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ANALYSIS OF EDUCATION LEVEL AND UNEMPLOYMENT TOWARDS THE GINI INDEX IN EAST JAVA

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ABSTRACT

This study aims to analyze the effect of education level and open unemployment rate on income inequality as measured by the Gini Index in East Java during the 2007–2024 period. The study applies a quantitative explanatory approach using time series secondary data obtained from *Badan Pusat Statistik*. Data analysis was conducted through multiple linear regression after fulfilling classical assumption tests, including normality, multicollinearity, heteroskedasticity, and autocorrelation tests. The results indicate that the education level, proxied by average years of schooling, does not have a statistically significant effect on the Gini Index. In contrast, the open unemployment rate has a significant negative effect on income inequality, indicating that changes in labor market conditions are more influential in shaping income distribution than educational attainment alone. These findings imply that policies aimed at reducing income inequality in East Java should prioritize inclusive employment creation, strengthen labor market absorption, and improve the relevance of education to labor demand to support more equitable regional development.

Keywords: Income Inequality, Education Level, Unemployment, Gini Index, East Java

ABSTRAK

Penelitian ini bertujuan menganalisis pengaruh tingkat pendidikan dan tingkat pengangguran terbuka terhadap ketimpangan pendapatan yang diukur menggunakan Indeks Gini di Jawa Timur periode 2007–2024. Penelitian menggunakan pendekatan kuantitatif eksplanatori dengan data sekunder time series yang diperoleh dari Badan Pusat Statistik (BPS). Teknik analisis data menggunakan regresi linier berganda dengan bantuan software EViews serta melalui uji asumsi klasik yang meliputi uji normalitas, multikolinearitas, heteroskedastisitas, dan autokorelasi. Hasil penelitian menunjukkan bahwa tingkat pendidikan yang diproksikan dengan rata-rata lama sekolah tidak berpengaruh signifikan terhadap Indeks Gini dengan nilai probabilitas sebesar 0,5376. Sementara itu, tingkat pengangguran terbuka berpengaruh signifikan terhadap ketimpangan pendapatan dengan koefisien sebesar $-0,015379$ dan nilai probabilitas sebesar 0,0267. Hasil ini menunjukkan bahwa dinamika pasar tenaga kerja lebih dominan memengaruhi distribusi pendapatan dibandingkan peningkatan pendidikan secara kuantitatif. Keterbatasan penelitian terletak pada penggunaan dua variabel independen dan data tingkat provinsi, sehingga belum mencakup faktor struktural lainnya. Oleh karena itu, kebijakan pengurangan ketimpangan perlu difokuskan pada penciptaan lapangan kerja yang inklusif dan peningkatan kualitas tenaga kerja.

Kata Kunci: Ketimpangan Pendapatan, Tingkat Pendidikan, Pengangguran, Indeks Gini, Jawa Timur

I. INTRODUCTION

Income inequality remains one of the main challenges in regional economic development because high economic growth does not always lead to an equitable distribution of welfare. In many developing countries, increases in production and regional output often generate unequal benefits because economic gains tend to be concentrated among specific income groups, productive sectors, and urban growth centers. Meanwhile, vulnerable communities continue to face limited access to productive assets, quality employment, and opportunities for social mobility (Omowole et al., 2024).

Under these conditions, economic growth may improve macroeconomic indicators without significantly improving the distribution of welfare across society. As a result, inequality persists even in regions with relatively strong economic performance (Henson, 2025). Within the framework of sustainable development, inequality is not only reflected in differences in income levels, but also in disparities in access to education, healthcare, employment opportunities, infrastructure, and productive resources (Tu et al., 2025).

These disparities weaken the ability of development policies to create inclusive growth and equitable welfare distribution (Henson, 2025). Therefore, reducing inequality has become an important objective in regional development policy, particularly in regions characterized by uneven sectoral transformation and spatial economic disparities (Omowole et al., 2024).

The persistence of income inequality is closely associated with uneven regional development. Economic expansion is often concentrated in modern and high-productivity sectors, while traditional sectors experience slower growth. In many developing regions, industrialization and service-sector expansion provide greater returns to capital owners and skilled workers, whereas workers in agriculture, informal activities, and low-productivity sectors experience relatively slower income growth (Ramasamy, 2024). Consequently, regional

output may increase without substantially reducing welfare disparities among households.

This condition indicates that development performance should not only be evaluated through economic growth indicators, but also through the extent to which economic opportunities are distributed across sectors and social groups. In this context, labor absorption, educational attainment, and institutional support become important channels through which development influences income distribution (Akomolehin et al., 2025).

East Java is one of Indonesia's most important economic regions because of its significant contribution to national production, industrial activities, trade, logistics, and service-sector development. The province consistently contributes a large share to Indonesia's gross regional domestic product due to the presence of manufacturing centers, urban economic corridors, and integrated transportation infrastructure connecting western and eastern Indonesia. The manufacturing sector remains the largest contributor to East Java's economy, accounting for more than thirty percent of regional output, followed by trade, transportation, and warehousing activities that continue to support regional economic growth (Akter & Mamun, 2023).

Industrial expansion in urban areas such as Surabaya, Sidoarjo, and Gresik has strengthened investment inflows and regional productivity. However, despite this strong economic performance, development outcomes remain uneven across districts and socio-economic groups. Economic concentration in industrial centers has not been followed by equal improvements in welfare in peripheral regions. This condition indicates that strong regional economic growth alone is insufficient to ensure equitable income distribution (Aluko et al., 2024).

The dynamics of income inequality in East Java can be observed through changes in the Gini Index, which is widely used to measure income distribution across households. During the 2007–2024 period,

the Gini Index in East Java fluctuated within the category of moderate inequality, indicating that welfare disparities remained persistent despite the absence of extreme inequality (Isayed et al., 2024). These fluctuations also show that income distribution is highly sensitive to macroeconomic conditions, labor market adjustments, and sectoral transformation occurring during different phases of regional development (George & George, 2024).

The trend presented in Figure 1 indicates that economic expansion in East Java has not consistently produced equitable distributive outcomes. In several periods, industrial and service-sector growth increased regional output but also widened income disparities because high-productivity sectors generated greater returns for skilled labor and capital-intensive activities. Conversely, during periods of slower economic growth, inequality occasionally declined because differences in sectoral income growth became temporarily smaller rather than because welfare improved evenly across society. These patterns suggest that inequality in East Java is structurally embedded in the regional development process through unequal sectoral productivity, uneven labor absorption, and disparities in access to productive opportunities between urban and non-urban areas (Zheng et al., 2026).

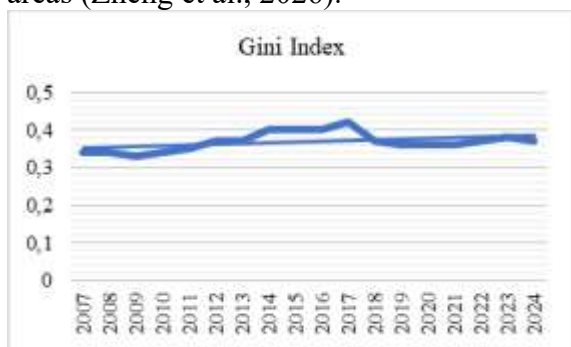


Figure 1. Tren of Gini Index in East Java 2007–2024
Source: Data process, 2025

Despite continuous economic growth and improvements in educational indicators, income inequality in East Java remains relatively persistent. During the 2007–2024 period, the province consistently recorded strong economic growth supported by industrial expansion, trade activities, and

infrastructure development concentrated in major urban corridors. At the same time, educational indicators, particularly average years of schooling, continued to improve, while the open unemployment rate generally declined in several periods. Nevertheless, these improvements were not consistently followed by significant reductions in the Gini Index (Octavia et al., 2024).

This condition indicates that economic growth and human capital development have not yet generated evenly distributed welfare outcomes. Structural disparities between urban industrial districts and peripheral regions remain evident in terms of labor productivity, employment opportunities, infrastructure availability, and economic access. As a result, the benefits of development remain concentrated in industrial centers such as Surabaya, Sidoarjo, and Gresik, while many rural and peripheral areas continue to depend on low-productivity sectors. Therefore, East Java represents a relevant case for examining the relationship between education, labor market conditions, and income inequality because the province simultaneously demonstrates strong economic performance and persistent regional disparities (Zulfia et al., 2024).

The persistence of inequality in East Java also reflects an inconsistency with Human Capital Theory, which generally assumes that improvements in education and labor productivity contribute to more equitable income distribution. In practice, however, increases in average years of schooling have not consistently reduced the Gini Index. In several periods, educational attainment improved while income inequality remained stable or even increased (Aqil & Wahyuniati, 2021).

This phenomenon suggests that the benefits of educational expansion are not distributed evenly across society because labor market opportunities, sectoral productivity, and access to high-income employment remain concentrated in specific urban and industrial areas. Consequently, educational progress alone may not automatically function as an equalizing mechanism in regions characterized by

uneven structural transformation and segmented labor markets (Makhlouf & Lalley, 2023).

From a theoretical perspective, education plays a central role in development economics because it strengthens human capital formation. Human Capital Theory explains that education improves productivity, enhances technical skills, and increases access to better employment opportunities, thereby supporting higher income and upward social mobility (Sairmaly, 2023).

Individuals with higher educational attainment generally possess stronger adaptive capacity to technological change and greater competitiveness in increasingly selective labor markets. Therefore, education is widely regarded as an important policy instrument for reducing inequality because it expands productive capabilities and participation in economic activities (Kokkinopoulou et al., 2025).

However, the relationship between education and inequality is not always linear. Improvements in average years of schooling do not automatically produce equal welfare outcomes because educational expansion may occur alongside disparities in educational quality, access, and labor market relevance (Sennuga et al., 2023). In many developing regions, educational indicators improve quantitatively, while qualitative disparities between urban and rural populations remain substantial.

Differences in school quality, educational infrastructure, family support, and access to advanced educational facilities often create unequal returns to education. Under these conditions, improvements in educational attainment may increase average schooling statistically, while the economic benefits remain concentrated among groups with stronger social and economic advantages (ÖZER, 2023).

This issue becomes more evident when labor market absorption does not expand proportionally with educational attainment. Increasing educational levels may produce a larger number of educated workers without sufficient employment opportunities capable

of utilizing their qualifications effectively. As a result, education may fail to function as an equalizing mechanism because educational attainment alone cannot guarantee productive employment or stable income generation (Afandi et al., 2026).

Therefore, the distributive effect of education largely depends on whether structural transformation creates sufficient demand for skilled labor. Several empirical studies indicate that education contributes more effectively to reducing inequality when accompanied by inclusive employment expansion and stronger alignment between educational outcomes and labor market needs (Akintayo et al., 2024).

In addition to education, labor market conditions also represent an important determinant of income inequality. The open unemployment rate reflects the inability of the regional economy to absorb available labor productively. High unemployment increases inequality because unemployed individuals lose stable income sources, while employed groups continue to accumulate income and strengthen their economic position. Consequently, lower-income households experience weaker consumption capacity and greater welfare vulnerability (Tjan, 2024).

This issue becomes particularly relevant in regions experiencing industrial restructuring, where sectoral transformation may temporarily displace workers before new employment opportunities emerge (Ramasamy, 2024).

The labor market structure in East Java shows conditions that make unemployment highly relevant to inequality analysis. Although industrial and service sectors continue to grow, labor absorption remains uneven across educational groups and regions. Urban centers generally provide more diverse employment opportunities, whereas peripheral districts continue to depend on agriculture, informal trade, and low-productivity service activities. This segmentation creates unequal labor market outcomes in which highly educated workers benefit more from sectoral modernization, while lower-skilled workers remain

vulnerable to unstable earnings and low productivity (Otomasyon, 2025).

An inconsistency can also be observed in the relationship between unemployment and inequality. Conventional economic theory suggests that higher unemployment tends to increase inequality because unemployed individuals lose stable sources of income. However, empirical patterns in East Java indicate that changes in unemployment do not always correspond proportionally with changes in the Gini Index. In several periods, reductions in unemployment were not followed by substantial declines in inequality, suggesting that employment growth may have occurred mainly in informal or low-productivity sectors with limited welfare improvement. This condition indicates that employment quantity alone is insufficient to explain distributive outcomes because employment quality, stability, and productivity also influence whether labor market expansion contributes to more equitable income distribution (Tremblay et al., 2016).

Previous studies examining education, unemployment, and income inequality generally focus on national-level analysis, cross-country comparisons, or panel data involving multiple regions. Most findings conclude that education tends to reduce inequality through human capital improvement, while unemployment tends to increase inequality due to unequal labor market participation (Akintayo et al., 2024).

However, several recent studies reveal inconsistent results, particularly in developing regions where improvements in educational attainment are not always accompanied by equal labor market access and productive employment absorption (Ernst et al., 2025).

The novelty of this study lies in its focus on East Java as one of Indonesia's largest industrial provinces with persistent inequality despite strong regional economic performance. Unlike many previous studies that emphasize cross-sectional or panel approaches, this research employs a provincial time-series analysis covering the 2007–2024 period to capture long-term

structural dynamics between educational attainment, labor market conditions, and income inequality. In addition, this study highlights the possibility of structural anomalies in which improvements in education and reductions in unemployment do not automatically produce more equitable welfare distribution. Therefore, this research contributes to the literature on regional development and inequality by providing empirical evidence from a rapidly transforming regional economy in a developing-country context.

Based on these considerations, this study aims to analyze the effect of educational attainment and the open unemployment rate on income inequality, as measured by the Gini Index, in East Java during the 2007–2024 period. By applying time-series analysis, this study seeks to identify whether educational progress and labor market conditions significantly influence inequality patterns. The findings are expected to contribute to the formulation of regional development policies that not only promote economic growth but also strengthen equitable welfare distribution through more inclusive development strategies.

II. METHOD

This study employs a quantitative approach with an explanatory research design to analyze the effect of educational attainment and the open unemployment rate on income inequality in East Java. The explanatory quantitative approach is selected because the research aims to explain causal relationships among variables through statistical testing based on numerical data. The study uses secondary time-series data covering the period 2007–2024.

The data are obtained from official publications of Badan Pusat Statistik (BPS), including statistical reports related to the Gini Index, average years of schooling, and the open unemployment rate in East Java. Data collection is conducted through documentation techniques by compiling, recording, and processing annual statistical data that are consistent in terms of period,

variable definition, and measurement comparability across years.

The dependent variable in this study is income inequality, measured using the Gini Index (GINI). The independent variables consist of educational attainment, proxied by average years of schooling (EDU), and the open unemployment rate (UNEMP). The selection of these variables is theoretically grounded in Human Capital Theory and labor market theory, which explain that educational quality and labor absorption are closely related to regional income distribution patterns.

The analytical approach applies multiple linear regression using a time-series framework. To ensure the validity of the time-series estimation, the analysis begins with a stationarity test for all variables using the Augmented Dickey-Fuller (ADF) test. This procedure is conducted to determine whether the variables are stationary at the level form or require differencing to achieve stationarity. Stationarity testing is essential to avoid spurious regression results that may arise when non-stationary data are used in econometric estimation.

Furthermore, if the variables are found to be integrated at the same order, a cointegration test is performed to examine the existence of a long-run equilibrium relationship among the variables. The cointegration analysis is conducted using the Engle-Granger Cointegration Test by examining the stationarity of the residuals generated from the long-run regression model. The existence of cointegration indicates that educational attainment, unemployment, and income inequality move together in the long run despite short-term fluctuations.

After confirming the stationarity and cointegration properties of the data, the estimation model is formulated as follows:

$$Gini_t = \alpha + \beta_1 EDU_t + \beta_2 UNEMP_t + e_t \dots \dots \dots \text{Equation 1}$$

In this model, GINI represents the Gini Index as an indicator of income inequality, EDU refers to educational attainment measured by average years of schooling,

UNEMP denotes the open unemployment rate, and ε represents the error term.

Before conducting the regression estimation, the data are further examined through several classical assumption tests, including normality, multicollinearity, heteroskedasticity, and autocorrelation tests. These procedures are carried out to ensure that the regression model fulfills the Best Linear Unbiased Estimator (BLUE) assumptions.

To improve the analytical depth despite the limited number of explanatory variables, this study also incorporates descriptive trend analysis and an examination of structural changes occurring during the 2007–2024 period. The analysis emphasizes the movement and consistency of trends among educational attainment, unemployment, and income inequality to provide a more comprehensive understanding of regional development dynamics in East Java. Consequently, although the econometric model is relatively simple, the interpretation is strengthened through contextual analysis of educational progress, labor market transformation, and regional economic disparities.

In addition to econometric estimation, descriptive statistical analysis is employed to identify the development pattern and fluctuation of each variable throughout the observation period. This approach allows the study to complement quantitative estimation with a broader explanation of socio-economic changes in the region.

All data processing and statistical estimations are conducted using EViews software because it offers comprehensive support for time-series econometric analysis, including stationarity testing, cointegration analysis, and regression estimation. The estimation results are subsequently interpreted to explain the empirical relationship between education, unemployment, and income inequality, which may serve as a reference for formulating more inclusive and equitable regional development policies.

III. RESULTS AND DISCUSSION

A. Multiple Linear Regression

In this study, the multiple linear regression method is employed to determine the magnitude of the influence of educational attainment (EDU) and the open unemployment rate (UNEMP) on income inequality. The estimation results are presented in the following table.

Table 1. Multiple Linear Regression Results

Variable	Coefficient	t-Statistic	Prob.
Constant	0,389473	0,109165	0,0031
EDU	0,007754	0,012271	0,5376
UNEMP	-0,015379	0,006212	0,0267
R-squared			0,338882
Adjusted R-squared			0,197214
F-statistic			2,392081
F(prob)			0,112226
Durbin Watson stat			1,006172

Source: Data Processed, 2025

Table 1 shows that when the estimated coefficients are incorporated into the multiple regression model, the resulting multiple linear regression equation is as follows:

$$GINI = 0,389473 + 0,007754EDU - 0,015379UNEMP + e \dots \dots \dots \text{Equation 2}$$

Based on the multiple linear regression estimation presented in Table 1, the constant value of 0,389473, which is significant at the 5% level, indicates the baseline level of the Gini Index when all independent variables are assumed to remain constant.

The educational attainment variable (EDU) has a positive coefficient of 0,007754, indicating that an increase in educational attainment tends to raise the Gini Index by 0,007754 points. However, the t-statistic value of 0,632 is smaller than the t-table value ($\pm 2,042$ at $\alpha = 5\%$), and the probability value of 0,5376 is greater than 0,05. Therefore, EDU has no statistically significant effect on income inequality in East Java during 2007–2024.

Meanwhile, the open unemployment rate variable (UNEMP) has a regression coefficient of $-0,015379$, indicating that an increase in unemployment tends to reduce the

Gini Index by 0,015379 points. The t-statistic value of $-2,476$ is greater than the t-table value ($\pm 2,042$), and the probability value of 0,267 is smaller than 0,05. Therefore, UNEMP has a statistically significant negative effect on income inequality in East Java during the observation period.

The simultaneous significance test (F-test) produces an F-statistic value of 2,392081, which is smaller than the F-table value (3,44), with a probability value of 0,112226 greater than 0,05. Therefore, the variables EDU and UNEMP simultaneously do not have a statistically significant effect on the Gini Index. This indicates that the independent variables in the model are not sufficient to comprehensively explain income inequality in East Java.

The coefficient of determination shows an Adjusted R-squared value of 0,197214, meaning that 19,72 percent of the variation in the Gini Index can be explained by educational attainment and unemployment, while the remaining 80,28 percent is influenced by other factors outside the model. Meanwhile, the Durbin-Watson statistic value of 1,006172 is below the ideal value of 2, indicating the possibility of positive autocorrelation in the regression model. This suggests that the residuals may still be correlated across time periods, so the model may require further improvement using a more appropriate econometric approach.

B. Classical Assumption Tests

1. Normality Test

The normality test is used to examine whether the disturbance term or residuals in the regression model are normally distributed. Normality testing can be conducted using a histogram approach by observing the *Probability Jarque-Bera* value. The decision criterion in this test is based on the probability value: if the *Jarque-Bera* probability is less than 0,05, the data are considered not normally distributed; conversely, if the probability value exceeds 0,05, the data are considered normally distributed. Based on the results of the normality test, the following findings were obtained:

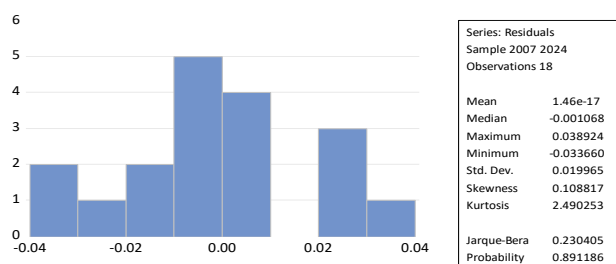


Figure 2. Development of Gini Index in East Java 2007-2024

Source: Data Processed, 2025

The residual normality test indicates that the regression model satisfies the normality assumption, as evidenced by a Jarque-Bera value of 0,230405 with a probability of 0,891186, which exceeds the 5% significance level, thus failing to reject the null hypothesis. The mean of the residuals is close to zero, while the skewness and kurtosis values approximate those of a normal distribution, suggesting that the residuals are unbiased and symmetrically distributed. With the normality assumption fulfilled, the regression model is deemed suitable for further inferential analysis, and the results of the statistical tests can be interpreted reliably.

2. Multicollinearity Test

The multicollinearity test is conducted to determine whether there is a high correlation among independent variables in the regression model. A good regression model should not exhibit multicollinearity. This test can be assessed using the correlation matrix or the Variance Inflation Factor (VIF). If the VIF value is less than 10, it indicates that multicollinearity is not present in the model. The results of the Multicollinearity Test are presented in the table below:

Table 2. Multicollinearity Test

Variable	Coefficient	Centered VIF
EDU	0,000151	1,334811
UNEMP	3,86E-05	1,119753

Source: Data Processed, 2025

The multicollinearity test was conducted to examine the presence of linear relationships among the independent variables in the regression model. Based on Table 2, the Centered Variance Inflation Factor (VIF) values for education level and

open unemployment rate are 1,33 and 1,12, respectively, both of which remain below the critical threshold. These results indicate the absence of multicollinearity among the independent variables, confirming that the regression model is appropriate for estimation. Therefore, the partial effects of each independent variable on the Gini Index of East Java during the 2007–2024 period can be interpreted without bias arising from strong linear relationships among the explanatory variables.

3. Heteroskedasticity Test

The heteroscedasticity test is used to determine whether the variance of residuals is constant across observations in the regression model. A good regression model should exhibit homoscedasticity, meaning constant variance of residuals. The test can be conducted using the Glejser test, where a probability value greater than 0.05 indicates the absence of heteroscedasticity. The results of the heteroskedasticity test are presented in the table below:

Table 3. Heteroskedasticity Test

Heteroskedasticity Test: ARCH			
F-statistic	0,831861	Prob. F (9,8)	0,6080
Obs*R-squared	8,701729	Prob. Chi-Squared (9)	0,4653
Scaled explained SS	3,922353	Prob. Chi-Squared (9)	09163

Source: Data Processed, 2025

The heteroskedasticity test results indicate that the regression model does not exhibit heteroskedasticity, as evidenced by the F-statistical probability, ObsR-squared*, and Scaled Explained SS values of 0,6080, 0,4653, and 0,9163, respectively, all of which exceed the 5% significance level. This suggests that the residual variance is homogeneous and does not depend on changes in the independent variables. With the homoscedasticity assumption satisfied, the estimated regression coefficients are efficient, and the results of the statistical tests can be interpreted reliably.

4. Autocorrelation Test

The autocorrelation test aims to identify whether residuals in one observation are correlated with residuals in another observation within the regression model. This test is commonly performed using the Durbin-Watson statistic. A Durbin-Watson value close to 2 indicates that there is no autocorrelation in the model. The results of the LM Test are presented in the table below:

Table 4. Autocorrelation Test			
Breusch-Godfrey Serial Correlation LM Test			
F-statistic	2,887743	Prob. F (2, 12)	0,0947
Obs*R-squared	5,848433	Prob. Chi-Square (2)	0,0537

Source: Data Processed, 2025

The autocorrelation test results indicate that the regression model does not exhibit autocorrelation, as shown by Prob. F-statistic of 0,0947 and Prob. Chi-Square (ObsR-squared*) of 0,0537, both exceeding the 5% significance level. This suggests that the residuals are independent across periods and do not display systematic correlation. With this assumption satisfied, the estimated regression coefficients are efficient, and the results of the statistical tests can be interpreted reliably.

C. Supporting Time-Series Diagnostics

Since the primary estimation method employed in this study is Ordinary Least Squares (OLS) multiple linear regression rather than an Error Correction Model (ECM), additional time-series analyses were performed only as supporting diagnostic analyses. Specifically, the Augmented Dickey-Fuller (ADF) unit root test and the Engle-Granger cointegration test are reported solely as robustness checks to describe the statistical properties of the data. These tests are not used as the basis for selecting the estimation model or for implementing an ECM.

1. Stationarity

The stationarity of the variables was examined using the Augmented Dickey-Fuller (ADF) unit root test as a supporting diagnostic analysis (robustness check) to

identify the time-series properties of the data. Since this study employs multiple linear regression rather than an Error Correction Model (ECM), the ADF test is not used as the basis for selecting the estimation model, but rather to provide additional evidence regarding the stochastic characteristics of the variables.

Table 5. Stationarity Results

Variable	Level of Testing	ADF Test Statistic	Prob. Value
GINI	SI (1)	-3,992140	0,0087
EDU	SI (1)	-3,874011	0,0061
UNEMP	SI (1)	-4,123210	0,0068

Source: Data Processed, 2025

The results presented in Table 5 indicate that all variables became stationary after being transformed into their first differences, implying that they are integrated of order one, I(1). The GINI variable recorded an ADF test statistic of $-3,992140$ with a probability value of 0,0087, which is below the 5% significance level. This indicates that the null hypothesis of a unit root can be rejected and that the GINI series is stationary after first differencing.

Similarly, the EDU variable produced an ADF test statistic of $-3,874011$ with a probability value of 0,0061, confirming that the series is stationary at the first difference level. The UNEMP variable also became stationary after first differencing, with an ADF test statistic of $-4,123210$ and a probability value of 0,0068.

Overall, the results suggest that all variables are integrated of order one, I(1). These findings are reported solely as supporting evidence regarding the statistical properties of the data and are not used to justify the application of an Error Correction Model (ECM), as the main analysis in this study relies on multiple linear regression.

2. Cointegration Test

To complement the stationarity analysis, the Engle-Granger cointegration test was performed as a supporting robustness check to examine whether a long-run equilibrium relationship exists among income inequality (GINI), educational attainment (EDU), and the open unemployment rate (UNEMP). The

cointegration test is presented only as additional information regarding the long-run association among the variables and is not intended to justify the use of an Error Correction Model (ECM), which is beyond the scope of this study.

Table 6. Cointegration Test

Residual Variable	Level of Testing	ADF Test Statistic	Probability Value
Residuals Model	SI(1)	-3,820610	0,0121

Source: Data Processed, 2025

The Engle–Granger cointegration test indicates that the residual series is stationary, with an ADF statistic of -3,820610 and a probability value of 0,0121. This result suggests the existence of a stable long-run relationship among income inequality, educational attainment, and the unemployment rate. Nevertheless, because the objective of this study is to estimate the contemporaneous relationship among the variables using OLS multiple linear regression, the cointegration results are interpreted solely as supporting evidence and are not used as the basis for implementing an Error Correction Model (ECM).

In summary, the analytical procedure adopted in this study follows the sequence of OLS estimation, classical assumption testing, and supporting time-series diagnostics. Accordingly, the ADF and cointegration tests should be interpreted only as robustness checks that provide additional information on the statistical properties of the data, rather than as the econometric basis for selecting an Error Correction Model (ECM).

The regression estimation results indicate that education level, proxied by average years of schooling, has a positive coefficient of 0,007754 with a probability value of 0,5376, indicating that education does not have a statistically significant effect on income inequality in East Java during the 2007–2024 period. This finding implies that improvements in educational attainment, as measured quantitatively through schooling duration, have not yet functioned as an effective mechanism for reducing income disparities across households in the province.

In empirical terms, the increase in average years of schooling during the observation period has not been followed by proportional changes in income distribution, suggesting that educational expansion alone is insufficient to alter structural inequality.

From the perspective of Human Capital Theory, education is theoretically expected to improve productivity, increase labor efficiency, and enhance access to higher-income employment opportunities. Individuals with higher educational attainment generally possess stronger cognitive skills, better adaptive capacity to technological change, and broader opportunities to enter productive sectors with relatively stable earnings.

Under ideal labor market conditions, such improvements should contribute to upward social mobility and eventually reduce income inequality because education increases earning capacity across wider segments of society. Empirical literature consistently recognizes education as one of the main long-term instruments for distributive improvement because investment in human capital strengthens labor competitiveness and productivity formation (Kouskoura et al., 2024).

However, the present findings indicate that this theoretical relationship does not automatically materialize in the regional development context of East Java. The absence of statistical significance suggests that the transmission mechanism from educational improvement to income equalization remains weak. This result supports the argument of (Ernst et al., 2025), who explain that educational expansion may fail to reduce inequality when structural transformation benefits only specific segments of the labor market. In such circumstances, educational gains are captured disproportionately by groups already connected to modern sectors, while lower-income groups continue to experience limited returns from schooling.

One important explanation concerns the distinction between educational quantity and educational quality. Average years of schooling reflects only the duration of formal

education but does not capture disparities in school quality, instructional effectiveness, infrastructure availability, or access to advanced competencies. In East Java, educational attainment has improved over time, yet differences between urban and peripheral districts remain substantial in terms of school facilities, teacher quality, digital learning access, and continuation to higher education.

Urban districts generally benefit from stronger institutional capacity, better educational infrastructure, and wider access to private and public higher education institutions, while rural and peripheral districts often face limitations in educational support systems. As a result, individuals with the same years of schooling may experience very different labor market outcomes depending on where and how education was obtained. This condition causes unequal economic returns from education and weakens the equalizing effect expected from schooling expansion (Nybom et al., 2026).

A second explanation relates to the persistent education-employment mismatch in the regional labor market. Educational expansion has increased the supply of educated workers, but labor demand has not grown proportionally in sectors capable of absorbing such qualifications. This creates a situation in which higher educational attainment does not necessarily lead to productive employment corresponding to acquired skills.

Many educated workers remain concentrated in informal employment, temporary jobs, or occupations below qualification level. Zaman, 2025 explains that when labor markets fail to match educational qualifications with occupational demand, the economic return of schooling declines and education loses its distributive effectiveness.

This phenomenon is particularly relevant in East Java because provincial economic growth remains strongly driven by manufacturing, trade, and services concentrated in several urban industrial corridors such as Surabaya, Sidoarjo, and Gresik, while peripheral districts remain

dependent on agriculture and informal activities.

Such sectoral dualism means that educational attainment yields higher returns only for those able to enter formal modern sectors, whereas workers outside those sectors often experience stagnant income despite educational improvement. Consequently, the benefits of education are distributed unevenly across territories and social groups, reinforcing structural inequality rather than reducing it (Freddie, 2025).

Another important aspect is that educational improvement in East Java has occurred simultaneously with changing labor demand associated with technological modernization. Modern sectors increasingly require specific technical skills, digital competence, problem-solving ability, and adaptive capacity rather than merely formal years of schooling. Therefore, average schooling may not adequately reflect labor market readiness.

Workers with equivalent educational duration may differ significantly in productivity depending on vocational exposure, technical training, and practical competence. This explains why quantitative educational indicators often fail to show significant direct effects on inequality unless accompanied by curriculum relevance, vocational strengthening, and sectoral alignment.

The insignificant coefficient also needs to be interpreted carefully because the regression model only employs two independent variables, namely education level and open unemployment rate. As reflected in the relatively low adjusted R-squared value, variations in income inequality in East Java are likely influenced more strongly by other structural determinants outside the model, such as wage disparities, sectoral productivity gaps, urban concentration of economic activities, infrastructure inequality, ownership of productive assets, and regional development disparities.

Therefore, the model is still limited in capturing the broader determinants of

inequality comprehensively, especially considering that only the open unemployment rate variable demonstrates statistical significance in the regression results.

In addition, the distributive role of education is highly dependent on the speed of structural transformation within the regional economy. When economic transformation occurs faster than educational adaptation, labor market rewards tend to favor workers who already possess advanced competencies or access to stronger economic networks. This creates unequal returns even when educational attainment improves statistically. Under these circumstances, education contributes more to differentiation than to equalization because only certain groups can convert educational attainment into productive earnings.

The result also confirms that education contributes to inequality reduction only when supported by inclusive labor market expansion. Scandurra et al., 2024, demonstrate that education becomes distributively effective when employment opportunities expand broadly and when educational outcomes correspond closely to labor market requirements. Without such complementary structural conditions, education may raise individual potential but not necessarily improve aggregate welfare distribution.

Another relevant explanation is the time-lag effect of education. Educational investment generally produces distributive outcomes over a longer horizon because improvements in schooling require time before translating into occupational mobility and intergenerational welfare changes.

During the 2007–2024 period, improvements in average years of schooling may still be in the process of generating economic returns that have not yet fully appeared in provincial inequality indicators. Therefore, the short- to medium-term statistical effect may remain weak even though long-term human capital benefits continue to accumulate.

Thus, the findings confirm that educational attainment alone cannot yet be

considered a sufficient policy instrument for reducing income inequality in East Java. Policies focusing solely on increasing years of schooling may improve human capital statistically, but without parallel improvements in education quality, equal access, and labor market absorption, distributive effects remain limited.

Therefore, policy direction should prioritize strengthening vocational relevance, reducing territorial educational disparities, expanding access to quality secondary and tertiary education, and improving integration between educational institutions and productive sectors.

In broader regional development terms, education should be positioned not merely as a social indicator, but as part of an integrated economic inclusion strategy capable of connecting human capital formation with productive employment opportunities, technological adaptation, and equitable sectoral transformation across districts in East Java.

This study has several limitations. First, the regression model only includes two independent variables, namely education level and open unemployment rate, so it has not fully captured other structural determinants of income inequality such as wage disparities, economic growth, sectoral productivity, urbanization, and ownership of productive assets.

Second, the use of provincial-level time series data may not adequately reflect inequality differences across districts and cities in East Java.

Third, only the open unemployment rate variable shows a statistically significant effect, while the education variable is insignificant, indicating that the explanatory power of the model remains limited, as reflected in the relatively low adjusted R-squared value. Therefore, future studies are recommended to include additional variables and apply panel data approaches to obtain more comprehensive results.

The regression estimation demonstrates that the open unemployment rate has a coefficient of $-0,015379$ with a probability value of $0,0267$, indicating that the variable

has a statistically significant effect on income inequality in East Java during the 2007–2024 period. The negative coefficient implies that variations in unemployment are associated with changes in the Gini Index in the opposite direction, meaning that labor market dynamics remain an important factor influencing regional income distribution.

However, because the regression model only employs two independent variables, namely educational attainment and the open unemployment rate, the model is still limited in capturing broader structural determinants of inequality. This limitation is reflected in the relatively low adjusted R-squared value, indicating that variations in the Gini Index are also strongly influenced by other factors outside the model.

From a theoretical perspective, unemployment occupies a central position in welfare economics because employment constitutes the primary channel through which households obtain income and participate in productive economic activities. In labor market theory, unemployment reflects the inability of the economic system to absorb available labor supply effectively, thereby limiting access to stable earnings among certain population groups. Nevertheless, the relationship between unemployment and inequality may vary across regions depending on economic structure, labor market segmentation, and sectoral transformation.

In economies dominated by low-wage and labor-intensive sectors, reductions in unemployment do not always directly improve equality because newly absorbed workers may remain concentrated in low-productivity employment with relatively limited income gains. Håkansta et al., (2025) explain that labor absorption in precarious sectors may reduce open unemployment statistically without substantially improving long-term welfare outcomes.

The negative coefficient identified in this study suggests that during several periods, increases in unemployment were not necessarily followed by wider inequality, but instead coincided with narrower income gaps. This condition may emerge during

economic slowdowns in which both middle-income and high-income groups experience simultaneous income pressure, causing measured inequality to decline statistically even though overall welfare conditions weaken. Hazra & Shiau, (2022) argue that lower inequality during recessionary periods does not always indicate stronger distributive justice, but may instead reflect a temporary contraction in income differences across economic groups.

This finding also indicates that the relationship between unemployment and inequality in East Java is strongly influenced by structural labor market characteristics. East Java's economy is supported by manufacturing, trade, transportation, and service sectors, yet labor absorption remains uneven across regions and sectors. Urban industrial areas such as Surabaya, Sidoarjo, and Gresik provide relatively stronger formal employment opportunities, whereas many peripheral districts continue to depend on agriculture, informal trade, and low-productivity services. Consequently, fluctuations in unemployment often interact with sectoral labor shifts rather than purely reflecting labor exclusion. Cieřlik & Stel, (2024) emphasize that labor market transformation in developing regions frequently produces segmented employment outcomes, particularly between formal and informal sectors.

In addition, the negative relationship may indicate that when unemployment decreases, newly created employment opportunities are concentrated in sectors characterized by relatively homogeneous wage structures, such as labor-intensive manufacturing, informal services, and retail trade. Under these conditions, broader labor absorption can reduce open unemployment while simultaneously narrowing measured income disparities because more households gain access to minimum income sources. Haque & Mahmud, (2025) explain that employment expansion, even in relatively low-productivity sectors, may still moderate inequality by increasing participation in income-generating activities among lower-income households.

Nevertheless, the effect should be interpreted cautiously because the quality of employment remains a crucial issue. Reductions in unemployment dominated by informal or unstable jobs may improve short-term distribution indicators without strengthening sustainable welfare. Workers employed in vulnerable sectors often face unstable wages, limited social protection, and restricted upward mobility opportunities. Olatunbosun et al., (2025) explain that employment growth only functions effectively as an equalizing mechanism when accompanied by improvements in productivity, job stability, and labor protection.

The finding further suggests that East Java's labor market still exhibits segmented characteristics, where educational background, sectoral specialization, and geographic location significantly influence labor market outcomes. Workers with higher qualifications are generally absorbed into formal sectors with stronger wage protection, while lower-skilled workers remain concentrated in informal activities. Consequently, changes in unemployment among low-income groups may generate stronger aggregate effects on income distribution because they directly affect household earning capacity. Cámara et al., 2024, also emphasize that labor market segmentation remains one of the key determinants of inequality persistence in developing economies.

Empirically, this result confirms that labor market dynamics constitute a more immediate channel affecting inequality compared with education. Unlike educational attainment, whose distributive impact tends to emerge gradually through long-term human capital accumulation, unemployment directly influences household income formation and consumption capacity. This explains why, within the regression model, the unemployment variable appears statistically significant while education does not.

However, these findings should also be interpreted within the limitations of the research model. Since the study only

incorporates two explanatory variables, the analysis has not fully captured broader determinants of inequality such as wage disparity, industrial concentration, urbanization, labor productivity, investment distribution, regional infrastructure inequality, and ownership of productive assets. Furthermore, the simultaneous test results indicate that the independent variables jointly do not significantly explain inequality variation, suggesting that inequality in East Java is multidimensional and structurally complex.

This study has several limitations that should be considered in interpreting the findings. First, the regression model only employs two independent variables, namely educational attainment and the open unemployment rate, so the model has limited capacity to explain the broader structural determinants of income inequality in East Java. Second, the analysis uses provincial-level time series data, which may not fully capture disparities across districts and municipalities with different economic structures and labor market conditions. Third, the study focuses primarily on quantitative indicators and does not include qualitative dimensions such as employment quality, labor productivity, wage structure, and access to productive assets, which may also significantly influence inequality patterns. Therefore, future research is recommended to incorporate additional structural variables, panel data approaches, and district-level analysis in order to obtain a more comprehensive understanding of regional income inequality dynamics.

IV. CONCLUSION

Based on the results of the study, education level in East Java has not yet shown a direct role in reducing income inequality. Although educational attainment has continued to improve, its contribution to income distribution remains limited because educational expansion has not been fully supported by equal quality, balanced access, and strong alignment with labor market needs. This indicates that increasing years of

schooling alone is not sufficient to create distributive improvements when structural disparities in employment opportunities and economic sectors persist.

In contrast, the open unemployment rate has a more visible influence on income inequality because labor market dynamics directly affect household income formation. Changes in employment absorption determine how broadly economic opportunities are distributed across society, especially for lower-income groups that depend heavily on labor earnings. This confirms that employment remains a more immediate channel in shaping regional income distribution.

Overall, income inequality in East Java is influenced not only by education and unemployment, but also by broader structural conditions such as sectoral disparities, uneven regional development, and differences in productive economic access. Therefore, reducing inequality requires integrated policies that strengthen inclusive employment creation, improve workforce quality, and connect educational development with productive sector expansion across regions.

V. RECOMMENDATIONS

Policy efforts to reduce income inequality in East Java should not rely solely on expanding educational attainment but must also focus on improving the quality and relevance of education to labor market demands. Strengthening vocational education, technical skills, and digital competencies is essential so that educational outcomes can generate stronger economic returns across wider social groups. Equal access to quality education between urban and peripheral areas also needs to be prioritized in order to reduce disparities in human capital formation.

At the same time, employment policy should become a central component of inequality reduction. Regional development strategies need to encourage broader job creation, particularly in productive sectors capable of absorbing labor outside major

urban centers. Support for labor-intensive industries, micro and small enterprises, and local economic diversification is important to widen income opportunities and reduce dependence on informal employment.

In a broader perspective, reducing inequality requires stronger integration between educational policy, labor market development, and regional economic transformation. Government intervention should therefore emphasize inclusive sectoral development, improved connectivity between districts, and expansion of productive investment so that economic growth can generate more balanced welfare distribution across East Java.

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