private partnership investments and the entry of international players in the tech industry. In spite of this development, Nigeria is still facing challenges with network coverage in rural areas and high service costs, raising problems related to infrastructure quality, resulting in more than 38% of its population not

being able to access the internet.

4.2. Descriptive Statistics

The statistics of higher poverty incidence and inconsequential effort to poverty reduction in Nigeria are represented by the mean value at 46.966 of the poverty rate and the skewness value around the mean of 1.116. The dataset ranged between the values of 42.7 and 57.09, and this outcome is also represented in figure 1. The value for kurtosis is nearle the skewness and kurtosis with the respective values of -0.044 and 1.895 suggest the poor nature of energy infrastructure and investment, not normal distribution. 3; of course, the data has presented a normal distribution, but the slight variability will point to some fluctuations. The results of transportation infrastructuand recorded a mean value of 40.378, and the standard deviation of almost half of the mean indicates significant variability for the dataset that ranged between 15.94 to 68.73. The negative value of -0.335 for skewness confirms that lower transport values are more frequent, demonstrating the poor nature of transport infrastructure in Nigeria. The kurtosis of 1.694 less than 3 depicts that the dataset is not normally distributed and does not vary with inconsistent or poor governance and commitment to infrastructure development in Nigeria. The energy infrastructure revealed a mean value of 51.663 and a standard deviation of 5.185, far away from the mean, which implies that energy infrastructure over time remained volatile. While the skewness and kurtosis with the respective values of -0.044 and 1.895 suggest the poor nature of energy infrastructure and investment, not normal distribution. The mean and standard deviation of water and sanitation are 20.984 and 5.546, which are fairly stable over time and do not demonstrate the required commitment for the development of this infrastructure.

The mean value of telecommunications recorded 18.955 less than the standard deviation of 19.223, indicating high variability with a range of 0.041 to 61.148, demonstrating that certain areas have remarkably high telecommunications infrastructure. The trend towards poor development in infrastructure is demonstrated in the results of skewness and kurtosis, which are respectively negative and not normally distributed as values less than 3. The outcomes for health care depicted a mean value of 3.600 close to the median of 5.054, suggesting low variability with the dataset ranging from 2.491 to 5.054, and this is normally distributed since the kurtosis value of 3.549 is greater than 3. Thus, this is an indication of the poor state of investment in healthcare, as the investment does not progressively increase over time with the increasing population that needs healthcare services. Nigeria is a very volatile country in terms of political stability, as the results recorded a mean of 5.479 with a positive skewness of 0.667 that is skewed around the mean. The state of political instability is pinpointed in the range of 2.415 to 9.944, and the kurtosis value of 2.772 is less than 3, which indicates that the dataset is not normally distributed.

Table 1: Descriptive Statistics

Variable	Mean	Max	Min	Std. Dev.	Skewness	Kurtosis	Jarque-Bera
Poverty	46.966	57.091	42.700	4.196	1.116	3.121	4.996
Transport	40.378	68.730	15.935	16.932	-0.335	1.694	2.155
Energy	51.663	60.500	43.200	5.185	-0.044	1.895	1.228
Water & San.	20.984	28.985	12.303	5.546	-0.178	1.648	1.955
Telecom	18.955	61.148	0.041	19.223	0.863	2.512	3.216
Health	3.600	5.054	2.491	0.570	0.775	3.549	2.706
Political Stab.	5.479	9.944	2.415	2.008	0.667	2.772	1.833

***Source*:** Descriptive Statistics using E-view

4.3. Correlation Analysis

The results of the correlation coefficient among the employed variables in the study are presented in Table 2. The outcome of transport infrastructure on poverty alleviation revealed a strong negative correlation of -0.615, signifying that transport infrastructure development is significantly negatively related to poverty level. This strong negative correlation of -0.698 reveals that energy infrastructure is associated with a decline in the poverty level in Nigeria. However, there is a significant negative strong correlation of -0.804, demonstrating that water and sanitation infrastructure is connected to decreasing poverty level by 80.4% in Nigeria since it leads to decreases in poverty headcount ratio. In the same manner, infrastructure development in telecommunications is associated with a 52.7% decrease in poverty level with a negative correlation of -0.527.

Table 2: Correlation Analysis

Variable	Poverty	Transport	Energy	Water & San.	Telecom	Health	Political Stab.
Poverty	1						
Transport	-0.615**	1					
Energy	-0.698**	0.355	1				
Water & Sanitation	-0.804**	0.426*	0.909**	1			
Telecom	-0.527**	0.202	0.842**	0.916**	1		
Health	-0.012	0.186	0.010	-0.158	-0.173	1	
Political Stability	0.782**	-0.577**	-0.330	-0.411*	-0.129	-0.189	1

***Source*:** Pearson Correlation Results using SPSS

Note: **. Correlation is significant at the 0.01 level (2-tailed) and *. Correlation is significant at the 0.05 level (2-tailed).

4.4. Unit Root Test

A unit root test is one of the statistical tests that can be used to establish the stationary or non-stationary nature of a time series. A non-stationary time series has a mean and variance that fluctuate over time, whereas a stationary time series has a constant mean and variance. The Augmented Dickey-Fuller

(ADF) and Phillips-Perron (PP) unit root test is shown in Table 4. The null hypothesis for the tests is that the time series has a unit root (i.e., is non-stationary), and the alternative hypothesis is that there is a unit root in the time series. The results in Table 4 indicate that the employed variables are integrated at levels 1(0) and at first difference 1(1). Specifically, the findings on the first panel revealed that energy infrastructure is the only variable that is stationary at level, demonstrating that the p-values less than 0.05 level for both ADF and PP are sufficient to rule out the null hypothesis. While other variables cannot be used as is in the regression analysis because they are all non-stationary at level. But as the second panel of Table 4 illustrates, we employ the first differencing approach to render the time series stationary for these variables. Since all p-values are now less than 0.05, the null hypothesis can be rejected, leading us to the conclusion that all of the variables' first differences are stationary. This indicates that we have eliminated any trend or seasonality by taking the first difference of the data, making them ready for regression analysis.

Table 3: Unit Root Test

Stationarity test result at level				
Variable	**Augmented Dickey-Fuller**		**Phillips-Perron**	
	Test statistic	**p-value**	**Test statistic**	**p-value**
Poverty	-2.980	0.160	-1.081	0.910
Transport	-2.154	0.490	-2.127	0.505
Energy	-5.859	0.001	-6.499	0.000
Water & Sanitation	-2.985	0.158	-3.041	0.144
Telecommunication	-3.198	0.110	-3.198	0.110
Health	-3.152	0.118	-3.137	0.122
Political Stability	-1.689	0.723	-1.075	0.912
Stationarity test result at first difference				
Variable	**Augmented Dickey-Fuller**		**Phillips-Perron**	
	Test statistic	**p-value**	**Test statistic**	**p-value**
Poverty	-1.635	0.045	-3.110	0.040
Transport	-4.722	0.006	-5.115	0.003
Energy	-5.463	0.002	-25.787	0.000
Water & Sanitation	-3.986	0.026	-3.986	0.026
Telecommunication	-5.498	0.001	-6.002	0.000
Health	-3.909	0.030	-6.471	0.000
Political Stability	-5.519	0.001	-7.111	0.000

***Source*:** Unit Root Test using E-view

4.5. Regression Analysis

The regression analysis presents the effect of infrastructure development on poverty alleviation in Nigeria, spanning the period from 1999 to 2022. The regression outcomes in table 4 showed the effect of infrastructure development on poverty alleviation in Nigeria, and the results revealed mixed effects, with some infrastructure development indicators having a statistically significant effect on poverty reduction, while others recorded a statistically insignificant effect. Specifically, the coefficient of transport infrastructure, with a slight value of 0.009, revealed that a 1% increase in transport infrastructure resulted in a statistically insignificant change in poverty level by 0.9%. Also, the energy infrastructure, with a coefficient of 0.124 and a p-value greater than 5%, indicates a statistically insignificant effect on poverty level in Nigeria. On the other hand, water and sanitation, with a coefficient of -1.307 and a p-value less than 5%, showed that increased investment in water and sanitation significantly resulted in a decrease in the poverty level in Nigeria since an increase in water and sanitation leads to a decrease in the poverty headcount ratio. The investments in telecommunications infrastructure contributed a coefficient of 0.204 with a p-value less than 5% significance level, signifying that telecommunications infrastructure development significantly contributed to an increase in poverty levels since an increase in telecommunications infrastructure led to an increase in poverty headcount ratio. This outcome can be attributed to the high costs of telecommunications services as a result of the high operating costs in the telecommunications industry in Nigeria. The health investment depicted a negative coefficient, but the impact on poverty alleviation is not statistically significant with a p-value greater than 5% level of significance. The coefficient of political stability depicted a statistically significant impact on poverty level with a p-value less than 5%. Indicates that political stability has a significant effect, contributing to an increase in poverty level since an increase in political stability leads to an increase in the poverty headcount ratio. R-squared for the model estimation produced a result of 96.1%, indicating that the independent variables in the model accounted for variation in poverty level. This suggests a very good fit, and the model does a great job of explaining the levels of poverty. Hence, it implies that the remaining 3.9% variation in poverty level was explained by other factors not included in the model estimation, and the R-squared adjusted value of 94.7% indicates that the model's predictive power is relatively high.

Table 4: OLS Regression

Variable	**Coefficient**	**t-Statistic**	**Prob.**
Intercept	63.177	14.894	0.000
Transport	0.009	0.541	0.596
Energy	0.124	1.181	0.254
Water & Sanitation	-1.307	-6.804	0.000
Telecommunication	0.204	5.317	0.000
Health	-0.628	-1.437	0.169
Political Stability	0.518	3.177	0.006
R-squared	0.961		
Adj. R-squared	0.947		

***Source*:** OLS Regression using E-view

6 Robust Test

The autoregressive distributed lag (ARDL) model was employed as a robust test in this study. This model is used to examine both short-term and long-term relationships between a dependent variable and its explanatory variables, which may include lagged values of both. The model is particularly useful for handling datasets that are non-stationary and integrated at different levels (integrated at levels 1(0) and at first difference 1(1)). The results in Table 5 present the outcomes of ARDL estimation: a coefficient of 1.225 for lagged poverty level and significant with a p-value less than 5% level of significant. This is an indication that a 1% increase in the previous period's poverty rate contributed to a 1.225% increase in current poverty. This suggests that poverty is highly persistent over time and has a self-perpetuating effect. The infrastructure development measured as the principal components factor (PCA) of transport, energy, water and sanitation, and telecommunications infrastructure recorded a significant coefficient value of 0.58 at a p-value of 0.004 less than the 0.05 level. This outcome implies that a unit increase in infrastructure development contributed to an increase in poverty level by 0.58 units. This is contrary to the expectation since infrastructure development is fundamentally to reduce poverty level, which can be attributed to Nigerian government habits of embarking on infrastructure projects that displace people. For instance, during road construction that takes many years without completion, businesses in Nigeria do experience disruptions that lead to job losses or reduced incomes. The outcome of lagged infrastructure development with the coefficient value of 0.382 and significant at 5% level since the p-value of 0.041 is less than 0.05 indicates that even a year after investment infrastructure projects, infrastructure development does not contribute to poverty reduction in Nigeria. The results of the control variables, such as investment in healthcare and political stability, depicted a negative coefficient value, which is an indication that they contribute to a reduction in poverty level, but these outcomes are statistically insignificant with a p-value greater than 5% level of significance. The R-squared of 0.995 signifies that 99.5% of the variation in poverty is explained by the explanatory variables employed in this model. This suggests that the remaining 0.5% variation in poverty level was explained by other factors not included in the model. The R-squared adjusted value of 99.3% indicates that the model is a good fit and predictive power is relatively high. On that note, the outcomes for this estimation validate the results of OLS that infrastructure development has not contributed to poverty reduction in Nigeria over the period of the study.

Table 5: ARDL Results

Variable	Coefficient	t-Statistic	Prob.
Intercept	-9.652	-4.186	0.001
Poverty(-1)	1.225	21.420	0.000
Infrastructure Development	0.580	3.407	0.004
Infrastructure Development(-1)	0.382	2.227	0.041
Health	-0.091	-0.732	0.475
Political Stability	-0.065	-0.893	0.385
R-squared	0.995		
Adj. R-squared	0.993		

***Source*:** ARDL Estimation using E-view

5. Conclusion

Infrastructure development in Nigeria has not helped to reduce poverty due to a number of difficulties that SMEs in Nigeria are currently facing. The level of development in infrastructure has a negative effect on people's living conditions throughout the nation, indicating that infrastructure growth throughout time has contributed to an increase in poverty in Nigeria. The result can be linked to the large percentage of private family investments in infrastructure, which come with extremely high financing and operating costs for small and medium-sized enterprises in Nigeria. This is unlike other developing economies, which have successfully built sufficient infrastructure, promoting economic expansion and reducing poverty. These economies have made significant efforts to reduce poverty through strategic investments in infrastructure, government support and policy framework, public-private partnerships (PPPS), human and corporate capacity, and financial mechanisms. These success factors in other developing regions can thus model the development of major infrastructures in Nigeria by guaranteeing that the coordination of government commitment is channelled into growing large-scale infrastructure projects.

6. Practical Policy Implications

The outcomes of this study provide valuable insights on policy implications for tackling infrastructure challenges in Nigeria to reduce poverty levels:

- A robust institutional and regulatory framework is important for the Nigerian government to foster infrastructure development. It is obvious that putting in place a clear policy framework and strategic planning will greatly aid in infrastructure development, which will lower Nigeria's poverty rate.
- To establish connections between Nigeria's major cities, the government and important players must invest appropriately in high-speed rail. This will promote access between cities and local travel, resulting in more efficient trade. The nation can strive to become a network of smart cities that use telecommunications to enhance the development of transport infrastructure.
- In order to attain a consistent supply of electricity through dependable energy sources, including nuclear, coal, and renewable energy sources, the Nigerian government needs to start a more effective and successful public-private partnership to construct energy infrastructure.
- The Nigerian government ought to establish additional public-private partnerships with global telecommunications companies in order to foster a competitive market that would propel the greatest rates of mobile adoption and the fastest internet speeds in key regions of the nation. Additionally, it has the potential to stimulate innovation in fields like smart cities, autonomous automobiles, and artificial intelligence.
- A policy framework that balances the development of infrastructure in urban and rural areas is necessary to encourage the expansion of SMEs in Nigeria's rural areas, minimise potential disparities in poverty between rural and urban populations, and raise living standards.
- The Nigerian government must incorporate technology into its plans for infrastructural development, with a focus on telecommunications and smart cities in particular, to boost economic activities, create jobs, and

lower the country's poverty rate.

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