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INSTITUTIONAL QUALITY AS A MODERATOR OF THE EFFECTS OF INFRASTRUCTURE AND HUMAN CAPITAL DEVELOPMENT ON ECONOMIC GROWTH IN NIGERIA

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ABSTRACT

This study examined the moderating role of institutional quality in the relationship between infrastructural development, human capital development, and economic growth in Nigeria from 1990 to 2023. The study employed a Simultaneous Equation Model (SEM) estimated using the Two-Stage Least Squares (2SLS) technique to account for endogeneity and simultaneity among the variables. The results showed that infrastructural development had a negative and significant effect on economic growth, while human capital development exerted a positive and significant effect. The interaction between institutional quality and infrastructural development was negative and significant, whereas the interaction between institutional quality and human capital development was positive and significant. The study contributes to the literature by providing empirical evidence on the moderating role of institutional quality in the infrastructure–growth and human capital–growth relationships in Nigeria. The findings suggest that the growth effects of development investments are influenced by the quality of institutions. The study recommends strengthening institutional quality through improved governance, transparency, and accountability, while promoting investments in both infrastructure and human capital to support sustainable economic growth.

***Keywords**: Institutional Quality; Infrastructure Development; Human Capital Development; Economic Growth*

***JEL Classification Codes**: O43; H54; I25; C36*

1.0 Introduction

Economic growth represents a sustained increase in an economy's productive capacity, underpinning improvements in living standards, employment creation, and poverty reduction. In developing economies such as Nigeria, the importance of growth extends beyond aggregate output expansion to encompass social stability, national security, and overall quality of life. With a rapidly expanding population and a high dependency ratio of 73.3% compared to the global average of 47%, the urgency of achieving inclusive and sustained growth has become more pronounced (World Economics, 2024). Projections that the population may reach 400 million by 2050

further intensify the need for policies that can effectively harness demographic potential while mitigating risks associated with unemployment, poverty, and social unrest (Nwanze, 2019).

Despite its abundant natural resources, particularly oil and gas, Nigeria's growth trajectory has remained volatile and inconsistent. The country experienced robust growth rates of 6–7% in the mid-2000s, largely driven by oil revenues, but this momentum has weakened in recent years. Following the COVID-19 pandemic, economic growth decreased to −1.8% in 2020, but recovered to 3.3% in 2023 and 3.4% in 2024. The improvement was primarily driven by growth in the services sector and the adoption of macroeconomic reforms targeted at improving fiscal and external balances. Nonetheless, growth remains below the level needed to address Nigeria's economic issues, as growth remained at about 3.6% in 2025, (World Bank, 2025; Reuters, 2025; World Bank, 2023). Moreover, per capita income growth remains sluggish, and significant regional disparities persist, particularly between urban and rural areas where access to infrastructure, healthcare, and education is limited (World Bank, 2024). These patterns underscore the need for a more inclusive and resilient growth framework.

Among the key drivers of economic growth such as physical capital, human capital, technology, natural resources, and institutional quality, including infrastructure and human capital development, occupy a central position. Infrastructure, as a component of physical capital, facilitates economic activities by providing essential services such as transportation, energy, and digital connectivity. However, Nigeria continues to face substantial infrastructure deficits, including inadequate transport networks, unreliable electricity supply, and limited digital infrastructure, all of which constrain productivity and increase the cost of doing business (Agwu & Ukakwu, 2019). These deficiencies reflect longstanding structural challenges rooted in historical legacies, weak planning frameworks, and inefficient investment patterns (Sturup & Low, 2019).

Complementing infrastructure is human capital development, which plays a critical role in enhancing productivity, innovation, and long-term competitiveness. Empirical evidence consistently shows that investments in education, health, and skills acquisition significantly improve economic performance (Faggian et al., 2019; Tran & Vo, 2020; Okunade et al., 2022). Theoretical contributions from Becker (1964) and Lucas (1988) further emphasize that sustained investment in human capital generates cumulative growth benefits over time. However, Nigeria's progress in this area remains constrained by systemic challenges, including underfunding of education and healthcare, weak policy coordination, and

regional inequalities. Public spending on education falls below the recommended benchmark of 15–20% (UNESCO, 2023), while healthcare financing is heavily reliant on out-of-pocket expenditures, accounting for 70–75% of total health spending (Jia et al., 2025). Consequently, Nigeria's Human Capital Index stands at 0.36, indicating that a child born today is expected to achieve only 36% of their potential productivity (World Bank, 2020).

The relationship between infrastructure and human capital is mutually reinforcing. Infrastructure investments not only enhance productivity directly but also improve access to education and healthcare, thereby strengthening human capital. In turn, a skilled and healthy workforce enhances the effective utilization of infrastructure, creating a virtuous cycle of growth and development (Romer, 1990; Aghion & Howitt, 1998). This interdependence suggests that isolated policy interventions may be insufficient; rather, coordinated investments are necessary to achieve sustainable economic outcomes.

However, the extent to which infrastructure and human capital contribute to economic growth depends critically on institutional quality. Strong institutions characterized by effective governance, rule of law, policy consistency, and low levels of corruption are essential for ensuring that investments translate into tangible development outcomes. In contrast, weak institutions can undermine the efficiency of public spending, distort resource allocation, and limit the impact of development initiatives. In Nigeria, persistent institutional challenges, including corruption, fiscal indiscipline, and governance inconsistencies, continue to hinder growth prospects (Transparency International, 2023). This aligns with broader development frameworks emphasizing the importance of institutional strength in achieving sustainable and inclusive growth (Uddin et al., 2023).

Despite numerous policy initiatives aimed at stimulating growth, including reforms targeting infrastructure development and human capital enhancement, outcomes in Nigeria remain suboptimal. Infrastructure stock is estimated at only 30% of GDP, significantly below the global benchmark of 70% (World Bank, 2020), while human capital indicators remain weak. Furthermore, existing empirical studies often examine infrastructure and human capital in isolation, neglecting their interaction and the moderating role of institutional quality (Ogbebor & Ashakah, 2021; Benne et al., 2021; Khan et al., 2023; Effiom & Okoli, 2018). This fragmented approach limits a comprehensive understanding of how these variables jointly influence economic growth.

Against this backdrop, this study examines the combined effects of infrastructure and human capital development on economic growth in Nigeria, with particular emphasis on the moderating role of institutional quality. By integrating these dimensions, the study

provides a more holistic framework for understanding the drivers of growth and offers insights into how strengthening institutions can enhance the effectiveness of development policies.

2.0 Literature Review

2.1. Conceptual Literature

2.1.1. Economic Growth

Economic growth represents the central objective of macroeconomic policy and serves as a key indicator of a country's economic performance. It is commonly defined as the sustained increase in the production of goods and services, typically measured by real Gross Domestic Product (GDP) (Mankiw, 2016). Rising GDP reflects improvements in national income, consumption, and overall living standards. However, GDP as a measure has limitations, as it does not capture income distribution or the sustainability of growth. Consequently, while economic growth signals economic progress, it must be interpreted within broader developmental contexts. In this study, economic growth is conceptualized as the outcome variable influenced by infrastructural development and human capital development, within the conditioning role of institutional quality.

2.1.2. Infrastructural Development

Infrastructural development constitutes a fundamental driver of economic growth, particularly in developing economies such as Nigeria (Calderón & Servén, 2004). It encompasses the provision and maintenance of critical physical systems, including transportation networks, energy supply, communication infrastructure, and essential utilities. These components form the backbone of economic activities by facilitating production, enhancing connectivity, and reducing transaction costs (World Bank, 2016).

Transportation infrastructure plays a vital role in integrating markets and enabling the efficient movement of goods, services, and labour. However, deficiencies in Nigeria's transport systems have constrained industrial competitiveness and regional integration (Onokala & Olajide, 2020; Theresa, Gloria & Frank, 2025). Similarly, energy infrastructure is indispensable for industrialization and economic diversification. Persistent energy shortages in Nigeria have increased production costs and discouraged investment (OECD, 2010; Emovon et al., 2018), underscoring the need for improved electricity generation and distribution systems (Adebayo & Ainah, 2024).

Communication infrastructure has also emerged as a key enabler of modern economic growth, particularly in knowledge-based economies. It supports innovation, information exchange, and participation in digital markets (Sindakis, Depeige & Anoyrkati, 2015). Although Nigeria has made progress in this area, digital disparities persist, limiting inclusive economic participation (Adeleke,

2021). Overall, the synergy among transportation, energy, and communication infrastructure enhances productivity, fosters innovation, and drives structural transformation (World Bank, 2016).

2.1.3. Human Capital Development

Human capital development refers to the process of enhancing individuals' skills, knowledge, and health to improve productivity and economic performance. It involves investments in education, training, and healthcare, which transform individuals into productive economic agents (Harbison, 1962; Becker, 1964). According to Schultz (1961), human capital improves workers' efficiency by increasing their cognitive abilities, thereby contributing to higher productivity and sustained economic growth.

The importance of human capital development is widely recognized in the literature, with studies emphasizing its critical role in achieving long-term economic growth (Barro, 1991; World Bank, 1995; Adedeji & Bamidele, 2003; Nwokoye et al., 2020). As economies become increasingly knowledge-driven, the demand for skilled and adaptable labour continues to rise. Human capital not only enhances individual productivity but also supports innovation, technological advancement, and competitiveness at the national level.

In the context of this study, human capital development is conceptualized as a key input that complements infrastructural development. While infrastructure provides the physical platform for economic activities, human capital ensures its effective utilization, thereby reinforcing the growth process.

2.1.4. Institutional Quality

Institutional quality broadly refers to the ability of formal institutions, governance frameworks, and public-sector arrangements to influence economic and social results. The World Bank defines institutional quality as the extent to which public institutions design and implement sound policies, provide effective public services, uphold the rule of law, and promote accountability and openness in governance (World Bank, 2024). The World Bank's Worldwide Governance Indicators (WGI) evaluate institutional quality on six dimensions: voice and accountability, political stability and lack of violence, government effectiveness, regulatory quality, rule of law, and corruption control (World Bank, 2024). Similarly, the International Monetary Fund (IMF) defines institutional quality as an institution's ability to set and enforce norms, support market functioning, safeguard property rights, and create a conducive environment for economic activity (IMF, 2019). High-quality institutions enable better resource allocation, lower transaction costs, stronger governance, and support long-term economic growth (IMF,

2019). According to these ideas, institutional quality can be defined as the effectiveness of political, legal, and administrative structures in managing economic activity and assuring accountability. It includes governance characteristics like rule of law, regulatory quality, government performance, and anti-corruption measures. Strong institutions ensure a stable and predictable economic environment by enforcing contracts, preserving property rights, decreasing uncertainty, and improving the efficiency of public and private investments (World Bank, 2024; IMF, 2019).

Strong institutions create a stable and predictable environment for economic activities by enforcing contracts, protecting property rights, and reducing uncertainty (Acemoglu & Robinson, 2012). In contrast, weak institutional frameworks are associated with corruption, inefficiency, and policy inconsistency, which undermine economic performance. In Nigeria, institutional challenges such as weak enforcement mechanisms and governance inefficiencies have historically limited the effectiveness of development initiatives. These weaknesses often reduce the returns on investments in infrastructure and human capital. However, institutional reforms, including anti-corruption measures and regulatory improvements, have demonstrated the potential to enhance economic outcomes during periods of stability.

Within the framework of this study, institutional quality is conceptualized as a moderating variable. It conditions the extent to which infrastructural development and human capital development translate into economic growth. Strong institutions amplify the positive effects of these variables by ensuring efficient resource allocation and policy implementation, while weak institutions diminish their impact.

The conceptual relationship among economic growth, infrastructural development, human capital development, and institutional quality is inherently interdependent. Infrastructure and human capital serve as complementary drivers of growth, with infrastructure enabling access to education and healthcare, and human capital enhancing the productivity of infrastructure. Institutional quality, in turn, shapes the effectiveness of these interactions by providing the governance framework within which they operate. Thus, sustainable economic growth in Nigeria is best understood as the outcome of the combined and mutually reinforcing effects of these variables within a sound institutional environment.

2.2. Empirical Literature

Empirical studies on the nexus between infrastructural development, human capital development, and economic growth provide mixed but largely supportive evidence of their growth-enhancing roles, particularly within developing economies.

Sapkota (2014) examined the effect of infrastructure on human development in 91 developing countries over the period 1995 to 2010. The study employed dynamic panel estimation techniques and found that infrastructure indicators, including electricity access, clean water supply, and road density, exerted a positive and significant effect on human development outcomes. Mohanty et al. (2016) investigated the relationship between infrastructure and human development across 30 districts in Odisha, India. Using a panel data model, the study found a positive and significant relationship between infrastructure and human development, particularly in less developed districts. Olagunju et al. (2017) assessed the effect of rural infrastructure on household welfare and poverty reduction in Oyo State, Nigeria, using data from 263 households. The study employed descriptive statistics, Foster–Greer–Thorbecke (FGT) poverty measures, and Probit regression analysis. The findings revealed that access to roads, electricity, education, health facilities, and agro-processing infrastructure had a significant positive effect on household welfare and a significant negative effect on poverty.

Enilolobo and Sodeinde (2019) examined the impact of human capital and infrastructural development on industrial productivity in Nigeria using annual data from 1991 to 2014. The study employed the Ordinary Least Squares (OLS) technique and found that human capital development had a positive and significant effect on industrial productivity, while infrastructural development exerted a positive but insignificant effect. Anochiwa and Maduka (2014) investigated the influence of human capital and infrastructure on economic growth in Nigeria from 1970 to 2010. The study adopted cointegration and error-correction modelling (VECM) techniques and found that human capital had a positive and significant effect on economic growth, whereas infrastructure, proxied by electricity supply, had a positive but insignificant effect. Tsaurai and Ndou (2019) examined the interaction effect of infrastructure and human capital on economic growth in transitional economies. Using a dynamic panel Generalized Method of Moments (GMM) approach, the study found that the interaction between infrastructure and human capital had a positive and significant effect on economic growth, indicating a complementary relationship between the two variables.

Nedozi et al. (2014) examined the relationship between infrastructure development and economic growth in Nigeria. Using a simultaneous analysis framework estimated with OLS, the study found that infrastructure plays a significant positive role in economic growth by serving as both an intermediate and final good in the economy. Owolabi-Merus (2015) investigated the nexus between infrastructural development and economic growth in Nigeria using annual data from 1983 to 2013. The study employed OLS and Granger

causality techniques and found that infrastructural development had a positive and significant effect on economic growth, although no causal relationship was established. Ogbaro and Omotoso (2017) examined the impact of infrastructure development on economic growth in Nigeria between 1980 and 2015. The study utilized a Cobb-Douglas production function estimated with OLS and found that air transport, communication, power, and rail infrastructure had positive and significant effects on economic growth.

Bennee et al. (2021) investigated the relationship between infrastructure expenditure and economic growth in Nigeria from 2000 to 2020. Using a longitudinal research design, the study found that infrastructure expenditure exerted a positive and significant effect on real GDP. Ekpung (2014) analysed the impact of public expenditure on infrastructure and economic growth in Nigeria over the period 1970–2010. The study employed the vector error correction mechanism (VECM) and found that infrastructure expenditure was insufficient and ineffective in stimulating economic growth, indicating an insignificant growth effect. Fatai et al. (2016) examined the impact of public and private infrastructure investment on economic growth in Nigeria from 1970 to 2014. Using the Engle-Granger cointegration and ECM, the study found that infrastructure contributed positively to growth, while domestic investment in infrastructure exerted a negative effect on economic growth. Siyan and Adegoriola (2017) investigated the relationship between infrastructure development and economic growth in Nigeria between 1981 and 2014. The study employed the VECM and found that infrastructure had a positive effect on economic growth, whereas education exhibited a negative relationship with growth.

Adelakun (2011) investigated the relationship between human capital development and economic growth in Nigeria. The study employed the OLS technique and found a positive and significant effect of human capital development on economic growth. Eigbiremolen and Anaduaka (2014) examined the impact of human capital development on output growth in Nigeria using quarterly data from 1999 to 2012. The study adopted the augmented Solow growth model and found that human capital development had a positive and significant effect on output growth. Keji (2021) investigated the effect of human capital development on economic growth in Nigeria from 1981 to 2017. The study employed Vector Autoregression (VAR) and Johansen cointegration techniques and found that investments in education and health had a positive and significant effect on economic growth. Anyanwu et al. (2015) examined the relationship between human capital development and economic growth in Nigeria using data spanning 1981 to 2010. The study employed the Autoregressive Distributed Lag

(ARDL) model and found that human capital development had a positive but statistically insignificant effect on economic growth. Adeyemi and Ogunsola (2016) investigated the effect of human capital indicators on economic growth in Nigeria from 1980 to 2013. Using the ARDL cointegration approach, the study found that human capital indicators exerted a positive but insignificant effect on economic growth.

Ogunjobi et al. (2021) examined the roles of human capital and infrastructure in promoting economic growth in Nigeria over the period 1981 to 2018. The study employed cointegration and ARDL techniques and found that educational quality, transportation, and communication infrastructure had positive and significant effects on economic growth. Ogbebor and Ashakah (2022) investigated the impact of infrastructure and human capital development on economic growth in Nigeria from 1990 to 2020. Using the ARDL estimation technique, the study found that infrastructure and human capital individually exerted insignificant effects on economic growth, but their interaction had a positive effect on growth.

Ogbaro (2019) examined the moderating role of institutional quality in the infrastructure–growth relationship in 41 Sub-Saharan African countries between 1996 and 2015. The study employed a dynamic panel threshold regression model and found that infrastructure exerted a positive effect on economic growth only when institutional quality exceeded a specified threshold level. Zergawu et al. (2020) investigated the joint effect of infrastructure and institutional quality on economic growth using data from 99 countries covering 1980–2015. Employing the GMM, the study found that the interaction between infrastructure and institutional quality had a positive and significant effect on economic growth. Aslam (2020) examined the relationship among human capital, institutional quality, and economic growth in selected Asian countries using a panel econometric framework. The findings revealed that human capital had an insignificant effect on economic growth when considered independently but exerted a positive and significant effect when complemented by strong institutional quality. Funlayo et al. (2022) investigated the role of infrastructure and institutional quality in economic growth across ECOWAS countries from 2006 to 2020. The study employed a one-step difference GMM technique and found that infrastructure had a negative effect on economic growth, while the interaction between infrastructure and institutional quality also exerted a negative effect on growth.

Despite extensive empirical studies on infrastructure, human capital, and economic growth, the existing literature reveals important gaps. Many studies examine the direct effects of infrastructure or human capital on growth in isolation, while others consider their interaction without adequately incorporating

institutional quality as a conditioning factor. Although a few studies (e.g., Ogbaro, 2019; Zergawu et al., 2020; Aslam, 2020) recognize the role of institutions, they are largely cross-country analyses with limited focus on Nigeria. Moreover, conflicting findings on the effectiveness of infrastructure and human capital investments suggest that the institutional environment may play a critical moderating role that remains underexplored in the Nigerian context. Therefore, this study fills this gap by explicitly examining institutional quality as a moderator of the effects of infrastructural development and human capital development on economic growth in Nigeria, thereby providing a more integrated and context-specific understanding of the growth process.

3.0 Methodology

3.1. Theoretical Framework

This study is anchored on the New Growth Theory, as advanced by Romer (1986) and Lucas (1988), which emphasizes the central role of human capital in driving long-term economic growth. The theory departs from traditional growth models by recognizing that economic growth is not solely determined by exogenous technological progress but is significantly influenced by endogenous factors such as education, innovation, and knowledge accumulation. Human capital development, achieved through investments in education, healthcare, and skills acquisition, enhances labour productivity, promotes innovation, and supports sustainable economic development.

Within this theoretical perspective, infrastructure plays a complementary role by providing the physical foundation necessary for effective human capital development. Access to quality education and healthcare services depends heavily on the availability of functional infrastructure such as transportation, electricity, and communication systems. Thus, infrastructure not only facilitates production activities but also enhances the accumulation and utilization of human capital, reinforcing its contribution to economic growth.

The framework further incorporates physical capital and labour as essential inputs in the production process, while total factor productivity (TFP) captures the efficiency with which these inputs are utilized. The relationship among these variables is expressed using an extended Cobb-Douglas production function:

$$Y = AK^{\alpha}H^{\beta}L^{(1-\alpha-\beta)} \qquad 1$$

Where Y represents economic output, A denotes total factor productivity, K is physical capital (including infrastructure), H represents human capital, and L denotes labour. The parameters α and β measure the output elasticities of physical and human capital, respectively.

In this model, total factor productivity (A) embodies technological progress as well as

institutional quality. Institutional quality is particularly important in this study, as it influences how effectively physical and human capital are utilized in the production process. Strong institutions characterized by effective governance, rule of law, and regulatory quality enhance efficiency, reduce uncertainty, and promote optimal resource allocation. Conversely, weak institutions may hinder the productivity of both infrastructure and human capital by encouraging inefficiencies and misallocation of resources.

Thus, within the context of this study, institutional quality is conceptualized as a moderating factor that conditions the impact of infrastructural development and human capital development on economic growth. While infrastructure and human capital are direct inputs into the production process, their effectiveness depends largely on the institutional environment in which they operate. This theoretical positioning aligns with the New Growth Theory's emphasis on the role of systemic and structural factors in shaping long-term growth outcomes.

The framework provides a robust foundation for analysing the interactive effects of infrastructure, human capital, and institutional quality on economic growth in Nigeria, highlighting that sustainable growth is achieved not only through resource accumulation but also through the efficiency and quality of the institutional environment.

3.2. Data and Measurement of Variables

The study utilizes annual time series data covering the period from 1990 to 2023. Economic growth is proxied by Real Gross Domestic Product Growth Rate (RGDPG), measured as the annual percentage change in RGDP after adjusting for inflation. This variable serves as an indicator of overall economic performance and the productive capacity of the economy. Infrastructural development is measured using the Aggregate Infrastructure Development Index (AIDI), which captures the level of development in key infrastructure sectors, including transportation, energy, information and communication technology, and water infrastructure. Human capital development is proxied by the Human Capital Development Index (HCDI), constructed using Principal Component Analysis (PCA) from indicators such as life expectancy at birth, education attainment, and Gross National Income (GNI) per capita, thereby providing a multidimensional measure of human capital. Institutional quality (INSTQI) is measured using a composite index generated through Principal Component Analysis (PCA) from the six Worldwide Governance Indicators, namely government effectiveness, regulatory quality, rule of law, control of corruption, voice and accountability, and political stability and absence of violence.

Inflation rate (INFL) is measured by the annual percentage change in consumer prices and is

included to capture macroeconomic stability. Government expenditure (LNGEXP) is measured as the natural logarithm of government expenditure on education, reflecting public investment in human capital development. Labour force participation rate (LNLABF) is measured as the natural logarithm of the percentage of the working-age population actively participating in the labour market, while domestic credit to the private sector (LNDCPS) is measured as the natural logarithm of domestic credit provided to the private sector, indicating the level of financial sector development and access to credit. Population growth (POPG) is measured as the annual percentage growth rate of the total population. Furthermore, the moderating role of institutional quality is captured through two interaction terms: institutional quality and infrastructural development (INSTQI × AIDI), and institutional quality and human capital development (INSTQI × HCDI). These interaction terms assess whether the effectiveness of infrastructure and human capital development in promoting economic growth depends on the quality of institutions. Data for the study were obtained from the World Development Indicators (WDI), Africa Infrastructure Development Index (AIDI), Humanitarian Data Exchange (HDX), Worldwide Governance Indicators (WGI), and the Central Bank of Nigeria (CBN).

3.3. Model Specification

This study examines the moderating effect of institutional quality on the relationship between infrastructural development, human capital development, and economic growth in Nigeria. The inclusion of institutional quality as a moderating variable is supported by both theoretical and empirical literature, which emphasizes the role of strong institutions in enhancing the effectiveness of development policies and economic performance (Andrianarison, 2023; Thi-Cam-Ha et al., 2024). Institutional quality influences how efficiently infrastructure is utilized and how effectively human capital is deployed within the economy, thereby shaping overall growth outcomes.

Accordingly, the functional form of the model is specified as:

$$RGDPGt = f(AIDIt, HCDIt, INSTQIt * AIDIt, INSTQIt * HCDIt, INFLt, LNGEXPt, LNLABFt, LNDCPSt, POPGt) \quad 2$$

Where $HCDI_t$ is human capital development index at time *t;* $AIDI_t$ is aggregate infrastructural development index; $INFL_t$ is inflation rate; $LNGEXP_t$ is Log government expenditure; $LNLABF_t$ is Log labour force participation rate; $LNDCPS_t$ is Log domestic credit to private sector; POP_t is population growth rate. The interaction terms, $INSTQIt * AIDIt$ and $INSTQIt * HCDIt$, capture the

moderating effects of institutional quality on infrastructural development and human capital development, respectively. The econometric form of the model is expressed as:

$$\text{RGDPGt} = \beta_0 + \beta_1\text{AIDIt} + \beta_2\,\text{HCDIt} + \beta_3\,(\text{INSTQIt} * \text{AIDIt}) + \beta_4\,(\text{INSTQIt} * \text{HCDIt}) + \beta_5\text{INFLt} + \beta_6\text{GEXPt} + \beta_7\text{LABFt} + \beta_8\text{DCPSt} + \beta_9\text{POPGt} + \varepsilon\text{t} \quad 3$$

The log-linear form of the model is specified as:

$$\text{RGDPGt} = \beta_0 + \beta_1\text{AIDIt} + \beta_2\,\text{HCDIt} + \beta_3\,(\text{INSTQIt} * \text{AIDIt}) + \beta_4\,(\text{INSTQIt} * \text{HCDIt}) + \beta_5\text{INFLt} + \beta_6\text{LNGEXPt} + \beta_7\text{LNLABFt} + \beta_8\,\text{LNDCPSt} + \beta_9\text{POPGt} + \varepsilon\text{t} \quad 4$$

Where β_0 is the intercept, β_1 to β_9 are the regression coefficients, εt is the error term, and t represents time.

The coefficients of the interaction terms are expected to be positive. This implies that improvements in INSTQ are anticipated to enhance the effectiveness of infrastructural and HCDI in promoting economic growth. Strong institutional frameworks are expected to improve transparency, reduce inefficiencies, and ensure optimal resource allocation, thereby amplifying the growth effects of both infrastructure and human capital investments.

This study employs a Simultaneous Equation Model (SEM) with the Two-Stage Least Squares (2SLS) technique to analyse the models. The SEM framework is suitable due to the interdependence among infrastructural development, human capital, and economic growth, where feedback effects violate the exogeneity assumption of OLS. Originally developed by Henri Theil, Tjalling Koopmans and R. L. Basmann, 2SLS effectively captures both direct and indirect relationships while addressing endogeneity through instrumental variables. These instruments are correlated with endogenous variables but uncorrelated with error terms, ensuring consistent estimates. Diagnostic tests, including Durbin and Wu-Hausman, confirm endogeneity, while Sargan and Basmann tests validate instrument exogeneity. First-stage F-statistics assess instrument strength, ensuring robustness and reliability of the results.

4.0. Results' Presentation and Discussion of Findings

4.1. Unit Root Test

Table 4.1 presents the results of the Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) unit root tests used to examine the stationarity properties of the variables.

Table 4.1: Unit Root Test Results

Variable	ADF	ADF_{1st}	Order	PP	PP_{1st}	Order
RGDPG	-2.7565*** (0.0676)	-	I(0)	-2.6436* (0.0869)	-	I(0)
AIDI	-2.1109 (0.5316)	-2.6928*** (0.0098)	I(1)	-0.0115 (0.9542)	-2.8238*** (0.0195)	I(1)
HCDI	-1.5555 (0.5021)	-3.6199* (0.0000)	I(1)	-0.5156 (0.8833)	-4.8076* (0.0000)	I(1)
INSTQI	-3.2895** (0.0185)	-	I(0)	-2.3941 (0.1365)	-3.4978* (0.0007)	I(1)
INFL	-3.8167** (0.0222)	-	I(0)	-2.1849 (0.2128)	-3.5616* (0.0079)	I(1)
GEXP	-0.5209 (0.8816)	-3.7097* (0.0053)	I(1)	-0.1004 (0.9644)	-3.4022* (0.0131)	I(1)
LABF	0.09065 (0.9639)	-3.0682** (0.0316)	I(1)	1.8194 (1.0000)	-3.4782* (0.0006)	I(1)
DCPS	-2.7504* (0.0685)	-	I(0)	-2.0785 (0.2537)	-3.9317* (0.0024)	I(1)
POPG	-1.3282 (0.6151)	-3.9397 (0.000)	I(1)	-2.0012* (0.9965)	-4.0988* (0.0000)	I(1)

*Notes: *, ** and *** denote significant at 1%, 5% and 10% levels respectively. Figures in parenthesis denote p-values.*

Source: Researchers' computation, 2025

The findings from the ADF and PP unit root tests demonstrate that the variables exhibit mixed integration orders, specifically I(0) and I(1), with no variables showing integration of order two, I(2). In particular, the ADF results indicate that the Real Gross Domestic Product Growth Rate (RGDPG), Institutional Quality Index (INSTQI), Inflation Rate (INFL), and Domestic Credit to the Private Sector (DCPS) are stationary at their levels, signifying that they are integrated of order zero, I(0). Conversely, the Aggregate Infrastructure Development Index (AIDI), Human Capital Development Index (HCDI), Government Expenditure (GEXP), Labour Force Participation Rate (LABF), and Population Growth Rate (POPG) achieve stationarity following first differencing, which suggests they are integrated of order one, I(1). Likewise, the PP test corroborates that RGDPG is stationary at level, while AIDI, HCDI, INSTQI, INFL, GEXP, LABF, DCPS, and POPG reach stationarity after first differencing, thus categorizing them as integrated of order one. In summary, both tests affirm the absence of I(2) variables and confirm the presence of a combination of I(0) and I(1) series, thereby alleviating concerns related to higher-order integration that could undermine the estimation process. Moreover, while the unit root tests reveal a combination of I(0) and I(1) variables, the lack of cointegration testing is not a significant issue for this research. This is due to the fact that

the main aim of the analysis is not to determine a long-term equilibrium relationship, but rather to investigate the simultaneous and interrelated dynamics among the variables. As a result, the application of the SEM-2SLS framework remains suitable for fulfilling the study's objectives, provided that the diagnostic assessments for endogeneity, instrument validity, and instrument strength are adequately met.

4.2 The Moderating Role of Institutional Quality in the Infrastructure–Human Capital–Growth Nexus

The result of the moderating role is presented in Table 4.2.

Table 4.2: 2SLS Regression Results on the Moderating Role of Institutional Quality in the Infrastructure–Human Capital–Growth Nexus

Variable	Coefficient (B)	Std. Error	z	p-value
Infrastructural Development (AIDI)	-6.142483*	3.308374	-1.86	0.063
Human Capital Index (HCDI)	73.67989***	32.51907	2.27	0.023
Institutional Quality*AIDI (INSTQI*AIDI)	-0.7514485**	0.3200345	-2.35	0.019
Institutional Quality*HCDI (INSTQI*HCDI)	11.28573***	4.841216	2.33	0.020
Inflation (INF)	0.5484433	0.4097990	1.34	0.181
Government Expenditure (LNGEXP)	7.527066	7.731795	0.97	0.330
Labour Force (LNLABF)	-267.206*	128.8843	-2.07	0.038
Domestic Credit (LNDCPS)	9.873321***	3.857853	2.56	0.010
Population Growth (POPG)	31.1587***	9.397955	3.31	0.001
Constant	4620.473**	2263.053	2.04	0.041
Model Statistics				
R-squared:	0.7997			
Wald $chi^2(9)$:	244.44 ($p < 0.001$)			
Root MSE:	0.98691			
Sargan (score) $\chi^2(1)$	5.4650 ($p = 0.1407$)			
Basmann $\chi^2(1)$	4.5606 ($p = 0.2069$)			
Durbin (score) $\chi^2(5)$	18.729 ($p = 0.0009$)			
Wu-Hausman F(5, 33)	5.3684 ($p = 0.0016$)			
*Note: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$*				

Source: Researchers' computation 2025

The model exhibits strong explanatory power, as reflected by an R-squared value of 0.7997, indicating that approximately 80 percent of the variation in economic growth is explained by the included regressors. The Wald chi-square statistic of 244.44 ($p < 0.001$) confirms the joint statistical significance of the explanatory variables, while the root mean square error (0.9869) suggests a satisfactory model fit. Collectively, these diagnostic indicators affirm the robustness of the model and the reliability of the estimated coefficients.

The coefficient of infrastructural development (AIDI) is negative and marginally significant at the 10 percent level (–6.1425, p = 0.063). This finding deviates from conventional expectations that infrastructure promotes economic activity by facilitating production and trade. The negative sign may reflect inefficiencies in infrastructure provision in Nigeria, including cost overruns, poor maintenance, and misallocation of resources driven by weak institutional oversight. As a result, infrastructure investment may impose fiscal and economic costs that outweigh its potential benefits, particularly in an environment characterized by governance challenges.

In contrast, human capital development (HCDI) exhibits a positive and statistically significant effect at the 5 percent level (73.6799, p = 0.023), indicating that investments in education, health, and skills acquisition play a critical role in driving economic growth. The magnitude of this coefficient suggests that improvements in human capital generate substantial productivity gains, enhance innovation, and strengthen the adaptive capacity of the workforce.

The interaction terms provide further insight into the moderating role of institutional quality. The coefficient for the interaction between institutional quality and infrastructure (INSTQI*AIDI) is negative and statistically significant (–0.7514, p = 0.019). This suggests that institutional quality does not enhance, but rather constrains, the growth impact of infrastructure. This outcome may indicate that existing institutional frameworks are insufficiently effective in addressing inefficiencies and rent-seeking behaviours in infrastructure provision, thereby limiting its contribution to growth.

Conversely, the interaction between institutional quality and human capital development (INSTQI*HCDI) is positive and statistically significant (11.2857, p = 0.020). This finding implies that improvements in institutional quality strengthen the growth-enhancing effects of human capital. Effective governance structures, policy consistency, and accountability mechanisms appear to facilitate the translation of investments in education and health into improved labour productivity and economic performance.

Regarding the control variables, inflation (INF) has a positive but statistically insignificant effect (0.5484, p = 0.181), indicating no systematic influence on growth during the study period. Government expenditure (LNGEXP) is also positive but insignificant (7.5271, p = 0.330), suggesting that public spending has not consistently translated into growth, possibly due to inefficiencies in allocation. The labour force

(LNLABF) shows a negative and significant effect at the 10 percent level (–267.206, p = 0.038), reflecting structural challenges such as unemployment, underemployment, and skills mismatch. Domestic credit to the private sector (LNDCPS) is positive and statistically significant (9.8733, p = 0.010), highlighting the importance of financial sector development in supporting economic growth. Population growth (POPG) is also positive and highly significant (31.1587, p = 0.001), indicating that demographic expansion contributes to growth, although this effect depends on the capacity of the economy to absorb the growing population productively.

The results reveal a structural imbalance in Nigeria's growth process. While human capital development, supported by institutional quality, emerges as a consistent driver of growth, infrastructural development appears to have a counterproductive effect under weak institutional conditions. This underscores the importance of strengthening institutional frameworks to enhance the efficiency of infrastructure investment. The findings suggest that sustainable economic growth in Nigeria depends not only on increasing investments in infrastructure and human capital but also on improving governance structures to ensure that such investments yield optimal outcomes.

The Sargan test reports a chi-square statistic of 5.4650 (p = 0.1407), while the Basmann test yields a chi-square value of 4.5606 (p = 0.2069). Given that both p-values are above the conventional 5% significance level, the null hypothesis of instrument validity cannot be rejected. This suggests that the instruments are exogenous and correctly excluded from the structural model. The agreement between the Sargan and Basmann test outcomes further strengthens confidence in the validity of the instruments, indicating that they affect economic growth only through the included endogenous variables rather than through other channels.

The Durbin test produces a chi-square statistic of 18.729 (p = 0.0009), while the Wu-Hausman test yields an F-statistic of 5.3684 (p = 0.0016). Both statistics are significant at the 1% level, leading to the rejection of the null hypothesis of exogeneity. This implies that AIDI, HCDI, and their interaction terms with institutional quality are endogenous, possibly due to simultaneity or omitted variable bias.

Table 4.3: Weak Instrument Diagnostics

Variable	R-sq.	Adjusted R-sq.	Partial R-sq.	F(6,38)	Prob > F
Id	0.9997	0.9996	0.9802	213.636	0.0000
HCI	0.9997	0.9996	0.9348	83.9448	0.0000
INSTQ*AIDI	0.994	0.9978	0.9852	187.987	0.0000
INSTQ*HCDI	0.9849	0.9801	0.7955	21.3671	0.0000

Source: Researchers' computation, 2025

For AIDI, the first-stage F-statistic is 213.636 ($p < 0.001$) with a partial R^2 of 0.9802; for HCDI, the F-statistic is 83.9448 ($p < 0.001$) with a partial R^2 of 0.9348; for the interaction term (INSTQAIDI), the F-statistic is 187.987 ($p < 0.001$) with a partial R^2 of 0.9852; and for (INSTQHCDI), the F-statistic is 21.3671 ($p < 0.001$) with a partial R^2 of 0.7955. In all cases, the F-statistics far exceed the conventional threshold of 10, indicating that the instruments are strong and sufficiently relevant in explaining variations in the endogenous variables. The consistently high R^2 and adjusted R^2 values across the first-stage regressions further underscore the strong explanatory power of the instruments. Although the interaction term (INSTQ*HCDI) shows relatively lower explanatory strength, its F-statistic still surpasses the rule-of-thumb benchmark, confirming that the instruments remain adequately strong.

The diagnostic tests support the robustness of the 2SLS estimation technique employed. The Sargan and Basmann test also confirmed instrument exogeneity, while the Durbin and Wu-Hausman tests establish the presence of endogeneity. Additionally, the weak instrument diagnostics demonstrated that the instruments are both strong and relevant. These results validate the econometric reliability of the model and strengthen confidence in the 2SLS estimates used to assess the moderating role of institutional quality in the relationship between infrastructural development, human capital development, and economic growth in Nigeria.

4.3. Discussion of Findings

The observation that infrastructural development fosters human capital development aligns with previous studies conducted in Nigeria and across various countries, including Olagunju et al. (2017), Sapkota (2014), and Acheampong et al. (2022). These studies contend that enhanced access to electricity, transportation, healthcare services, and information technology significantly improves educational outcomes and health metrics. Furthermore, the beneficial role of human capital development in driving economic

growth is supported by the findings of Adelakun (2011), Eigbiremolen and Anaduaka (2014), and Keji (2021), who recognized education and health investments as essential components for boosting productivity and economic expansion in Nigeria. In contrast, the adverse impact of infrastructural development on economic growth stands in opposition to the positive growth effects documented by Nedozi et al. (2014), Owolabi-Merus (2015), and Ogbaro and Omotoso (2017). This discrepancy may be attributed to the unique circumstances in Nigeria, where significant investments in infrastructure have frequently been compromised by issues such as project abandonment, budget overruns, insufficient maintenance, corruption, and ineffective oversight. As a result, expenditures on infrastructure do not consistently yield productive assets that can invigorate economic activities. Thus, this finding reinforces the arguments presented by Aworinde and Akintoye (2019), which assert that the impact of infrastructure on growth is contingent not only on the amount of investment but also on the effectiveness and quality of its execution.

The beneficial interaction between infrastructure and human capital reinforces the complementary relationship articulated by Tsaurai and Ndou (2019) as well as Nchofoung et al. (2022). This relationship posits that infrastructure can yield enhanced economic advantages when it is bolstered by a skilled and healthy workforce. Crucially, the moderating influence of institutional quality underscores the challenges faced by the Nigerian economy, where governance issues persistently affect developmental outcomes. The adverse interaction between institutional quality and infrastructure indicates that deficiencies in public institutions such as corruption, regulatory inefficiencies, and inadequate accountability mechanisms, diminish the efficacy of infrastructure investments. Conversely, the positive interaction between institutional quality and human capital suggests that enhancements in governance can increase the returns on investments in education and health. These observations align with the institutional economics framework proposed by North (1990), which asserts that institutions play a pivotal role in determining the efficiency of resource allocation and utilization within an economy. Furthermore, they support the tenets of endogenous growth theory, which regards human capital as a crucial driver of sustained economic growth while acknowledging that its productivity is contingent upon the surrounding institutional context. Consequently, the findings indicate that mere investments in infrastructure and human capital may not suffice to foster sustainable growth unless they are complemented by robust institutional

Science, *21*(3), 1–7. https://doi.org/10.9790/0837-2103040107

Agwu, N., & Ukakwu, A. (2019). Beyond oil: The imperative for diversification of the Nigeria economy. *International Journal*, *6*(1), 1 – 12.

African Development Bank Group. (2023). *Nigeria economic outlook*. https://www.afdb.org/en/countries-west-africa-nigeria/nigeria-economic-outlook

Anochiwa, L. I., & Maduka, A. (2014). Human capital, infrastructure and economic growth in Nigeria: An empirical evidence. *IOSR Journal of Electrical and Electronics Engineering*, *9*(4), 1–6. https://doi.org/10.9790/1676-09410106

Anyanwu, S. O., Adam, J. A., Obi, B., & Yelwa, M. (2015). Human capital development and economic growth in Nigeria. *Journal of Economics and Sustainable Development*, *6*(14), 16 – 26.

Aslam, A. (2020). The hotly debated of human capital and economic growth: Why institutions may matter? *Quality & Quantity*, *54*(4), 1351–1362. https://doi.org/10.1007/s11135-020-00989-6

Aworinde, O. B., & Akintoye, I. R. (2019). Institutions, infrastructure and economic growth in Nigeria. *Acta Universitatis Danubius. Œconomica, 15*(3), 145 – 162.

Barro, R. J. (1991). Economic growth in a cross section of countries. *The Quarterly Journal of Economics*, *106*(2), 407–443. https://doi.org/10.2307/2937943

Becker, G. S. (1964). *Human capital: A theoretical and empirical analysis, with special reference to education*. University of Chicago Press.

Bennee, E., Okoye, P. V., & Amahalu, N. N. (2021). Infrastructural development and economic growth of Nigeria. *African Journal of Business and Economic Development*, *1*(6), 52–69.

Effiom, L., & Okoi, O. B. (2018). Human capital, technological development, infrastructure, and manufacturing subsector performance in Nigeria. *International Journal of Economics, Commerce & Management*, *6*(7), 203–231.

Eigbiremolen, G. O., & Anaduaka, U. S. (2014). Human capital development and economic growth: The Nigeria experience. *International Journal of Academic Research in Business and Social Sciences*, *4*(4), 25–35. https://doi.org/10.6007/IJARBSS/v4-i4/749

Ekpung, E. G. (2014). Trends analysis of public expenditure on infrastructure and economic growth in Nigeria. *International Journal of Asian Social Science*, *4*(4), 480 – 491.

Emovon, I., Samuel, O. D., Mgbemena, C. O., & Adeyeri, M. K. (2018). Electric power generation crisis in Nigeria: A review of causes and solutions. *International Journal of Integrated Engineering*, *10*(1), 1–12. https://doi.org/10.30880/ijie.2018.10.01.008

Enilolobo, O. S., & Sodeinde, O. (2019). Human capital development, infrastructural development and industrial sector productivity in Nigeria. *Archives of Business Research*, *7*(1), 1–14.

https://doi.org/10.14738/abr.71.6048

Faggian, A., Modrego, F., & McCann, P. (2019). Human capital and regional development. In *Handbook of regional growth and development theories* (pp. 149–171). Edward Elgar Publishing. https://doi.org/10.4337/9781788970020.00014

Fatai, O. O., Omolara, Y. J., & Taiwo, A. B. (2016). Infrastructure finance and development in Nigeria. *Nigerian Chapter of Arabian Journal of Business and Management Review, 62*(3414), 1 – 11.

Funlayo, A. K., Jeremiah, O. O., & Thomas, A. K. O. D. E. (2022). Impact of infrastructure and institutional quality on economic growth in ECOWAS countries. *International Journal of Social Sciences Perspectives, 10*(1), 9–16. https://doi.org/10.33094/7.2017.2022.101.9.16

International Monetary Fund. (2019). *Building institutions for resilience and prosperity*. IMF Policy Paper. Washington, DC: International Monetary Fund.

Jia, H., Han, X., Aderemi, T. A., Ifekwem, N. E., & Al-Faryan, M. A. S. (2025). Out-of-pocket expenditure and human welfare in Nigeria: Evidence from a fully modified ordinary least squares regression. *African Journal of Reproductive Health, 29*(2), 151–159. https://doi.org/10.29063/ajrh2025/v29i2.12

Keji, S. A. (2021). Human capital and economic growth in Nigeria. *Future Business Journal, 7*(1), 49. https://doi.org/10.1186/s43093-021-00105-8

Khan, M. T. I., Anwar, S., Sarkodie, S. A., Yaseen, M. R., & Nadeem, A. M. (2023). Do natural disasters affect economic growth? The role of human capital, foreign direct investment, and infrastructure dynamics. *Heliyon, 9*(1), e12709. https://doi.org/10.1016/j.heliyon.2022.e12709

Mohanty, A. K., Nayak, N. C., & Chatterjee, B. (2016). Does infrastructure affect human development? Evidences from Odisha, India. *Journal of Infrastructure Development, 8*(1), 1–26. https://doi.org/10.1177/0974930616645907

National Bureau of Statistics. (2023). *Nigeria Gross Domestic Product Q2 2023*. https://nigerianstat.gov.ng/elibrary/read/1241369

Nchofoung, T. N., Asongu, S. A., Njamen Kengdo, A. A., & Achuo, E. D. (2022). Linear and non-linear effects of infrastructures on inclusive human development in Africa. *African Development Review, 34*(1), 81–96. https://doi.org/10.1111/1467-8268.12624

Nedozi, F. O., Obasanmi, J. O., & Ighata, J. A. (2014). Infrastructural development and economic growth in Nigeria: Using simultaneous equation. *Journal of Economics, 5*(3), 325–332. https://doi.org/10.1080/09765239.2014.11885006

Nwanze, K. F. (2019). Nigeria's population may exceed 400 million by 2050: Risks and opportunities [Keynote address]. *Fayode.* https://www.fayode.org/speech/nigeria-400-million-people-2050-risks-and-opportunities-keynote-address-kanayo-f-nwanze-phd

Nwokoye. E.S, Onugha C.B. & Kalu C.U. (2020) Drivers of human Capital development: Evidence from Nigeria. Tunisora Journal of Economics and Business 13 (1), 15 – 30.

Ogbaro, E. O., & Omotoso, D. C. (2017). The impact of infrastructure development on economic growth in Nigeria. *Nigerian Journal of Management Sciences, 6*(1), 1 – 12.

Ogbebor, T. O., & Ashakah, F. O. (2021). Access to electricity and economic growth in Sub-Saharan Africa: Is there an energy-growth nexus. *Journal of Economics and Allied Research, 6*(1), 103 – 119.

Ogunjobi, J. O., Eseyin, O., & Popoola, O. R. (2021). Human capital and energy infrastructure: Implications for economic growth in Nigeria. *International Journal of Energy Economics and Policy, 11*(3), 149–154. https://doi.org/10.32479/ijeep.11037

Okunade, S. O., Alimi, A. S., & Olayiwola, A. S. (2022). Do human capital development and globalization matter for productivity growth? New evidence from Africa. *Social Sciences & Humanities Open, 6*(1), 100291. https://doi.org/10.1016/j.ssaho.2022.100291

Olagunju, K., Neszmelyi, G., Oguntegbe, K., Nikola, T., & Ogunniyi, A. (2017). Welfare impact of rural infrastructural development in Oyo State, Nigeria. *Asian Journal of Agricultural Extension, Economics & Sociology, 17*(2), 1–13. https://doi.org/10.9734/AJAEES/2017/33336

Onokala, P. C., & Olajide, C. J. (2020). Problems and challenges facing the Nigerian transportation system which affect their contribution to the economic development of the country in the 21st century. *Transportation Research Procedia, 48*, 2945–2962. https://doi.org/10.1016/j.trpro.2020.08.188

Owolabi-Merus, O. (2015). Infrastructure development and economic growth nexus in Nigeria. *International Journal of Academic Research in Business and Social Sciences, 5*(1), 376–382. https://doi.org/10.6007/IJARBSS/v5-i1/1430

Reuters**.** (2025, February 25). *Nigeria's economy grows fastest in three years in fourth quarter*. Reuters. https://www.reuters.com/world/africa/nigerias-economy-grows-fastest-three-years-fourth-quarter-2025-02-25/

Reuters**.** (2025, May 12). *Nigeria's economy grows strongly amid high inflation, World Bank says*. Reuters. https://www.reuters.com/world/africa/nigerias-economy-grows-strongly-amid-high-inflation-world-bank-says-2025-05-12/

Romer, P. M. (1990). Endogenous technological change. *Journal of Political Economy, 98*(5, Part 2), S71–S102. https://doi.org/10.1086/261725

Sankay, O. J., Ismail, R., & Shaari, A. H. (2010). The impact of human capital development on the economic growth of Nigeria. *Prosiding Perkem, 5*(1), 63 – 72.

Sapkota, J. B. (2014). Access to infrastructure and human development: Cross-country evidence (No. 70). *JICA-RI Working Paper*. https://www.jica.go.jp/jica-

ri/publication/workingpaper/wp_70.html

Schultz, T. W. (1961). Investment in human capital. *The American Economic Review, 51*(1), 1–17. https://www.jstor.org/stable/1818907

Sindakis, S., Depeige, A., & Anoyrkati, E. (2015). Customer-centered knowledge management: Challenges and implications for knowledge-based innovation in the public transport sector. *Journal of Knowledge Management, 19*(3), 559–578. https://doi.org/10.1108/JKM-02-2015-0048

Siyan, P., & Adegoriola, A. E. (2017). An assessment of nexus between infrastructural development and Nigerian economic growth. *African Journal of Business Management, 11*(18), 470–477. https://doi.org/10.5897/AJBM2017.8337

Sturup, S., & Low, N. (2019). Sustainable development and mega infrastructure: An overview of the issues. *Journal of Mega Infrastructure & Sustainable Development, 1*(1), 8–26. https://doi.org/10.1080/24724718.2019.1649999

Theresa, U. O., Gloria, A. O., & Frank, E. U. (2025). Impact of export-related infrastructure development on Nigeria's economic diversification. *Journal of Architecture and Civil Engineering, 10*(3), 20–31.

Tran, N. P., & Vo, D. H. (2020). Human capital efficiency and firm performance across sectors in an emerging market. *Cogent Business & Management, 7*(1), 1738832. https://doi.org/10.1080/23311975.2020.1738832

Tsaurai, K., & Ndou, A. (2019). Infrastructure, human capital development and economic growth in transitional countries. *Comparative Economic Research. Central and Eastern Europe, 22*(1), 33–52. https://doi.org/10.2478/cer-2019-0003

Uddin, I., Ahmad, M., Ismailov, D., Balbaa, M. E., Akhmedov, A., Khasanov, S., & Haq, M. U. (2023). Enhancing institutional quality to boost economic development in developing nations: New insights from CS-ARDL approach. *Research in Globalization, 7*, 100137. https://doi.org/10.1016/j.resglo.2023.100137

UNESCO. (2023). *Nigeria: Education sector expenditure and institutional review.* https://unesdoc.unesco.org/ark:/48223/pf0000388733

World Bank. (2025). *Building momentum for inclusive growth: Nigeria Development Update*. World Bank Group. https://www.worldbank.org/en/news/press-release/2025/05/12/afw-nigeria-building-momentum-for-inclusive-growth

World Bank. (2024). *Worldwide Governance Indicators (WGI)*. Washington, DC: World Bank. Retrieved from https://info.worldbank.org/governance/wgi/

World Bank. (2024). *Maldives human capital review: Unleashing people's full potential.* https://www.worldbank.org/en/country/maldives/publication/maldives-human-capital-review-unleashing-people-s-full-potential

World Economics. (2024). *Age dependency ratio - Young: Nigeria*. https://www.worldeconomics.com/Demographics/Age-Dependency-Ratio-Young/Nigeria.aspx

World Bank. (2023). *Nigeria development update: Turning the corner*. https://www.worldbank.org/en/country/nigeria/publication/nigeria-development-update-ndu

World Bank. (2020). *Nigeria human capital index 2020*. Human Capital Project. https://databankfiles.worldbank.org/public/ddpext_download/hci/HCI_2pager_NGA.pdf

Zergawu, Y. Z., Walle, Y. M., & Giménez-Gómez, J. M. (2020). The joint impact of infrastructure and institutions on economic growth. *Journal of Institutional Economics, 16*(4), 481–502. https://doi.org/10.1017/S1744137420000016