

THE DYNAMIC RELATIONSHIP BETWEEN POVERTY, EDUCATION, ECONOMIC GROWTH, UNEMPLOYMENT, AND INCOME INEQUALITY IN INDONESIA: EVIDENCE FROM TIME-SERIES MODELLING

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Abstract

This empirical study aims to examine the determinants of poverty in Indonesia, focusing on the roles of education, economic growth, unemployment, and income inequality. Annual data covering the period 1991–2021 are obtained from the World Bank, Our World in Data, and the Global Data Lab. The Autoregressive Distributed Lag (ARDL) bounds testing approach and Granger causality analysis are employed to investigate the dynamic relationships and causal directions among the variables. The results of the Bounds test confirm the presence of a cointegrating relationship. In the long run, mean years of schooling and GDP per capita are negatively associated with poverty rates, suggesting the beneficial role of education and economic growth in reducing poverty. Increases in educational attainment and income per capita lead to decreases in poverty rates. Conversely, unemployment and the Gini index are positively linked with poverty rates, indicating that limited job opportunities and greater income inequality contribute to higher poverty rates. The results of Granger causality test reveal bidirectional causal relationships between poverty and education, poverty and economic growth, and poverty and unemployment. It also identifies a unidirectional causal relationship running from income inequality to poverty. These findings underscore the importance of policies aimed at expanding access to education, fostering inclusive economic growth, stimulating job creation, and reducing income inequality to achieve sustainable poverty reduction.

Keywords: poverty, education, economic growth, unemployment, income inequality

INTRODUCTION

Poverty and rural development remain among the most persistent structural challenges confronting Indonesia. Despite sustained macroeconomic expansion averaging approximately 5% annually over the past decade, poverty reduction has been markedly slower in rural areas than in urban areas. While Indonesia's national poverty rate declined to 8.57% in March 2024, the lowest level on record, the rural poverty rate (11.34%) remained substantially higher than its urban counterpart (6.04%), denoting persistent spatial disparities in poverty (Badan Pusat Statistik, 2024). This gap is not merely statistical; it reflects entrenched inequalities in access to labour markets, quality education, and productive economic opportunities that disproportionately disadvantage rural households. The provinces of Papua, Papua Barat, and Nusa Tenggara Timur (NTT) where rural poverty exceeds 22% illustrate how geography, infrastructure deficits, and limited human capital interact to trap communities in chronic poverty, as detailed in Figure 1.

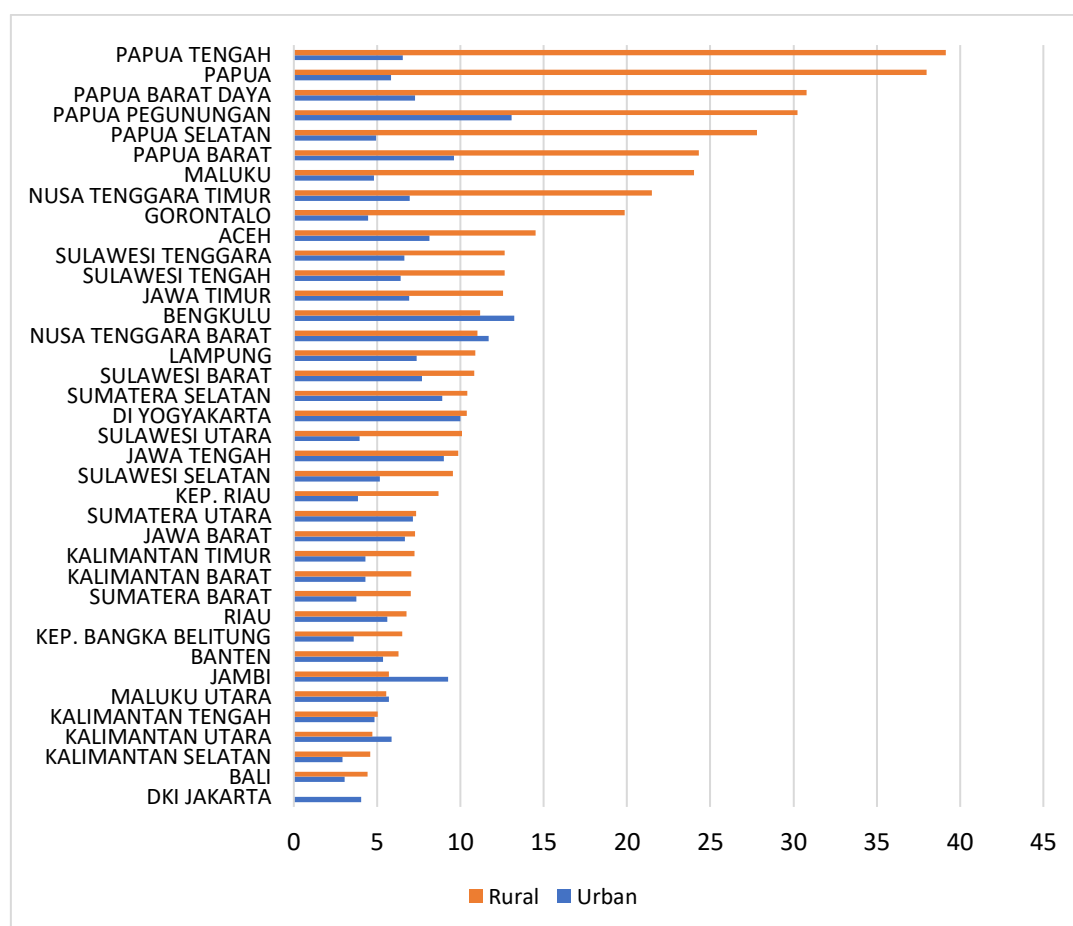


Figure 1 Rural and Urban Poverty Rates in Indonesia, 2025 (%)

Source: Badan Pusat Statistik, 2024

Three macroeconomic determinants have attracted sustained theoretical and empirical attention as principal channels through which poverty may be reduced: unemployment, education, and economic growth. Unemployment is simultaneously a symptom and a cause of poverty: prolonged joblessness depresses household expenditure, erodes human capital, and reinforces poverty traps (Ezindu et al., 2021). Economic growth, operating through Okun's Law and the Trickle-Down Effect, generates employment and raises household incomes, particularly when spatially inclusive (P. Leiwakabessy & Payapo, 2022; Suryahadi et al., 2012). Education, grounded in Human Capital Theory, can enhance individual knowledge, skills, and productive capacity, which in turn increases labour productivity and earning potential (Lucas, 1988; Schultz, 1961). By facilitating access to higher value-added economic activities, education attainment contrives to breaking the intergenerational transmission of poverty, particularly in rural areas (Akita & Miyata, 2020b; Duflo, 2001). These channels are integrated by the Poverty Growth Inequality Triangle (Bourguignon, 2003), which posits that poverty reduction depends jointly on income growth and distributional change, and by Endogenous Growth Theory (Lucas, 1988), which embeds education as a long-run engine of development. Kakwani & Pernia (2000) further distinguish explicitly pro-poor growth directly benefiting low-income groups from growth that merely raises the aggregate mean, a distinction critical for rural policy design.

A substantial empirical literature has examined poverty's determinants in Indonesia, yet critical gaps persist. Ernawati et al. (2021) reported that the village fund policy is pro-poor at the provincial level but insignificant in reducing income inequality, while Agussalim, Hamid, et al. (2024) documented that fiscal spending on education and health directly reduces poverty in non-Java provinces. Internationally, Li et al. (2024) confirmed that higher educational attainment significantly

raises GDP per capita across 38 OECD countries, and Berdegúe et al. (2015) found that intermediate urban centres accelerate rural poverty reduction through improved services and public investment. Notwithstanding these contributions, most Indonesian studies examine aggregate rather than rural poverty; unemployment as an explicit determinant has been largely overlooked domestically (Ezindu et al., 2021); and the rural-specific heterogeneity in the education poverty relationship has not been rigorously tested across all provinces within a unified panel framework gaps this study directly addresses.

Against the foregoing background, this study aims to empirically assess whether education, economic growth, lower unemployment rates, and lower income inequality contribute to poverty reduction in Indonesia using time-series data. Therefore, the Autoregressive Distributed Lag (ARDL) bounds testing framework is adopted to estimate the dynamic relationship among the variables. Furthermore it permits variables of mixed integration orders and produces unbiased estimates with relatively small sample sizes typical of annual data, while simultaneously capturing both short-run adjustment dynamics and long-run structural relationship.

To further strengthen the empirical analysis, the Granger causality analysis is integrated to establish the direction of causal relationships among the variables, a necessary step for policy formulation because poverty, unemployment, education, economic growth, and income inequality represent interconnected dimensions of development. The study contributes to the literature in three aspects. First, it focuses explicitly on extreme poverty. Second, it adopts a multidimensional modelling framework that incorporates education, economic growth, unemployment, and income inequality as key determinants of poverty. Third, it distinguishes between short-run and long-run parameters to identify different temporal effects in the poverty reduction process. The findings are expected to provide policy-relevant insights for Indonesia's development agenda while enriching the comparative literature on poverty dynamics and time-series modelling in middle-income developing economies

LITERATURE REVIEW AND HYPOTHESIS FORMULATION

The theoretical case for education as an instrument of poverty reduction rests on human capital theory, which posits that years schooling constitutes a productive investment that raises individual productivity and, by extension, wage-earning potential (Becker, 1993). The returns to this investment, however, are not uniform. Spada et al. (2024) described a self-reinforcing cycle in which income deprivation constrains household investment in education, thereby suppressing human capital accumulation and perpetuating intergenerational poverty. The severity of this trap is compounded in rural settings by lower household incomes, higher illiteracy rates, and structurally limited access to quality education. Critically, Yue (2020), drawing on household survey evidence from rural China, found that parental pessimism regarding the returns to education was the primary driver of school dropout decisions, revealing that poverty suppresses human capital accumulation partly through aspirational channels independent of material constraints.

The earlier investigations broadly validate these theoretical expectations while revealing important contextual variation. Abdelsalam (2025), applying binary logistic regression to Egyptian household survey data, found that educational expenditure was significantly and inversely related to poverty incidence, with the poverty reducing affect markedly larger for rural than urban households. This spatial asymmetry is consistent with Hall & Jones's (1999) diminishing returns schedule, given that rural populations are clustered at the lower end of the educational attainment distribution, where marginal welfare returns remain highest. At the cross-national level, Spada et al. (2024) examined 34 European countries over 2015-2019 using fixed effects panel regression and found that both a cultural educational composite index and a schooling attainment index exerted significant negative effects on poverty risk.

The extent to which education's welfare effects are realized depends on the macroeconomic environment, a relationship conceptualized most directly by Bourguignon's (2004) poverty growth

inequality triangle. This framework establishes that growth's capacity to translate into welfare gains is fundamentally conditioned by prevailing income distribution. Growth raises average income across society, but whether the poor share in that rise hinges on where the resulting gains are concentrated. When growth is distributionally regressive, aggregate expansion becomes a weak instrument of welfare improvement. The empirical literature lends substantial support to this logic. Garza-Rodriguez (2018), employing a Vector Error Correction Model (VECM) for Mexico over 1960-2016, estimated a long run growth elasticity of poverty of approximately -2.4, consistent with cross-country evidence from Fosu (2017) and Adams (2004) reported significant negative growth-poverty relationships across developing-country samples. Yet distributional conditioning is dramatically illustrated by Ravallion (2001), who reported that economies experiencing worsening inequality achieved annual poverty reductions of only 1.3 %, compared to 9.6 % in economies where distributional conditions improved alongside growth, a nearly eightfold difference underscoring that aggregate elasticity estimates can obscure the degree to which poverty outcomes are determined by distribution rather than output expansion per se.

Evidence from Indonesia reinforces this conclusion while integrating spatial and structural nuances directly relevant to rural poverty dynamics. Nursini, et al. (2024a), applying Structural Equation Modelling (SEM) across 34 provinces over 2010-2023, documented that economic growth directly and significantly reduced poverty in Java. In provinces where agriculture and extractive industries dominate, growth transmits more directly into the incomes of low-wage rural workers; in more urbanized economies, the poverty-reducing signal of aggregate growth is diffused across a more heterogeneous population. Erlando et al. (2020a), using a Panel Vector Autoregression (PVAR) model of twelve Eastern Indonesian provinces, confirmed the negative long-run effect of economic growth on poverty. However, they found that poverty temporarily rises in the short run before declining from the second period onward, a non-monotonic pattern consistent with the structural adjustment costs of economic transformation.

The nexus between economic growth and poverty reduction operates largely through the labor market. As the primary source of income, employment enhances household welfare, while unemployment directly increases the risk of poverty. Classical frameworks attribute unemployment to market rigidities, while Keynesian economics views it as a consequence of insufficient aggregate demand, who absorb contractionary shocks simultaneously as displaced workers and as consumers whose purchasing power contracts alongside their incomes (Suparman & Muzakir, 2023). Building on this supply-side and demand-side perspective, Romer's (1990) endogenous growth framework includes a structural perspective by showing that technological change can render existing skills obsolete, generating unemployment even during periods of economic expansion. This effect is particularly relevant in rural economies undergoing agricultural modernization. These theories suggest that unemployment reduces income and consumption, thereby perpetuating poverty, especially where social protection systems remain limited.

The quantitative evidence on the unemployment-poverty relationship confirms a direct and significant effect, though its magnitude varies with context and methodology. Feriyanto et al. (2020), employing a fixed-effects estimator on a panel of 33 Indonesian provinces over the 2010–2019 period, estimated that a one percentage point increase in the unemployment rate leads to raise the provincial poverty headcount by approximately 0.044%. Zwelakhe Ngubane et al. (2023) reported that unemployment exacerbates poverty in the long run. Further evidence is provided by Suparman et al. (2024) documented that a higher concentration of informal agricultural workers is linked with higher unemployment, while stronger human capital reduces unemployment. These findings highlight the role of education in improving labor market outcomes and linking human capital development to employment performance. More complex spatial dynamics were unraveled by Fattah et al. (2025a), who found that rural-to-urban migration reduces rural unemployment through labor reallocation. However, this adjustment does not necessarily improve the underlying productivity conditions that sustain poverty.

Across the three strands reviewed, a consistent overarching conclusion emerges. Education, economic growth, and labour market performance each exert independent and theoretically grounded effects on rural poverty, but these effects are fundamentally conditional on distributional structures, the sectoral composition of growth, the quality of employment generated, and the cognitive conditions governing household investment behaviour. No single variable operates in isolation. A related puzzle documented by Suparman & Muzakir (2023), the positive association between unemployment rates and gross regional domestic product in some Indonesian provinces is theoretically coherent within Romer's (1990) structural unemployment framework, wherein capital-intensive growth displaces traditional-sector workers at a pace exceeding the absorptive capacity of emerging industries.

Within this broader structural context, income inequality constitutes a structural dimension that both directly worsens rural poverty outcomes and mediates the poverty-reducing capacity of economic growth, education, and employment. Supporting this view, Cerra et al. (2021) unraveled that the relationships among growth, inequality, and poverty are bidirectional. While growth can reduce poverty, its distributional impact is ambiguous and conditioned by the sectoral composition and inclusiveness of that growth, and inequality in turn suppresses long-run growth through multiple channels a finding with particular relevance for rural economies where income distribution is structurally skewed. This bidirectional relationship is further nuanced by Marrero & Servén (2021), who, using a panel of 158 countries over 1960–2010, demonstrate that although the direct effect of inequality on growth is empirically fragile, its indirect effect operating through poverty is robustly negative: rising inequality pushes more households below the poverty line, which in turn depresses economic dynamism and perpetuates a self-reinforcing cycle of deprivation.

Following the theoretical and previous studies above, hypotheses are proposed as follows:

H1: Education is negatively associated with poverty rates

H2: Economic growth is negatively associated with poverty rates

H3: Unemployment is positively associated with poverty rates

H4: Income inequality is positively associated with poverty rates

RESEARCH METHODS

Model Specification

Working with annual data spanning 1991–2022, the main objective of this study is to examine the linkage among poverty, education, economic growth, unemployment, and income inequality in Indonesia. Therefore, the functional form of the model is specified in Equation (1).

$$POV_t = f(EDU_t, GDP_t, UNEM_t, GINI_t) \dots \dots \dots (1)$$

Hence, the empirical model is written as Eq. (2)

$$POV_t = \beta_0 + \beta_1 EDU_t + \beta_2 GDP_t + \beta_3 UNEM_t + \beta_4 GINI_t + \varepsilon_t \dots \dots \dots (2)$$

Taking a logarithmic transformation:

$$\ln POV_t = \beta_0 + \beta_1 \ln EDU_t + \beta_2 \ln GDP_t + \beta_3 \ln UNEM_t + \beta_4 \ln GINI_t + \varepsilon_t \dots \dots \dots (3)$$

where POV represents poverty rates. EDU, EG, and UNM denote education, economic growth, and unemployment rates, respectively. GINI denotes the Gini index, which serves as a proxy for income inequality. β_0 is the constant term while β_1 , β_2 , β_3 , and β_4 are parameters to be estimated. ε_t is the error term. Both education and economic growth are expected to have a negative impact on poverty rates ($\beta_1 < 0$ and $\beta_2 < 0$). Conversely, unemployment and income inequality (the Gini index) are expected to have a positive impact on rural rates ($\beta_3 > 0$ and $\beta_4 > 0$).

Estimation Method

Augmented Dickey Fuller (ADF) test

Before to applying time-series modeling, it is necessary to determine the order of integration of the variables. Since the ARDL bounds testing approach is not valid in the presence of variables integrated of order two, $I(2)$, the Augmented Dickey–Fuller (ADF) test is employed to examine the presence of unit roots in each series. The general specification of the ADF test is presented in Equation (4).

$$\Delta y_t = \alpha + \beta t + \lambda y_{t-1} + \sum_{j=1}^k c_j \Delta y_{t-1} + e_t \quad \dots\dots\dots (4)$$

Hypotheses for the unit root test are expressed as follows:

$$H_0: \lambda = 0, y \text{ has a unit root}$$

$$H_1: \lambda < 0, y \text{ has no unit root.}$$

where Δ denotes the first difference term. y is the variable under investigation. $\lambda = \rho - 1$. α is the constant term. βt is the deterministic trend. k is the optimal lag length. Reject the null hypothesis if the p -value is less than critical value.

ARDL-Bounds testing

The ARDL-Bounds testing is applied to examine the dynamic and cointegration relationship between rural poverty rates and its set of determinant variables. It can produce both short-run and long-run parameters. Furthermore, It is preferred for the estimation method since it has the ability to provide unbiased estimates regarding small sample sizes such as current investigation. Following equation (3), the ARDL (p, q) model can be established as follows

$$\begin{aligned} \ln POV_t = & \eta_0 + \sum_{i=1}^p \eta_1 \ln POV_{t-i} + \sum_{i=0}^q \eta_2 \ln EDU_{t-i} + \sum_{i=0}^q \eta_3 \ln GDP_{t-i} \\ & + \sum_{i=0}^q \eta_4 \ln UNEM_{t-i} + \sum_{i=0}^q \eta_5 \ln GINI_{t-i} + \vartheta_1 \ln EDU_{t-i} \\ & + \vartheta_2 \ln GDP_{t-i} + \vartheta_3 \ln UNEM_{t-i} + \vartheta_3 \ln GINI_{t-i} + \varepsilon_{t-i} \end{aligned} \quad \dots\dots\dots (5)$$

The presence of cointegration is a necessary condition for interpreting long-run estimates. In the ARDL bounds testing approach, the cointegration relationship is tested by adopting the bounds test statistics, which consist of the lower bound, $I[0]$, and the upper bound, $I[1]$, critical bounds. Hypotheses are proposed as follows:

$$H_0: \vartheta_1 = \dots \vartheta_4 = 0 \text{ (no cointegration)}$$

$$H_1: \text{at least } \vartheta_i \neq 0 \text{ (cointegration)}$$

The rule of thumb is to reject the null hypothesis if the computed F-statistic exceeds the upper bound, $I[1]$. Otherwise, there is no long-run relationship. If cointegration is confirmed, the error correction model can be specified as follows:

$$\begin{aligned} \ln POV_t = & \eta_0 + \sum_{i=1}^p \eta_1 \ln POV_{t-i} + \sum_{i=0}^q \eta_2 \ln EDU_{t-i} + \sum_{i=0}^q \eta_3 \ln GDP_{t-i} \\ & + \sum_{i=0}^q \eta_4 \ln UNEM_{t-i} + \sum_{i=0}^q \eta_5 \ln GINI_{t-i} + \phi ECM_{t-1} + \varepsilon_{t-i} \end{aligned} \quad \dots\dots\dots (6)$$

where ϕ shows the speed of adjustment toward the long-run equilibrium. The ECM coefficient of ϕ must be negative and statistically significant to provide sufficient evidence of the existence of a long-run cointegration relationship. Otherwise, there is no cointegration relationship.

Granger Causality

To provide more nuanced findings, this study employs Granger causality test to investigate the direction of causality among poverty, education, economic growth, unemployment, and income inequality. The Granger causality test provides valuable insights for policy formulation by revealing the predictive relationships among these variables. By denoting the variables in a general form as y and x , the Granger causality model can be specified as follows:

$$\begin{aligned} y_t &= v_1 + \sum_{i=1}^{\kappa} \pi_{1j} y_{t-i} + \sum_{i=1}^{\kappa} \omega_{1j} x_{t-i} + \mu_{1t} \\ x_t &= v_2 + \sum_{i=1}^{\kappa} \pi_{2j} y_{t-i} + \sum_{i=1}^{\kappa} \omega_{2j} x_{t-i} + \mu_{2t} \end{aligned} \quad \dots\dots\dots (7)$$

The null hypothesis that x does not Granger-cause y ($H_0: \omega_1 = \dots = \omega_{\kappa} = 0$) is examined against the alternative hypothesis ($H_1: \omega_1 = \dots = \omega_{\kappa} \neq 0$). Similarly, the null hypothesis that y does not Granger-cause x ($H_0: \pi_1 = \dots = \pi_{\kappa} = 0$) is examined against the alternative hypothesis ($H_1: \pi_1 = \dots = \pi_{\kappa} \neq 0$). The possible outcomes of the Granger causality test include unidirectional causality, bidirectional causality, and the absence of causality between the variables.

Data and Variables

This study relies on annual data covering the period 1991–2022 for Indonesia. Poverty is measured as the percentage of the population living below the extreme poverty line. The poverty rate refers to the poverty headcount ratio at the \$2.15 international poverty line (constant 2015 USD). Rural poverty data are obtained from *Our World in Data*. Education is proxied by mean years of schooling (MYS), with data sourced from the Global Data Lab. Economic growth is measured by GDP per capita (constant 2015 USD). The unemployment rate is defined as the percentage of the labor force that is unemployed, based on International Labour Organization (ILO) estimates. Finally, income inequality is proxied by the Gini index. Data on GDP per capita, unemployment, and the Gini index are obtained from the World Development Indicators (WDI) database published by the World Bank.

Table 1. Summary Variables Measurements

Variables	Definition	Unit	Source
Poverty rates	Poverty headcount index	Percent (%)	Our World in Data
Education	Mean years of schooling	Years	Global Data Lab
Economic growth	GDP per capita	USD	World Bank
Unemployment	Unemployment rate	Percent (%)	World Bank
Income inequality	Gini index	index	World Bank

RESULTS AND DISCUSSION

To begin with results and discussion, this study presents the results of the ADF test in Table 2. The test results reveal that all variables are non-stationary in their level, as the null hypothesis of a unit root cannot be rejected at the 5% significance level. However, after first differencing, all variables become stationary, with p-values below 0.05. These findings suggest that POV, MYS, GDP, UNEM, and GINI are integrated of order one, $I(1)$. Therefore, subsequent analysis should account for the non-stationary nature of the variables, and cointegration techniques, such as ARDL-bounds testing may be employed to investigate the existence of a long-run equilibrium relationship among them.

Table 2. The ADF Test Results

	Level		First difference	
	Stat.	p-value	Stat.	p-value
POV	-3.366	0.080	-12.453	0.000

MYS	-2.243	0.451	-7.692	0.000
GDP	-1.079	0.917	-4.351	0.009
UNEM	-1.668	0.741	-5.719	0.000
GINI	-1.443	0.827	-4.155	0.014

Source: Data estimation, STATA

Subsequent to the ADF unit root test, Table 3 reports the results of the ARDL bounds test for cointegration. The computed F-statistic of 6.114 exceeds the upper critical bound at the 10%, 5%, 2.5%, and 1% significance levels, leading to the rejection of the null hypothesis of no cointegration. In addition, the t-statistic of -3.529 exceeds the upper critical bound in absolute value at the 5% significance level, providing further evidence of a long-run relationship among the variables. Overall, the results confirm the existence of cointegration, indicating that the variables move together in the long run and maintain a stable equilibrium relationship. Consequently, the estimation of ECM justified to examine both the short-run dynamics and the long-run equilibrium relationship among the variables.

Table 3. Bounds Cointegration test results

	Statistic	Sign.	Critical bounds	
			Lower	Upper
F	6.114	10%	2.2	3.09
t	-3.529	5%	2.56	3.49
		2.50%	2.88	3.87
		1%	3.29	4.37

Source: Data estimation, STATA

Table 4 presents the long-run estimation results derived from the ARDL (1,1,1,0,1) model. Mean years of schooling is found to have a negative and statistically significant effect on poverty rates, highlighting the important role of education in poverty reduction. The estimated coefficient of -2.7476 implies that a 1% increase in mean years of schooling is linked with an approximately 2.75% decrease in poverty rates, *ceteris paribus*. This finding emphasizes that improvements in educational attainment contribute to poverty reduction through enhanced human capital, higher productivity, and greater economic opportunities. The result further implies that education serves as a key instrument for breaking the cycle of poverty in the long run. Therefore, policymakers should continue to expand access to quality education and strengthen investments in human capital development to support sustainable poverty reduction.

The negative relationship between poverty and education identified in this study reinforces the argument that education constitutes one of the most consistently documented structural determinants of poverty reduction. Zuo et al. (2023) documented that each additional semester of compulsory education reduces the probability of relative poverty by 6-8% through labour market performance and human capital accumulation. F. Panyi et al. (2025) further demonstrated, through multiscale geographically weighted regression, that bachelor's degree attainment bears a progressively expanding negative relationship with poverty by operating through stronger ties to labor force participation and lower unemployment. These mechanisms are equally relevant to the rural Indonesian context examined in the present study.

Table 4. Long-run Estimation Results

	Coeff.	Std. error	t-stat	p-value
LnMYS	-2.7476	0.8028	-3.42	0.003
LnGDP	-2.0696	0.6979	-2.97	0.008
LnUNEM	1.1858	0.3555	3.34	0.003

LnGINI	2.8781	1.0683	2.69	0.014
Constant	12.1267	3.6867	3.29	0.004

Source: Data estimation, STATA

Another finding indicates that GDP per capita has a negative and statistically significant effect on poverty rates at the 1% critical level. The estimated coefficient of -2.0696 represents that a 1% increase in GDP per capita is associated with an approximately 2.07% decrease in poverty rates, *ceteris paribus*, indicating a highly elastic response. This finding suggests that economic growth plays a crucial role in poverty alleviation by raising income levels and improving overall economic welfare. The result implies that policies aimed at sustaining economic growth can be effective in reducing poverty. Thus, it is crucial to consistently promote inclusive economic growth through investment, job creation, and productivity-enhancing policies to ensure that the benefits of economic expansion are broadly shared, particularly among low-income households.

The broader body of evidence consistently positions poverty as a structural impediment to economic growth rather than merely its byproduct, a distinction with direct relevance to the rural Indonesian context examined here. Breunig & Majeed (2020) confirmed that the negative effect of inequality on growth is most pronounced precisely where poverty is highest, implying that poverty itself constitutes a binding constraint on productive capacity. Marrero & Servén (2022) reinforce this mechanism at greater scale, finding across 158 countries that a ten percentage point reduction in the headcount poverty rate corresponds to an annual per capita GDP increase of 0.5 to 1.2%, with the growth-detering effect concentrated exclusively among high-poverty observations.

The unemployment rate has a positive and statistically significant effect on poverty rates at the 1% critical level. The estimated coefficient of 1.1858 shows that a 1% increase in unemployment is associated with an approximately 1.19% increase in poverty rates, *ceteris paribus*, suggesting an elastic relationship. This finding implies that unemployment is a key driver of poverty, as job losses reduce household income and weaken individuals' ability to meet basic needs. The result highlights the importance of labor market policies in poverty alleviation. Therefore, governments should prioritize employment-generating strategies, including support for labor-intensive industries, vocational training programs, and entrepreneurship development, to expand job opportunities and reduce poverty.

The findings is consistent with prior studies which support the positive linkage between unemployment and poverty. Zwelakhe Ngubane et al. (2023) demonstrated that unemployment inflates poverty in the long run, with positive unemployment shocks systematically amplifying poverty levels, confirming that economic growth alone is insufficient to reduce poverty without addressing unemployment. In a similar vein, Rehman et al. (2022) argued that unemployment maintains a persistent positive association with poverty across both short- and long-run dynamics, underscoring the detrimental role of joblessness on household welfare in developing economies. Together, these findings reinforce the present study's result that unemployment is a key driver of poverty persistence in Indonesia's rural context.

Income inequality also exerts a positive and statistically significant influence on poverty rates at the 5% significance level. The estimated coefficient of 2.8781 implies that a 1% increase in income inequality is linked with an approximately 2.88% increase in poverty rates, *ceteris paribus*, suggesting an elastic relationship. This finding indicates that a more unequal distribution of income exacerbates poverty by limiting access to economic resources, productive opportunities, and social mobility among lower-income groups. This empirical result highlights the importance of inclusive development policies aimed at reducing income disparities. Therefore, governments should strengthen income redistribution mechanisms, expand access to quality education and healthcare, and promote inclusive economic opportunities to ensure that the benefits of economic growth are shared more equitably across society.

Table 5. Short-run Estimation Results

	Coeff.	Std. error	t-stat	p-value
$\Delta \ln \text{MYS}$	-1.2731	0.3474	-3.66	0.002
$\Delta \ln \text{GDP}$	-1.9598	0.7235	-2.71	0.014
$\Delta \ln \text{UNEM}$	0.0896	0.1979	0.45	0.656
$\Delta \ln \text{GINI}$	-0.2980	0.6531	-0.46	0.653
ECT	-0.46336	0.13130	-3.53	0.002

Source: Data estimation, STATA

Regarding the short-run estimates, the results in Table 5 denote that mean years of schooling and GDP per capita are found to have negative effects on poverty rates, consistent with the long-run estimation results. These findings suggest that both education and economic growth are pivotal factors in driving poverty reduction. It should be noted that improvements in educational attainment enhance individuals' skills and employability, while economic growth expands income-generating opportunities, which in turn contribute to a decline in poverty rates.

Conversely, unemployment and income inequality are found to be statistically insignificant in the short run. While unemployment exhibits a positive effect on poverty rates and the Gini index shows a negative effect, neither coefficient is statistically significant. Importantly, ECT is negative and statistically significant, indicating the existence of a long-run equilibrium relationship among the variables. The estimated ECT coefficient suggests that approximately 46.34% of short-run disequilibrium is corrected within one year, implying a relatively rapid adjustment toward the long-run equilibrium.

Table 6. Diagnostic test results

Test	Statistic	p-value
Breusch-Godfrey	1.030	0.402
ARCH-LM	0.081	0.776
Ramsey RESET	0.490	0.484
Jarque-Bera	2.482	0.289

Source: Data estimation, STATA

Following the application of the ARDL bounds testing approach, this study conducted a series of diagnostic and parameter stability tests. Table 6 presents the results of the diagnostic tests for serial correlation, heteroskedasticity, model specification, and residual normality. The results of the Breusch–Godfrey and ARCH-LM test fail to reject the null hypothesis of no serial correlation and no heteroscedasticity, suggesting that the residuals are free from autocorrelation and follow constant variance. The results of the Ramsey RESET test supports the adequacy of the model specification, indicating the absence of significant functional form misspecification. In other words, no evidence of omitted variable bias is detected. The Jarque–Bera test indicates that the residuals are normally distributed. Additionally, the results of the recursive Cumulative Sum (CUSUM) and Cumulative Sum of Squares (CUSUMSQ) tests, presented in Figures 2 and 3, indicate that the estimated parameters remained stable throughout the observation period.

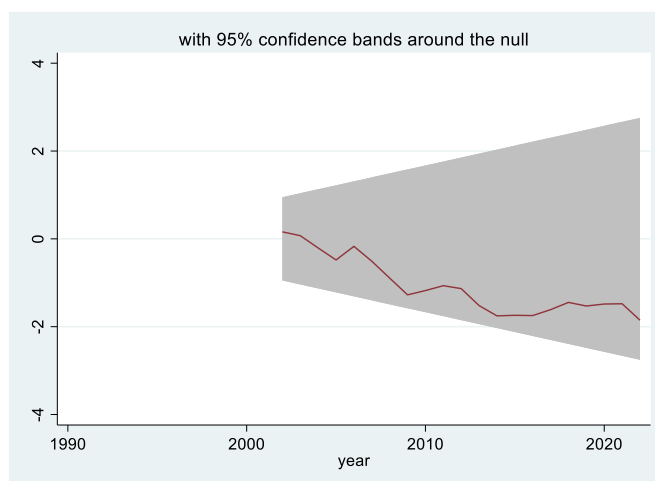


Figure 2. the CUSUM test results

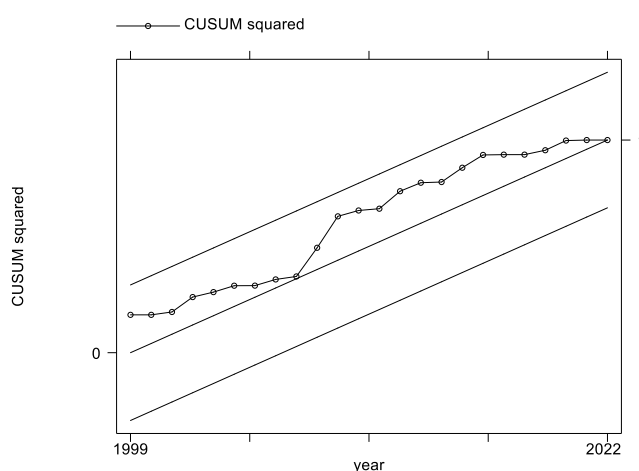


Figure 3. the CUSUMSQ test results

Regarding the causality analysis, Table 7 reports the results of the Granger causality test using a lag length of two, as suggested by the AIC statistics. The findings show that education, economic growth, unemployment, and income inequality each Granger-cause poverty, suggesting that these variables contain significant predictive information about future poverty dynamics in Indonesia over the period 1990-2022. These empirical findings reinforce the view that poverty is influenced by multiple interrelated socioeconomic factors rather than by a single determinant. Specifically, bidirectional causal relationships are identified between education and poverty, GDP per capita and poverty, and unemployment and poverty, whereas a unidirectional causal relationship runs from income inequality to poverty.

The bidirectional causality between education and poverty indicates that improvements in educational attainment significantly contribute to poverty reduction, while lower poverty levels, in turn, facilitate greater access to education by reducing financial constraints faced by households. Similarly, the bidirectional relationship between economic growth and poverty indicates that higher income levels help alleviate poverty, whereas reductions in poverty can further stimulate economic growth through increased productivity, human capital accumulation, and consumer spending. The bidirectional causality between unemployment and poverty points to a self-reinforcing cycle in which rising unemployment leads to higher poverty, while persistent poverty constrains access to education, skills development, and job opportunities, thus limiting labour market participation and reinforcing unemployment.

Table 7. Granger causality test results

Equation	Excluded	chi2	p-value
LnPOV	LnEDU	28.591	0.000
LnPOV	LnGDP	11.699	0.008
LnPOV	LnUNEM	12.977	0.005
LnPOV	LnGINI	32.007	0.000
LnMYS	LnPOV	9.1067	0.028
LnEDU	LnGDP	114.31	0.000
LnEDU	LnUNEM	0.49378	0.920
LnEDU	LnGINI	3.4961	0.321
LnGDP	LnPOV	27.873	0.000
LnGDP	LnEDU	8.4162	0.038
LnGDP	LnUNEM	1.2923	0.731
LnGDP	LnGINI	44.355	0.000
LnUNEM	LnPOV	27.149	0.000
LnUNEM	LnEDU	12.496	0.006
LnUNEM	LnGDP	10.735	0.013
LnUNEM	LnGINI	5.9974	0.112
LnGINI	LnPOV	0.40362	0.939
LnGINI	LnEDU	5.6609	0.129
LnGINI	LnGDP	5.4723	0.140
LnGINI	LnUNEM	5.3933	0.145

Source: Data estimation, STATA

Unlike the bidirectional relationships discussed above, the unidirectional causality running from income inequality to poverty indicates that changes in income distribution precede changes in poverty rates. This finding indicates that increasing income inequality may weaken the poverty-reducing effects of national output growth by concentrating economic gains among higher-income groups. Consequently, policies aimed at reducing inequality through progressive social protection programs, equitable access to education, and inclusive labor market opportunities may play an important role in supporting sustainable poverty reduction. To facilitate interpretation, Figure 4 illustrates the causal relationships among poverty, education, economic growth, unemployment, and income inequality.

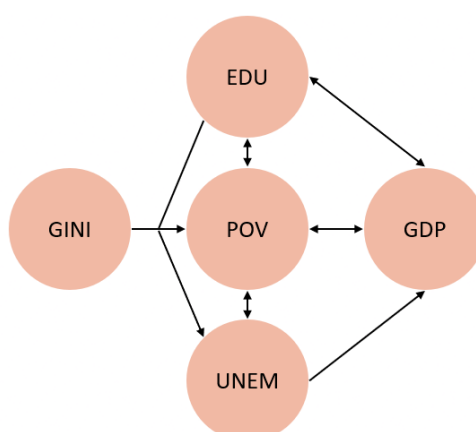


Figure 4. Illustration of Causal Directions

CONCLUSION

This empirical study aims to examine the determinants of poverty by considering the effects of education, economic growth, income inequality, and unemployment. Using annual data, the study employs the ARDL bounds testing approach and the Granger causality test. As expected, education and GDP per capita are found to be negatively associated with poverty rates, whereas unemployment and income inequality, as measured by the Gini index, are positively associated with poverty rates. The estimated coefficients indicate that education has a greater effect on poverty reduction than GDP per capita. The Granger causality test reveals bidirectional causality between poverty and unemployment, poverty and education, and poverty and GDP per capita. In addition, a unidirectional causal relationship is found running from income inequality to poverty. These findings suggest that policies aimed at improving educational attainment, promoting inclusive economic growth, reducing unemployment, and mitigating income inequality are essential for sustainable poverty reduction.

Based on the empirical findings, policy recommendations can be proposed as follows: First, policymakers should prioritize investments in education as a long-term strategy for poverty reduction, given its stronger effect compared to economic growth. Expanding access to quality education, particularly for disadvantaged and low-income populations, can enhance human capital and improve employment opportunities. At the same time, policies aimed at promoting inclusive economic growth should be strengthened to ensure that the benefits of economic expansion are broadly shared across society. Efforts to reduce unemployment through job creation programs, skills development initiatives, and labor market interventions are also essential, considering the bidirectional relationship between unemployment and poverty. Furthermore, measures to reduce income inequality, such as progressive social protection programs and equitable access to economic opportunities, should be implemented, as income inequality has been found to contribute to higher poverty levels. Collectively, these policy measures can support sustainable poverty reduction and foster more inclusive socioeconomic development in Indonesia.

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