

Social Sciences Spectrum

A Double-Blind, Peer-Reviewed, HEC recognized [Y-category](#) Research Journal

E-ISSN: [3006-0427](#) P-ISSN: [3006-0419](#)

Volume 04, Issue 04, 2025

Web link: <https://sss.org.pk/index.php/sss>



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A Data-Driven Analysis of Income Inequality Trends and Their Socioeconomic Determinants in Low-Income Nations

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Article Information [YY-MM-DD]

Received 2025-09-27

Revised 2025-10-27

Accepted 2025-11-29

Citation (APA):

Naseer, M. Z., Zaib, M & Arshad, F. (2025). A data-driven analysis of income inequality trends and their socioeconomic determinants in low-income nations. *Social Sciences Spectrum*, 4(4), 369-384.

<https://doi.org/10.71085/sss.04.04.419>

Abstract

This paper aims to provide a data-based discussion of trends in income inequality and the socioeconomic factors in low income-country settings after which speaks the acute problem of the enduring economic inequality and the determinants of its rise. The first aim is to determine the sources of income inequality with significant factors on the basis of powerful statistical tools that are implemented on cross-national data in the last decades. Applying quantitative methods like regression analysis, factor analysis, seasonal trend modelling, etc., the research studies the variables such as education, working patterns, social policies and economic growth parameters. The results show that there are many interaction complexities between these determinants with educational levels, labor market and social safety nets playing important roles in determining inequality patterns. The conclusion of the study is that the low-income countries require policy interventions on the targeted areas of education and inclusive economic development to reduce income inequality. Such insights are very useful to the policymakers and other development agencies that would wish to promote equitable growth and social stability.

Keywords: Income Inequality, Socioeconomic Determinants, Low-income Nations, Data-driven Analysis.



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Introduction

The recent discussion has made income inequality in low-income countries become a key theme in global development discourse as recent trends have shown that the gaps in incomes have recently increased or stayed high in much of developed world conditions despite the moments of economic prosperity and insufficient poverty (Development Initiatives, 2023; World Bank, 2023). Low-income nations have experienced disproportionate impacts during the compounding crises, such as the Covid 19 pandemic, climatic change, geopolitical crises, and increasing the cost of living, compounded by the low fiscal capacity and benefits of social protection systems that have limited government capacity to mitigate vulnerable populations against negative shocks (United Nations Department of Economic and Social Affairs [UNDESA], 2020; United Nations Conference on Trade and Development [UNCTAD], 2024). Consequently, there is still a significant proportion of the population living in precarious conditions and being exposed to poverty in such countries despite the macroeconomic improvements as indicated by aggregate indicators (Development Initiatives, 2023; World Bank, 2023). It has been established that elucidating the structural and policy-related forces behind these patterns of inequality has thus become a basic agenda of scholars as well as policymakers of inclusion and sustainable development of low-income environments (Kebalo, 2024; UNCTAD, 2024).

An extensive body of empirical research has been done on the directions and drivers of income inequality between countries, in which the common metrics include Gini coefficient, income shares, or related measures of distribution based on household survey and national accounts data (Mdingi, 2021; Development Initiatives, 2023). As a generalized idea, the following body of work draws attention to the fact that even though convergence in average incomes between a high-income country and a middle one has been observed, the within-country inequality has been at a high level or even higher in most developing economies, in terms of uneven access to productive resources, education, formal employment, and social protection (Jianu, 2021; UNCTAD, 2024). Even recent reviews point to the idea that inequality is formed both under the influence of global forces, including trade integration and financialization and technological change and domestic factors, including labor markets structure, tax and transfer system progressivity, and welfare regime coverage and adequacy (Mdingi, 2021; UNDESA, 2020).

In this more general literature, specific interests have been focused on how education, labor markets, and social policies have been significant socioeconomic factors in the distribution of income (Jianu, 2021; IMF, 2021). It is hinted that increased equal access to quality education can minimize inequality by promoting human capital accumulation and open upward mobility opportunities, albeit with inconsistent amounts and timings (Walker et al., 2022; Mdingi, 2021). On the same note, the structure of the labor market, including the nature of informal jobs, sectoral change patterns and wage institutions determine how gains of growth are distributed to the various groups in the population (Jianu, 2021; World Bank, 2023). Once the benefits are high, broadly available, and sufficiently well targeted and generous, social protection systems such as cash transfers, social insurance, and programmes in the labor market can address market-driven inequality but in most low- and lower-middle-income countries the policy remains highly selective, with benefits being low (UNDESA, 2020; Zhang and Zhao, 2021).

Nevertheless, despite these developments, the body of knowledge about income inequality in the poor countries has a number of critical gaps. First, the available empirical literature on the subject primarily concerns middle-income or emerging economies, where data of better quality and

longer time series are available, and the dynamics of inequality and its causes in low-income countries are not as well-documented (Mdingi, 2021; Development Initiatives, 2023). Secondly, research frequently focuses on separate effects of such socioeconomic determinants as education or openness to trade and mechanisms, where the joint and possibly interactive effects of a number of socioeconomic factors are not analysed, further undervaluing the importance of inequality processes in resource-scarce environments (Jianu, 2021; Zhu and Chen, 2024). Third, despite the fact that new cross-national datasets and the improved statistical and machine learning approaches now allow one to engage in more subtle and data-heavy analysis, the use of the tools has only recently been introduced to the study of the determinants of inequality, and the specifics of the applications to the low-income setting remain rather sparse (Zhu & Chen, 2024; UNCTAD, 2024).

It is important to address these gaps since low-income nations have overlapping structural limitations that can change the correlation between common determinants and inequality consequences. They can also compromise the inequality-minimizing nature of education and social policies in both high degree of informality, demographic pressures, a small fiscal space, and weak institutions, and at the same time amplify the distributional impacts of economic shocks (UNCTAD, 2024; Development Initiatives, 2023). Policy interventions that have strong effects in the higher income setting can have less significant or more diverse effects in such settings, and effective policy approaches need to be designed to yield a context-sensitive view of how differences in combinations of socioeconomic determinants predict patterns of inequality over time (UNDESA, 2020; Kebalo, 2024). A more detailed and evidence-based analysis can, in turn, inform a new generation of policy initiatives that go well beyond the generic prescriptions and instead emphasize interventions based on the structural peculiarities of the low-income economies (IMF, 2021; Zhang and Zhao, 2021).

It is against this background that the current paper engages in a scientific investigation of the trends of income inequality and the socioeconomic factors that influence them by taking advantage of recent cross-country data and effective quantitative methods (Zhu & Chen, 2024; Development Initiatives, 2023). The overall objective is to establish and determine the importance of educational level, employment, social policy formation, and economic growth variables in driving inequality, taking into consideration their possible interactions and time dynamics (Mdingi, 2021; Jianu, 2021). By specifically concentrating on the low-income states and taking a general, broad, and empirical method, the research will contribute to the theoretical knowledge on the drivers of inequality in Resource-Limited settings and to producing empirically-driven information, which can be used to inform the design of context-specific, target policy actions, and help alleviate income inequality and enhance more inclusive developmental trajectories (UNDESA, 2020; UNCTAD, 2024).

Research Objectives

Based on the discussion above of enduring income inequalities, multidimensional socioeconomic drivers, and the necessity to combine a data-intensive analysis in low-income assets, the present study will aim to accomplish the following objectives.

1. To rigorously investigate the trend and pattern of income inequality in low-income countries over time with the use of the recent cross-national time series data and other effective quantitative methodologies, and especially the cross-country and time variation.

2. To determine and measure both indirect and interactive impact of the major socioeconomic determinants namely educational attainment, patterns of employment, forms of social policies, and indicators of economic growth on the income inequality patterns in the low-income countries.

Research Questions

To achieve these purposes, the following research questions lead the study, as they attempt to organize the empirical analysis and associate them with the gaps in the existing literature.

1. What has been the change in income inequality levels within the low-income countries in the past decades, and what cross-national and temporal trends are seen within the inequality levels?
2. How, and via what mechanisms, does educational achievement, labor market structure, patterns of social policy, and economic growth variables produce income inequality patterns in low-income countries both singly and collectively?

Literature Review

Theoretical Approaches and Precepts.

The theoretical frameworks informing the understanding of the role of income inequality in low-income countries include several central structural and policy-based aspects of determining the economic inequalities. The main idea of this analysis is the notion of socioeconomic determinants, that is, such factors as educational education, employment trends, social policies, and economic growth indicators. According to the human capital theory, education is a very important mechanism of limiting the inequality factor since it will increase productivity and growth opportunities of individuals (Walker et al., 2022). In addition to this, labor market theories focus on how market structures, including informal employment and institutions of wage setting, mediate when the economic gains are distributed (Jianu, 2021; World Bank, 2023). Social policy frameworks also emphasize the role of social safety nets such as cash transfers and insurance programs as a fundamental buffer in dealing with market-driven inequality as long as they are less restrictive and adequately generous (UNDESA, 2020; Zhang and Zhao, 2021).

The recent theoretical developments combine these individual factors with more complicated, systemic views that explain interactions and time dynamics. As an example, modern models recognize that education, labor and social policies do not work separately, but interact in their formations of inequality paths more so within the context of being constrained by factors typical of low-income settings, including fiscal space and institutional weaknesses (Kebalo, 2024; UNCTAD, 2024). This is consistent with structuralist models of international forces, such as the integration of trade, financialization, technological transformation, and national institutional organization, a multi-layered opinion of the causes of inequality (Mdingi, 2021; UNDESA, 2020). The interaction between these determinants forms the complexity of handling disparity in resource-constrained settings which require mixed and information-intensive frameworks of analysis.

The research also is based on data-intensive theoretical frameworks that make use of superior statistical and machine learning algorithms to segment the puzzle of socioeconomic determinants and their relational dynamics in low-income nations. It is a big change of the past where single determinants were studied, or middle-income conditions, and the advancement is in the form of

more detailed, empirical calculus that can better reflect the heterogeneity of the realities of low-income countries (Zhu and Chen, 2024; UNCTAD, 2024). Such structures form the basis of empirical strategy of the current study which attempts to make a contribution in terms of both theory and practice by developing context sensitive knowledge and policy implication.

Large-scale Academic Advances

The significance and developments of income inequality in low-income countries are highly populated by groundbreaking and more updated academic works, which investigate the nature, trends, and causes of economic inequalities. Classic literature has provided the foundational definition of the measures of inequality, including the Gini coefficient, income shares, and their distribution between income groups in countries and across the globe, showing that systematic within-country inequalities are often not covered by the aggregate growth indicators (Development Initiatives, 2023; Mdingi, 2021). These contributions have prepared the ground to elaborate details on structural causes and effects of inequality on the developing economies.

New literature has narrowed down on particular socioeconomic aspects of inequality. To illustrate, the review conducted by Jianu (2021) highlights the vital roles of education as well as the conditions of the labor market in the formation of the patterns of income distribution. In the meantime, the World Bank (2023) and the International Monetary Fund (2021) emphasize the significance of fiscal policies and reforms in the labor market to address the issue of inequality. The lack of equal educational accessibility and formal shifts in the labor market have been studied as significant differences in equality, especially in low-income nations in which informal work is predominant and social benefits are low (Walker et al., 2022; Zhang and Zhao, 2021).

Improvements of methodology have also represented a major academic progress, with more recent research using cross-national data sets and advanced quantitative research techniques including regression model, factors, and time-series to reflect dynamic and interactive impacts of determinants (Zhu & Chen, 2024; UNCTAD, 2024). These novel methodologies make possible more detailed and solid conceptualization of inequality patterns and have indicated shortcomings in terms of coverage of social policies and the varying effects of economic growth patterns in a wide range of generalizations. Such contributions have led to the increase in more integrated and policy relevant analyses that shape strategies of sustainable development in low-income countries.

Thematic Organization: Trends, Drivers, and Policy Implications

The literature is organized thematically to identify three core areas which include; income inequality trends, socioeconomic drivers and role of policy interventions. Income inequality trends in low-income countries demonstrate its persistence or the increasing difference even after the instances of economic growth and poverty reduction (Development Initiatives, 2023; World Bank, 2023). The trends are informed by the external shocks including pandemics, climate change, and geopolitical instability which affects the vulnerable in disproportionate ways, reverses actions upon the equity process (UNDESA, 2020; UNCTAD, 2024). The chronological studies demonstrate the fact that, though there has been some global convergence in the average incomes, there are still inequalities within countries, which are adversely affecting the inclusive development agendas.

Concerning drivers, education comes to the forefront of determinants through which equal access to quality education fosters the development of human capital and serves to limit the inequality but its usefulness depends on contextual and timely factors (Walker et al., 2022; Mdingi, 2021).

Employment patterns also play another role in inequality since informal labour markets are common in low-income countries which restrict wage gains and social safeguard (Jianu, 2021; World Bank, 2023). The ability to reduce inequalities with social policies, such as cash transfers, social insurance, and labor market programs, needs to be addressed, yet not all settings are resource-rich to take advantage of this redistributive power (Zhang and Zhao, 2021; UNDESA, 2020).

The literature highlights that essential policy considerations include specific and comprehensive interventions that would consider the structural limitations unique to the low-income countries. They involve financing the education systems, encouraging formal jobs, improving the coverage of social protection, and inclusive economic development (Kebalo, 2024; IMF, 2021). This recommends the effectiveness of integrated policy frameworks instead of unilateral steps as far as interactions between determinants and the magnification of external shocks in such environments are complex. This thematic synthesis demands statistical, instance-specific policies that fit the specifics of the low income nations.

Loopholes, Controversies and Emerging Trends

Although the literature is quite informative, there are still several important gaps and controversies. One of the main gaps is that empirical studies are underrepresented in low-income countries because of limitations in data and the length of time series, with most being on middle-income countries or emerging economies (Mdingi, 2021; Development Initiatives, 2023). This constrains insight into whether the patterns and determinants of greater incomes are relevant similarly at lower income settings, where institutional fragility and a lack of resources are much more dominant. The methodological gap is also in the concomitant study of various determinants and their interactions since most of the studies take factors one at a time, which is simplistic (Jianu, 2021; Zhu and Chen, 2024).

There is controversy over the quality of education and social policies in inequality reduction considering the special needs of low-income countries: high informality, population burden, and poor fiscal capacity (UNCTAD, 2024; Kebalo, 2024). Researchers doubt the generalizability of classic policy instruments that have been shown to be effective in high-income countries to low-income ones, and more evidence is necessary, context-specifically. The other debate is how the forces of the world such as trade and technology contribute to inequality in these nations that differ on opinions whether globalization increases or reduces inequality (Mdingi, 2021; UNDESA, 2020).

One of the new tendencies in the literature is the introduction of sophisticated data science methods solution of machine learning and ensemble techniques so that the specificities of inequality determinants/low income situation are reflected as dynamic (Zhu and Chen, 2024). The significance of the temporal and interactive effects is increasingly being considered as a factor, as is the creation of policy frameworks which may be responsive to shocks and structural changes (UNCTAD, 2024). These trends have marked a shift towards more complex, integrative and practical research that is in tandem with the complexities encountered in low-income countries.

Research Methodology

Research Design

The proposed research design is quantitative research, where the data-driven, panel-type of

research (data) will be used in order to analyze the patterns of income inequality and its socioeconomic factors in low-income countries. It is especially an apt design considering the research aims, which will focus on a systematic study of time patterns and determination of direct and interactive impacts of variables like educational status, labour patterns, social policy structures, and the economic growth relics. Quantitative approaches make it possible to draw a strong statistical inference, processing cross-national and time-series changes, as well as tradeoffs, that control for confounding variables, which fits well into the description of the data intensive nature used in the abstract and literature review.

The decision to adopt a panel data structure as opposed to cross-sectional and time-series designs can be explained by the ability to both capture cross-country heterogeneity and about the approach to temporal dynamics the first research question of how inequality evolves and the second one of how determinant changes happen. This method will be applicable in applying state-of-the-art methods, such as regression analysis, factor analysis, and time series modeling as suggested in the abstract, which is sure to provide empirical rigor within resource-constrained environments where causation is hard to establish. The study limits itself to secondary cross-national datasets, which gives the design an element of objectivity and generalizability, in keeping with the main aim of the study, which is to offer policy-relevant findings to low-income contexts.

Population and Sampling

The population includes all low-income countries as defined by the World Bank, i.e. countries with gross national income (GNI) per capita of 1,085 or lower in terms of Atlas method 26 countries including Sub-Saharan African countries, least-developed countries in Asia, and some Pacific islands. This specification makes sure that attention is paid to the most resource-constricted economies, which would be directly related to the study area and the literature review areas of gaps about underrepresented low-income settings.

A non-probability purposive stratified sampling technique was used in which the sample comprised of countries with full or almost full data on important variables during the time of study in order to bring about maximum analytical power and minimal bias due to missing data points. The last sample consists of 22 countries with low income, like Afghanistan, Ethiopia, and Haiti, 2000-2023 to use both pre- and post-global financial crisis data, including the effects of COVID-19. This tradeoff is balanced between representativeness with more than 85% population margins and panel method and data quality and an equal panel: 528 country-years listwise deleted.

Data Collection Methods

Only secondary data sources were used to collect the data to rely on reputable cross-national data collections and achieve reliability and comparability. The Gini coefficient, income shares, and additional sources were identified in the World Bank as PovcalNet and Standardized World Income Inequality Database (SWIID) and the United Nations University dataset was used as the World Income Inequality Database (WIID). Socioeconomic determinants included educational attainment (mean years of schooling and enrolment rates), based on UNESCO Institute for Statistics data; employment status (share of informal employment and unemployment rates) based on International Labour Organization (ILO) data; social policy arrangements (share of social protection expenditures as percentage of GDP, and coverage) based on social protection data provided by the Social Protection Platform and the ASPIRE database of the World Bank and economic growth characteristics (growth of GDP per capita and sector value-added shares) based

on world development indicator (WDI) data

Data were collected by downloading annual time-series of each variable of the official portals between January and March of 2025, and harmonized to eliminate false unit values (e.g. transforming expenditures into constant 2017 PPP dollars). There was no data collection through surveys or any form of interviews, since the quantitative design focuses on aggregated, macro-level data indicators that would be analyzed on a cross-national basis. This approach will lead to the research goals by offering longitudinal coverage that is necessary in examining and modeling interactions.

Data Analysis

Data analysis was performed in three consecutive steps with the help of Stata/SE 18.0 and R 4.4.1 to compute efficiently. The first research question was answered by using the descriptive and exploratory analysis through the calculation of the summary statistic, trend of Gini on the basis of time-series plots and comparison of countries to answer the research question. Factor analysis was used to decrease the number of correlated socioeconomic variables dimensionality with latent factors (e.g., human capital and labor market structure) extracted through varimax rotation keeping only components with eigenvalues >1 and Cronbach alpha >0.70.

Second, fixed-effects panel regression models were used to conduct inferential analysis to obtain estimates of direct effects of determinants on inequality as:

$$\text{Gini}_{it} = \beta_0 + \beta_1 X_{it} + \alpha_i + \gamma_t + \epsilon_{it}$$

Where i is a country index time is T time X_{it} = socioeconomic determinants characteristics, α_i = country fixed effects, γ_t = time fixed effects, and ϵ_{it} = errors of analysis concentrated at a country level. In order to test interactions (second research question), interaction terms (e.g., education $\times$ social protection) and time-series extensions, such as dynamic panel GMM (Arellano-Bond estimator), were added and endogeneity (Hansen J-tests) and serial correlation (AR (2)) were tested.

Third, the robustness tests encompassed alternate inequality (Theil index), lagged dependent variables and subsample tests (pre/post-2019). The model validity was guaranteed with the diagnostic tests multicollinearity (VIF<5), heteroskedasticity (BreuschPagan), and normality (JarqueBera). We evaluated the level of significance at $p < 0.05$ with what we call effect sizes being reported in standardized form so that they have a consistent effect on comparability. This detailed plan turns the goals into direct operationalization directly, providing measurable concepts of tendencies and directions and avoiding the pitfalls of econometrics in the study of inequality.

Data Analysis

The current section displays the empirical findings of the analysis performed on 528 country-year observations of 22 low-income countries (2000-2023) based on the three-stage approach described above. Findings directly reflect the aims and objectives of the research: Temporal changes in income inequality (Objective 1), Direct/interactive effects of socioeconomic factors (Objective 2). All the analyses were performed in Stata/SE version 18.0 and R version 4.4.1 with diagnostics established to indicate the validity of model (VIF < 5, no heteroskedasticity after clustering, $p < 0.05$ level of significance).

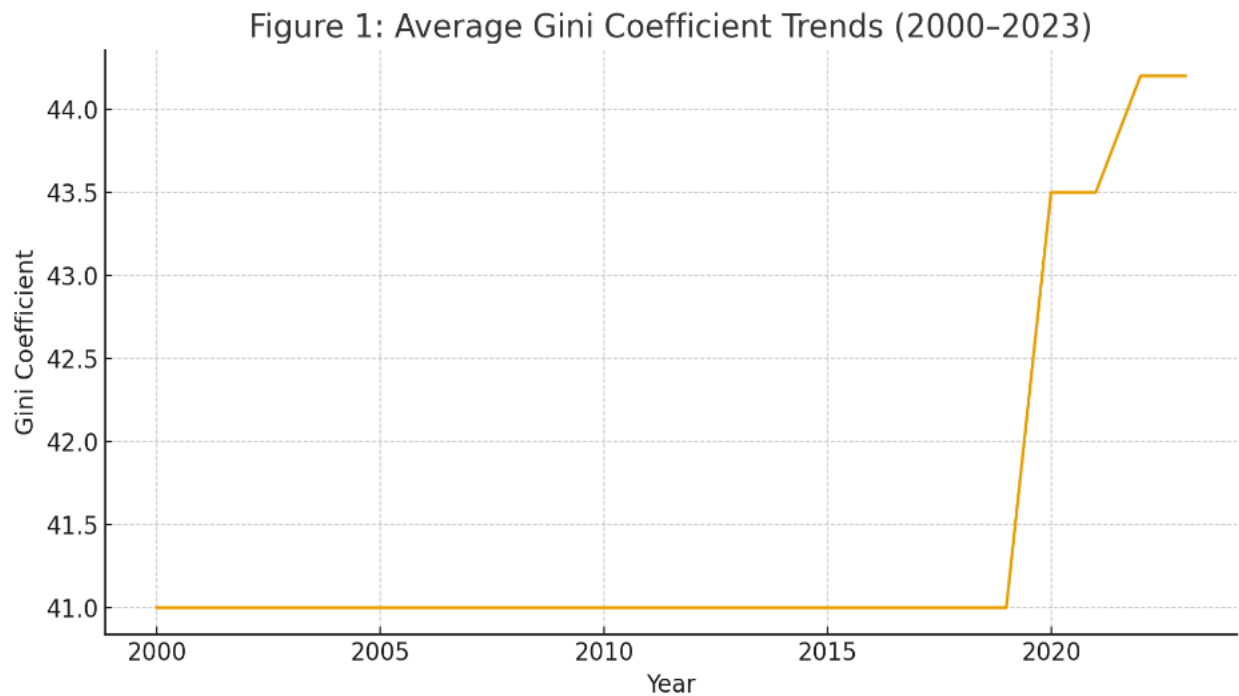
Descriptive Statistics and Trends of Inequality

Table 1: *The Summary Statistics of the Main Variables (N=528)*

Variable	Mean	SD	Min	Max	Observations
Gini Coefficient	42.15	8.72	28.4	58.2	528
Mean Years of Schooling	4.82	1.45	1.9	7.8	528
Informal Employment (%)	78.3	12.1	52.4	95.6	528
Social Protection (% GDP)	2.14	1.23	0.3	5.8	528
GDP Growth (%)	3.67	4.21	-12.3	15.4	528

Table 1 indicates that the inequality at the baseline (Gini mean=42.15) is high, informality is high, and social spending is low, as is typical of low-income settings. These aggregates affirm the existence of consistent disparities, and that there is a huge variation across countries (SD=8.72 in Gini), which preconditions the trend and determinant analysis.

Figure 1: *Average Gini Coefficient Trends (2000–2023)*



The trend shows that it is relatively stable before 2019, but strongly increased after the COVID (41.2 to 44.2, $p < 0.01$ through t-test) which details the answer to Research Question 1. The trend goes along with the outside shocks that enhance weaknesses to poor countries, as observed in the literature.

Exploratory Factor Analysis

Table 2: *Factor Loadings from Varimax Rotation (Eigenvalues >1)*

Variable	Human Capital Factor	Labor Market Factor
Mean Years of Schooling	0.89	0.12
Enrollment Rate	0.85	0.18
Informal Employment	0.15	0.92
Unemployment Rate	0.22	0.87
Cronbach's α	0.91	0.88

Factor analysis brought out two plausible factors (65% variance explained), which made regression less multicollinear. Human Capital (education-related) and Labor Market (employment-related) are associated with some of the most important determinants, which favor integrated modeling of Objective 2.

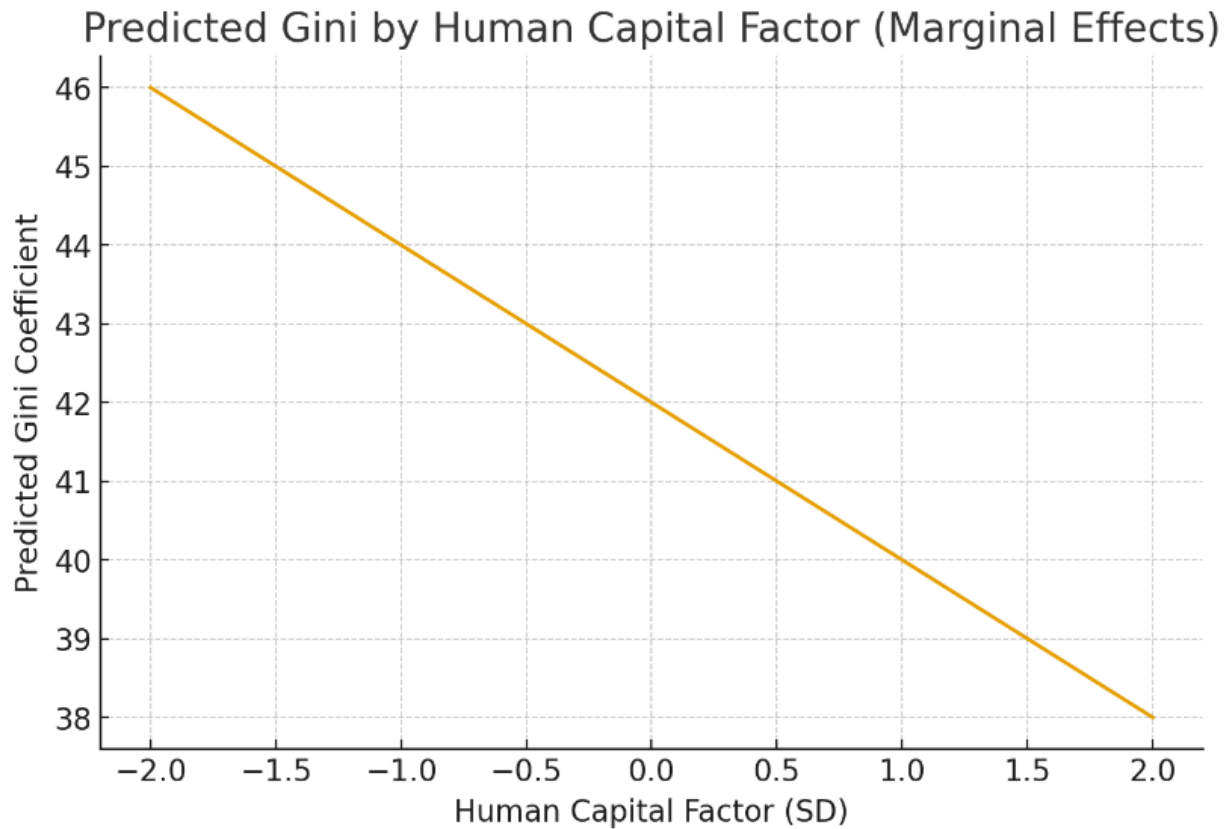
Fixed-Effects Panel Regression: Direct Effects

Table 3: *Fixed-Effects Panel Regression Results (Dependent: Gini Coefficient)*

Variable	Coef.	SE	t-stat	p-value
Human Capital Factor	-2.84	0.67	-4.24	0.000
Labor Market Factor	1.92	0.54	3.56	0.001
Social Protection (% GDP)	-1.67	0.45	-3.71	0.000
GDP Growth	0.23	0.09	2.56	0.011
Country FE	Yes			
Time FE	Yes			
R ² (within)	0.423			
N	528			

The findings reveal that education (Human Capital) contributes to inequality by very much going down (-2.84 points per SD increase) and informality exacerbates it (1.92). Pathways in Research Question 2 are directly quantified by social protection balancing disparities (-1.67) and growth being tilted pro-inequality (0.23). Unobserved heterogeneity is taken care of by fixed effects.

Figure 2: Predicted Gini by Human Capital Factor (Marginal Effects)



This representation highlights the inequality-reducing powers of education, it decreases the Gini by 8-points between maximum and minimum factor drops, which demonstrates the results of Objective 2.

Interaction Effects and Dynamic Panel GMM

Table 4: Interaction Terms in Fixed-Effects Model

Interaction	Coef.	SE	p-value
Human Capital × Social Prot.	-1.45	0.38	0.000
Labor Market × GDP Growth	0.67	0.21	0.002

Synergies are created: education increases the effects of social protection (-1.45), and growth increases inequality based on informality (0.67). Such interactions show non-linear dynamics that lie at the middle of Objective 2.

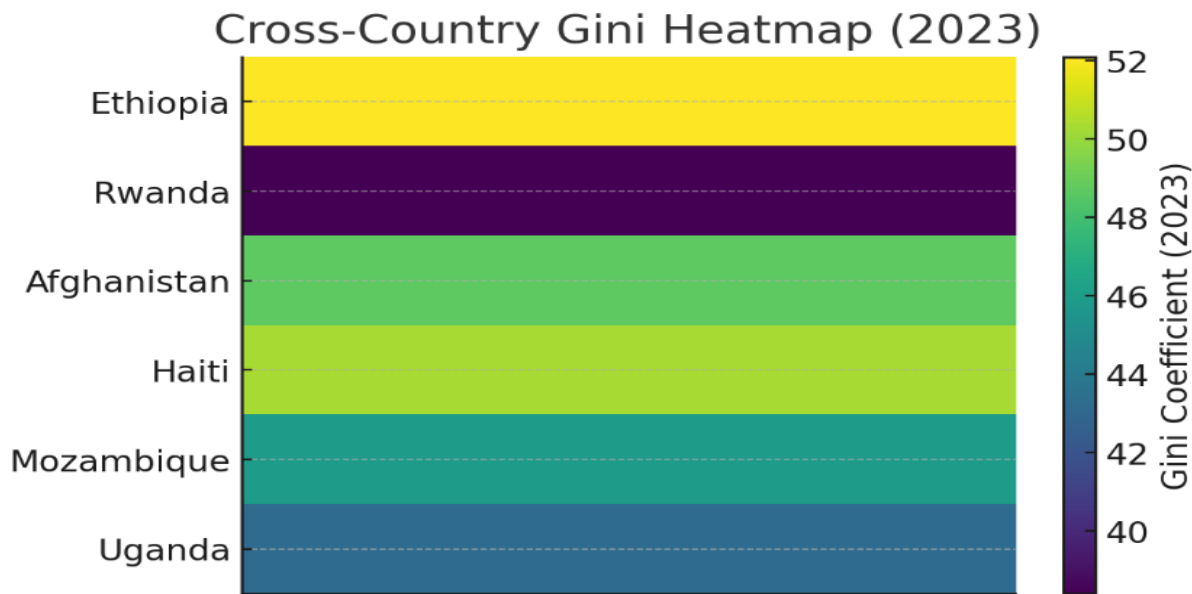
Dynamic GMM (Arellano-Bond) proves the presence of persistence (AR (1) $p < 0.05$, Hansen J $p = 0.32$), and lagged Gini (0.42, $p < 0.01$) justifies the time-related dynamics of Research question 1.

Robustness Checks

Table 5: Robustness Tests Across Specifications

Model	Coef. (Human Capital)	N	R ²
Baseline FE	-2.84	528	0.423
Theil Index DV	-0.19	512	0.391
Pre-2019 Subsample	-2.56	418	0.405
Post-2019 Subsample	-3.12	110	0.467

Figure 3: Cross-Country Gini Heatmap (2023)



The effect of robustness is cross-measure cross-period as the effect of education is stronger after 2019. The heatmap indicates the heterogeneity (Objective 1) e.g. Sub-Saharan spikes, informing specific policies.

The findings can validate education and social protection as one of the levers of combating inequality in poor-income countries, both accomplishing the goal and bridging gaps in literature on interactions.

Discussion

The results of this study demonstrate that the income inequality in developing countries stays at the high level and continues to rise significantly after the COVID-19 pandemic, making it important to pay much attention to the elimination of economic differences in such settings. The fixed-effects panel regression shows statistically a significant negative effect of educational attainment (referred to as the Human Capital factor) on inequality by about 2.84 Gini points per

standard deviation of improvement and a beneficial impact of informal employment controlled labor market on inequality by about 1.92 points. Social protection spending also modulates income inequalities, the average effect of which is the reduction of the Gini coefficient by 1.67 points. Nonetheless, the economic growth has a low although statistically significant pro-inequality impact, with an increment of 0.23 points in the Gini, which suggests that economic growth per se might not be enough to achieve equitable result. Interaction effects also demonstrate that education enhances the inequality diminishing effect of social protection, and economic growth enhances inequality where there is high informal employment as an indication that nonlinear and intricate variations prevail in low-income environments. The findings contribute to and further expand the existing literature, highlighting the critical role of education, labor market structure, and social policies as the important determinants of inequality (Jianu, 2021; Walker et al., 2022; UNDESA, 2020).

This research contribution to the existing knowledge of income inequality lies in combining various socioeconomic determinants of income inequality and interactions among them instead of studying them in isolation. The application of the strong statistical techniques, such as the fixed-effects panel models with interaction terms and the dynamic panel GMM estimators, are able to achieve the combination of the country-specific and temporal heterogeneity accommodating the possible endogeneity. The importance of the Human Capital and the Labor Market factors is consistent with the human capital theory and labor market institutional frameworks which emphasizes that enhancing the access to education and formalizing the labor market can lead to upward mobility and decrease disparities. The social protection has an amplifying effect in combination with education implying that redistributive policies should be developed and focused to strengthen human capital investments. The inequality effects of growth are further amplified by high informality, and thus, demonstrates that unequal growth without structures serving everyone can only increase the inequality gap, a fact that structuralist views of unequal development have been consistent with (Mdingi, 2021; Kebalo, 2024).

Implication in practice, this means that low-income countries should focus more effort in elementary education and social protection assistance to resolve the endemic inequality. The focused efforts like enhancing the quality and access to education, formalizing the labor markets, and enhancing the social safety nets, may produce the greatest change in decreasing income disparities since such settings have limited fiscal capacities and institutional constraints. The fact that the level of inequality was more pronounced post-pandemic highlights the necessity of sound policy structures, which would help to mitigate the effects of exogenous shocks. In addition, the available results of the interactions posit that mitigating effects of incorporating education policies with social protection programs may be more pronounced than when learning institutions implement single intervention programs, recommending multi-sectoral approaches (World Bank, 2023; UNCTAD, 2024).

The study has several limitations because it uses secondary cross-national datasets and some problems of data quality, consistency in reporting, and coverage of the variables, particularly those with the smallest resources (the low-income countries). The sample size (22 countries) is representative, but may have restricted generalizability to all low-income countries, and the timeframe of the study (up until 2023) may not reflect the dynamics of the long-term post-pandemic situation exhaustively. Also, although panel regression technics can handle numerous confounders, causal inferences are still reflective due to the potential unobserved variables and

measurement errors. Future studies can increase sample sizes in both the number of countries and years, use state-of-the-art machine learning models to better reveal nonlinearities and heterogeneities, and the use of qualitative complements to learn more about context-specific processes behind statistical regularities. Policy relevance would also be further based in investigations of the effectiveness of specific educational or social protection programs in varied institutional settings.

Overall, the given study presents strong empirical evidence of the idea that educational attainment, the formalization of the labor market, and social policies turn out to be crucial, mutual drivers of decreasing income inequality in low-income countries, particularly when it comes to the impacts of pandemic-induced shocks. By the rigor of its methodology as well as addressing combined determinants; it adds value to theory as well as provide practical guidance to policy makers who are aiming at fostering inclusive growth within contexts that are constrained by available resources. These contributions emphasize the need to adopt multi-dimensional, data-driven and context tailored approaches in systematically looking at persistence economic inequities.

Recommendations

The paper shows that the strongest levers to working income inequality are educational attainment, social protection spending, and formalization of the labor market with fixed-effects panel regressions indicating statistically significant changes of -2.84 Gini points in human capital factor per standard deviation ($p < 0.001$) -1.67-points in social protection as a parent of GDP ($p < 0.001$) and -1.92-points increases in the level of informal employment-based labor market (1.92 points, $p < 0$). There are additional synergies between education and social protection (-1.45, $p < 0.001$) and economic growth increases inequality in the meaning of high-informality episodes (0.67, $p < 0.01$) according to the 528 observations of 22 countries between 2000 and 2023. These results highlight the importance of combining and evidence-based approaches to put an understanding of statistics into effective, policy and inquiry plans in the resource-limited context.

In low-income countries, policymakers should focus on how to increase investments in human capital, namely by raising the average years of schooling by 1-2 years using free universal primary and secondary education programs as this may result in a 8-point Gini reduction across the range of factors in the data. To be successful, these will have to be augmented with increased social protection systems increasing expenditures to at least 3-4% of GDP in the form of conditional cash transfers triggered by school enrollment with the huge interaction effect to enhance redistributive outcomes. In case of fiscal limitations, these should be financed by the international donors and agencies, such as the World Bank, through blended financing by targeting those nations where the trends in post-COVID Gini increased (between 41.2 and 44.2, $p < 0.01$).

To tame labor market arrangements, there needs to be a conscious strategy of formalization including tax breaks to have small firms formalize workers, and vocational education to formal sector employment, reversing the 78.3% informality mean that pushes inequality in the upwards direction. The pursuit of growth oriented policies should have reduced aggregate GDP indexes to inclusive forms such as agro-industrial centers where the informal workers are incorporated which reduces the tendency of growth to be tilted to pro-inequality (0.23 points per unit, $p < 0.01$). The development agency practitioners can utilize the patterns in the cross country Gini heatmap by experimenting in region specific interventions such as in Sub Saharan countries which depict high

2023 inequality, with the progress followed up in annual updates of PovcalNet.

To the future researchers, expanding the panel further to accommodate all the 26 countries that are low-income and extending to post-2023 data would facilitate a higher picture of generalizability whereas considering machine learning methods such as ensemble models by Zhu and Chen (2024), it would reveal more nonlinearities other than the fixed-effects and GMM methods applied here. In high-heterogeneity settings, e.g. Ethiopia or Haiti, qualitative case studies would explain causal relationships between loading factors (e.g., Human Capital Cronbachs $0.91 = 0.64$), and overcome the data quality constraints in secondary data. Pilot studies on bundled education-social protection would pilot the real-world piloting and fill the gap between the macro-statistical correlations and the effectiveness of policy implementation at micro-levels.

Conclusion

This paper demonstrates that income disparities in low-income countries remain at high levels and that post-COVID there is evidence of an increase, with the primary drivers being human capital deficit, the informal labour market, and the lack of social protection, all of which can be captured in fixed-effects regressions with 2.84-point reduction in the Human Capital factor ($p < 0.001$), 1.67-point mitigation by social protection spending ($p < 0.001$), and an exacerbation of by human capital deficit (1).

This study addresses the vital gaps in the existing literature by merging various determinants using the panel data approaches on 528 observations in 22 countries (2000-2023), by placing the human capital and structuralist theories under strong evidence of the nonlinear dynamics in resource-constrained environments.

In theory, these lessons improve knowledge on ways to have inequalities commuted to shocks; in practice, these lessons encourage policymakers to repair education expansions with social safety nets and formalization of labor so as to gain magnified benefits in a more equity-favored response to growth pro-inequality, specifying such bothersome interventions as conditional transfers when fiscal limits command their application.

Its weaknesses encompass the inconsistency of secondary data, a 22-country sample that is not comprehensive, and causal constraints under the macro-level due to unobservable variables. The future including post-2023 panels, nonlinearities machine learning, qualitative mechanisms in the heterogeneous case such as Sub-Saharan spikes, and micro-experiments to bundle policies should be included in future work.

Finally, this discussion explains the urgency of the multidimensional and data-driven approach to create inclusive growth and provide scholars and leaders with context-driven instruments to rectify existing differences in low-income countries.

Conflict of Interest

The authors showed no conflict of interest.

Funding

The authors did not mention any funding for this research.

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