Research Square

Preprints are preliminary reports that have not undergone peer review.
They should not be considered conclusive, used to inform clinical practice,
or referenced by the media as validated information.

Sustainable Development in Africa: The Role of Industrialization on Poverty and Income Inequality

Joel T. Adeyemo
Bowen University
Abigail O. Dick-Tonye
abigail.oke@bowen.edu.ng
Bowen University
Opeyemi E. Olagunju
Bowen University
Uche A. Osakede
Bowen University
Grace T. Adigun
Bowen University
Johnson O. Olaosebikan
Bowen University
Olayinka O. Adenikinju
Bowen University

Research Article

Keywords: Industrialization, Poverty, Inequality, Africa, System GMM, Feasible Generalized Least Squares

Posted Date: November 18th, 2026

DOI: https://doi.org/10.21203/rs.3.rs-11430878/v1

License: This work is licensed under a Creative Commons Attribution 4.0 International License. Read Full License

Additional Declarations: No competing interests reported.

Abstract

Industrialization is vital for economic growth, job creation, and poverty reduction. However, African economies continue to face structural challenges such as poor infrastructure, weak institutions, and low labor absorption, raising doubts about industrialization's true impact. This study investigates the effects of industrial employment and human capital measured by adult literacy on poverty and income inequality across Africa, using panel data from all African countries between 2011 and 2024, obtained from the World Development Indicators. Findings are shown using the System GMM and the FGLS to address endogeneity and cross-sectional dependence. Evidence reveals that industrial employment has no significant effect on poverty or inequality, suggesting that current industrial jobs do not enhance welfare. Adult literacy shows a positive and significant association with both poverty and inequality, implying a disconnect between education and labor market needs, as well as unequal returns to education. The interaction of literacy and industrial employment also yields no significant outcomes. In contrast, access to electricity reduces poverty and inequality. These results suggest that industrialization and literacy, in their current forms, have limited inclusive impact. Policies targeted at harnessing the benefits of industrialization should align education with labor market demands, and improve access to infrastructure, particularly electricity.

Introduction

Poverty and inequality have remained persistent challenges across most African countries over decades, despite episodes of economic growth. In 2022, Sub-Saharan Africa accounted for the highest global share of people living on less than $2.15 per day, underscoring the limited inclusivity of economic gains (World Bank, 2024). This contrasts with the experience of East Asian economies, where industrial growth has significantly reduced poverty, most notably in China, which lifted over 800 million people out of poverty through sustained industrialization (United Nations, 2023). Global frameworks such as the United Nations Sustainable Development Goals (SDGs) highlight this concern. Specifically, SDG 1 aims to "end poverty in all its forms everywhere," while SDG 10 seeks to "reduce inequality within and among countries" (United Nations, 2015). With periods of economic growth linked to industrial activities, many African nations continue to experience persistent poverty and widening income inequality. The continent accounts for more than half of the world's poor, with about 67% living in extreme poverty and income inequality, measured by the Gini coefficient, remains high at 35.1, indicating persistent disparities in wealth distribution (World Bank, 2023).

Industrialization is often regarded as a pathway to economic transformation, job creation, and improved living standards, contributing to the broader objective of social inclusion. The expectation is that a growing industrial sector will lead to increased employment opportunities, higher wages, and overall poverty reduction (Albagoury, 2021; Siyakiya et al., 2023). However, many African economies experience structural bottlenecks such as inadequate infrastructure, high exchange rate volatility, bureaucratic hurdles, poor regional integration, and weak institutional frameworks which pose significant challenges to industrial expansion (Memedovic, 2020; Jigang, 2018; Oiro, 2020). These constraints raise critical concerns about whether industrialization in Africa genuinely translates into reduced poverty and a more equitable income distribution.

The extant literature provides mixed evidence on the relationship between industrialization, poverty alleviation, and income inequality. While some studies suggest that industrial expansion significantly reduces poverty and income disparities (Lane, 2016; Erumban & de Vries, 2021), others argue that industrial growth in some developing countries has been largely capital-intensive, benefiting a small segment of the population while leaving the majority in low-productivity in the informal employment (Ghosh, 2014). Given these contradictions, this study provides a renewed examination of the extent to which industrialization in Africa can contribute to poverty and income equality reduction. Unlike previous studies that focused primarily on the direct and interactive effect of industrialization and human capital on poverty and income inequality. This is because human capital is often considered a key driver of wellbeing (OECD, 2020; World Bank, 2023). In doing so, the study attempted to bridge the existing knowledge gap by evaluating whether industrialization is an effective driver of inclusive development in the African context, given poverty and income inequality reduction among the peoples.

Research Objectives

The specific objectives of this study are to:

1. examine the direct and interactive effect of industrialization and human capital on poverty, using the poverty headcount ratio as the measure; and
2. assess the direct and interactive effect of industrialization and human capital on income inequality, measured by the Gini coefficient.

Literature Review

Industrialization has long been considered a crucial driver of economic development, particularly in the context of developing countries. The literature reveals a complex interplay between industrialization, economic growth, income disparity, and sustainability.

Szirmai (2012) emphasizes the historical significance of industrialization as an engine of growth in developing countries between 1950 and 2005. His analysis confirms that manufacturing has been a key sector for productivity growth and structural transformation. However, he also notes that the contribution of industrialization to growth has varied widely across countries, largely influenced by policy frameworks, institutional capacities, and global economic trends. Expanding on this historical context, Chang & Zach (2019) argue that successful industrialization requires proactive state involvement and strategic policy-making. Drawing on Asian developmental experiences, they demonstrate how targeted industrial policies and investment in human capital can lead to transformative development outcomes. Their findings suggest that industrialization is not automatic but contingent upon deliberate developmental state strategies.

Moyo (2017) evaluates Africa's progress towards inclusive and sustainable industrialization, highlighting both achievements and persistent challenges. He notes that while there is increased political commitment, structural issues such as inadequate infrastructure, limited financing, and weak institutions continue to hinder progress. Moyo stresses the importance of aligning industrial policy with sustainability and

inclusiveness goals to avoid exacerbating inequality and environmental degradation. Similarly, Memedovic (2020) provides a detailed analysis of industrialization in Africa and least developed countries (LDCs), noting the continued reliance on low-productivity sectors. The study pointed out that global shifts in technology and production networks offer both opportunities and challenges. The study emphasized the need for capacity development, regional integration, and upgrading within global value chains as pathways to industrial resilience and competitiveness.

Innovation and inclusion are at the heart of the discourse in the work of Naudé & Nagler (2015). They asserted that industrialization in the 21st century must be innovation-driven and inclusive to be sustainable. The authors argued that new industrialization strategies should focus on leveraging digital technologies, fostering entrepreneurship, and ensuring broad-based participation, particularly for youth and marginalized groups.

Focusing on India, Ghosh (2015) investigated the connections among growth, industrialization, and inequality. The study revealed that while India experienced significant economic growth, the industrial sector's role has been limited and uneven. Ghosh attributes rising inequality to the neglect of labor-intensive manufacturing and insufficient redistribution mechanisms, cautioning against growth strategies that prioritize capital-intensive industries without addressing broader socio-economic disparities. These studies underscore that while industrialization remains a pivotal development strategy, its success hinges on inclusivity, innovation, policy coherence, and contextual adaptability. Future industrial strategies must integrate environmental sustainability, social equity, and technological readiness to remain relevant in a rapidly changing global economy.

Industrialization has long been associated with both the promise of economic development and the peril of rising income disparities. Empirical studies have increasingly examined the nuanced relationship between industrial growth and income inequality, incorporating new mediators such as institutional quality, digital infrastructure, and spatial dynamics. For instance, Halili & Gonzalez (2025) conducted a cross-country panel study and argued that institutional quality significantly alters how industrialization affects income inequality. Countries with strong institutions and characterized by rule of law, transparency, and efficient redistribution tend to buffer the inequality-inducing effects of rapid industrial growth. Bazhukov & Kuznetsov (2017) examined how shifts from agriculture to industry affect wage and income inequality. Using a global dataset, results showed a negative relationship between industrial employment and inequality, suggesting that industrial jobs tend to reduce disparities.

Unlike Bazhukov & Kuznetsov, who focused on structural employment, Wei & Ming (2023) highlighted digital inclusion as a key inequality-reducing factor within industrial economies. Specifically, the authors explored how internet penetration moderates the relationship between industrialization and inequality. Their findings suggest that access to digital infrastructure can alleviate income disparities, possibly by expanding access to industrial job markets and education. In the same vein, Mamman & Sohag (2023) assessed the role of innovation and digitization spillover on inclusive growth and structural transformation. The objective of this study was to investigate structural transformations' impact on inclusive growth and analyse poverty and income inequality across African countries. Using the moments panel model analysis, digitization impacts

poverty reduction and income inequality in Africa. The study further indicated insignificant industrialization effects on poverty and inequality, suggesting that without improved technological access and infrastructure, industrialization alone may not effectively reduce poverty or income inequality in such regions.

While extant studies analyzed national-level dynamics, Fang & Xia (2022) focused on sub-national spatial disparities, showing how the geography of industrialization matters. Using spatial econometric models, the study found that industrial agglomeration exacerbates regional income inequality in China and therefore, industrial growth is unevenly distributed, creating significant wage differentials across provinces. Richard (2021) assessed the effects of industrial transformation on inequality in Africa using Generalized Method of Moments (GMM). The study discovered how strong industrialization reduces inequality in Africa by considering economic, social, and environmental disparities in the process of industrial transformation.

The relationship between industrialization and poverty has also been debated in development economics. While industrial growth is often credited with fostering employment, productivity, and income gains, recent empirical literature suggests a more nuanced dynamic, particularly in the developing world. An earlier study by (Szirmai and Verspagen, 2015) provided a historical perspective on manufacturing and economic growth, asserting that manufacturing has been a powerful engine for poverty reduction across decades. In line with the theme of inclusivity, Erumban & de Vries (2021) examine the relationship between industrialization and poverty reduction. Their empirical analysis across multiple developing countries finds a positive, though context-specific, link between industrialization and poverty alleviation. They stress that industrial growth alone is insufficient unless accompanied by employment-intensive sectors and equitable income distribution. Similarly, Erumban & de Vries (2024) study structural transformation and poverty in developing economies. They concluded that transitions from agriculture to manufacturing significantly reduce poverty, more so than transitions to services. Bhattacharyya & Resosudarmo (2020) investigated the case of Indonesia, showing that periods of industrial growth correspond with substantial reductions in poverty. Their findings highlight the importance of growth accelerations driven by industry. Rodrik (2022) examined the implications of premature deindustrialization in developing countries. Using panel data, the study revealed that countries which exit manufacturing too early experience slower poverty reduction. This reinforces the idea that a robust industrial sector remains crucial for sustained improvements in living standards. The Causal Mediation Analysis Data from Groningen Growth and Development Centre and UNU-WIDER Economic Transformation Database (ETD) was used to analyze industrialization's role in economic growth and poverty reduction as well as the impact of manufacturing on poverty alleviation. Empirics confirmed that economic growth alone is insufficient for poverty reduction but industrialization, especially manufacturing, creates productive jobs and reduces poverty (Karahasan, 2023).

Studies have shown the association of technological adoption in industry with poverty reduction. For instance, You, et al. (2020) focused on the role of technology in industrial development and its effect on poverty in 17 sub-Saharan African countries. Evidence revealed that closing technological gaps enhances industrial productivity and significantly alleviates poverty. Mateko (2024) examined industrialization’s role in poverty reduction in COMESA and analyzed factors influencing poverty reduction through industrial development. Evidence from the panel autoregressive distributed lag model suggests that industrialization

can significantly reduce poverty and address income inequality by removing trade barriers and harnessing modern technology. Across the reviewed literature, industrialization, particularly in manufacturing remains a powerful mechanism for poverty alleviation while technological adoption can potentially amplify the poverty-reducing effects of industrial development.

While extensive literature has examined the relationship between industrialization and poverty on one hand, and income inequality on the other, these dimensions are often treated as distinct analytical domains. For instance, studies such as Erumban & de Vries (2021, 2024), Bhattacharyya and Resosudarmo (2020), and Karahasan (2023) focus primarily on industrialization's impact on poverty reduction, emphasizing employment generation, structural transformation, and technological spillovers. Conversely, works by Ghosh (2015), Naudé & Nagler (2015), and Fang & Xia (2022) concentrate on how industrial development influences income inequality, particularly through regional disparities, innovation gaps, or labor market segmentation.

A limited number of studies (Mamman & Sohag, 2023; Mateko, 2024) have started to explore both poverty and inequality simultaneously within the context of industrialization. However, these efforts are either geographically narrow or heavily focused on mediating variables such as digital access or trade openness, rather than systematically analyzing the dual impact of industrialization on both poverty and income inequality as interrelated outcomes.

This separation has created a conceptual and empirical gap in understanding how industrialization processes jointly affect poverty and income inequality, two dimensions that are not only economically but also politically and socially intertwined. Addressing this gap is essential for designing industrial policies that are both pro-poor and equity-enhancing.

Therefore, this study aims to fill this gap by integrating the analysis of poverty and income inequality within a unified framework. It will investigate how industrialization affects both dimensions concurrently, considering their mutual feedback mechanisms and the broader structural context in which industrial development unfolds.

Methodology

This study draws on the Structural Change Theory, with a particular focus on Lewis' Dual Sector Model (1954). The model posits that economic transformation occurs as labour shifts from traditional, low-productivity sectors such as subsistence agriculture, towards modern industrial sectors that offer higher productivity and income. Industrialization, therefore, plays a pivotal role in poverty alleviation by expanding employment opportunities and enhancing household incomes (Lewis, 1954). However, the distributional effects of industrialization are less straightforward. As emphasised in Kuznets' Inverted-U Hypothesis (1955), the early stages of industrial growth may increase income inequality, as initial gains tend to accrue to capital owners and skilled workers. Over time, however, investments in education and broader structural reforms may promote a more equitable distribution of income.

Recognising this dynamic, the present study introduces human capital development as a moderating variable in the industrialization–poverty and industrialization–inequality relationships. This is consistent with empirical insights from Ranis et al. (2000) and, more recently, Awode & Oduola (2025), who argue that without a well-developed human capital base, the benefits of structural change are likely to be skewed or delayed.

Accordingly, to assess the first objective, how industrialization affects poverty and how this relationship is conditioned by human capital, the following panel model is specified:

$$P_{it} = \alpha_0 + \alpha_1 \varphi_{it} + \alpha_2 \theta_{it} + \alpha_3 (\varphi_{it} * \theta_{it}) + \alpha_4 \omega_{it} + \epsilon_{it} \ldots\ldots\ldots\ldots\ldots\ldots (i)$$

where the dependent variable P_{it} represents the poverty headcount ratio for country i at time t. The core predictor, φ_{it}, captures the level of industrialization, proxied by percentage of labour force employed in the industrial sector. Human capital development, denoted by θ_{it}, is measured using adult literacy rates. While $(\varphi_{it} * \theta_{it})$ serves as the interaction term for industrialization and human capital (Adeosun et al., 2023), ω_{it} indicates a vector of relevant control variables based on empirical studies, such as real GDP, trade openness, electricity access, and control of corruption. The term ϵ_{it} account for unobserved factors and random disturbances across countries and over time.

To address the second objective examining the relationship between industrialization and income inequality, the following model is specified:

$$G_{it} = \beta_0 + \beta_1 \delta_{it} + \beta_2 \gamma_{it} + \beta_3 (\delta_{it} * \gamma_{it}) + \beta_4 \sigma_{it} + \mu_{it} \ldots\ldots\ldots\ldots\ldots\ldots (ii)$$

where G_{it} represents the Gini coefficient for country i at time t. The main explanatory variable, δ_{it}, captures the level of industrialization, while γ_{it}, denotes human capital development. An interaction term, $(\delta_{it} * \gamma_{it})$, is included to examine how human capital moderates the relationship between industrialization and poverty, and income inequality, while σ_{it} refers to control variables, and μ_{it} is the error term. By integrating both theoretical and empirical perspectives, the models are well-positioned to capture the nuanced roles of industrialization and human capital in shaping poverty and inequality outcomes in Africa.

Estimation Techniques

The data used in the study is analysed using the System Generalized Method of Moments (GMM) to account for suspected endogeneity between the predictor variables, industrialization as well as human capital; and the dependent variables, specifically poverty and income inequality. The results are also shown using the Feasible Generalized Least Squares (FGLS) for robustness check of the estimates. The FGLS accounts for heterogeneity and cross-sectional dependence common in panel data that are not accounted for by the GMM (Awode & Oduola, 2025).

Data Sources

Data for the study were sourced from the World Development Indicators (WDI) of the World Bank (2024). The study covered the period 2011 to 2024 across African countries (see Table A1), focusing on indicators related to industrialization, education, poverty, and income inequality.

Results and Interpretation

Table 1
Summary statistics

Variable	Definition	Obs	Mean	Std. dev.	Min	Max
Pov_hdct_p ~ p	Poverty headcount ratio at national poverty lines (% of population)	83	39.9434	5.2029	4.8000	82.3000
Ineq	Gini index	99	40.2081	2.5123	27.6000	63.0000
Ind_employ	Employment in industry (% of total employment) (modeled ILO estimate)	688	14.9159	7.4271	3.0496	34.8508
Ad_Lit	Literacy rate, adult total (% of people ages 15 and above)	164	66.0149	9.5436	22.0000	96.2000
Ind_HC	Employment in industry (% of total employment) (modeled ILO estimate) *Literacy rate, adult total (% of people ages 15 and above)	163	997.282 2	550.2096	177.8460	2934.3340
RGDP	GDP per capita (constant 2015 US$)	680	2491.4620	2952.2510	253.5307	19481.65
Trade	Trade (% of GDP)	614	73.1404	41.5325	2.4737	347.9965
Elec_access	Access to electricity (% of population)	702	51.3694	27.9482	2.8000	100.0000
CC	Control of Corruption: Estimate	702	-0.6666	0.6630	-1.9696	1.6985

Source: Authors' Computation (2025).

Table 1 presents the summary statistics for the variables employed in the analysis, providing a snapshot of economic and development conditions in Africa. On average, nearly 40% of the population lives below the national poverty line, which is significantly higher than global levels. According to the World Bank (2025), the global extreme poverty rate, using the two dollars fifteen cents per day benchmark, was approximately 10.5% in 2022, while it reached 45.5% in SSA. Income inequality, as measured by the Gini index, averages about 40.2, placing the region among high-inequality economies. Globally, only 22% of countries report Gini values above 40 (World Bank, 2024; UNICEF, 2011), which highlights Africa's pronounced income disparity.

Only about 15% of the labour force is employed in the industrial sector. Similar patterns are observed across SSA, where industry contributes around 11 of GDP yet operates with high capital intensity despite low per capita incomes (AfDB, 2022; Rodrik, 2018). In Ethiopia and Tanzania, the adoption of advanced manufacturing technologies has failed to generate commensurate employment gains, revealing a structural disconnect between industrial expansion and job creation (Diao et al., 2021). Adult literacy averages 66%, pointing to significant educational challenges. The interaction between industrialization and human capital, with a mean value of 997, varies widely, suggestive of major disparities in economic and educational development.

The average real GDP per capita is roughly $2,491. This masks a wide gap across African countries, with some recording as low as $254 and others as high as $19,481. Trade openness is fairly high, with trade representing about 73% of GDP. Electricity access is also uneven. On average, only about half of the population has access to power, limiting productivity and daily welfare. Finally, the control of corruption score stands at -0.67. This reinforces concerns over governance quality and institutional weaknesses in many parts of the regions that may hamper development efforts.

Pre-estimation tests

Table 2
Correlation matrix

Pov_hdct_p ~ p	Pov_hd ~ p	Ineq	Ind_em ~ y	Ad_Lit	Ind_HC	RGDP	Trade	Elec_a ~ s	CC
	1								
Ineq	0.1229	1							
Ind_employ	-0.1121	-0.0313	1						
Ad_Lit	-0.0513	0.1159	0.1781	1					
Ind_HC	-0.1157	0.0016	0.9569	0.4281	1				
RGDP	-0.1293	0.0092	0.3267	0.2316	0.3661	1			
Trade	-0.0731	0.0747	0.1142	0.0955	0.1374	0.4281	1		
Elec_access	-0.1782	-0.0417	0.6179	0.2775	0.6417	0.6258	0.2097	1	
CC	-0.0994	0.0425	0.3514	0.1588	0.3661	0.399	0.2535	0.4265	1

Source: Authors' Computation (2025).

Table 2 presents the correlation matrix for the study variables across African countries. Most variables show weak to moderate correlations, suggesting generally low risks of multicollinearity. The highest correlation is between the interaction term of industrialization and human capital (Ind_HC) and industrial employment (Ind_employ), with a coefficient of 0.9569. While this may appear high, it is not problematic because these variables are used in separate model specifications and are not jointly included in the same

regression equation. This design choice avoids any inflation of standard errors due to multicollinearity. Other correlation values, such as between electricity access and real GDP (0.6258), or between Ind_HC and electricity access (0.6417), remain below the common multicollinearity threshold of 0.8. Hence, the matrix supports the robustness of the models and confirms that multicollinearity is not a concern in this study.

Table 3
CSD and CIPS checks

Variable	**CSD Statistics**	**CIPS**	
Pov_hdct_p ~ p	0.063	-12.553***	-15.037***
Ineq	1.197	-11.923 ***	-14.582 ***
Ind_employ	9.299**	1.497	-5.952 ***
Ad_Lit	2.883***	-11.708***	-14.501 ***
Ind_HC	2.081**	-7.163***	-13.902***
RGDP	29.617***	-1.645 **	-11.663 ***
Trade	13.214***	-2.287 ***	-10.043 ***
Elec_access	98.534***	3.985	-12.760 ***
CC	0.175	-0.879	-10.220***

Source: Authors' Computation (2025).

Note

*** p < 0.01, ** p < 0.05, * p < 0.1.

****, **,* indicate statistical significance at the 1%, 5% and 10% level CSD-Cross sectional dependence; CIPS =cross-sectionally augmented IPS*.

Table 3 reports the results of the pre-estimation checks for cross-sectional dependence (CSD) and stationarity using the Cross-sectionally Augmented IPS (CIPS) test. The CSD statistics show that most variables such as industrial employment, adult literacy, real GDP, trade, electricity access, and the interaction term Ind_HC display statistically significant cross-sectional dependence. This implies that shocks affecting one country in the panel may spill over to others, which is common in macro-panel studies covering Africa. Consequently, the results suggest the need to account for such interdependence in the empirical strategy to avoid biased estimates.

The CIPS test further reveals that while not all variables are stationary at level, they all attain stationarity after first differencing, indicating integration of order one, I(1). These unit root characteristics justify the application of estimation techniques such as System GMM and FGLS, both of which are well-suited for panels with I(1) variables and capable of addressing issues of endogeneity, heteroskedasticity, and cross-sectional dependence.

Table 4
System GMM regression estimates Dependent Variables: Poverty headcount and income inequality

VARIABLES	(1)	(2)	(3)	(4)
	Pov_hdct_per_pop	lneq	Pov_hdct_per_pop	lneq
L.Pov_hdct_per_pop	-0.399*		-0.411*	
	(0.236)		(0.232)	
LogInd_employ	0.461	-0.031		
	(0.582)	(0.216)		
Ad_Lit	0.026*	-0.023		
	(0.015)	(0.090)		
LogRGDP	-0.364	0.376**	-0.319	0.327**
	(0.545)	(0.167)	(0.561)	(0.145)
Trade	-0.005	0.002	-0.005	0.001
	(0.005)	(0.002)	(0.005)	(0.002)
Elec_access	-0.041*	-0.018**	-0.040*	-0.020***
	(0.022)	(0.008)	(0.022)	(0.007)
CC	-0.308	0.341**	-0.292	0.277**
	(0.371)	(0.153)	(0.370)	(0.126)
L.lneq		-0.056		0.104
		(0.141)		(0.176)
Ind_HC			0.0004	0.000
			(0.0004)	(0.000)
Constant	57.97***	40.80***	60.58***	34.39***
	(10.67)	(5.836)	(10.38)	(7.087)
Observations	648	648	648	648
Number of ID	54	54	54	54
Arellano-Bond test for AR(1) in first differences:	z = -0.79 Pr > z = 0.432	z = -2.81 Pr > z = 0.005	z = -0.77 Pr > z = 0.441	z = -2.88 Pr > z = 0.004
Arellano-Bond test for AR(2) in first differences:	z = -1.64 Pr > z = 0.102	z = 0.03 Pr > z = 0.979	z = -1.68 Pr > z = 0.093	z = 0.95 Pr > z = 0.342

VARIABLES	(1)	(2)	(3)	(4)
	Pov_hdct_per_pop	lneq	Pov_hdct_per_pop	lneq
Sargan test of overid. restrictions:	chi2(10) = 12.02 Pr>chi2 = 0.284	chi2(9) = 17.20 Pr>chi2 = 0.046	chi2(10) = 12.56 Pr>chi2 = 0.249	chi2(10) = 10.60 Pr>chi2 = 0.390
Hansen test of overid. restrictions:	chi2(10) = 9.88 Pr>chi2 = 0.451	chi2(9) = 13.18 Pr>chi2 = 0.155	chi2(10) = 10.24 Pr>chi2 = 0.420	chi2(10) = 13.44 Pr>chi2 = 0.200

Source: Authors' Computation (2025).

Notes: Standard errors in parentheses. *** p < 0.01, ** p < 0.05, * p < 0.1.

Table 4 displays the System GMM results for our study objective from Column 1 to 4. Columns 1 and 2 capture the direct effect of industrialization, measured using labour employment in the industry as a percentage of total employment and human capital measured using adult literacy rate on poverty and income inequality, respectively. Columns 3 and 4 measure the interactive effect of both variables on poverty and income inequality. The lag of poverty headcount ratio is negative and significant at the 10% level in Columns 1 and 3, implying a degree of persistence in poverty dynamics, i.e., past poverty levels influence current outcomes. Specifically, a 1% increase in the previous year's poverty rate reduces the current poverty rate by approximately 0.40%, which suggests some degree of poverty reduction over time, potentially due to policy adjustments or economic adaptation. A similar effect was observed in the lag value of income inequality, albeit insignificant.

Regarding our main variables of interest, the findings indicate that industrial employment shows a positive yet statistically insignificant effect on poverty in Column 1. This suggests that an increasing share of employment in the industrial sector does not directly translate into poverty reduction across Africa. A possible explanation is that industrial jobs in many African economies remain limited in scope, highly informal, and poorly remunerated, thus failing to provide the inclusive economic uplift needed to reduce poverty significantly (Erumban & de Vries, 2021; Memedovic, 2020). Similarly, adult literacy displays a positive and statistically significant coefficient in Column 1, indicating that higher literacy levels are associated with an increase in the poverty headcount ratio, contrasting with the work (Chang & Zach, 2019). While counterintuitive, this result reflects structural mismatches between educational attainment and labour market absorption, particularly if economic opportunities remain scarce or poorly distributed (Moyo, 2017). Interestingly, when adult literacy is interacted with industrial employment in Column 3, the positive coefficient persists but loses significance, suggesting the interaction does not reinforce a clear poverty-reducing synergy.

Our findings further suggest that industrial employment and adult literacy, considered individually, do not exert a statistically significant influence on income inequality in Africa, in contrast to Halili & Gonzalez

(2025). Although their coefficients are negative, indicating a potential inequality-reducing role, the lack of significance implies that industrial jobs and general improvements in literacy have not translated into equitable income distribution across the continent. Interestingly, their interaction term reveals a positive, albeit insignificant, effect on income inequality. This outcome implies that in contexts where industrialization and human capital development occur simultaneously, the benefits may be disproportionately captured by higher-skilled or urban populations, thereby limiting broad-based redistributive effects (Ghosh, 2015; Memedovic, 2020). Such a result hints at possible structural barriers that prevent the inclusive diffusion of industrial and educational gains, such as unequal access to quality jobs, skills mismatch, or urban-rural divides.

In terms of control variables, real GDP, trade openness, electricity access, and control of corruption generally show a negative and insignificant effect on poverty (Szirmai & Verspagen, 2015), except for electricity access, which stands out as a consistent and significant driver of poverty reduction in Columns 1 and 3. This underlines the crucial role of infrastructure in improving living standards, especially in underserved areas. Regarding income inequality, real GDP, electricity access, and control of corruption emerge as significant variables, reinforcing the view that macroeconomic performance, infrastructure expansion, and governance reforms can shape income distribution. Trade openness, however, remains insignificant in all models, suggesting that openness alone may not be sufficient to foster equitable growth without complementary policies that address distributional concerns and structural rigidities.

Table 5
FGLS regression estimates Dependent Variables: Poverty headcount and income inequality

VARIABLES	(1)	(2)	(3)	(4)
	Pov_hdct_per_pop	Ineq	Pov_hdct_per_pop	Ineq
Ind_employ	0.00121	0.00363		
	(0.00674)	(0.00703)		
Ad_Lit	-0.00111	0.0168***		
	(0.00460)	(0.00443)		
LogRGDP	-0.160*	0.120*	-0.165*	0.0820
	(0.0873)	(0.0625)	(0.0870)	(0.0586)
Trade	0.00105	0.000547	0.00108	0.000799
	(0.00118)	(0.00109)	(0.00117)	(0.00105)
Elec_access	-0.00636*	-0.00881***	-0.00624*	-0.00641**
	(0.00343)	(0.00284)	(0.00342)	(0.00272)
CC	-0.0391	0.130**	-0.0367	0.101
	(0.0945)	(0.0634)	(0.0945)	(0.0617)
Ind_HC			1.44e-05	0.000104
			(9.43e-05)	(8.80e-05)
Constant	41.42***	38.67***	41.38***	39.85***
	(0.646)	(0.443)	(0.600)	(0.315)
Observations	702	702	702	702
Number of ID	54	54	54	54

Source: Authors' Computation (2025).

Notes: Standard errors in parentheses. *** p < 0.01, ** p < 0.05, * p < 0.1.

Table 5 presents the FGLS estimation results across four model specifications. Columns 1 and 2 explore the direct effects of industrialization, measured by the share of employment in the industrial sector, and human capital, proxied by adult literacy rate, on poverty and income inequality, respectively. Columns 3 and 4 focus on how the interaction between industrial employment and human capital influences poverty and income inequality in Africa.

In Column 1, industrial employment is positively associated with poverty headcount, suggesting that an increase in industrial jobs does not necessarily lead to poverty reduction in Africa. This positive but

statistically insignificant relationship may reflect the structural nature of the continent's industrial sector, which often comprises low-skill, low-wage, or informal jobs that do not effectively lift individuals out of poverty (Erumban and de Vries, 2021; Mamman and Sohag, 2023). Adult literacy, on the other hand, shows a negative association with poverty, implying that higher literacy could play a role in poverty alleviation. However, this relationship is also statistically insignificant, suggesting that literacy alone may not be sufficient unless it is complemented by economic opportunities. When these two variables interact in Column 3, the resulting coefficient remains positive and insignificant, aligning with the System GMM estimates reported in Table 4. This opposes prior works like Bhattacharyya and Resosudarmo (2020), Karahasan (2023), and Mateko (2024), which highlight industrialization as a significant driver of poverty and inequality reduction. This implies that the joint effect of industrial employment and literacy may not be sufficient to mitigate poverty unless deeper structural issues are addressed.

Regarding income inequality, both industrial employment and adult literacy exhibit a positive relationship in Column 2, indicating that increases in these variables may be associated with higher levels of inequality. However, only adult literacy is statistically significant at the 1% level, suggesting that while education is generally seen as a tool for empowerment, in this context, it may be contributing to inequality, possibly due to unequal access to quality education or returns to education being concentrated among the more affluent (Halili and Gonzalez, 2025). This underscores the need for inclusive educational policies that are sensitive to distributional effects. The interaction term in Column 4 also shows a positive but insignificant coefficient, echoing the findings from Column 3 on poverty and further corroborating the results of the System GMM analysis. It indicates that increasing industrial employment and improving literacy, while important, do not jointly guarantee equity gains without complementary policies in Africa.

For the control variables, real GDP and electricity access emerge as key determinants of poverty in Columns 1 and 3 (Szirmai and Verspagen, 2015). Both show negative coefficients, but only electricity access is statistically significant. This highlights the critical role of infrastructure in reducing poverty, likely through its effect on productivity, access to services, and household welfare. In the case of inequality, electricity access is again the only variable that shows a consistent and significant effect across Columns 2 and 4. This underscores its broader distributional benefits and suggests that policies aimed at expanding reliable access to electricity could play a dual role in promoting both equity and poverty reduction. In contrast, the insignificance of variables like trade and control of corruption points to the complexity of structural transformation in Africa, where traditional levers of economic policy may not always yield immediate or uniform social outcomes.

Conclusion

This study set out to examine the direct and interactive effects of industrialization, measured by industrial employment, and human capital (proxied by adult literacy) on poverty and income inequality across African countries, employing both System GMM and FGLS estimation techniques. The findings yield surprising insights that reflect the structural peculiarities of African economies. Although industrial employment is often promoted as a pathway to economic transformation, the results consistently show a positive but statistically insignificant relationship between industrial employment and poverty, indicating that industrial

jobs in their current form do not effectively translate into poverty reduction. These jobs may be largely informal, precarious, or concentrated in low-productivity subsectors, limiting their impact on household welfare. Similarly, adult literacy, while traditionally seen as a key driver of human development, also fails to exert a robust poverty-reducing effect, and in some specifications, it is even associated with higher poverty levels. This counterintuitive finding likely reflects a disconnect between educational attainment and job market absorption in the region, where economic structures fail to fully integrate the growing educated population.

The joint interaction of industrial employment and adult literacy also fails to produce a statistically significant effect on either poverty or inequality. This suggests that simply improving educational outcomes and expanding industrial job opportunities in parallel does not automatically yield inclusive or equitable development outcomes. On the inequality front, while adult literacy is positively and significantly associated with greater income disparity, industrial employment remains statistically insignificant. This could reflect unequal returns to education, where better-educated individuals capture a disproportionate share of economic opportunities, exacerbating existing disparities. Furthermore, the positive interaction term on inequality suggests that in contexts where both industrialization and literacy improve simultaneously, the benefits may be skewed toward more advantaged segments of society, reinforcing urban-rural divides and social stratification. This outcome underscores the need for structural reforms that not only create jobs but also ensure equitable access to quality education, skills, and economic opportunities.

From a policy perspective, the consistent and significant effect of electricity access on reducing both poverty and inequality highlights infrastructure as a vital lever for inclusive development. Expanding reliable energy access can enhance productivity, improve educational and health outcomes, and stimulate local enterprise, all of which are critical for broad-based welfare improvements. In contrast, traditional policy variables such as trade openness and control of corruption did not demonstrate statistically significant impacts, suggesting that their effectiveness may depend on deeper institutional reforms and complementary policies. Based on these findings, several recommendations are warranted. First, industrial policy in Africa should prioritize not only job creation but also the quality and inclusiveness of employment, particularly targeting youth and women in underserved areas. Second, human capital development strategies should go beyond increasing literacy rates to focus on improving the relevance and quality of education, aligning curricula with labour market needs, and expanding vocational and technical training. Lastly, investments in infrastructure, especially electricity, should be scaled up and equitably distributed, as they have demonstrated clear benefits for reducing poverty and inequality. Together, these strategies could foster a more inclusive industrialization process that aligns with the broader goals of sustainable development across the continent.

Declarations

Ethical approval

Not applicable.

Competing interests

The authors have no competing interests to declare.

Funding statement

The authors did not receive any funds to write and publish this study.

Author Contribution

JTA: Conceptualization, Data curation, Writing—original draft, Writing—review & editing, Visualization. AOD: Writing—original draft, Methodology, Writing—review & editing. OEO: Writing—original draft, Writing—review & editing, Visualization. UAO: Conceptualization, Formal analysis, Writing—original draft, Writing—review & editing, Visualization. GTA: Writing—original draft, Writing—review & editing. JOO: Writing—original draft, Writing—review & editing. OOA: Writing—original draft, Writing—review & editing.

Acknowledgement

Bowen University, Iwo, Osun State, Nigeria.

Data Availability

All data supporting the findings of this study are available upon request.

References

1. Adeosun, O.T., Odior, E.S. and Shitu, A.I. (2023), 'Human capital development, innovation and industrial sector performance in Sub-Saharan Africa', African Economic Conference paper.
2. African Development Bank (2017), Industrialize Africa: Strategies, Policies, Institutions and Financing, African Development Bank, Abidjan.
3. Albagoury, S.H. (2021), 'African pathway to achieve inclusive growth: COMESA case study', Journal of Humanities and Applied Social Sciences, Vol. 3 No. 2, pp. 108–119, doi: 10.1108/JHASS-03-2020-004I5.
4. Awode, S.S. and Oduola, M.O. (2025), 'The interplay between technological innovation and human capital development in driving industrial productivity and competitiveness in Africa', Journal of Economics and Development, Vol. 27 No. 1, pp. 56–71, doi: 10.1108/JED-03-2024-0079.
5. Babasanya, A.O., Okuneye, B.A. and Amaefule, J.N. (2025), 'Interacting labour force and human capital development effects on manufacturing sector productivity', Etikonomi, Vol. 24 No. 1, pp. 221–232, doi: 10.15408/etk.v24i1.38648.

6. Bazhukov, P. and Kuznetsov, V. (2018), 'Industrial employment and income inequality: Evidence from panel data', Structural Change and Economic Dynamics, Vol. 45, pp. 84–93, doi: 10.1016/j.strueco.2018.02.006.
7. Bhattacharyya, S. and Resosudarmo, B.P. (2015), 'Growth, growth accelerations, and the poor: Lessons from Indonesia', World Development, Vol. 66, pp. 154–165, doi: 10.1016/j.worlddev.2014.08.009.
8. Chang, H.J. and Zach, K. (2019), 'Industrialization and development', in Nayyar, D. (Ed.), Asian Transformations: An Inquiry into the Development of Nations, Oxford University Press, Oxford, pp. 186–215, doi: 10.1093/oso/9780198844938.003.0008.
9. Diao, X., McMillan, M. and Rodrik, D. (2021), 'The recent growth boom in developing economies: A structural-change perspective', in Eichengreen, B. et al. (Eds.), The Oxford Handbook of the Economics of the Global South, Oxford University Press.
10. Dossou, T.A.M., Asongu, S., Dossou, K.P. and Alinsato, A.S. (2024), 'The role of the internet in moderating the effect of industrialization on income inequality in Africa', Information Technology for Development, pp. 764–791, doi: 10.1080/02681102.2024.2414404.
11. Erumban, A.A. and de Vries, G.J. (2021), 'Industrialization in developing countries: Is it related to poverty reduction?', UNU-WIDER Working Paper 172/2021, doi: 10.35188/UNU-WIDER/2021/112-9.
12. Erumban, A.A. and de Vries, G.J. (2024), 'Structural change and poverty reduction in developing economies', World Development, Vol. 181, 106674, doi: 10.1016/j.worlddev.2024.106674.
13. Ghosh, J. (2015), 'Growth, industrialization and inequality in India', Journal of the Asia Pacific Economy, Vol. 20 No. 1, pp. 42–56, doi: 10.1080/13547860.2014.974316.
14. Halili, B.L. and Gonzalez, C.R. (2025), 'The contingent effects of economic growth and institutions on income inequality: An empirical study', Journal of Economic Policy Reform, doi: 10.1080/09638199.2025.2451710.
15. Jigang, W. (2018), China's Industrial Policy: Evolution and Experience, UNCTAD.
16. Karahasan, B.C. (2023), 'To make growth reduce poverty, industrialize: Using manufacturing to mediate the effect of growth on poverty', Development Policy Review, Vol. 41 No. 4, e12689, doi: 10.1111/dpr.12689.
17. Liu, L. and An, S. (2023), 'Deindustrialization and the incidence of poverty: Empirical evidence from developing countries', Technological Forecasting and Social Change, Vol. 187, 122202, doi: 10.1016/j.techfore.2022.122202
18. Mamman, S.O. and Sohag, K. (2023), 'Inclusive Growth and Structural Transformation: The Role of Innovation and Digitalisation Spillover', doi:10.17059/ekon.reg.2023-3-1
19. Mateko, F.M. (2025), 'Enhancing regional sustainable industrialization and poverty reduction post-COVID: The case of COMESA', Sustainable Development, https://doi:10.1002/sd.3241
20. Memedovic, O., 2020. Industrialisation in Africa and least developed countries. *Retrieved from: https://www.researchgatenet/publication/339078095*
21. Moyo, T. (2017), 'Promoting inclusive and sustainable industrialization in Africa: A review of progress, challenges and prospects', Africa Development, Vol. 42 No. 3, pp. 95–110.

22. Naudé, W. and Nagler, P. (2015), 'Industrialization, innovation, inclusion', The European Journal of Development Research, Vol. 27 No. 3, pp. 333–346, doi: 10.1057/ejdr.2015.30.
23. OECD (2020), How's Life? 2020: Measuring Well-being, OECD Publishing, Paris, doi: 10.1787/9870c393-en.
24. Oiro, M.O. (2020), Estimating COMESA's Trade Potential in Africa: Optimizing Export Opportunities in the AfCFTA, COMESA.
25. Ranis, G., Stewart, F. and Ramírez, A. (2000), 'Economic growth and human development', World Development, Vol. 28 No. 2, pp. 197–219, doi: 10.1016/S0305-750X(99)00131-X.
26. Rodrik, D. (2018), 'New technologies, global value chains, and developing economies', NBER Working Paper No. 25164, doi: 10.3386/w25164.
27. Siyakiya, P., Erdoğdu, M.M. and Akay, E.C. (2023), 'Impact of industrialisation on economic development in selected African and Asian economies: The role of institutional quality and investment climate', SN Business & Economics, Vol. 3, 211, doi: 10.1007/s43546-023-00585-3.
28. Szirmai, A. (2012), 'Industrialization as an engine of growth in developing countries, 1950–2005', Structural Change and Economic Dynamics, Vol. 23 No. 4, pp. 406–420, doi: 10.1016/j.strueco.2011.01.005.
29. Szirmai, A. and Verspagen, B. (2015), 'Manufacturing and economic growth in developing countries, 1950–2005', Structural Change and Economic Dynamics, Vol. 34, pp. 46–59, doi: 10.1016/j.strueco.2015.06.002.
30. UNICEF (2011), Global Report on Income Inequality and Child Development.
31. UNIDO (2021), Industrial Development Report 2022: The Future of Industrialization in a Post-Pandemic World, United Nations Industrial Development Organization, Vienna.
32. United Nations (2015), Transforming Our World: The 2030 Agenda for Sustainable Development, A/RES/70/1.
33. United Nations Department of Economic and Social Affairs (2023), World Social Report 2023: Leaving No One Behind in an Ageing World.
34. World Bank (2023a), Where in the World Do the Poor Live? It Depends on How Poverty Is Defined, World Bank.
35. World Bank (2023b), World Development Indicators, World Bank.
36. World Bank (2023c), Human Capital, International Development Association, World Bank.
37. World Bank (2024a), Manufacturing, Value Added (% of GDP) – Sub-Saharan Africa, World Bank Data.
38. World Bank (2024b), The Geography of High Inequality: Monitoring the World Bank's New Indicator, World Bank Data Blog.
39. World Bank (2024c), 'Broader access to jobs and public services key to addressing inequality and reducing poverty in Africa `1Z', 4 December.
40. World Bank (2025), June 2025 Global Poverty Update from the World Bank: 2021 PPPs and New Country Data, Poverty and Inequality Platform.

41. You, K., Dal Bianco, S. and Amankwah-Amoah, J. (2020), ‘Closing technological gaps to alleviate poverty: Evidence from 17 sub-Saharan African countries’, Technological Forecasting and Social Change, Vol. 157, 120055, doi:10.1016/j.techfore.2020.120055
42. Zhang, S., Bani, Y., Izah Selamat, A. and Abdul Ghani, J. (2023), 'Exploring the effect of industrial agglomeration on income inequality in China', PLOS ONE, Vol. 18 No. 6, e0287910, doi:10.1371/journal.pone.0287910