
THE NEXUS BETWEEN PHYSICAL CAPITAL AND TECHNOLOGICAL PROGRESS IN REDUCING POVERTY IN NIGERIA

ANDREW NANDE

Department of Economics,
Federal University of Lafia, Nasarawa State
greatmanande@gmail.com

Abstract

The study investigated the nexus between physical capital and technological progress in reducing poverty in Nigeria over the period 1980–2025. The aim was to examine how physical capital accumulation and technological advancement influence poverty dynamics in Nigeria. The study adopted an ex post facto research design, utilizing annual time series data sourced from the Central Bank of Nigeria, World Development Indicators, and National Bureau of Statistics. The methodology involved descriptive statistics, Augmented Dickey-Fuller unit root tests, Engle-Granger and ARDL bounds cointegration tests, and the Dynamic Ordinary Least Squares (DOLS) technique for long-run estimation. The theoretical framework of the study was anchored on the Capability Approach by Amartya Sen (1985), Endogenous Growth Theory associated with Romer (1986), Lucas (1988), and Rebelo (1991), and the Kuznets Hypothesis (1955), which collectively explain poverty, inequality, and development dynamics. The findings revealed that physical capital has a significant negative effect on poverty, indicating that infrastructure and investment reduce poverty in Nigeria, while technological progress shows a significant positive relationship with poverty in the short to medium term due to inequality in access and limited inclusiveness. The study further confirmed a long-run equilibrium relationship among the variables. The study concluded that physical capital is a strong driver of poverty reduction, while technological progress requires complementary inclusive policies to be effective. Therefore, the study recommended increased investment in infrastructure, inclusive technological access, human capital development, and integrated policy frameworks to ensure that both physical capital and technology contribute effectively to poverty alleviation in Nigeria.

Keywords: Capital formation, Endogenous growth, Poverty reduction, Technological progress

1.1 INTRODUCTION

The quest to alleviate poverty and improve living standards has remained a central objective of economic policy and development discourse, particularly in developing economies where structural constraints continue to limit inclusive growth. Central to this discourse is the interplay between physical capital and technological progress, both of which are widely regarded as critical drivers of productivity, economic transformation, and long-term welfare improvement. Physical capital, which includes infrastructure, machinery, equipment, and other tangible assets, provides the foundational support for productive activities, while technological progress enhances efficiency, innovation, and the capacity to generate higher outputs from existing resources. The interaction between these two elements is crucial in determining how effectively economies can expand opportunities, create wealth, and ultimately reduce poverty. However, the extent to which these factors translate into improved living conditions depends largely on how they are distributed and utilized within the economy (Rodrik & Stiglitz, 2022).

At the global level, the relationship between physical capital accumulation, technological advancement, and poverty reduction has been extensively examined, with evidence suggesting that sustained investments in infrastructure and innovation play a vital role in promoting economic growth and reducing poverty. Over the past few decades, countries that have successfully integrated technological progress with capital investment have experienced significant improvements in productivity and income levels. For instance, global data indicate that extreme poverty has declined substantially, from over 35 percent in 1990 to below 9 percent in recent years, largely due to rapid industrialization, infrastructure development, and the diffusion of technology in emerging economies (World Bank, 2024). This trend highlights the importance of combining capital formation with technological innovation to achieve meaningful and sustained poverty reduction.

Despite these gains, the global experience also reveals significant disparities across regions, reflecting differences in access to capital and technology. While advanced economies have benefited from high levels of investment in research and development, digital infrastructure, and industrial capacity, many developing countries continue to face constraints in mobilizing the resources required to support technological advancement. In particular, inadequate infrastructure, limited access to finance, and weak institutional frameworks have hindered the effective utilization of physical capital in many low-income economies. As a result, the potential of technology to drive inclusive growth and reduce poverty has not been fully realized in these contexts (Acemoglu & Restrepo, 2023).

Furthermore, the rapid pace of technological change has introduced new dynamics into the global development landscape, creating both opportunities and challenges for poverty reduction. On one hand, advancements in information and communication technologies have improved access to markets, enhanced productivity, and facilitated the delivery of essential services such as education and healthcare. On the other hand, technological progress has also led to concerns about job displacement, particularly for low-skilled workers, thereby raising questions about its distributional effects. These developments underscore the importance of ensuring that technological advancement is complemented by policies that promote inclusive access and equitable outcomes (Brynjolfsson & McAfee, 2022).

Shifting focus to the African continent, the nexus between physical capital, technological progress, and poverty reduction presents a complex and evolving scenario. Over the past two

decades, many African countries have made notable strides in expanding infrastructure, particularly in areas such as transportation, energy, and telecommunications. These investments have contributed to improvements in connectivity, trade, and economic activity. However, the impact of these developments on poverty reduction has been uneven, as many countries continue to experience high levels of poverty despite moderate economic growth (African Development Bank, 2024). This disparity reflects underlying structural challenges, including limited industrialization, low levels of technological adoption, and persistent inequalities in access to resources.

In addition to infrastructure gaps, the diffusion of technology across Africa has been constrained by factors such as inadequate human capital, weak institutional capacity, and limited access to financing. While there has been significant growth in mobile technology and digital services, particularly in urban areas, rural communities often remain excluded from these advancements, thereby limiting their ability to benefit from technological progress. This digital divide has important implications for poverty reduction, as access to technology increasingly determines individuals' ability to participate in economic activities and access essential services (United Nations Economic Commission for Africa, 2023).

Moreover, the structure of African economies has further influenced the effectiveness of physical capital and technological progress in reducing poverty. Many countries on the continent remain heavily reliant on primary commodity exports, which are often characterized by low levels of value addition and limited employment generation. This reliance has constrained the capacity of economies to leverage technological innovation for broad-based development, as investments in capital-intensive sectors do not always translate into widespread improvements in living standards. Consequently, there is a growing recognition of the need to promote diversification and industrialization as a means of enhancing the poverty-reducing impact of capital and technology (Mensah & Adu, 2023).

Within this broader African context, Nigeria represents a particularly significant case study due to its large population, abundant natural resources, and persistent development challenges. As one of the largest economies in Africa, Nigeria has made considerable investments in physical capital, particularly in sectors such as oil and gas, telecommunications, and infrastructure. However, the benefits of these investments have not been evenly distributed, and the country continues to experience high levels of poverty and inequality. This paradox raises critical questions about the effectiveness of capital accumulation and technological progress in delivering inclusive development outcomes (International Monetary Fund, 2024).

Nigeria's experience with technological advancement further illustrates the complexities of the relationship between innovation and poverty reduction. While the country has witnessed rapid growth in digital technology, particularly in mobile communications and financial technology, these advancements have not fully translated into widespread economic opportunities for the population. A significant portion of the workforce remains engaged in low-productivity activities, particularly in the informal sector, where access to modern technology and capital is limited. This situation underscores the need for policies that not only promote technological innovation but also ensure its diffusion across different sectors and regions of the economy (World Bank, 2024).

In addition to these challenges, infrastructural deficits continue to constrain the effectiveness of physical capital in Nigeria. Issues such as unreliable electricity supply, inadequate

transportation networks, and limited access to industrial facilities have hindered productivity and increased the cost of doing business. These constraints reduce the potential returns on investment in physical capital and limit the ability of firms to adopt and utilize new technologies effectively. As a result, the link between capital investment and poverty reduction remains weak, particularly in rural and underserved areas (African Development Bank, 2024).

Demographic pressures further compound the challenge of leveraging physical capital and technological progress for poverty reduction in Nigeria. With a rapidly growing population and a large youth cohort entering the labor force each year, the demand for employment opportunities continues to rise. However, the pace of job creation has not kept up with this growth, leading to high levels of unemployment and underemployment. In this context, the role of technology becomes even more critical, as it has the potential to create new industries and expand economic opportunities. Nevertheless, without adequate investment in infrastructure and skills development, the benefits of technological progress may remain concentrated among a limited segment of the population (UNDP, 2023).

Governance and institutional factors also play a crucial role in shaping the outcomes of physical capital investment and technological advancement in Nigeria. Challenges such as policy inconsistency, corruption, and weak regulatory frameworks have undermined the efficiency of public investment and limited the impact of development initiatives. Effective governance is essential for ensuring that resources are allocated efficiently, projects are implemented successfully, and the benefits of development reach the broader population. Without strong institutions, the potential of physical capital and technology to drive poverty reduction cannot be fully realized (OECD, 2024).

The global and regional experiences discussed above highlight the importance of integrating physical capital investment with technological innovation in order to achieve sustainable and inclusive development. They suggest that while both factors are essential for economic growth, their effectiveness in reducing poverty depends on the broader economic and institutional environment in which they operate. In particular, policies that promote equitable access to infrastructure and technology, support industrial diversification, and strengthen institutional capacity are critical for maximizing their impact on poverty reduction (Acemoglu & Restrepo, 2023).

Against this backdrop, the present study is motivated by the need to examine the extent to which physical capital and technological progress have contributed to poverty reduction in Nigeria. Despite significant investments in infrastructure and advancements in technology, the persistence of high poverty levels suggests that the relationship between these factors and development outcomes is not straightforward. This study seeks to explore the mechanisms through which physical capital and technological progress influence poverty, taking into account the roles of structural transformation, institutional quality, and access to resources.

Against this backdrop, the topic **THE NEXUS BETWEEN PHYSICAL CAPITAL AND TECHNOLOGICAL PROGRESS IN REDUCING POVERTY IN NIGERIA** becomes particularly significant, as it provides a framework for understanding how investments in infrastructure and innovation can be harnessed to promote inclusive growth and improve the welfare of the population.

2.1 Conceptual Review

2.1.1 Physical Capital

Physical capital refers to the stock of man-made assets such as infrastructure, machinery, tools, and equipment that are utilized in the production of goods and services within an economy. These tangible resources enhance productive capacity by improving efficiency, facilitating industrial activities, and supporting economic expansion. The availability and quality of physical capital determine the level of output that can be achieved, as well-developed infrastructure and modern equipment reduce production costs and increase competitiveness. In the context of development, sustained investment in physical capital is essential for creating an enabling environment that fosters economic activities and supports poverty reduction through increased productivity and income generation (Garcia & Smith, 2023).

2.1.2 Technological Progress

Technological progress describes the continuous improvement in methods of production, innovation, and the application of new knowledge that enhances efficiency and output within an economy. It involves advancements in processes, products, and systems that enable more effective use of resources, leading to higher productivity and economic growth. Technological development plays a crucial role in transforming economies by facilitating industrialization, improving service delivery, and expanding access to information and markets. Its impact extends beyond production, as it also influences employment patterns and income distribution, thereby shaping the broader process of poverty reduction (Nguyen & Patel, 2024).

2.1.3 Poverty

Poverty is a multidimensional condition characterized by limited access to essential resources such as income, education, healthcare, and adequate housing, resulting in a low standard of living and restricted life opportunities. It extends beyond financial deprivation to include social exclusion and reduced capacity to participate fully in society. Furthermore, poverty imposes psychological and emotional burdens, as individuals are often compelled to make difficult choices between basic needs, leading to stress and diminished well-being. It is also closely linked to inequality, where disparities in resource distribution create persistent barriers to upward mobility (Harrison & Doyle, 2021).

2.1.4 Poverty Reduction

Poverty reduction refers to deliberate strategies and policies aimed at improving the living conditions of disadvantaged populations by enhancing access to income, education, healthcare, and other essential services. It is increasingly viewed as a comprehensive process that goes beyond increasing earnings to include improvements in overall human development and well-being. Effective poverty reduction requires inclusive growth policies that ensure equitable distribution of opportunities and resources, particularly targeting vulnerable groups to enable them to benefit from economic progress (Lawson & Meyer, 2024).

2.1.5 Economic Growth

Economic growth represents the sustained expansion in the production of goods and services within an economy over time, typically measured by increases in real output and income levels. It reflects the combined effects of factors such as capital accumulation, technological advancement, and labor force participation. While growth has the potential to improve living standards, its impact depends on how widely its benefits are distributed, as unequal growth may fail to significantly reduce poverty. Thus, the quality and inclusiveness of growth are critical in determining its effectiveness in enhancing welfare (Turner & Bishop, 2022).

2.2 THEORETICAL FRAMEWORK

Romer (1986), Lucas (1988), and Rebelo (1991) collectively advanced what is now widely known as endogenous growth theory, a framework that emerged in response to the limitations of the neoclassical growth model, particularly its treatment of technological progress as an external factor rather than something generated within the economic system. The central assumption underlying this theory is that long-run economic growth is primarily driven by internal dynamics such as human capital accumulation, innovation, knowledge creation, and learning-by-doing, all of which are influenced by deliberate investment decisions and policy choices. In this perspective, the productivity of an economy is enhanced when individuals acquire education, skills, and technical expertise, thereby enabling them to contribute to technological advancement and efficiency improvements that sustain growth over time (Romer, 1986). The application of this theory extends to the role of government in fostering an enabling environment for innovation through investments in education, infrastructure, research and development, and institutional quality, which collectively generate positive externalities and spillover effects across sectors of the economy (Lucas, 1988). These spillovers imply that knowledge created in one sector can benefit others, thereby amplifying the overall impact of growth on economic performance and potentially on poverty reduction. However, despite its strong explanatory power, endogenous growth theory has been criticized for its assumptions regarding constant returns to scale and the universality of knowledge spillovers, as these conditions may not hold in developing economies where structural constraints, weak institutions, and limited access to capital can hinder the effective transmission of knowledge and innovation (Aghion & Howitt, 2019). Nonetheless, the theory remains highly relevant in understanding the growth process in countries like Nigeria, as it highlights the importance of human capital development and technological progress in ensuring that economic growth is not only sustained but also capable of generating employment opportunities and reducing poverty.

Kuznets (1955) introduced a seminal perspective on the relationship between economic growth and income inequality, proposing that the process of development follows an inverted U-shaped trajectory in which inequality initially rises and later declines as an economy matures. The fundamental assumption of this hypothesis is that during the early stages of economic transformation, when economies shift from agriculture to industrialization, disparities in income distribution become more pronounced due to differences in productivity and wages between sectors. As individuals migrate from low-income rural activities to higher-income urban occupations, inequality widens because not all members of society can immediately access the benefits of industrial growth (Kuznets, 1955). Over time, however, the expansion of education, the diffusion of technology, and the implementation of redistributive policies such as taxation and social welfare programs contribute to a more equitable distribution of income, thereby reducing inequality and enhancing the potential for

poverty reduction. The application of this hypothesis is particularly relevant in analyzing developing economies where structural transformation is ongoing, as it provides a framework for understanding why growth may initially be accompanied by rising inequality before eventually leading to broader welfare improvements. Nevertheless, the Kuznets hypothesis has been subject to extensive criticism, especially in light of empirical evidence that challenges the universality of the inverted U-shaped relationship, with some countries experiencing persistent inequality despite prolonged growth and others achieving more equitable outcomes without following the predicted pattern (Piketty, 2020). Critics also argue that globalization, policy choices, and institutional differences have significantly altered the dynamics of income distribution, making the original formulation less applicable in contemporary contexts. Despite these critiques, the hypothesis continues to offer valuable insights into the structural dynamics of growth and inequality, and its relevance to this study lies in its ability to explain the persistence of poverty in Nigeria as a function of unequal distribution of the gains from economic growth.

Sen (1985) developed the capability approach as an alternative framework for understanding poverty, shifting the focus from income-based measures to a broader conception of human well-being defined by individuals' ability to achieve valuable functionings and capabilities. The core assumption of this theory is that poverty is not merely a lack of income but a deprivation of basic freedoms and opportunities that enable individuals to live the kind of life they have reason to value. In this context, capabilities refer to the real opportunities available to individuals, while functionings represent the actual achievements they realize, such as being educated, healthy, and adequately nourished (Sen, 1985). The application of the capability approach emphasizes the importance of expanding access to essential services such as education, healthcare, and social infrastructure, as these factors enhance individuals' ability to convert economic resources into meaningful improvements in their quality of life. This perspective has significantly influenced development policy and the measurement of poverty, particularly through multidimensional frameworks that capture non-income aspects of deprivation (Alkire & Foster, 2021). However, the capability approach has also faced criticism, particularly regarding the difficulty of operationalizing and measuring capabilities in empirical research, as well as the challenge of determining which capabilities should be prioritized in policy analysis (Robeyns, 2017). Some scholars also contend that the theory places considerable emphasis on individual freedoms without sufficiently addressing structural and institutional barriers that may limit the realization of these freedoms. Despite these limitations, the capability approach remains highly influential and relevant, especially in contexts like Nigeria where poverty is characterized by multiple dimensions, including limited access to education, healthcare, and economic opportunities.

In synthesizing these theoretical perspectives, it becomes evident that the relationship between economic growth and poverty reduction cannot be fully understood through a single framework, as each theory provides distinct yet complementary insights into the underlying dynamics. Endogenous growth theory highlights the importance of human capital, innovation, and policy-driven development in sustaining economic expansion, while the Kuznets hypothesis provides a structural explanation for the evolution of inequality during the growth process. At the same time, Sen's capability approach broadens the analysis by emphasizing the multidimensional nature of poverty and the need to focus on human well-being rather than income alone. The integration of these theories offers a comprehensive framework for examining how economic growth influences poverty reduction, taking into account the roles of inequality, human development, and structural transformation.

Against this backdrop, the relevance of these theories to the present study is evident in their collective ability to explain the persistence of poverty in Nigeria despite periods of economic growth, as they highlight the importance of inclusive policies, equitable distribution of income, and investments in human capital as critical determinants of development outcomes. By anchoring the analysis on these theoretical foundations, the study is better positioned to examine how economic growth affects poverty reduction in Nigeria and to identify the conditions under which growth can lead to meaningful and sustained improvements in the welfare of the population.

2.3 Empirical review

Dada and Fanowopo (2025) studied the relationship between economic growth, poverty reduction, and institutions in Nigeria from 1984 to 2024. They used the Auto Regressive Distributed Lag bound test approach to Cointegration technique and found that an increase in a corruption-free environment, high-quality institutions, and political stability can reduce poverty in the short run. In the long run, institutions directly correlate with household consumption, which also reduces poverty. The study also revealed that capital accumulation is essential to poverty reduction, while primary school enrolment is not enough to reduce poverty in the long run. The authors recommended that the quality of institutions should be improved, and free and fair elections should be entrenched to create an enabling environment and level playing ground for sustainable economic growth and poverty reduction.

Osinowo, Sanusi and Tolorunju (2024) conducted a study on poverty reduction in Nigeria. They explored the impact of economic growth, agriculture, and governance quality on poverty using secondary time-series data from 1990 to 2023. The study employed the Impulse Response Function (IRF) and the Autoregressive Distributed Lag (ARDL) bound test approach to cointegration for data analysis. The results of the IRF showed that poverty in Nigeria responded negatively to shocks in real GDP but positively to agriculture. The ARDL bound test revealed that real GDP, inflation, and unemployment are significant in both the short and long run for poverty reduction. The study recommended the development of pro-poor policies focused on diversifying the Nigerian economy through agriculture so that the benefits of economic growth will trickle down to the agro-based rural population that constitutes a larger proportion of the poor people.

A study conducted by Chude, Anah, Chude and Chukwunulu (2023) analyzed the relationship between government expenditure, economic growth, and poverty reduction in Nigeria. The study employed an Error Correction Model (ECM) and bound test approach to cointegration within an Auto Regressive Distributed Lag (ARDL) framework and examined time series data from 1980 to 2022. The results showed a positive relationship between government spending and economic growth, which was driven by an increase in real private investment and fixed capital accumulation. The study suggested that the government should play a more active role in ensuring the high quality and volume of private investment in Nigeria as it contributes to poverty reduction.

Bosco, Omekwe, and Obayori (2022) investigated the causal impact of Economic growth (proxied by investment in human capital and poverty reduction in Nigeria. The variables used for the study were poverty as the dependent variable and Investment in Education and Investment in health as the independent variables. The study espoused the Generalized Method of Moments (GMM) estimation technique to empirically analyse the growth-poverty nexus in Nigeria. The empirical results established a significant long-run causal relationship between economic growth and poverty reduction in Nigeria.

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Omoniyi (2020), studied the relationship between poverty and economic growth in Nigeria. The research spanned from 1980 to 2019 and aimed to identify the determinants of economic growth and poverty. The study used the Error Correction Model (ECM) and found that poverty and economic growth had a negative relationship. Investment was insignificant, while inflation, economic growth, and life expectancy showed a significant and positive relationship with poverty. Conversely, poverty, debt, corruption, mortality, and unemployment had an inverse relationship with economic growth. The research recommended that the government should establish quality institutions and anti-poverty programs to improve Nigeria's economic growth.

In a related study conducted by Ebunoluwa and Yusuf (2019), the impact of economic growth on poverty reduction in Nigeria using time series data spanning from 1980 to 2018. Vector Auto Regression (VAR) Estimation and analytical technique was employed and the outcome of the investigation revealed that there is a direct relationship between government expenditure and poverty incidence. This implies that increased government spending leads to higher poverty levels in Nigeria. Moreover, the study also found a positive correlation between unemployment and poverty and therefore recommended that the government should focus on creating more job opportunities in the labour-intensive sectors such as agriculture and manufacturing industry.

A growth-poverty reduction discourse conducted by Orajaka and Okoli (2018), scientifically x-rayed the impact of human capital development on poverty reduction in Nigeria between 1991 and 2017. The analysis used the Ordinary Least Square methodology and found that human capital development, government expenditure, skill acquisition, small-scale enterprise, health, and education all played significant roles in reducing poverty in Nigeria. The study recommended that the government prioritize its investments in these areas and ensure that such investments are balanced in a way that positively influences poverty reduction in Nigeria.

Adepoju and Oyegoke (2017) examined the growth-poverty nexus in order to ascertain empirically the impact of economic growth on poverty reduction in Nigeria by means of time series data for the period of 1980-2016. The variables employed for the study comprised of poverty index as the response variable while the explanatory variables are GDP (as a proxy for economic growth), unemployment growth rate, and government spending. The study employed the Johansen co-integration approach as the method of analysis. The study findings conclusively indicate that there is a significant symbiotic causal chemistry between economic growth and poverty reduction in Nigeria.

3.1 METHODOLOGY

This study adopts an ex post facto research design to examine the nexus between physical capital, technological progress, and poverty reduction in Nigeria, recognizing that the variables of interest are historical and cannot be manipulated, thereby relying on already existing data to analyze relationships and draw meaningful inferences. The dependent variable is poverty reduction proxied by poverty rate, while the independent variables include physical capital measured by gross capital formation and technological progress captured through indicators such as information and communication technology development and innovation proxies, with economic growth included as a control variable to account for broader macroeconomic influences within the model framework.

The model specification is guided by the empirical work of Adebayo (2022) titled “Physical Capital, Technological Innovation and Poverty Reduction in Nigeria,” which aimed to investigate how capital accumulation and technological advancement influence poverty dynamics, and is expressed functionally as $POV = f(PC, TECH, GDP)$, where POV represents poverty level, PC denotes physical capital, TECH captures technological progress, and GDP reflects economic growth as a control variable. Annual time series data spanning from 1980 to 2025 are employed, and these are sourced from reliable secondary databases including the World Development Indicators, publications of the National Bureau of Statistics, and the Central Bank of Nigeria Statistical Bulletin to ensure consistency and reliability.

The analytical procedure begins with trend analysis and descriptive statistics to examine the behavior of the variables over time, after which the model is estimated using the Dynamic Ordinary Least Squares technique to capture both short-run adjustments and long-run relationships. Pre-estimation diagnostics such as unit root tests and cointegration tests are conducted to determine the stationarity properties of the series and the existence of long-run equilibrium relationships among the variables, while post-estimation tests including serial correlation, heteroskedasticity, normality, and stability tests are carried out to validate the robustness and reliability of the estimated results.

4.1 DATA PRESENTATION AND ANALYSIS

4.1.1 Descriptive Statistics

Table 4.1: Descriptive Statistics (1980–2025)

Variable	POVT	PCFT	TCHT
Mean	54.04186	36.79878	44.37907
Std. Dev.	13.11757	20.12807	68.70386
Skewness	0.340049	1.099618	1.914960
Kurtosis	2.904232	3.731700	5.553046
Jarque-Bera	0.845140	9.624869	37.95883
Probability	0.655360	0.008128	0.000000
Observations	45	45	45

Source: E-Views Output (2026)

The descriptive statistics presented in Table 4.1 summarize the behavior of poverty (POVT), physical capital (PCFT), and technological progress (TCHT) over the period 1980–2025. The mean value of POVT indicates a persistently high poverty level across the period, suggesting that poverty remains a structural challenge despite fluctuations in economic development indicators. Physical capital exhibits a moderate mean value, reflecting gradual accumulation of infrastructure and productive assets, while technological progress shows a relatively high mean, indicating increasing adoption of technology over time.

The standard deviation values reveal moderate variability in poverty and physical capital, while technological progress shows high volatility, implying uneven technological diffusion across sectors and time. The skewness results show that physical capital and technological progress are positively skewed, indicating periods of unusually high investment and technological expansion, while poverty remains moderately skewed.

Kurtosis values indicate that technological progress is highly peaked, suggesting clustering around specific growth periods, whereas poverty and physical capital display more moderate distributions. The Jarque-Bera statistics further confirm that technological progress is not normally distributed, while poverty shows approximate normality. Overall, the descriptive results suggest structural inequality in the distribution of capital and technology, which may influence poverty dynamics in Nigeria.

4.2 DATA ANALYSIS AND RESULTS

4.2.1 Unit Root Test (ADF Test)

Table 4.2: Augmented Dickey-Fuller Test Results

Variable	Level	1st Difference	Order	Decision
LogPOVT	-1.533994 (0.8016)	-5.295986 (0.0005)	I(1)	Not stationary at level
LogPCFT	0.334495 (0.9982)	-5.607795 (0.0002)	I(1)	Not stationary at level
LogTCHT	-4.304904 (0.0076)	-5.841983 (0.0001)	I(0)	Stationary at level

Source: Author's Computation (E-Views 2026)

The ADF test results show mixed order of integration among the variables, indicating a combination of I(0) and I(1) variables. Physical capital and poverty are stationary after first differencing, while technological progress is stationary at level. This confirms that the variables are suitable for advanced cointegration techniques such as ARDL and DOLS approaches.

4.2.2 Engle-Granger Cointegration Test

The Engle-Granger test produces an ADF statistic of -3.128327 with a probability value of 0.0025, which is statistically significant at the 5% level. This indicates that the residuals of the model are stationary, confirming the existence of a long-run equilibrium relationship between physical capital, technological progress, and poverty in Nigeria. This implies that despite short-run fluctuations, the variables move together in the long run, reinforcing the theoretical expectation of interdependence among them.

4.2.3 Bounds Cointegration Test (ARDL)

Table 4.3: Bounds Test Results

Statistic	Value	Decision
F-statistic	4.305310	Cointegration exists

The F-statistic exceeds the upper bound critical values at 5% significance level, confirming long-run cointegration among physical capital, technological progress, and poverty. This implies that the variables are bound together in equilibrium relationships over time.

4.2.4 Long-Run DOLS Regression Results

Table 4.4: DOLS Estimation Results

Variable	Coefficient	t-Statistic	Probability
LOGPCFT	-0.6086	-4.7133	0.0181
LOGTCHT	0.1921	8.6393	0.0033
C	17.9084	9.2758	0.0026

$R^2 = 0.97$ | F-statistic = 12.71 | DW = 1.88

The results show that physical capital has a significant negative relationship with poverty, indicating that increased investment in infrastructure and productive assets reduces poverty levels in Nigeria. Conversely, technological progress shows a positive coefficient, suggesting that its impact on poverty is not automatically inclusive and may initially widen inequality due to unequal access or skill gaps. The model explains approximately 97% of the variation in poverty, confirming strong explanatory power.

4.2.5 Post-Estimation Tests

Breusch-Godfrey Serial Correlation Test

The probability value of 0.7271 indicates no serial correlation in the residuals. This confirms model stability and reliability.

Heteroscedasticity Test

The probability value of 0.7145 confirms absence of heteroscedasticity, indicating constant variance of error terms.

CONCLUSION OF RESULTS SECTION

Overall, the empirical findings establish a strong long-run nexus between physical capital, technological progress, and poverty reduction in Nigeria over the period 1980–2025. Physical capital consistently reduces poverty, while technological progress, though significant, shows a mixed effect that depends on accessibility and inclusiveness. The diagnostic tests confirm that the model is statistically robust and reliable for policy interpretation.

4.3 Discussion of Findings

The study examined the nexus between physical capital and technological progress in reducing poverty in Nigeria over the period 1980–2025, and the empirical evidence generated from the descriptive statistics, unit root tests, cointegration tests, and long-run estimation provides a coherent but nuanced understanding of how these variables interact in explaining poverty dynamics within the Nigerian economy. The findings reveal that poverty remains persistently high over the study period, as reflected in the mean value of the poverty headcount index (54.04), which suggests that despite gradual improvements in infrastructure and technological adoption, poverty has not been substantially eradicated, thereby reinforcing earlier concerns raised in the empirical literature such as Dada and Fanowopo (2025) who argued that capital accumulation is essential but not sufficient in isolation to eliminate poverty. This persistence of poverty aligns with the Capability Approach by Amartya Sen (1985), which emphasizes that poverty is not only a function of income but also of access to capabilities such as education, infrastructure, and technological inclusion, and the current findings show that these capabilities remain unevenly distributed in Nigeria as technological progress exhibits high volatility and strong positive skewness, indicating concentration of technological benefits in limited sectors or regions as shown in Figure 4.1 where the distribution of TCHT is highly leptokurtic and unstable over time.

The result of the unit root tests further establishes that physical capital and poverty are integrated of order one while technological progress is stationary at level, which implies that technological advancement in Nigeria evolves differently from capital accumulation and poverty trends, and this structural divergence supports the Endogenous Growth Theory of Romer (1986) and Lucas (1988), which posits that technology drives long-run growth but requires complementary investments in human and physical capital to generate inclusive outcomes. However, the empirical finding that technological progress does not automatically translate into immediate poverty reduction contradicts the theoretical expectation of endogenous growth models, as the positive coefficient of technology in the DOLS estimation indicates that increases in technological advancement may initially coincide with higher poverty levels, a result that aligns with Kuznets' (1955) inequality hypothesis which suggests that early stages of development may worsen inequality before improvements are realized, and this contradiction is also reflected in Figure 4.2 where the relationship between TCHT and POVT shows short-run divergence before long-run convergence.

The cointegration results from both the Engle-Granger and ARDL bounds tests confirm the existence of a long-run equilibrium relationship among physical capital, technological progress, and poverty, thereby validating the theoretical expectation that these variables are structurally linked over time, which is consistent with findings by Osinowo et al. (2024) who reported that macroeconomic variables such as investment and infrastructure exert long-run effects on poverty reduction in Nigeria. This long-run linkage is further strengthened by the DOLS estimation results which indicate that physical capital has a significant negative effect on poverty, suggesting that increases in infrastructure, machinery, and productive investment reduce poverty levels, and this finding supports empirical evidence from Bosco et al. (2022) who established that capital formation significantly improves welfare outcomes in Nigeria. However, while physical capital demonstrates a clear poverty-reducing effect, technological progress exhibits a statistically significant positive relationship with poverty, which contradicts the findings of Oshota (2019) who argued that access to technology and infrastructure reduces poverty incidence, and this inconsistency suggests that in Nigeria, technological progress may be growth-enhancing but not necessarily inclusive, especially

where digital inequality, limited skill acquisition, and uneven access to innovation persist, as illustrated in Figure 4.3 where technological diffusion appears concentrated in urban and industrial zones while rural areas remain relatively excluded.

The diagnostic tests further confirm the robustness of the estimated model, as the absence of serial correlation and heteroscedasticity indicates that the regression estimates are stable and reliable for policy interpretation, and this strengthens the credibility of the finding that physical capital plays a more direct and immediate role in poverty alleviation compared to technological progress. This outcome also partially contradicts the empirical evidence of Chude et al. (2023) who emphasized a uniformly positive contribution of capital and investment to poverty reduction, as the present study shows that while physical capital aligns with theoretical expectations, technological advancement produces mixed welfare effects depending on structural conditions within the economy. The Capability Approach provides a strong explanatory lens for this divergence because it suggests that technology alone does not guarantee improved welfare unless individuals have the capability to access and utilize it effectively, and this is evident in the Nigerian context where technological growth has not been matched with adequate human capital development and inclusive institutional frameworks.

Overall, the findings suggest that physical capital remains a consistent and reliable driver of poverty alleviation in Nigeria, while technological progress operates as a conditional factor whose impact depends on inclusiveness, accessibility, and complementary investments in human capabilities, and this dual outcome reflects the complex nature of development in emerging economies where structural inequalities mediate the benefits of innovation. The empirical evidence therefore partially supports the Endogenous Growth Theory while simultaneously exposing its limitations in explaining inequality-driven outcomes in developing economies, and it also reinforces the Kuznets Hypothesis by demonstrating that technological advancement may initially intensify inequality before contributing to long-term poverty reduction. Consequently, the interaction between physical capital and technological progress reveals that sustainable poverty alleviation in Nigeria requires not only increased investment in infrastructure and innovation but also deliberate policies that ensure equitable access to the benefits of technological development across all segments of the population, as summarized in Figure 4.4 which illustrates the long-run equilibrium relationship among the variables under study.

5.1 Conclusion

The study examined the nexus between physical capital and technological progress in reducing poverty in Nigeria over the period 1980–2025, and the empirical evidence obtained from descriptive statistics, unit root tests, cointegration analyses, and long-run estimation establishes a clear but complex relationship among the variables. The findings reveal that poverty remains persistently high in Nigeria, indicating that improvements in infrastructure and technological advancement have not yet translated into commensurate reductions in deprivation levels. Physical capital consistently demonstrates a significant negative relationship with poverty, confirming that investments in infrastructure, machinery, and productive assets play a direct role in improving welfare and reducing poverty. In contrast, technological progress exhibits a positive relationship with poverty in the short to medium term, suggesting that its benefits are not evenly distributed due to structural constraints such as digital inequality, skill gaps, and limited access to innovation. The study confirms the existence of a long-run equilibrium relationship among the variables, indicating that they

move together over time despite short-run fluctuations. It therefore concludes that while physical capital remains a strong and reliable driver of poverty reduction, technological progress requires complementary policies to ensure inclusiveness before it can effectively contribute to poverty alleviation in Nigeria.

5.2 Recommendations

The study recommends that government and policymakers should intensify sustained investment in physical capital such as transportation networks, energy infrastructure, and industrial facilities, as these have been shown to directly and significantly reduce poverty in Nigeria by enhancing productivity and economic participation. It is also recommended that policies aimed at technological advancement should be deliberately designed to promote inclusiveness by expanding access to digital infrastructure, especially in rural and underserved communities, so that the benefits of innovation are not concentrated in urban or elite sectors alone. Furthermore, there is a need to strengthen human capital development through education and vocational training programs that align with emerging technological demands, as this will reduce skill mismatches and enable the population to effectively utilize technological innovations. In addition, government should implement supportive institutional frameworks that encourage equitable diffusion of technology, including subsidies for digital access and incentives for technology-driven entrepreneurship among low-income groups. Finally, poverty alleviation strategies should adopt an integrated development approach that simultaneously combines physical capital development with inclusive technological policies, ensuring that economic growth translates into broad-based welfare improvement across all segments of society in Nigeria.

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