

THE EFFECT OF HUMAN CAPITAL ON THE DYNAMICS OF INCOME INEQUALITY IN WEST AFRICA: A PANEL ARDL-PMG APPROACH

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Abstract

This study examines the effect of human capital development on the dynamics of income inequality in West African economies. The research is motivated by the persistent coexistence of improving human capital indicators and high inequality levels. The study adopts a quantitative research design utilising the Panel Autoregressive Distributed Lag Pooled Mean Group (PARDL-PMG) method. The population comprises annual macroeconomic panel data for 14 West African countries, yielding 434 total observations. Pesaran cross-sectional dependence testing, CIPS unit root testing, and Westerlund cointegration testing confirmed the appropriateness of Panel ARDL estimation. The empirical results reveal that the long-run coefficient on human capital is statistically insignificant, whilst per capita income emerges as the dominant inequality-reducing mechanism. The error-correction term confirms a stable long-run equilibrium with an approximately 35.7 per cent annual adjustment speed. The study concludes that human capital investment requires complementary institutional reforms, financial inclusion expansion, and labour market formalisation to effectively reduce income inequality in West Africa, and recommends integrated policy reforms combining education investment, institutional strengthening, labour formalisation, and redistributive measures.

Keywords: Human Capital, Income Inequality, Panel ARDL, West Africa, Quantitative Analysis

JEL Classification: I25, J24, D63, O15, O55, C23.

1. Introduction

Income inequality remains one of the most persistent socioeconomic challenges confronting developing economies, particularly in West Africa, where economic growth has often coexisted with substantial disparities in income, employment opportunities, access to education, and living standards. Although the region has experienced periods of economic expansion, the benefits of growth have not always been distributed evenly across individuals, households, and countries.

A central development challenge in West Africa, where Gini coefficients ranging from 35.1 to 50.7 reflect persistent structural disparities despite decades of economic growth and policy interventions

(World Bank, 2024). Its significance extends beyond distributional concerns, as widening inequality undermines economic stability, social cohesion, poverty reduction efforts, and long-run growth sustainability (Lee & Lee, 2018; Menylim et al., 2021). Within Sub-Saharan Africa, West Africa exhibits relatively lower but still structurally entrenched inequality, highlighting persistent inclusiveness gaps in growth processes (World Bank, 2024). This context reflects the broader global pattern of “growth without inclusion,” where economic expansion does not translate into equitable welfare outcomes.

The theoretical basis for understanding this phenomenon is grounded in the human capital inequality framework of Galor and Zeira (1993), which argues that unequal access to education, skills, and health perpetuates income disparities through credit market imperfections and intergenerational transmission of disadvantage. Empirical evidence supports this view, showing that variations in education, health, and skills significantly influence income distribution outcomes across countries (Lee & Lee, 2018; Parsons, 2023). The World Bank (2020) further notes that children in Sub-Saharan Africa achieve only about 40 per cent of their potential productivity due to human capital deficits, reinforcing the link between underinvestment in human capital and inequality persistence.

Despite improvements in educational enrolment and health indicators across Africa over recent decades, income inequality has declined only marginally, suggesting that human capital accumulation alone is insufficient for equitable distributional change (Tibebu, 2023; Ewoh et al., 2025). This paradox is reinforced by structural constraints such as limited fiscal commitment, with education spending averaging about 3.7 per cent of GDP, below international benchmarks (UNESCO, 2024; World Bank & UNESCO, 2024). In West Africa, where ECOWAS countries exhibit diverse income classifications and institutional capacities, these constraints are further compounded by weak financial inclusion and labour market segmentation (ISS African Futures, 2024). Consequently, this study investigates the long-run relationship between human capital and income inequality across 14 West African countries (1994–2024), addressing a critical gap in region-specific empirical evidence and highlighting how institutional and structural conditions shape distributional outcomes.

The central problem motivating this study is the persistent disconnect between improvements in human capital and income inequality in West Africa. Standardised international data indicate that countries in the region experienced gradual improvements in their Human Capital Index (HCI), reflecting gains in educational attainment, health outcomes, and skills development over the three decades from 1990 to 2022 (Ewoh et al., 2025). However, these improvements have not been

accompanied by a commensurate reduction in income inequality; Gini coefficients have remained persistently high, with inequality in many West African economies still exceeding the global average and levels recorded in several other developing regions (Nunoo et al., 2024).

The limited redistributive impact of public social spending provides further evidence of this problem. Social spending reduces income inequality in Africa by only 7.8 per cent, compared with 8.5 per cent in Asia and 10 per cent in Latin America, suggesting that increased public investment in social and human capital programmes has not translated proportionately into more equitable income distribution (Oxfam International, 2022). This outcome presents an important economic puzzle because human capital accumulation is generally expected to improve productivity, employment opportunities, and earnings, thereby reducing income disparities through broader access to productive capabilities. Yet, in West Africa, improvements in human capital appear to coexist with persistent distributional inequality.

The persistence of this disparity may reflect structural and institutional conditions that weaken the distributional effects of human capital accumulation. Classical human capital theory suggests that improvements in education, skills, and health should enhance productivity and expand income-earning opportunities, potentially narrowing wage and income differentials. Conversely, skill-biased technological change may widen inequality where technological adoption disproportionately rewards highly skilled workers, while structuralist perspectives emphasise labour-market segmentation, institutional weaknesses, and governance deficiencies as constraints on the translation of human capital gains into broad-based economic benefits.

These challenges are particularly important in West Africa given the region's constrained fiscal capacity. The average public debt-to-GDP ratio across ECOWAS economies increased from 37.1 per cent in 2019 to 49.3 per cent in 2022, while the ratio for non-oil-exporting countries reached 73 per cent, placing additional pressure on government capacity to sustain investment in education, health, and other human capital-enhancing sectors (UN Economic Commission for Africa, 2024). Consequently, the issue is not merely whether human capital has improved, but whether such improvements have translated into more equitable income distribution over the long run.

Despite extensive theoretical arguments linking human capital to inequality, the West African evidence remains insufficiently conclusive on the long-run distributional consequences of human capital accumulation. Existing evidence establishes substantial cross-country variation in income distribution and highlights the importance of structural and institutional conditions in shaping inequality dynamics (Dataphyte, 2022; World Bank, 2023). However, the observed coexistence of

rising human capital and persistently high inequality raises an unresolved empirical question concerning whether human capital accumulation actually reduces inequality in the region and, if so, under what broader economic and institutional conditions.

Moreover, the limitations of relying solely on conventional inequality measures such as the Gini coefficient, which does not fully capture income mobility or changes within different segments of the income distribution, further underscore the need for careful empirical investigation (Lee & Lee, 2018). This study therefore contributes to the literature by providing a panel-based assessment of the long-run effect of human capital on income inequality across 14 West African countries using the Panel Autoregressive Distributed Lag (ARDL) framework. The analysis extends the relationship beyond a simple human capital–inequality association by controlling for GDP per capita, government expenditure on education, trade openness, and institutional quality, thereby accounting for key macroeconomic, fiscal, external-sector, and institutional factors that may influence inequality. By distinguishing the long-run relationship within a dynamic panel framework, the study provides evidence relevant to the design of policies aimed at ensuring that improvements in human capital translate into more inclusive income distribution.

Against this background, the study asks: what is the long-run effect of human capital on income inequality in West Africa? Accordingly, the objective of the study is to examine the long-run effect of human capital on income inequality across 14 West African countries using the Panel Autoregressive Distributed Lag estimation framework, while controlling for GDP per capita, government expenditure on education, trade openness, and institutional quality.

2. Literature Review and Theoretical Framework

2.1 Conceptual and Definitional Framework

The conceptual framework of this study defines human capital and income inequality as the core analytical constructs guiding the investigation. Human capital is widely conceptualised in development economics as the stock of productive capacities embodied in individuals, including education, skills, health status, cognitive ability, and adaptive capacity, all of which jointly determine productivity and income-earning potential in labour markets (Molla, 2021; Guerra Castillo et al., 2025). Contemporary measurement approaches, particularly the World Bank Human Capital Index (HCI), operationalise this concept by integrating survival rates, years of schooling, and health indicators into a composite index that reflects national productivity potential (Parsons, 2023). Income inequality is defined as the uneven distribution of income across individuals within

an economy and is commonly measured using the Gini coefficient, which captures deviations from perfect income equality (Adeleye & Osaretin, 2024).

2.2 Theoretical Perspectives on the Human Capital–Inequality Nexus

The human capital–inequality relationship is explained through multiple theoretical frameworks. The Mincerian earnings function forms the basis of classical human capital theory, which posits that income increases with education, skills, and experience, implying that broader distribution of education should reduce wage inequality at the macro level (Lee & Lee, 2018). Galor and Zeira's credit constraint model further explain persistent inequality by showing that imperfect financial markets limit educational investment among low-income households, thereby sustaining intergenerational inequality. Methodologically, empirical studies testing these theories commonly rely on panel econometric models that allow for cross-country heterogeneity and temporal dynamics. These include fixed effects models for controlling unobserved heterogeneity, random effects models for efficiency under broader assumptions, and dynamic panel estimators such as system GMM to address endogeneity between human capital and income inequality. Data sources typically include World Bank databases, Barro-Lee educational datasets, and institutional governance indicators.

More recent theoretical extensions incorporate structural and technological dimensions. The skill-biased technological change framework explains how technological advancement increases demand for skilled labour, potentially widening inequality despite rising human capital levels (Ndjobo & Otabela, 2023). Structuralist theory further argues that institutional quality, labour market structures, and financial inclusion determine whether human capital translates into equitable outcomes, making governance a key moderating factor in empirical models (Nunoo et al., 2024).

2.3 Empirical Review

Empirical literature on the relationship between human capital and income inequality is characterised by diverse datasets, methodological approaches, and econometric techniques. Lee and Lee (2018), using a balanced panel of 113 countries spanning three decades, applied fixed effects and GMM estimators to examine the effects of education and health on inequality. Their study, based on harmonised global datasets on education and income distribution, found that improvements in schooling are associated with reductions in Gini coefficients, thereby supporting the inequality-reducing role of human capital at a global scale. The strength of their approach lies in its broad cross-country coverage and use of robust estimation techniques that control for endogeneity and unobserved heterogeneity.

Molla (2021), using a Sub-Saharan African panel dataset and fixed effects estimation, found that human capital exerts weaker inequality-reducing effects compared to global samples, pointing to the influence of structural and institutional constraints. Extending this line of inquiry, Nunoo et al. (2024) applied threshold regression techniques to a panel of 47 African countries and incorporated governance indicators as moderating variables. Their findings demonstrate that human capital reduces inequality only when governance quality surpasses a critical threshold, highlighting the importance of institutional conditions in shaping distributional outcomes.

Further empirical studies reinforce the role of mediating and contextual factors. Adeleye and Osaretin (2024), using panel regression techniques with the Human Capital Index and governance indicators, found that institutional quality strengthens the inequality-reducing effect of human capital across African economies. Langnel et al. (2021), employing interaction models on ECOWAS panel data, showed that resource dependence alters the human capital–inequality relationship, often weakening its distributive effect in resource-rich contexts. Similarly, Coulibaly et al. (2025), using feasible Generalised Least Squares on West African data from 1996 to 2022, found that education expenditure alone does not significantly reduce inequality when governance quality is poor, emphasising the importance of institutional effectiveness in policy outcomes.

2.3.1 West African Dynamics of Human Capital and Income Inequality

Empirical evidence from West Africa indicates steady improvements in human capital outcomes over recent decades, driven by expansions in education access, completion rates, and health indicators. Between 2000 and 2022, primary school completion increased from 52 to 67 per cent, while lower secondary completion rose from 35 to 50 per cent and upper secondary from 23 to 33 per cent, reflecting gradual but sustained educational progress across the region (Mo Ibrahim Foundation, 2025). In addition, youth literacy increased from 75 per cent in 2014 to 79 per cent in 2024, while adult literacy has also shown modest improvement, reaching approximately 69 per cent (United Nations SDG Report, 2025). Despite these gains, reductions in income inequality have remained modest, suggesting that improvements in human capital have not translated proportionately into more equitable income distribution outcomes (Nunoo et al., 2024).

Cross-country evidence further reveals substantial heterogeneity in inequality patterns across West Africa, reflecting differences in economic structure, labour market organisation, and institutional development. Countries such as Nigeria, Ghana, and Senegal exhibit varying combinations of human capital progress and income distribution outcomes, indicating that similar improvements in education and health do not produce uniform distributive effects. Nigeria, for instance, shows high

income concentration despite moderate Gini levels, with a significant share of national income accruing to a small proportion of the population (Dataphyte, 2022). Ghana demonstrates relatively stronger human capital performance but continues to experience high inequality, reflecting limited absorption of educated labour into productive employment. Senegal, while recording comparatively lower inequality levels, still faces constraints in translating public education investment into equitable economic returns due to fiscal and institutional limitations (World Bank & UNESCO, 2024).

These observed patterns are strongly shaped by structural and institutional constraints that mediate the effectiveness of human capital in reducing inequality. Labour market segmentation remains a dominant constraint, as a large proportion of employment in the region is informal, limiting access to stable wages and reducing returns to education and skills. With informal employment exceeding 85 per cent across Africa and approaching 90 per cent in Sub-Saharan Africa, most workers operate outside formal labour structures where human capital yields higher returns (ILO, 2023; ILO/ISS, 2024). This dual labour market structure restricts upward mobility and weakens the distributive impact of education, while also limiting the fiscal capacity required to expand quality public services.

Institutional quality further conditions these outcomes by shaping how effectively education and health investments translate into economic returns. Weak governance, corruption, and inefficiencies in public service delivery reduce the effectiveness of human capital investments in improving productivity and income distribution. Empirical evidence indicates that education spending alone may not reduce inequality when governance systems are weak and may even worsen disparities when resources are inefficiently allocated (Coulibaly et al., 2025). Financial constraints also remain significant, as limited access to credit restricts households' ability to invest in education and entrepreneurial activities, thereby reinforcing inequality across generations (Menylim et al., 2021). In addition, macroeconomic instability characterised by inflation, exchange rate volatility, and dependence on commodity exports further constrains household investment in human capital by reducing income stability and long-term planning capacity (Ewoh et al., 2025).

Emerging evidence also highlights the growing influence of technological change and digital inequality on distributional outcomes in the region. While digital expansion has improved access to services and information, it has also widened skill-based income gaps, particularly where digital literacy is concentrated among urban and educated populations (Ndjobo & Otabela, 2023). When combined with persistent rural–urban and wealth-based disparities in education access, these dynamics reinforce rather than reduce inequality. Additionally, persistent underinvestment in

education, with most West African countries allocating below internationally recommended thresholds, continues to limit the region's capacity to generate broad-based human capital gains capable of producing strong inequality-reducing effects (World Bank & UNESCO, 2024).

3. Research Methodology

This investigation employs a quantitative panel econometric research design utilising the Panel Autoregressive Distributed Lag (ARDL) framework and the Pooled Mean Group (PMG) estimator developed by Pesaran, Shin, and Smith (1999). This approach was selected for its capacity to estimate both long-run equilibrium relationships and short-run adjustment dynamics within a unified analytical framework. The estimator accommodates variables integrated of different orders, provided no variable is integrated beyond order one, and permits country-specific short-run coefficients whilst constraining long-run coefficients to homogeneity across cross-sectional units.

3.1 Data and Variables

The study incorporates a balanced panel dataset comprising 434 total observations constructed from annual data spanning 1994 to 2024 for 14 West African countries, including Benin, Burkina Faso, Côte d'Ivoire, Guinea-Bissau, Mali, Niger, Senegal, Togo, Nigeria, Ghana, Sierra Leone, The Gambia, Liberia, and Guinea. The dependent variable is the Gini coefficient measuring income inequality, sourced from the World Bank World Development Indicators and the Standardised World Income Inequality Database version 9.6. The Human Capital Index derived from the World Bank Human Capital Project constitutes the principal explanatory variable, incorporating education, health, and skills dimensions. Control variables include logarithmic GDP per capita (constant 2015 USD), government education expenditure (percentage of GDP), trade openness (exports plus imports as percentage of GDP), and institutional quality constructed as the arithmetic mean of six World Governance Indicators.

Table 1: Selected Human Capital and Inequality Indicators for West African Economies

Country	HCI Score (2020)	Gini Coefficient	Survey Year	Informal Emp. (approx.)
Nigeria	0.36	35.1	2022	~80%
Ghana	0.45	43.5	2016	~85%
Senegal	0.38	38.1	2019	~88%
Benin	0.37	47.8	2015	~90%
Côte d'Ivoire	0.36	41.5	2018	~85%
Burkina Faso	0.34	35.3	2018	~85%
Mali	0.33	41.0	2018	~90%
Niger	0.29	42.5	2019	~90%
Togo	0.35	43.1	2017	~88%

Guinea-Bissau	0.29	50.7	2010	~91%
Sierra Leone	0.34	35.2	2018	~86%
Guinea	0.31	33.7	2012	~89%
The Gambia	0.36	47.3	2015	~87%
Liberia	0.33	36.5	2016	~85%
SSA Average	0.40	41.5	Varies	~85–89%

Sources: *World Bank Human Capital Project (2020); World Bank Poverty and Inequality Platform (2023); Dataphyte (2022); ILO Women and Men in the Informal Economy (2023).*

3.2 Model Specification

The empirical model for examining the effect of human capital on income inequality across the 14-country West Africa panel is specified as:

$$GINI_{it} = \beta_0 + \beta_1 HCI_{it} + \beta_2 \ln(GDP)_{it} + \beta_3 GOVEXP_{it} + \beta_4 OPEN_{it} + \beta_5 INSTQ_{it} + \alpha_i + \varepsilon_{it} \dots (1)$$

where $GINI_{it}$ represents the Gini coefficient for country i at time t ; HCI_{it} is the Human Capital Index; $\ln(GDP)_{it}$ is the natural logarithm of GDP per capita; $GOVEXP_{it}$ is government expenditure on education as a percentage of GDP; $OPEN_{it}$ is trade openness; $INSTQ_{it}$ is the composite institutional quality index; α_i denotes country-specific fixed effects; and ε_{it} is the error term.

3.3 Panel ARDL-PMG Error Correction Model

The Panel ARDL model in error correction representation is specified as:

$$\Delta GINI_{it} = \varphi_i ECT_{i,t-1} + \sum_{k=1}^n \lambda_{ik} \Delta GINI_{i,t-k} + \sum_{k=0}^n \delta'_{ik} \Delta X_{i,t-k} + \mu_i + \varepsilon_{it} \dots (2)$$

where $\Delta GINI_{it}$ represents the first difference of the Gini coefficient; $ECT_{i,t-1}$ is the error correction term lagged one period; φ_i is the adjustment coefficient (expected negative); λ_{ik} represents short-run lagged dependent-variable coefficients; δ_{ik} are short-run dynamic coefficients on regressor differences; X_{it} is the vector of explanatory variables (HCI , $\ln(GDP)$, $GOVEXP$, $OPEN$, $INSTQ$); and μ_i denotes country-specific effects. The long-run relationship embedded within the ECT is estimated using the Pooled Mean Group estimator.

3.4 Diagnostic Testing Procedure

Preliminary diagnostic testing includes cross-sectional dependence testing via the Pesaran CD test, second-generation unit root testing through the CIPS procedure, and Westerlund error-correction cointegration testing. The Pesaran CD test examines whether West African countries share common macroeconomic shocks. The CIPS unit root test accounts for cross-sectional dependence, with rejection of the unit root null hypothesis at critical values of approximately -2.16 at the five per cent significance level indicating stationarity. The Westerlund test examines whether long-run cointegrating relationships exist among variables. Robustness checks use Hausman testing to

compare Pooled Mean Group with Mean Group estimators, alongside variance inflation factor diagnostics to detect multicollinearity.

4. Data Analysis and Results

Table 2 presents the preliminary diagnostic tests, which confirm that the data satisfy Panel ARDL-PMG estimation requirements. The Pesaran cross-sectional dependence test yields a CD statistic of 12.47 ($p < 0.001$), strongly rejecting independence and confirming that West African countries share common macroeconomic shocks. The CIPS unit root test establishes that all variables are integrated of order one, $I(1)$, upon first differencing. The Westerlund cointegration test rejects the null hypothesis of no cointegration ($p < 0.05$ across all four test variants), confirming long-run equilibrium relationships.

Table 2: Preliminary Diagnostic Tests for Panel ARDL-PMG Estimation

Diagnostic Test	Test Statistic	P-value	Interpretation
Pesaran Cross-Sectional Dependence (CD)	12.47	<0.001	Strongly rejects independence; countries share common macroeconomic shocks.
CIPS Unit Root Test (Levels)	All variables > -2.16	—	All variables integrated of order one, $I(1)$, in levels
CIPS Unit Root Test (First Differences)	All variables < -2.16	<0.001	All variables stationary, $I(0)$, upon first differencing
Westerlund Cointegration Test	Rejects H_0 across all four variants	<0.05	Long-run equilibrium relationships confirmed among all variables

Note. H_0 denotes the null hypothesis. Critical value for the CIPS test at 5% significance ≈ -2.16 for $N = 14$, $T = 31$.

Source: Authors' computation, 2026

Table 3 presents the descriptive statistics for the full 14-country panel (434 observations), revealing a mean Gini coefficient of 40.64 (SD = 4.36), a Human Capital Index mean of 106.55 (SD = 42.17), a logarithmic GDP per capita mean of 6.75 (SD = 0.68), a government education expenditure mean of 2.85 per cent of GDP (SD = 1.12), a trade openness mean of 53.79 per cent (SD = 19.43), and an institutional quality mean of -0.68 (SD = 0.76), indicating persistently high inequality, low education spending relative to international benchmarks, and substantial governance deficits across the region.

Table 3: Descriptive Statistics for the 14-Country West Africa Panel (N = 434)

Variable	Mean	Std. Deviation	Minimum	Maximum
Gini Coefficient (GINI)	40.64	4.36	35.1	50.7
Human Capital Index (HCI)	106.55	42.17	43.12	222.88
ln(GDP per capita)	6.75	0.68	5.12	8.41
Government Education Expenditure (% GDP)	2.85	1.12	1.23	6.87
Trade Openness (% GDP)	53.79	19.43	18.64	118.32
Institutional Quality Index	-0.68	0.76	-2.34	+1.89

Note. High inequality: Gini mean of 40.64 exceeds the high-inequality threshold of 40.0. Low education spending: 2.85% is below the UNESCO benchmark of 4–6%. Negative institutional quality reflects governance deficits.

Source: Authors' computation, 2026

Table 4 presents the Panel ARDL-PMG long-run results. The human capital coefficient is $\theta_1 = +0.084$ (SE = 0.121, $z = 0.70$, $p = 0.459$), indicating statistical insignificance at conventional thresholds: a one-unit increase in the Human Capital Index is associated with a 0.084-unit increase in the Gini coefficient in the long-run equilibrium, but the large standard error and high p-value indicate this estimate is not reliably different from zero. The coefficient on logarithmic GDP per capita is $\theta_2 = -11.04$ (SE = 1.87, $z = -5.91$, $p < 0.001$), indicating that a one-percentage-point increase in real per capita income is associated with an 11-point reduction in the Gini coefficient in the long run — the dominant inequality-reducing mechanism identified in the model. The error-correction term is estimated as $\lambda = -0.357$ (SE = 0.084, $z = -4.25$, $p < 0.001$), indicating that approximately 35.7 per cent of any short-run deviation from the long-run inequality equilibrium is corrected annually, confirming a stable cointegrating relationship. Coefficients on government education expenditure, trade openness, and institutional quality are statistically insignificant across the specification ($p > 0.05$), suggesting that these variables do not exert significant direct long-run effects on inequality within the West African context.

Table 4: Panel ARDL-PMG Long-Run Coefficients (14-Country West Africa Panel)

Dependent variable: Gini Coefficient; Estimation method: Pooled Mean Group (PMG)

Variable	Coefficient	Std. Error	Z-statistic	P-value	Significance
Human Capital Index (θ_1)	+0.084	0.121	+0.70	0.459	Insignificant
ln(GDP per capita) (θ_2)	-11.04	1.87	-5.91	<0.001	***Highly significant
Government Educ. Exp. (θ_3)	-0.187	0.243	-0.77	0.442	Insignificant
Trade Openness (θ_4)	+0.031	0.058	+0.53	0.595	Insignificant
Institutional Quality (θ_5)	+0.142	0.156	+0.91	0.363	Insignificant
Error-Correction Term (λ)	-0.357	0.084	-4.25	<0.001	***Highly significant

Source: Authors' computation, 2026

Table 5 presents the Hausman specification test comparing Pooled Mean Group versus Mean Group estimators, which yields $H = 0.000$ ($df = 5$, $p = 1.000$), firmly failing to reject the null

hypothesis of long-run slope homogeneity and validating the Pooled Mean Group estimator as both consistent and more efficient than the heterogeneous Mean Group alternative. Variance inflation factor diagnostics confirm the complete absence of multicollinearity among regressors, with all VIF values ranging from 1.027 to 1.424, substantially below the critical threshold of 10.0.

Table 5: Specification Tests and Robustness Diagnostics

Test Name	Test Statistic / Specification	Result / Range	Interpretation
Hausman Test (PMG vs MG)	$H = 0.000$, $df = 5$	$p = 1.000$	Fails to reject the null of long-run slope homogeneity; PMG is consistent and efficient.
Variance Inflation Factor (VIF)	Range: 1.027–1.424	All VIF < 10.0	Complete absence of multicollinearity
Model Fit: R^2 (PMG)	Overall model	0.687	Model explains 68.7% of variation in the Gini coefficient
Lag Structure Selection	AIC vs BIC comparison	$p = 2$, $q = 2$ (AIC)	Optimal lag length via AIC; robust to alternative lag specifications
Long-run Slope Homogeneity	Pooled vs individual estimation	$p = 1.000$	Long-run coefficients are homogeneous across all 14 countries

Note. PMG = Pooled Mean Group; MG = Mean Group; AIC = Akaike Information Criterion; BIC = Bayesian Information Criterion. All diagnostic tests support the validity and appropriateness of the Panel ARDL-PMG methodology.

Source: Authors' computation, 2026

5. Discussion, Conclusion and Recommendations

The estimated long-run coefficient for human capital is positive but statistically insignificant ($\theta_1 = 0.084$, $p = 0.459$), indicating that the observed association between human capital and income inequality is weak and cannot be distinguished from zero at conventional significance levels. The positive sign suggests that, conditional on the other variables in the model, higher human capital is associated with a small increase in the Gini coefficient, although the statistical evidence does not support interpreting this as a systematic inequality-increasing effect. This result differs from Lee and Lee (2018), who reported that educational expansion was associated with lower income inequality in a 113-country panel, but is more consistent with Molla (2021), who found weaker inequality-reducing effects of human capital in Sub-Saharan Africa. The finding also accords with Nunoo et al. (2024), who reported that the inequality-reducing effect of human capital in African economies depends on governance quality, and with Adeleye and Osaretin (2024), who found that institutional quality strengthens the distributional effect of human capital. Similarly, Langnel et al. (2021) found that resource dependence can weaken the human capital–inequality relationship

within ECOWAS, indicating that the distributional effect of human capital is sensitive to the economic and institutional conditions within which it is accumulated.

Per capita income records a negative and highly statistically significant long-run coefficient ($\theta_2 = -11.04$, $p < 0.001$), making it the only variable in the estimated model with strong evidence of a direct inequality-reducing association. The magnitude indicates that a one-unit increase in the logarithm of GDP per capita is associated with an approximately 11.04-point reduction in the Gini coefficient, holding the other variables constant. This substantially larger estimated effect, relative to the coefficient on human capital, indicates that improvements in aggregate income conditions have a stronger observed distributional association in the sample than changes in the Human Capital Index. The result is consistent with the literature's observation that improvements in human capital have not necessarily produced proportional reductions in inequality across West Africa, partly because the translation of education and skills into income depends on access to productive employment and labour market conditions. Evidence from the region shows that labour market segmentation and limited absorption of educated workers into productive employment can restrict the distributional returns to human capital (ILO, 2023), which provides a plausible context for why income growth exhibits a stronger association with inequality than human capital in the present estimates.

The error-correction coefficient is negative and statistically significant ($\lambda = -0.357$, $p < 0.001$), providing evidence of adjustment towards the estimated long-run equilibrium, with approximately 35.7 per cent of short-run disequilibrium corrected within a year. The coefficient therefore indicates meaningful but incomplete annual adjustment, implying that changes in inequality do not fully transmit to their long-run equilibrium level within a single period. This pattern is consistent with the structural persistence identified in the literature, including labour market segmentation, financial constraints, institutional weaknesses, and macroeconomic instability, which can delay the distributional effects of economic and human capital changes (Menyilim et al., 2021; Ewoh et al., 2025). Government education expenditure has a negative but statistically insignificant coefficient ($\theta_3 = -0.187$, $p = 0.442$), while trade openness ($\theta_4 = 0.031$, $p = 0.595$) and institutional quality ($\theta_5 = 0.142$, $p = 0.363$) are also statistically insignificant, indicating insufficient evidence of direct long-run effects within this specification. This result is consistent with Coulibaly et al. (2025), who found that education expenditure alone did not significantly reduce inequality under weak governance conditions, and with Nunoo et al. (2024), whose threshold results indicate that institutional conditions influence when human capital generates stronger distributional effects.

The study concludes that human capital accumulation does not have a statistically significant long-run effect on income inequality in West Africa (1994–2024) under the Panel ARDL-PMG framework, although a stable cointegrating and equilibrium-adjusting relationship exists among the variables. Economic growth, measured through per capita income expansion, is the dominant force in reducing inequality, outweighing human capital effects. The findings imply that human capital only becomes distributionally effective when supported by strong institutions, inclusive labour markets, and equitable access mechanisms; poor institutional quality and labour market segmentation limit its impact on inequality reduction across the region.

Based on these findings, it is recommended that West African countries promote sustained and inclusive economic growth through structural transformation, agricultural productivity, and productive employment creation. Human capital investment should focus on improving the quality of, and equitable access to, education and health services rather than increasing expenditure alone. Financial inclusion should be expanded to improve households' access to resources for education, health, and productive activities. Labour market reforms should promote the equitable integration of skilled workers into productive employment. Institutional quality and public sector effectiveness should also be strengthened to improve the distributional benefits of human capital investment.

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