Moderating Role of Institutional Quality on Human Capital Development - Poverty Reduction Nexus in Nigeria: Evidence from Cointegrating Regressions

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Abstract

At the forefront of the Sustainable Development Goals (SDGs) is the need to end poverty in all its forms by 2030. To achieve this, investment in human capital development (HCD) has been identified as a fundamental factor. In line with this, the present study seeks to investigate the economic benefit of HCD on poverty in Nigeria. The study also examines the moderating role of institutional quality in the relationship between HCD and poverty by employing the Bound test for cointegration and cointegrating regression techniques on annual data between 1990 and 2023. To complement the outcomes from the main analysis, the Granger causality test is performed on the target variables. The results from the Bound test confirm the existence of cointegration between HCD and poverty level in all the estimated models. The findings from the DOLS reveal that both education and health spending stimulate household consumption expenditure per capita and income per capita. The outcomes are consistent across different model specifications and robust to alternative estimation strategies. The findings imply that HCD reduces poverty rate suggesting that HCD is a strong driver of poverty reduction in Nigeria. Conversely, institutional quality plays a strong negative moderating role by dampening the reducing effect of HCD on poverty. This implies that the quality of the institution matters in the effectiveness of HCD on poverty reduction in Nigeria. The finding from the Ganger causality test reveals a unidirectional causality stemming from HCD components to the two indicators of poverty except for life expectancy rate and poverty metrics where a feedback causal effect is established. The study highlights key policy recommendations for Nigeria to attain the goal of poverty eradication by 2030.

Keywords: human capital index, life expectancy rate, income per capita, cointegrating regression

JEL: I32, O15

Introduction

Due to the failure of many countries, particularly those in sub-Saharan Africa, to significantly reduce poverty, world leaders re-examined the now-defunct Millennium Development Goals (MDGs) in 2015. Following the meeting, a new set of 17 goals known as the Sustainable Development Goals (SDGs) or Global Goals were established, to be achieved by 2030. Similar

to the MDGs, the major goal of the SDGs is poverty eradication (United Nations, 2017). Although poverty is perceived as a global challenge, it is predominant in sub–Saharan Africa and Asia. While some notable achievements in poverty reduction are recorded in some countries including China and India, sub-Saharan African countries including Nigeria are still battling with poverty (Olowookere et al., 2022). For instance, the percentage of people living beneath the poverty line in China plummeted from 77% in 1980 to 14% in 2001 and then 3.1% in 2017. However, as documented by Abdullahi (2019), almost 6 people fall into the poverty trap every day in Nigeria. Similarly, the World Poverty Clock (2019) documents that about 91 million Nigerians live in extreme poverty. The emergence of the global pandemic, COVID-19, in 2020 further worsened the severity of poverty in Nigeria as many people lost their jobs with attendant consequences on a rising number of people without access to the necessities of life. Factors responsible for high poverty rate in Nigeria include high level of inequality which leads to overconcentration of income in the hands of very few individuals, neglect of agriculture, conflict, and urbanization (Babasanya et al., 2018), others include corruption among the political office holders, absence of economic infrastructure, limited access to education and health (Adekoya, 2018; Olowookere et al., 2022)

Over the years, researchers and policymakers have sought to unearth the drivers of poverty, especially from the context of developing economies. However, one major factor that has garnered researchers' attention in the literature is human capital development (Ahmad et al., 2018; Komarudin, 2020; Wang et al., 2021). It is important to state that poverty does not only involve low income and consumption, it also encompasses the feeling of helplessness caused by a lack of

opportunity, empowerment, and security (Thirlwall, 2003). Lack of opportunity can be associated with limited access to various essential assets for living such as financial, natural, social, financial, and human assets. In this study, our attention is on human assets stemming from access to education and health. Human capital development (HCD), according to Touray (2017), is the process of enhancing an individual's capabilities, freedoms, and opportunities to enhance their well-being. In the empirical literature, investment in health and education is the bedrock of HCD (Keji, 2021; Sarwar et al., 2021; Villela & Paredes, 2022). When people are educated, their capacity is enhanced and this enables them to contribute immensely to economic activity. Premised on the notion that "a healthy population is a productive population", investment in health also provides a major avenue to promote human capital. In line with this, Ajide et al. (2024) identify health as the bedrock of sustainable HCD. Buttressing this assertion, several studies have associated the severity of poverty in developing countries with poor health status manifesting in the forms of high mortality rate, low life expectancy, and malnutrition among others (Wang et al., 2021; Abreha & Zereyesus, 2021; Ajide et al., 2024). Therefore, as documented by Arthur and Oaikhenan (2020) and Ajide et al., (2024), poor health precludes an individual quest for employment, mutilates productivity, and consequently perpetuates individual poverty. Hence, we argue in this study that the role of HCD is critical in achieving a noticeable and consistent reduction in poverty in Nigeria.

However, in the empirics, a critical search into the literature reveals that several studies have been conducted on HCD - the economic growth relationship (see, Karambakuwa et al., 2020; Sarwar et al., 2021; Villela & Paredes, 2022; Sultana et al., 2022;

Eniekezimene et al., 2023; Almutairi, 2024) with scant studies HCD – poverty nexus. These studies conclude that sufficient investment in HCD delivers sustained economic growth. On the other hand, scholars such as Adekoya (2018) and Olowookere et al., (2022) support the importance of HCD in decelerating the poverty rate in an economy. Following this, Babasanya et al. (2018) link the slow pace of economic growth (by extension, high poverty incidence) in developing economies to limited access to education. In essence, the author hints that: "no illiterate society has been known to progress far in the modern world, also there is no educated society with initiative and leadership that remained backward". Literacy and education can therefore affect economic growth and by extension, poverty (Olowookere et al., 2022). However, one major weakness identified with the prior studies on HCD-poverty nexus is their failure to consider the channels through which the impact of HCD is transmitted to the poverty level. The beneficial or worsening effect of HCD on poverty can be attributed to several factors, which must be taken into consideration to unravel the impact of the former on the latter accurately. Based on this, the present study identifies institutional quality as a critical channel in the HCD-poverty nexus by delving into the moderating role of institutional quality (INS) in the intricate between HDC and poverty in Nigeria.

As documented by North (1990), Acemoglu et al. (2001), and Aracil *et al*. (2022), the quality of institutions in an economy matters in the determination of economic outcomes such as poverty reduction. The role of institutions in HCD – poverty nexus is crucial, especially from the context of sub-Saharan African countries like Nigeria where the quality of the institutions is perceived to be weak. The weak institution promotes corruption and encourages the diversion of productive resources from human capital development-related activities to the nonproductive sector, which in turn perpetuates poverty. Along this line, scholars such as Kouadio and Gakpa (2022) identify institutional failure as the root cause of poverty. With sound and efficient institutions, investment in human capital development especially in the areas of education and health can be enhanced. In the same way, Grindle (2004) and Aracil *et al*. (2022) hint that strong institutions enhance the effectiveness and efficiency of government expenditure. With adequate investment in human capital in a good institutional environment, individuals are equipped to contribute significantly to the nation's productivity and hence reduce poverty in the economy. Besides, Ouedraogo *et al*. (2022) note that the returns on investment in human capital are higher in a country with a sound institutional environment. Despite the importance of institutional quality on societal welfare, existing, studies have only focused on HCD – INS - economic growth nexus (Adams-Kane & Lim, 2016; Glawe & Wagner, 2020; Islam & Shindaini, 2022; Ofori et al., 2024; Esharif & Abida, 2025), INS and HCD relationship (Ouedraogo et al., 2022; Githaiga & Kilong'i, 2023) and INS and poverty linkage (Gaiha & Imai, 2008; Fagbemi et al., 2020; Singh, 2021; Ahmed et al., 2023). Specific studies that explore the joint or combined effect of INS and HCD on poverty using Nigerian data are scant. To our knowledge, apart from the study by Ayoade *et al*. (2023), no known study has explored the connection between HCD, INS and poverty in Nigeria. To bridge this lacuna, we identify the quality of institutions as a fundamental channel through which human capital development influences poverty in Nigeria. Thus, in this study, we argue that the impact of HCD on poverty can be moderated

by the degree of institutional quality in an economy.

Therefore, this study adds to HCD–poverty literature in the following ways. First, unlike the previous studies that employed a single measure of poverty such as per capita income (PCI) (see Chikelu, 2016, Adekoya, 2018; Olowookere et al., 2022; Gajure, 2023) and poverty headcount using the proportion of population living within $1 or $1.25 per day (Huay, & Bani, 2018; Sirag & Mohamed Nor, 2021; Azizi, 2021; Khan et al. 2022), the present study utilizes both income and expenditure approaches to proxy poverty. In developing countries, Nigeria inclusive, there is a dearth of consistent time series data on poverty headcounts, which limits the utilization of the variable as an indicator of poverty in country-specific studies. Furthermore, the PCI alone does not consider other dimensions of poverty such as health, or access to necessities of life. As argued in the literature, household consumption expenditure per capita (HCE) is more stable than income (Ogun, 2010; Oladipo and Olomola, 2015, Ojeyinka, 2018, Akinlo & Dada, 2021; Olaniyi & Dada, 2023). Therefore, in addition to PCI, we employ HCE as another poverty indicator. Besides, the adoption of HCE is in line with the recommendation of the World Bank which defines poverty as "the inability to reach the subsistence level of life" (World Bank, 1990). Second, while the influence of HCD on poverty has been sufficiently studied in the literature, the moderating role of INS in the relationship between the focal variables is relatively underexplored. The present study makes a fresh contribution to the body of knowledge by unraveling the role of INS as a channel in the interplay between HCD and poverty in the most populous nation in Africa. Third, a stream of studies on HCD - poverty nexus assumes that causality only runs from human capital development to

poverty without considering the possibility of a feedback effect between the two variables. The present study argues that poverty in an economy can influence HCD. For instance, the poor will lack access to good health care and may lack access to quality education which will in turn affect HCD. Therefore, the study addresses a major lacuna in the literature by unraveling the possibility of a feedback causal effect in the nexus between HCD and poverty in Nigeria. Fourth, the study focuses on Nigeria due to its peculiar attributes, especially its population and economic activity. For instance, Nigeria is the largest country in Africa based on its population strength and gross domestic product (GDP). For example, as of 2023, the Country accounts for 18% of the population of the sub-Saharan African (SSA) countries and 27.6% of the SSA's GDP (World Development Indicators, 2024). Besides, the country is blessed with a teeming youth population, which can be leveraged to deliver sustained economic progress. Specifically, the working-age population (age 15 – 64 years) in Nigeria accounts for 55.48% of the total population in 2023 (World Development Indicators, 2024). Over the years, the country has increased its expenditure on health and education as displayed in Figure 1 as indicated by a consistent rise in the two components of government expenditure. Despite this, the country is tagged the world capital of poverty (World Poverty Clock, 2018) where 4 out of every 10 Nigerians live below the poverty line (National Bureau of Statistics, 2020) with more than 6 Nigerians becoming impoverished every minute (WEF, 2019). Similarly, the country's performance in the metrics of institutional quality is low with an average institutional quality of 4.1 on the ordinal scale of 0.0 to 10.0 (ICRG, 2022). Given this paradoxical relationship, the major question addressed by the current study is whether the effect of health and education

expenditure on poverty is determined by the quality of institutions in the country. Given this background, the country provides a good platform to examine the intricacies of HCD, INS and poverty.

The layout of this study is in the following order. Following the introductory section, section 2 provides evidence from prior studies; model specification and estimation techniques are discussed in section 3. Section 4 contains data analysis and discussion of results while section 5 concludes the study.
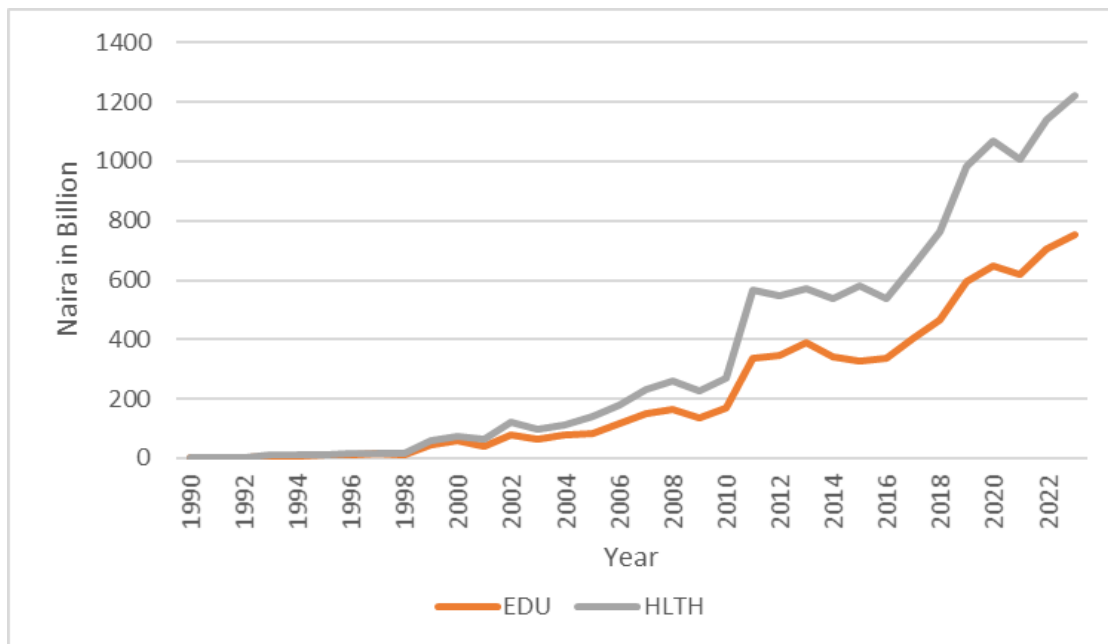

Figure 1: Trends of government expenditure on health and education in Nigeria (1990 – 2023)

Prior evidence

Delving into the empirics, substantial attention has been devoted to the economic impact of HCD on economic growth especially in the context of developing countries (see Keji, 2021; Bawono, 2021, Sarwar et al., 2021; Mohamed, 2022; Aghaei et al., 2023 among others). These studies identify investment in HCD as a potent weapon to herald sustained economic growth. Beyond the growth impact of HCD, its potential role on poverty in less developed countries, and most especially in Nigeria, has also been investigated (Chikelu, 2016; Ewubare et al., 2018; Olopade et al., 2019; Tsaurai, 2020; Olowookere et al., 2022). However, limited efforts have been made to unearth the effect of HCD on poverty,

although with inconclusive findings. For instance, Chikelu (2016) applies the ordinary least squares (OLS) approach to explore the influence of HCD (school enrolment) on poverty proxy with per capita income using Nigerian data between 1986 and 2012 and finds that HCD spurs poverty reduction. On the other hand, scholars such as Adekoya (2018) and Obayori and Udeorah (2018) employ public expenditure on health and education as HCD indicators and confirm a positive association between the two components of HCD and PCI implying that investment in human capital encourages poverty reduction. Their outcomes align with the finding of Chimoba (2010) who identifies government education spending as a robust driver of poverty reduction in Nigeria.

Asaju (2012) employs narrative analysis to examine the association between HCD and poverty alleviation in Nigeria. The author identifies HCD as a necessary condition to accelerate poverty reduction in Nigeria. Still, on the Nigerian economy, Adeyemi *et al.* (2018) examine the interplay between HCD and poverty between 1990 and 2017 in the context of the Sustainable Development Goals (SDGs). Empirical findings from the study show a favourable effect of government education expenditure on poverty. However, the authors discover that government health expenditure worsens poverty. Recently, Abdulrahman (2022) employed government education expenditure and life expectancy rate as HCD metrics and gauged their influence on poverty (proxy by misery index). Using the Bound test and the ARDL technique, the author finds that while education spending dramatically lowers poverty, a longer life expectancy is associated with a rise in the poverty level. Similarly, Olowookere *et al*. (2022) employed FMOLS and the Granger causality test to examine the implication of HCD in achieving the SDG's first goal of poverty reduction in Nigeria. The study reveals that government health expenditure promotes poverty reduction while the effect of education expenditure on poverty is inconsequential. The findings of the causality test indicate a unidirectional causal relationship between government health spending and the poverty indicator but no causal relationship between education spending and the poverty rate.

Using per capita income as a poverty metric, Omede and Adamu (2018) explore the linkage between HCD (using life expectancy and school enrolment) and poverty level in Nigeria. The study documents a positive association between life expectancy rate and per capita income signaling that an increase in life expectancy rate diminishes the incidence of poverty. However, the study also finds a negative correlation between per capita income and school enrolment rate. This result is in tandem with that of Orajaka and Okoli (2018) who assert that government expenditure on health and education significantly contributes to poverty reduction in Nigeria. Johnson et al. (2022) apply the Johansen Cointegration test, Granger causality test and FMOLS to analyse the effect of public investment in health and education on poverty in Nigeria toward achieving the SDGs. Results from the study reveal that HCD components reduce poverty in Nigeria with health expenditure and capital formation being statistically significant. This implies a trickle-down effect of health expenditures and capital formation on poverty reduction.

Using the National Poverty (NPI) Index, Anigboro (2024) recently investigated the connection between disaggregated health and education expenditure on poverty in Nigeria. Employing the Bound test for cointegration and ARDL approach, findings from the study reveal that all the components of HCD increase NPI except for the recurrent health expenditure, which is found to lower the NPI. In another study, Gajurel (2023) examines the nexus between HC and poverty in Nepal using the VECM and finds that health spending and secondary school enrolment are important in curbing the poverty rate while education spending is associated with lower per capita income. Besides the country-specific study, some authors focus on the intricate between the target variables in a panel framework. Along this line, Olopade *et al*. (2019) examine the direct and joint effect of HCD components (government health and education expenditure on the poverty level among the OPEC member countries. Using the cointegrating regression approach from the standpoint of fully modified OLS (FMOLS), the study reveals that human capital components accelerate poverty reduction among the studied countries.

Focusing on African countries, Josephine *et al.* (2021) reinforce the poverty-mitigating effect of human capital in African countries. The authors identify access to universal pre-tertiary education as a major weapon to combat poverty in Africa.

As argued in the preceding section, there is a plethora of studies on the trilogy among human capital development, institutional quality and economic growth. For example, Glawe & Wagner (2020) investigate the role of INS in the nexus between HCD and economic growth of Chinese provinces. Employing the system GMM technique, the authors find that human capital strongly influences per capita income while institutional quality hurts economic growth. Focusing on Bangladesh's economy, Islam and Shindaini (2022) apply the ARDL approach to examine the association among HCD, INS, and economic growth. Findings from the study reveal that institutional quality, and government expenditure on health and education have a positive long-run impact on economic growth. Besides, the outcome from the causality approach shows a bidirectional relationship between INS and economic growth in Bangladesh. Recently, the study of Ofori *et al.* (2024) examined the nexus between HCD, INS and inclusive growth among 43 African countries using the system GMM as a technique of analysis. Empirical outcomes from the study explicate that HCD promotes inclusive growth in Africa. However, the authors discover that INS variables in the selected African countries mitigate the positive effect of human capital on inclusive growth suggesting that institutional quality plays a negative moderating role in the nexus between the target variables. Still on the African countries, Esharif and Abida (2025) concentrate on four (4) MENA countries namely, Tunisia, Morocco, Algeria, and Egypt and examine the intricacies among HCD, INS and economic growth. Employing

the system GMM approach, the authors find that INS and HCD interact positively to spur economic growth in the MENA region. Meanwhile, the outcome of the scholarly work by Uddin *et al*. (2021) on 120 developing economies finds that political institutions and human capital variables interact in a negative way to limit economic growth.

Meanwhile, a fringe of studies have considered the combined and joint effect of HCD and INS on poverty. Focusing on the Nigerian economy, Ayoade *et al*. (2023) explore the joint effect of INS and human capital on poverty in Nigeria. Using annual data between 1981 and 2020 with the ARDL technique, the study discovers that institutional quality fails to moderate the influence of human capital on poverty. However, the study fails to substantiate the outcomes with robustness and sensitivity analysis, which might affect the credibility and reliability of the estimates. Besides, the diagnostic tests conducted by the author suggest that the results suffer from serial correlation and heteroscedasticity pitfalls, which have significant implications for the outcomes. Lastly, the study of Ayoade *et al.* (2023) ignores some important control variables that can potentially influence the relationship between human capital and poverty in Nigeria. Hence, there is a need to reexamine the economic benefit of good institutions in the interplay between HCD and poverty in Nigeria. In summary, the review above reveals that most of the studies on HCD - poverty nexus employ per capita income (PCI) to proxy poverty. For the robustness of the study's outcome, the study employs both the income and expenditure approach to proxy poverty. Again, the study also contributes to existing knowledge on HCD – poverty by focusing on the importance of institutional quality as a channel through which poverty responds to human capital development. Lastly, the study

accounts for the influence of control variables such as trade openness, financial development, and inflation and explores their effect on the target variable.

Methods

Theoretical foundation

The study employs human capital theory (HCT) proposed by Schultz (1961) as the theoretical foundation to examine the intricate between HCD, INS and poverty in Nigeria. Schultz's theory centers on the argument that education, training and investments in health enhance the opportunities and choices available to individuals. The HCT is premised on the notion that adequate investment in human capital improves individual efficiency (Adekoya, 2018). The progenitor of the HCT further contends that investment in education enhances an individual's cognitive skills and consequently leads to higher productivity. In line with this, Schultz argues that the divergence in income between people is conditioned on their access to health and education. Hence, the proponent of the HCT theory emphasises the importance of education and health investment as a potent weapon to fight poverty, especially in developing economies such as Nigeria.

Model specification

In line with the human capital theory, the study aligns with the modeling style of Adekoya (2018) and Olopade et al., (2019) and specifies poverty level as a function of human capital development as follows:

$$POV_t = f(HCD, Z) \tag{1}$$

Where POV is a measure of poverty which consists of income per capita (PCI) and household consumption expenditure per capita (HCE).

HCD represents human capital development variables such as government expenditure on education (EDU) and government expenditure on health. This is in line with prior studies on human capital development (see Ewubare & Mark, 2018; Adekoya, 2018; Obayori and Udeorah, 2018; Olopade et al., 2019; Tsaurai, 2020). From equation 1, Z stands for the control variables identified as critical drivers of poverty. Informed by the extant studies on the human capital-poverty nexus (Ogundari & Awokuse, 2018; Olopade et al., 2019), the study employs trade openness (TRD), inflation (INF), financial development (FD) and institutional quality (INS) as the control variables.

Therefore, equation 1 can be expanded to incorporate human capital development and control variables as follows:

$$POV_t = \varphi_0 + \varphi_1 HCD_t + \varphi_2 INS_t + \varphi_3 TRD_t + \varphi_4 INF_t + \varphi_5 FD_t + \varepsilon_t \tag{2}$$

All variables are as previously defined.

To examine the moderating role of institutional quality on the interplay between HCD and poverty, equation (2) is augmented with the interaction term between institutional quality and human capital development (INS*HCD) as presented in the following equation:

$$POV_t = \varphi_0 + \varphi_1 HCD_t + \varphi_2 INS_t + \varphi_3 INS * HCD_t + \varphi_4 TRD_t + \varphi_5 INF_t + \varphi_6 FD_t + \varepsilon_t \qquad (3)$$

Based on the proxies of human capital adopted, all the slope coefficients are expected to have a positive sign except the magnitudes of INF (φ_5). For instance, we expect an increase in human capital development components (EDU and HET) to stimulate income per capita and consumption per capita which will spur a poverty reduction. A higher rate of inflation, on the other hand, will reduce people's purchasing power and worsen poverty. Hence, φ_5 is expected to have a negative sign. On the other hand, there is no conclusive finding on the impact of trade openness on poverty and this implies that the estimate of TRD (φ_4) can be negative or positive. Also, better institution is expected to promote income per capita and consumption expenditure per capita (indicating poverty reduction) suggesting a positive link between INS and poverty proxies. Similarly, a strong financial system will encourage access to financial services and engender higher income per capita and consumption expenditure per capita.

Here, φ_3 is the estimate of the interaction term between institutional quality and human capital development that provides information on the moderating role of institutional environment on the relationship between HCD and poverty. The sign φ_3 can be positive or negative depending on whether the institutional environment complements or constrains the impact of HCD on poverty. To critically explore the moderating effect of the institutional environment on the focal variables, it is important to calculate the marginal effect of INS by differentiating equation 3 with respect to HCD as advised in the extant studies (Ehigiamusoe and Lean, 2020; Olaniyi & Adedokun 2022)

$$\frac{\partial POV_t}{\partial HCD_t} = \varphi_1 + \varphi_3 INS \qquad (4)$$

In line with Olaniyi and Adedokun (2022), parameters φ_1 and φ_3 information on the impact of HCD on poverty can be discussed under four scenarios as provided below:

i.   If $\varphi_1 > 0$ and $\varphi_3 > 0$, it implies that HCD alleviates poverty and institutional quality complements and reinforces the reducing impact of the former on the latter.
ii.   If $\varphi_1 > 0$ and $\varphi_3 < 0$, it implies that HCD alleviates poverty but institutional quality mutilates the alleviating effect of HCD on poverty
iii.   If $\varphi_1 < 0$ and $\varphi_3 > 0$, it suggests that HCD worsens poverty but institutional quality reduces the adverse effect of the former on the later
iv.   If $\varphi_1 < 0$ and $\varphi_3 < 0$, it indicates that HCD aggravates poverty and institutional quality reinforces the escalating effect of HCD on poverty.

All the variables are employed in logarithm form except INS, which is utilized in its level, or natural form. The description and measurement of variables are displayed in Table 1.

Estimation Techniques

Following the outcome from the unit root tests, the study employs the Autoregressive Distributed Lag (ARDL) Bound test proposed by Pesaran *et al.* (2001) to investigate the possibility of cointegration (long-run relationship) between human capita components and poverty indicators. The ARDL Bound test has advantages over other cointegration tests. First, unlike other cointegration tests such as the Johansen cointegration test, the ARDL Bound test is efficient with variables of mixed order of integration. Thus, the approach does not require series to be of the same other. Second, the approach is reliable, and efficient, especially for a small sample (Poole *et al.*, 2002; Ralhan *et al.,* 2022). Third, the technique is robust and consistent in dealing with a long-run model.

In line with the study by Pesaran et al. (2001), the ARDL specification of equation 2 is provided below:

$$\Delta POV_{t=}\emptyset_0 + \sum_{i=1}^{p} \partial_{1i}\Delta POV_{t-1} + \sum_{i=0}^{p} \partial_{2i}\Delta HCD_{t-1} + \sum_{i=0}^{p} \partial_{3i}\,\Delta INS_{t-1}$$

$$+ \sum_{i=0}^{p} \partial_{4i}\Delta INS * HCD_{t-1}$$

$$+ \sum_{i=0}^{p} \partial_{5i}\Delta TRD_{t-1} + \sum_{i=0}^{p} \partial_{5i}\Delta INF_{t-1}$$

$$+ \sum_{i=0}^{p} \partial_{6i}\Delta FD_{t-1} + \cap_1 POV_{t-1} + \cap_2 HCD_{t-1} + \cap_3 INS_{t-1} + \cap_4 INS * HCD_{t-1}$$

$$+ \cap_5 TRD_{t-1} + \cap_6 INF_{t-1} + \cap_7 FD_{t-1}$$

$$+ \varepsilon_t \qquad\qquad 5$$

Equation 5 represents the unrestricted version of the ARDL model in equation 3. From equation 5, Δ *is* the difference operator $\emptyset_0$ is the intercept and ε_t captures the error term. The $\cap_{is,}$ are the long-run coefficients associated with equation 3. Following the study of Pesaran *et al.* (2001), we select the optimal lag length using the Akaike Information Criteria to test the null hypothesis of no cointegration against the alternate hypothesis of cointegration between poverty and human capital development. In statistical parlance, for the null hypothesis of H_0: $\cap_1 = \cap_2 = \cap_3 = \cap_4 = \cap_5 = \cap_6 = \cap_7$ against the alternate hypothesis- H_1: $\cap_1 \neq \cap_2 \neq \cap_3 \neq \cap_4 \neq \cap_5 \neq \cap_6 \neq \cap_7$ If the calculated F statistic yields a value higher than the upper bound of the critical value, the null hypothesis of no cointegration is rejected.

The inference from the cointegration tests confirms the existence of a long-run relationship among the study's variables. This consequently informs the utilization of the cointegrating regression approach as the primary estimation technique to achieve the study's objective. Thereafter, we employ the Dynamic Ordinary Least Squares (DOLS) method based on its strength to accommodate the dynamics among the variables in the study. The DOLS was originally proposed by Stock and Watson (1993) and belongs to the class of cointegrating (long run) regression

technique. The DOLS is a cointegrating model that allows the inclusion of leads and lags values of the dependent and explanatory variables suggesting that the error terms from the regression are orthogonalised (Ralhan et al., 2022). Also, the inclusion of the lags value in the model helps to address potential endogeneity and simultaneity bias. Therefore, the study applies the DOLS method to estimate the long-run components (coefficients) of equation 5.

To establish the credibility of the DOLS results, we apply the FMOLS techniques to control for potential endogeneity in the study. In line with Philips and Hansen (1990), the outcomes from FMOLS are efficient and accurate when dealing with small samples. Also, the FMOLS is robust to econometric pitfalls such as serial correlation, endogeneity and omitted variable bias.

Table 1: Measurement and Description of Variables

Variables	Symbol	Unit of measurement	**Source**
Consumption per capita	HCE	final consumption expenditure per capita (constant 2015 US $)	World Bank
Income per capita	PCI	GDP per capita (Constant 2015 US $)	World Bank
Government expenditure on health	EDU	Total expenditure of government on health (N'billion)	Central Bank of Nigeria
Government expenditure on education	HET	Total expenditure of government on education (N'billion)	Central Bank of Nigeria
Human capital index	HCI	An index of human capital	Penn World Table
Life Expectancy at birth	LER	Life Expectancy at birth, total (years)	Word Bank
Financial Development	FD	Domestic credit to private sector (% of GDP)	Word Bank
Inflation	INF	Changes in consumer price index (%)	Word Bank
Institutional Quality	INS	Constructed by rescaling and averaging the five components of political risk (ranges between 0 and 10)	International Country Risk Guide
Trade Openness	TRD	Total trade (% of GDP)	Word Bank

Source: Authors' compilation

Results

Descriptive Statistics of Data Series
Sequel to the main analysis, it is important to examine the attributes of the series in the study. Table 2 contains the results from the descriptive statistics of the data. The average value of HCE and PCI are $1,722.9 and $2,019.98 respectively. According to these statistics, Nigeria is categorised by the World Bank as a middle-income nation. This

implies that the income per capita in Nigeria is low and this might be responsible for the high poverty rate in the country. In addition, Nigeria spent an average of N221.369 billion and N134.396 billion on education and health respectively. For other variables, it is revealed from Table 2 that, the average value of trade openness over the study period is 36.6% while an average inflation rate of 18.27% is recorded within the studied years. The mean of the institution index in Nigeria

is approximately 4.1 on a scale of (0 – 10) suggesting that the quality of institutions in the country is weak. On the other hand, the average value of domestic credit to the private sector to GDP stands at approximately 10.5%. Similarly, there is evidence of consistency among the series in the study based on the closeness of their mean and median values except for the inflation rate, and government expenditure on education and health, where a huge disparity is observed between the two measures of location. However, for the considered variables, the standard deviation is high, indicating that the series deviated significantly from their mean values. This is reinforced by the values of the coefficient of variation (*covar*) which measures the relative spread of the series. The value of skewness and kurtosis jointly provide insight into the

nature of the distribution of the series in the study. It is evident from the outcomes of descriptive statistics that some variables including HCE, PCI, and INS have negative skewness while others series are positively skewed. On the other hand, the kurtosis for all the variables is less than 3.0 (platykurtic) except INF and FID whose kurtosis are 6.855 and 3.137 respectively, and as such described as leptokurtic. Formally, the normality of variables is judged by the Jaque Berra (J-B) statistic. A variable has a normal distribution if the probability of J-B statistic is not significant or above 0.05 at a 5% level. Going by the probability value of the J-B statistic in Table 2, many of the series in the model are normally distributed and thus, the assumption of normal distribution is confirmed for all the series except for EDU, HET and INF, which departs from normal distribution assumption.

Table 2: Descriptive statistics

	HCE	PCI	EDU	HET	TRD	INF	INS	FID
Mean	1722.902	2019.980	221.369	134.828	36.671	18.278	4.104	10.439
Median	1967.901	2051.311	128.067	72.081	35.258	12.942	4.243	10.011
Maximum	2380.111	2688.267	752.980	468.640	53.278	72.836	4.611	19.604
Minimum	959.428	1414.101	0.291	0.150	20.723	5.388	3.417	4.948
Std. Dev.	492.514	467.585	233.454	149.447	8.194	15.902	0.296	3.640
Cov	3.498	4.320	0.948	0.902	4.475	1.149	13.850	2.868
Skewness	-0.399	-0.051	0.892	0.927	0.147	2.180	-0.803	0.770
Kurtosis	1.564	1.353	2.533	2.550	2.638	6.855	2.983	3.137
Jarque-Bera	3.821	3.856	4.821	5.160	0.307	47.994	3.654	3.387
Probability	0.148	0.145	0.090	0.076	0.858	0.000	0.161	0.184
Obs	34	34	34	34	34	34	34	34

Source: Authors' compilation

Correlation analysis and multicollinearity test

The study conducts correlation analysis among the studied variables to explore the degree of association among the series and to preclude the possibility of multicollinearity among the explanatory variables. The outcomes from the Pearson correlation

coefficient are presented in Table 3. The outcomes provide prior insight into the association between poverty indicators and human capital development in Nigeria. For instance, HCD variables (EDU and HET) have a positive correlation with the two indicators of poverty (CON and GDP). On the other hand, control variables such as trade openness (TRD) and inflation (INF) have a

negative association with the two indicators of poverty while financial development (FID) and poverty metrics are positively correlated. Meanwhile, institutional quality (INS) is negatively associated with consumption expenditure per capita (HCE) but positively correlated with income per capita (GDP). To rule out multicollinearity in the model, we apply the correlation coefficient threshold of 0.8 among the independent variables as an indication of multicollinearity as proposed by Kennedy (2008). Considering the magnitude

of the correlation coefficients among the explanatory variables, there is a high correlation among the human capita proxies. To avert the multicollinearity challenge, each component of human capita enters into a separate model. Besides, the highest correlation coefficient is 0.696 between HET and FID which is below the 0.8 threshold. Thus, there is no evidence of multicollinearity among the explanatory variables in all the estimated models.

Table 3: Correlation analysis

	HCE	PCI	EDU	HET	TRD	INF	INS	FID
HCE	1.000							
PCI	0.929	1.000						
EDU	0.805	0.824	1.000					
HET	0.846	0.854	0.993	1.000				
TRD	-0.191	-0.357	-0.181	-0.187	1.000			
INF	-0.305	-0.298	-0.368	-0.342	-0.160	1.000		
INS	-0.004	0.118	0.092	0.105	-0.148	0.399	1.000	
FID	0.730	0.718	0.668	0.696	-0.220	-0.173	0.180	1.000

Source: Authors' compilation

Unit Root tests

Another critical step in time series analysis is to examine the stationarity properties of the variables employed. This is important because any estimation performed on nonstationary series would produce spurious results which cannot be relied upon for any meaning inference. To explore the unit root of the series, the study performs the Augmented Dickey-Fuller and Philipps Peron unit root tests. The two tests are based on the null hypothesis that a series contains a unit root (nonstationary). Considering the results in Table 4, the variables in the study are of mixed order of integration. For instance, the outcomes from the ADF test show that all the variables are integrated with first order one (I (1)) except INS which is

stationary at level. On the other hand, all the control variables are I (0) while the poverty indicators and human capital components are I (1) variables under the PP test specification. However, there is no variable with a higher order of integration such as I (2). Thus, we conclude that the variables in the study are combinations of I (0) and I (1) series. Given this attribute, we test for cointegration between the target variables. However, it is crucial to choose an estimation method that can account for the series' peculiar order of integration. In the empirical literature, the autoregressive distributed lag (ARDL) technique is considered the best cointegration approach to handle variables with mixed order of integration, hence, the choice of the technique in this study.

Table 4: Unit root test results

	ADF Test			PP Test		
HCE	-1.425	-6.645***	I(1)	-1.33	-6.781***	I(1)
PCI	-1.049	-2.867*	I(1)	-0.722	-2.870*	I(1)
EDU	-1.496	-8.089***	I(1)	-1.493	-9.566***	I(1)
HET	0.982	-6.261***	I(1)	3.43	-6.651***	I(1)
TRD	-3.055***	-6.596***	I(1)	-3.055***	-6.596***	I(0)
INF	-2.425	-4.745***	I(1)	-2.734*	-4.709***	I(0)
INS	-4.145***	-6.597***	I(0)	-4.145***	-6.710***	I(0)
FID	-2.18	-4.988***	I(1)	-1.948	-4.988***	I(0)
	Critical values					
1%		-4.263			-4.263	
5%		-3.553			-3.553	
10%		-3.211			-3.211	

Note: ***, ** and * indicate 1%, 5% and 10% significance level respectively

Bound Test for Cointegration

To uncover the possibility of a cointegrating relationship among the series, the study adopts the Bounds Test for cointegration proposed by Pesaran et al. (2001). The study estimated four (4) different models consisting of two poverty indicators and two HCD metrics. In models 1 and 2, we regress HCE on the two measures of HCD (EDU and HET) while a similar estimation is conducted in models 3 and 4 using the PCI as a poverty indicator. The results from the Bound tests for all the estimated models are contained in Table 5. Evidence from Table 5 suggests that the value of the F – statistics for all the models exceeds the upper bound value, which signals the confirmation of a cointegrating relationship between the target variables. This further implies that all the variables in the study co-move in the long run.

Table 5: Bound test results

Models	Specifications	F-stat	Remark
1	HCE = f(EDU, TRD, INF, INS, FID)	3.29*	Cointegration
2	HCE = f(HET, TRD, INF, INS, FID)	3.03*	Cointegration
3	PCI = f(EDU, TRD, INF, INS, FID)	4.78***	Cointegration
4	PCI = f(HET TRD, INF, INS, FID)	3.89**	Cointegration
	Critical bounds		
level	Lower bound	upper bound	
1%	3.06	4.15	
5%	2.39	3.38	
10%	2.08	3.00	

Note: ***, ** and * represent 1%, 5% and 10% levels of significance respectively

Human Capital Development and poverty-nexus: DOLS approach

Following the outcomes from the Bound test, the study employs the cointegrating regression technique from the lens of dynamic ordinary least squares (DOLS) approach. The outcomes of the study are presented in sequential order starting with the primary effect of human capital development and institutional quality on poverty as presented in Table 6. Again, four models are analysed using HCE (models 1 and 2) and PCI (models 3 and 4) as indicators of poverty. Focusing on the results in Table 6, all the components of HCD assume the expected sign and direction. Specifically, education (EDU) and health (HET) components of human capital development have a positive and statistically significant effect on real consumption per capita (Part A) and income per capita (Part B). In a statistical sense, a 1% increase in EDU stimulates consumption expenditure and income per capita by 0.112% and 0.096% in panels A and B respectively. Similarly, a percentage rise in HET enhances HCE and PCI by 0.101% and 0.061% at a 5% significance level as depicted in panel A and panel B respectively. The key inference from

the results is that all the identified human capital indicators reduce poverty in Nigeria. Meanwhile, the estimate of institutional quality (INS) is significant and negatively signed for consumption expenditure per capital specification (Panel A). However, when poverty is proxy by income per capita (panel B), the impact of the institution is not statistically significant. This implies that a weak institutional environment impedes consumption per capita while its influence on per capita income is inconsequential.

To confirm the reliability of the DOLS results, the study carries out a battery of diagnostic tests. The outcomes from these tests are presented in the lower part of Table 6. The results from the diagnostic tests show that all the estimated models are immune from serial correlation and heteroscedasticity problems given the insignificance of the probability values of ARCH and LM tests that are greater than the 5% level. Similarly, the residual terms recovered from the models are normal based on the probability value of the J-B test. Based on the results, the estimates obtained from the DOLS models are unbiased, reliable, and consistent.

Table 6: Human capital and poverty nexus – DOLS approach

	PANE A: HCE		PANEL B: PCI	
EDU	0.112**		0.096**	
	(0.050)		(0.024)	
HET		0.101**		0.061**
		(0.040)		(0.023)
INST	-0.686***	-0.627***	-0.114	0.068
	(0.210)	(0.187)	(0.072)	(0.114)
TRD	-0.111	-0.086	-0.218***	-0.175**
	(0.171)	(0.162)	(0.046)	(0.078)
INF	0.234**	0.214**	0.032	0.03
	(0.089)	(0.086)	(0.027)	(0.073)
FID	0.787***	0.745***	0.453***	0.482
	(0.176)	(0.172)	(0.058)	(0.109)
C	7.680***	7.616***	7.256***	6.500***

	(1.149)	(1.046)	(0.340)	(0.599)
Diagnostics tests				
Jarque-Bera	0.595	0.325	1.547	0.644
Prob (J-b)	{0.743}	{0.850}	{0.461}	{0.725}
ARCH test	1.696	1.855	1.417	1.322
Prob (ARCH) test	{0.171}	{0.183}	{0.257}	{0.289}
Breusch-Godfey LM Test	1.665	1.85	2.048	1.795
Prob(LM test)	{0.166}	{0.222}	{0.118}	{0.161}
Obs	34	34	34	34

Note: *, ** and *** represents 1%, 5% and 10% levels of significance respectively

Values in () represent standard error while figures in {} indicate probability values.

Moderating role of institutional quality in HCD – poverty nexus

In the second stage of the analysis, we incorporate the interactive term in the model and estimate equation 3 using the DOLS approach. The outcomes of the moderating role of institutional quality in the interplay between HCD and poverty are displayed in Table 7. In line with the results in Table 6, panel A (models 1 and 2) contains the outcomes for HCE and panel B (models 3 and 4) presents the findings when PCI is utilized as a poverty indicator. Consistent with the earlier results, human capital metrics have a positive and significant effect on poverty. The outcome is consistent across the four models. This suggests that sufficient funding for the education and health sectors significantly contributes to poverty reduction in Nigeria. Focusing on the magnitudes of HCD, one percentage rise in education expenditure (EDU) spurs HCE and PCI by 2.488% (model 1) and 0.706% (model 3) respectively at a 5% level of significance. On the other hand, a % increase in health spending (HET) enhances HCE and PCI by 1.038% (model 2) and 0.271% (model 3) respectively. The implication of this discovery is that education and health expenditure lead to higher income and consumption expenditure per capita and thus ignite poverty reduction.

The results align with apriori expectations and conform to previous studies (Orajaka and Okoli, 2018; Adekoya, 2018; Collin and Weil, 2018). This implies that adequate investment in education is a strong driver of poverty reduction in Nigeria. The finding confirms the conclusion of Tsaurai (2020) for Central and Eastern European countries and the outcome from Olapade et al., (2019) on OPEC members including Nigeria. In the same way, the finding is in tandem with the outcomes of Moyo *et al*. (2022) who discover that an increase in human capital sufficiently leads to a decline in poverty in the Eastern Cape province of South Africa. The outcome is also consistent with the findings of Chong and Bani (2018) who assert that public spending on education significantly alleviates poverty among 54 developing countries. People are empowered when they have unrestricted access to education, which will subsequently increase economic production. Similar, evidence is documented by Josephine et al. (2021) for the African countries. The findings of the health component of human capital (HET) suggest

that an increase in health expenditure increases per capita income and consumption, which in turn lowers poverty. Adequate investment in health will boost individual productivity, increase economic growth and consequently mitigate the severity of poverty in the economy. The outcome aligns with the study of Komarudin (2020) who discovered that public health spending significantly reduces poverty headcount in 24 lower-middle and upper-middle-income countries. Similarly, the study of Olapade *et al.,* (2019) documents that an increase in health expenditure mitigates poverty level among the OPEC countries. The result is also consistent with recent research by Olowookere et al. (2022) showing that public health spending is a key factor in reducing poverty in Nigeria.

With the incorporation of the interactive term, the coefficients of institutional quality (INS) assume positive values across the four specifications suggesting that strong and better institutional quality promotes per capita income and consumption expenditure, which in turn signals poverty reduction. However, when accounting for education spending, the impact of INS is only significant in models 1 and 3. For instance, a unit increase in institutional quality magnifies HCE and PCI by 1.579% (model 1) and 0.521% (model 3) respectively. The finding corroborates the earlier discovery of Ahmed *et al*. (2023) who find that better institutional quality plummets poverty among the ECOWAS countries. Additionally, the outcome is consistent with Singh's (2021) conclusion that the rule of law is a necessary governance condition to expedite poverty reduction in the BRICS nations. The results suggest that Nigerian poverty can be reduced by the enforcement of the rule of law, stringent anti-corruption measures, and stable and efficient governance. The finding implies that a strong institutional environment boosts

consumption per capita and per capita income and consequently leads to poverty reduction in the country.

Despite the separate beneficial effects of human capital development and institutional quality on poverty, the magnitude of the interaction terms (INS*EDU) and (INS*HET) are negatively signed which suggests that institutional quality plays a strong but negative moderating role in the nexus between HCD and poverty in Nigeria. The outcomes are consistent across the two indicators of poverty as depicted in panel A and panel B of Table 7. This implies that institutional quality interacts with human capital variables to reduce HCE and PCI and consequently worsen the poverty situation in Nigeria. This finding signals that poor institutional quality hurts and nullifies the reducing effect of HCD on poverty. Rather than complementing the impact of HCD to alleviate poverty, institutional quality mutilates and constrains the alleviating effect of HCD on poverty. Hence, the quality of institutions in Nigeria constitutes a drag and leaks out the favourable and diminishing effect of government education and health on poverty. The outcome further suggests that the institutional environment in Nigeria dampens and curtails the reducing impact of human capital development on poverty. The outcome conforms with the finding of Ofori *et al*. (2024) who document that poor institutions in African countries impede the poverty-reducing effect of human capital. Our result challenges the outcome of Ayoade *et al*. (2023) that institutional quality has no impact on human capital and poverty nexus in Nigeria. However, the results of this study contradict those of a previous study by Esharif and Abida (2025), which found that the beneficial impact of HCD on poverty in four MENA countries is reinforced and complemented by institutional quality. This again reiterates the need for country-specific

study based on different institutional environments. Again, our research supports the finding of Uddin *et al*. (2021) that HCD and political institutions have a negative interaction that slows economic progress in developing nations. Poor institutions marked with weak enforcement of the law, large-scale corruption, absence of rule of law and weak regulatory environment dampen the effectiveness of the government's investment in education and health. This will in turn weaken individual capacity to contribute to the economy's productivity and consequently increase the proportion of poor people.

Furthermore, the effect of trade openness (TRD) on HCE is not significant across the model specifications in panel A. The outcome is in tandem with the study of Komarudin (2020) who finds that trade openness is not a significant determinant of poverty in middle-income countries. On the other hand, in panel B, an increase in trade openness is significantly and negatively associated with per capita income suggesting that economic openness worsens the poverty situation in Nigeria when poverty is measured by PCI. This implies that the impact of trade openness depends on the metric of poverty considered. Also, the effects of inflation on HCE and PCI are mixed. For instance, an increase in the inflation rate is associated with higher HCE (models 1 and 2) but has no significant impact on PCI (models 3 and 4). However, the outcome negates our expectations because the general increase in the price level is expected to reduce individual purchasing power and consequently exacerbate the poverty level. Consistent across different model specifications, the effect of financial development (FID) on the two indicators of poverty is overwhelmingly positive and statistically significant suggesting that the poverty level is reduced with a better and well-developed financial sector. Based on this result, the current study identifies financial development as a key factor in reducing poverty in Nigeria. The outcome is consistent with the findings of Chong and Bani (2018) who buttresses the poverty-reducing effect of financial development on poverty among 54 developing countries. The result agrees with the findings of Olohunlana and Dauda (2019) and Akinlo and Dada (2025) who opine that financial development contributes to poverty reduction in Nigeria and Sub-Saharan Africa respectively. With a virile financial sector, there would be improved access to financial resources which will in turn enhance the income-generating ability of the populace and consequently reduce poverty.

Table 7: Human capital and poverty nexus-DOLS approach
Dependent variable: POV

Variables	PANE A: HCE		PANEL B: PCI	
	Model 1	Model 2	Model 3	Model 4
EDU	2.488**		0.706**	
	(0.274)		(0.234)	
INS*EDU	-0.535***		-0.143**	
	(0.062)		(0.053)	
HET		1.038**		0.271**
		(0.350)		(0.109)
INS*HET		-0.217**		-0.047*
		(0.080)		(0.025)
INS	1.579***	0.234	0.521*	0.160
	(0.272)	(0.359)	(0.233)	(0.118)

TRD	-0.041	-0.044	-0.277***	-0.235***
	(0.063)	(0.122)	(0.055)	(0.076)
INF	0.171***	0.121*	0.044	-0.047
	(0.027)	(0.062)	(0.023)	(0.069)
FID	0.221**	0.543***	0.408***	0.153**
	(0.087)	(0.139)	(0.074)	(0.059)
C	-1.553	4.466**	4.811***	7.263***
	(1.145)	(1.463)	(0.981)	(0.439)
Diagnostics tests				
Jarque-Bera	0.754	0.147	0.594	0.259
Prob (J-b)	{0.686}	{0.929}	{0.743}	{0.878}
ARCH test	1.093	0.274	0.694	0.161
Prob (ARCH) test	{0.304}	{0.605}	{0.412}	{0.691}
Breusch-Godfey LM Test	0.71	0.119	1.501	1.352
Prob(LM test)	{0.509}	{0.889}	{0.236}	{0.264}
Obs	34	34	34	34

Note: *, ** and *** represents 1%, 5% and 10% levels of significance respectively
Values in () represent standard error while figures in {} indicate the probability
values

Robustness tests using alternative methods of estimations

To confirm the reliability of the outcomes from the study, we re-estimate equation 3 with interactive terms using alternative cointegrating regression of FMOLS as reported in Table 8. Specifically, the FMOLS is applied to address potential endogeneity issues in the model. The modeling style mimics the stepwise regression displayed under the DOLS approach. Considering the results in Table 8, government education (EDU) and health (HET) expenditures are positively and significantly associated with the two poverty metrics. Thus, the outcomes from the FMOLS are consistent with those from the main analysis for the target explanatory variables and robust to different model specifications. Thus, our results hold under different methodologies suggesting the consistency of the parameter estimates. Similarly, the responses of the poverty indicators to changes in the control variables are akin to those observed for the DOLS

results except for a few differences. For instance, the effect of trade openness on poverty is not consistent under the two indicators of poverty. Consistent with the outcomes with the primary results, trade openness militates income per capita and consequently spurs poverty in Nigeria (model 4 under panel B). When HCE is employed as a poverty indicator, trade openness is found to stimulate per capita consumption to reduce poverty in the countries suggesting that the impact of trade openness on poverty is sensitive to the indicator of poverty considered. Unlike the outcomes from the DOLS, inflation has no significant effect on the two poverty indicators. In line with the outcomes from the DOLS, financial development serves as a crucial predictor of poverty irrespective of the measure of poverty considered given the enhancing and favourable impact of FID on HCE and PCI. This suggests that financial development is an important determinant of poverty reduction in Nigeria.

Table 9: Robustness analysis using alternative technique- FMOLS

	Panel A: HCE		Panel B: PCI	
Variables	model 1	model 2	model 3	model 4
EDU	1.460***		1.295***	
	(0.225)		(0.222)	
INS*EDU	-0.324***		-0.289***	
	(0.052)		(0.051)	
HET		0.952***		0.649*
		(0.315)		(0.328)
INS*HET		-0.210***		-0.143*
		(0.073)		(0.076)
INS	1.261***	0.895***	1.454***	0.033***
	(0.174)	(0.206)	(0.172)	(0.215)
TRD	0.243	0.612***	0.212	-0.601***
	(0.143)	(0.168)	(0.142)	(0.175)
INF	-0.030	-0.014	-0.054	-0.032
	(0.068)	(0.085)	(0.067)	(0.088)
FID	0.394**	0.556**	0.240***	0.472**
	(0.159)	(0.206)	(0.157)	(0.215)

Note: *, ** and *** represents 1%, 5% and 10% levels of significance respectively

Values in () represent standard errors.

Sensitivity analysis using alternative measures of human capital development

To further explore the moderating role of institutional quality in the relationship between HCD and poverty, the study conducts a sensitivity analysis of the outcomes from the main analysis using alternative measures of human capital development. Following the studies of Ahmad *et al.* (2018), Karambakura et al. (2019) and Adeleye (2024), we utilize the human capital index (HCI) from Feenstra et al. (2015) Penn World Table 10.0 as another measure of educational dimension of human capital development. Similarly, the study employs life expectancy at birth (LER) to proxy the health human capital component. Other studies such as Ogundari and Awokuse, (2018) and Onatunji (2024) adopt LER as an indicator of human capital. Using

these proxies, the study re-estimates the equation by replacing education and health expenditure with human capital index (HCI) and life expectancy rate (LER) with the interactive terms on the two measures of poverty as displayed in Table 8.

Consistent with the prior findings, HCI and LER have a positive and significant effect on HCE and PCI and thus reduce poverty. This suggests that longevity increases per capita income and consumption, which in turn lowers poverty. In the same way, a higher human capital index empowers an individual's capability to contribute to economic productivity and accelerate poverty reduction. Similarly, the coefficient of the interactive terms is negatively signed in all the estimated models buttressing and reinforcing the dampening effect of HCD on poverty.

Table 8: Sensitivity analysis using alternative measures of human capital development

Variables	Panel A: HCE		Panel B: PCI	
	model 1	model 2	model 3	model 4
HCI	4.199**		3.902***	
	(1.885)		(1.161)	
INS*HCI	-0.765***		-0.725**	
	(0.438)		(0.27)	
LER		16.471**		15.061***
		(7.308)		(2.454)
INS*LER		-2.943*		-2.707***
		(1.718)		(0.575)
INS	0.844	11.029***	1.028**	10.342***
	(0.662)	(6.606)	(0.0.408)	2.218
TRD	0.006	0.131	-0.108*	-0.022
	(0.099)	(0.107)	(0.061)	(0.036)
INF	0.021	0.022	-0.015	0.002
	(0.040)	(0.041)	(0.025)	(0.137)
FID	0.182*	0.186*	0.057	0.005
	(0.102)	(0.099)	(0.062)	(0.033)
C	1.723	-55.908***	2.139	-50.190***
	(2.757)	(28.092)	(1.697)	(9.434)

Note: *, ** and *** represents 1%, 5% and 10% levels of significance respectively
Values in () represent standard errors.

Additional Analysis

As presented in the preceding sections, the study tests for the possibility of a feedback effect in HCD - poverty nexus by implementing the Granger Causality test on the target variables. The outcomes from the causality are summarised in Table 9. Statistical significance of the probability value indicates rejection of the null hypothesis of no causality. This connotes the establishment of a causal relation between the variables of interest. Again, for the robustness of the analysis, the study employs education expenditure (EDU) and human capital index (HCI) for education component human capital development and health spending and life expectancy rate as health

human capital variables. The results for the causality test between HCD components and poverty variables overwhelmingly reveal a unidirectional causality running from the former to the latter except for the causality between life expectancy rate (LER) and the selected two proxies of poverty where a bidirectional causality is observed. According to the findings, HCD can be used as a policy variable to predict changes in Nigeria's poverty rate. The results align with the research conducted in Nigeria by Ewubare and Mark (2018). In addition, the outcome also aligns with the findings of Adekoya (2018) who established a unidirectional causality between life expectancy and income per capita (a proxy for poverty). Similarly, Olowookere et al.

(2022) observe a one-way causality from health expenditure to poverty in Nigeria. However, the results of Adekoya (2018) conclude that no causality exists between education spending and poverty level in Nigeria which is a departure from the findings of the present study. All of the identified human capita indicators are significant predictors of poverty in Nigeria, according to the results of the causality analysis. The outcomes from the causality test reiterate and reinforce the findings from the DOLS and FMOLS regressions that HCD is a significant driver of poverty in Nigeria suggesting that HCD is a crucial determinant for poverty reduction in Nigeria. Another

insight from this study is that of all the HCD components employed, poverty indicators (HCE and PCI) granger cause life expectancy rate in Nigeria suggesting evidence of a bidirectional (feedback) causal relationship between life expectancy rate and poverty indicators. It would follow from this that actions aimed at raising Nigeria's life expectancy rate could also reduce the country's poverty rate. Thus, the outcomes from the cointegrating regression and Granger causality tests imply that investment in human capital is an essential condition to achieve the global goal of poverty eradication in Nigeria.

Table 9: Results from the Granger Causality Test

Null Hypothesis	test	Prob	Results
EDU ⇏ HCE	7.650**	0.023	Reject
HCE ⇏ EDU	1.467	0.48	Accept
HCI ⇏ HCE	5.527*	0.063	Reject
HCE ⇏ HCI	1.738	0.419	Accept
HLTH ⇏ HCE	8.452**	0.015	Reject
HCE ⇏ HLTH	0.521	0.771	Accept
LER ⇏ HCE	14.495***	0.001	Reject
HCE ⇏ LER	5.946*	0.051	Reject
EDU ⇏ PCI	7.228**	0.027	Reject
PCI ⇏ EDU	1.163	0.559	Accept
HCI ⇏ PCI	5.089*	0.079	Reject
PCI ⇏ HCI	1.069	0.586	Accept
HLTH ⇏ PCI	6.736**	0.035	Reject
PCI ⇏ HLTH	0.599	0.741	Accept
LER ⇏ PCI	10.294***	0.006	Reject
PCI ⇏ LER	12.587***	0.002	Reject

Note ***, ** and * denote 1%, 5% and 10% significant level respectively

Conclusion

The overall aim of this study is to examine the role of human capital on poverty in Nigeria using annual data between 1990 and

2023. As an auxiliary objective, the study further explores the moderating role of institutional quality between the two target variables. For the robustness of the analysis, expenditure, and income measures are

adopted to proxy poverty. In the same way, human capital is disaggregated into health and education components to enrich the study's outcomes. The study applies the ARDL Bound tests for cointegration between HCD components and poverty indicators. To address the study's objective, we employ cointegrating regressions such as DOLS and FMOLS with a battery of robustness sensitivity tests. As an additional check, the study conducts the Granger Causality test to explore the possibility of a feedback relationship between HCD and poverty.

Findings from the ARDL Bound test confirm the existence of cointegration between the variables of interest. Further, the outcomes from the DOLS approach reveal that all the components of human capital significantly enhance household consumption expenditure per capita and real income per capita and thus contribute to poverty reduction in Nigeria. Regarding the primary and direct effect of the moderating variable, institutional quality promotes per capita income and consumption expenditure and thus reduces poverty in Nigeria. However, institutional quality negatively moderates the relationship between HCD and poverty in Nigeria. This suggests that poor and weak institutions in Nigeria mutilate the beneficial effect of HCD on poverty. The outcomes from the DOLS are reinforced by the findings from the FMOLS approach suggesting that investment in human capital stimulates poverty reduction in Nigeria. Similarly, the finding is consistent when alternative measures of human capital development such as human capital index and life expectancy are employed. Thus, the study concludes that institutional quality in Nigeria serves as an impediment to the reducing effect of HCD on poverty in the country. Regarding the control variables, the study finds persistent evidence to support the poverty-reducing effect of financial development. The overall implication of the study's outcomes is that the quality of

institution matters in a quest to achieve the first sustainable goal of poverty reduction in Nigeria. Consistently, the outcomes of the causality test reveal a unidirectional causality from the components of human capital to poverty variables. However, the finding from the causality test produces a fresh insight in which a feedback relationship is observed between poverty variables and life expectancy rate. This implies that lowering poverty in Nigeria tends to increase life expectancy. The main conclusion from this study is that human capital is a crucial factor in accelerating poverty eradication in Nigeria.

The outcomes from the study offer some policy recommendations that can assist in actualizing the goal of poverty reduction in Nigeria. One, to achieve the first goal of SDG (poverty reduction), drastic steps must be taken by the Nigerian government to provide adequate and substantial investment in the health and education sectors which have been identified as catalysts of poverty reduction in the country. In 2024, budget allocation to the education sector was 7.9% which is grossly below the provision for Universal Basic Education of 11.5%. Conversely, the health sector received 4.47% of the total budget against the benchmark of 15% prescribed by the Abuja Declaration on education. Thus, the government is advised to prioritize investment in education and health to boost the country's human capital development and lift the majority of the populace out of the poverty bucket. However, for human capital to achieve its potential and intended poverty-reducing effect in Nigeria, adequate investment in the institutional environment is critical. Thus, the government is advised to prioritize and promote a strong and better institutional structure by discouraging corruption, ensuring strict adherence to the rule of law, and removing bureaucratic and administrative constraints to support human capital development to accelerate poverty

reduction in Nigeria. This can be achieved by empowering and strengthening the existing anti-corruption agencies to promote transparency and accountability in public administration and governance and thus achieving efficiency in public spending. Like other empirical works, the present study is not without its limitations. Given the country-specific nature of the study, the findings may not apply to other developing countries. Future studies may be conducted on the nexus between human capital development and poverty in other developing countries. Furthermore, the study explores the role of institutional quality as a channel via which human capital development can influence poverty. Future studies can consider other channels such as financial development in the relationship between HCD and poverty in Nigeria.

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