

## DOES SCHOOLING REDUCE INCOME INEQUALITY? PANEL EVIDENCE FROM REGENCIES AND CITIES IN WEST KALIMANTAN, INDONESIA, 2016–2025

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**Abstract:** Human capital theory predicts that wider schooling lowers income inequality, yet empirical evidence for Indonesian regions is contradictory. This study examines the effect of education, measured by mean years of schooling, on income inequality, measured by the Gini ratio, in the 14 regencies and cities of West Kalimantan Province over 2016–2025 (140 observations), using BPS data. The common, fixed, and random effect models are estimated, and the preferred model is selected with the Chow, Hausman, and Lagrange Multiplier tests. Across regencies, schooling and inequality are positively associated ( $r = 0.70$  for regency means), driven mainly by Pontianak City, which has both the highest schooling and the highest inequality; the common and random effect models therefore show a positive and significant coefficient. However, the tests favour the fixed effect model, in which schooling has a negative but insignificant effect on the Gini ratio ( $\beta = -0.0065$ ; cluster-robust  $p = 0.508$ ). The result is robust to year effects, the exclusion of outliers, and lagged schooling. The hypothesis that education reduces inequality is therefore not supported: the cross-regional link reflects persistent regional characteristics rather than the effect of rising schooling within regions. Policy should complement the expansion of schooling with measures that improve its quality and link it to productive local employment, especially in high-inequality areas.

**Keyword:** education; gini ratio; income inequality; panel data; West Kalimantan.

### INTRODUCTION

Economic development aims not only to raise output but also to distribute its benefits widely. When growth is concentrated in particular sectors, groups, or places, income inequality rises and limits the extent to which development improves living standards. Kuznets (1955) argued that inequality tends to rise in the early stages of development, as workers move from traditional to modern sectors, and to fall once the benefits of growth spread more widely. Whether a region is still on the rising or already on the falling part of this path depends heavily on whether its population can take part in higher-productivity activities.

Education is a central channel through which this participation occurs. Human capital theory holds that schooling raises workers' skills and productivity and

therefore their earnings (Becker, 1993). If schooling spreads to lower-income groups, the wage gap between more and less educated workers narrows and inequality should fall. If, however, the gains from schooling are captured first by groups that are already better off, or if educated workers concentrate in urban labour markets that pay a highskill premium, rising schooling can coincide with rising inequality.

West Kalimantan illustrates this tension. In 2025 the provincial Gini ratio stood at 0.316 and mean years of schooling at 8.07 years, both with wide variation across regencies and cities (Badan Pusat Statistik, 2026a, 2026b). Over 2016–2025, Pontianak City had both the highest average schooling (10.21 years) and the highest average Gini ratio (0.349), whereas Kayong Utara had the lowest schooling (6.12 years). This

pattern raises the question of whether education in the province reduces inequality or is associated with greater polarisation of incomes.

Empirical studies give contradictory answers. Education reduced income inequality across Indonesian provinces in Mumtaz and Amar (2024) and Ashari et al. (2024), and across provinces in Java in Vionita and Artha (2024). In contrast, it had a positive and significant effect on inequality in the regencies of Nusa Tenggara Barat (Oktaviani et al., 2025) and, using a random effect model, in the 14 regencies and cities of West Kalimantan over 2014–2023 (Oktasari & Suradi, 2025). Other studies find positive but insignificant effects (Duarsa & Wijaya, 2023; Dai et al., 2023). These differences may reflect not only regional conditions but also the choice of estimator, because a pooled or random effect model mixes differences between regions with changes within them.

This study therefore examines the effect of education, measured by mean years of schooling, on income inequality in the 14 regencies and cities of West Kalimantan over 2016–2025, testing the hypothesis (H1) that education has a negative effect on income inequality. It contributes in three ways: it uses the most recent regency-level data up to 2025; it formally selects among the common, fixed, and random effect models and shows how this choice changes the conclusion; and it separates the cross-regional association between schooling and inequality from the effect of rising schooling within regions.

## METHOD

This quantitative explanatory study uses secondary panel data for the 12 regencies and 2 cities of West Kalimantan Province over 2016–2025, giving a balanced panel of 140 observations. Data on the Gini ratio and mean years of schooling were obtained from Statistics

Indonesia (BPS) for West Kalimantan Province (Badan Pusat Statistik, 2026a, 2026b). Income inequality (GR) is measured by the Gini ratio, which ranges from 0 (perfect equality) to 1 (perfect inequality). Education (RLS) is measured by mean years of schooling of the population aged 25 years and over, which reflects the stock of human capital. The relationship is estimated with the panel regression model in equation (1):

$$GR_{it} = \beta_0 + \beta_1 RLS_{it} + \mu_i + \varepsilon_{it} \quad (1)$$

where  $i$  denotes the regency or city ( $i = 1, \dots, 14$ ),  $t$  denotes the year (2016, ..., 2025),  $\mu_i$  captures unobserved regional characteristics that do not change over time, and  $\varepsilon_{it}$  is the error term. H1 is supported if  $\beta_1$  is negative and significant at the 5 percent level. Equation (1) is estimated with three approaches: the common effect model (CEM), which pools all observations and ignores  $\mu_i$ ; the fixed effect model (FEM), which treats  $\mu_i$  as region-specific intercepts and uses only variation within each region over time; and the random effect model (REM), which treats  $\mu_i$  as a random component uncorrelated with RLS (Baltagi, 2021). The preferred model is selected with three tests: the Chow test (CEM versus FEM), the Hausman (1978) test (REM versus FEM), and the Breusch and Pagan (1980) Lagrange Multiplier test (CEM versus REM).

The preferred model is then checked for residual normality (Jarque–Bera), groupwise heteroskedasticity (modified Wald test), first-order serial correlation (Wooldridge test), and cross-sectional dependence (Pesaran CD test) (Pesaran, 2021; Wooldridge, 2010). Multicollinearity is not an issue because the model has a single explanatory variable. Because heteroskedasticity and serial correlation are common in regional panels, inference for the preferred model uses standard errors clustered by regency, which are robust to both problems. Robustness is assessed by adding year effects, excluding outlying observations, and using schooling lagged by one year.

Calculations were performed in Python.

## RESULTS AND DISCUSSION

### Descriptive Statistics

Table 1 presents the descriptive statistics. The Gini ratio averaged 0.299 across the 140 observations, ranging from 0.156 in Kayong Utara in 2016 to 0.392 in Melawi in 2023. Mean years of schooling averaged 7.29 years, ranging from 5.84 years in Kayong Utara in 2016 to 10.48 years in Pontianak City in 2025. The two variables vary in different ways: most of the variation in schooling is between regions (between SD 0.935 against within SD 0.342), whereas the Gini ratio varies more within regions over time than between them. Over the period, the average schooling of the 14 regions rose steadily from 6.85 to 7.86 years, while their average Gini ratio fluctuated and declined slightly from 0.306 to 0.291.

**Table 1 Descriptive Statistics of Research Variables**

| Variable                      | Unit        | n   | Mean  | SD overall | SD between | SD within | Min.  | Max.  |
|-------------------------------|-------------|-----|-------|------------|------------|-----------|-------|-------|
| Gini ratio (GR)               | Index (0-1) | 140 | 0.299 | 0.033      | 0.020      | 0.027     | 0.156 | 0.392 |
| Mean years of schooling (RLS) | Years       | 140 | 7.29  | 0.97       | 0.94       | 0.34      | 5.84  | 10.48 |

### Model Estimation and Selection

Table 2 reports the estimates from the three models. In the CEM and REM, mean years of schooling has a positive and significant coefficient, implying that regions with more schooling have higher inequality. In the FEM, which uses only changes within each region, the coefficient becomes negative (−0.0065) and is not significant ( $p = 0.349$ ).

**Table 2 Panel Regression Estimates of the Effect of Schooling on the Gini Ratio**

| Variable                 | CEM                | FEM                          | REM                |
|--------------------------|--------------------|------------------------------|--------------------|
| Constant                 | 0.2100*** (0.0198) | 0.3464                       | 0.2346*** (0.0278) |
| RLS                      | 0.0122*** (0.0027) | −0.0065 (0.0069)             | 0.0088** (0.0038)  |
| p-value of RLS           | <0.001             | 0.349                        | 0.021              |
| Cluster-robust SE of RLS | -                  | 0.0096 ( $p = 0.508$ )       | -                  |
| R <sup>2</sup>           | 0.129              | 0.007 (within); 0.346 (LSDV) | 0.129              |
| Observations             | 140                | 140                          | 140                |

Table 3 shows that the model selection tests consistently favour the FEM. The Chow test rejects the CEM in favour of the FEM, and the Hausman test rejects the REM in favour of the FEM. The Lagrange Multiplier test also shows that regional effects are significant, confirming that the CEM is inappropriate. The significant Hausman statistic indicates that the regional effects are correlated with schooling, so the REM estimate is inconsistent and the FEM is the preferred model.

**Table 3 Panel Model Selection Tests**

| Test                | Comparison | Statistic            | p-value | Selected model |
|---------------------|------------|----------------------|---------|----------------|
| Chow                | CEM vs FEM | $F(13, 125) = 3.185$ | < 0.001 | FEM            |
| Hausman             | REM vs FEM | $\chi^2(1) = 6.915$  | 0.009   | FEM            |
| Lagrange Multiplier | CEM vs REM | $\chi^2(1) = 8.607$  | 0.003   | REM            |

### Diagnostic Tests and Hypothesis Testing

Diagnostic tests on the FEM show that the residuals are not normally distributed (Jarque–Bera = 105.26;  $p < 0.001$ ), largely because of the 2016 value for Kayong Utara, and that they are heteroskedastic across regions (modified Wald  $\chi^2(14) = 100.00$ ;  $p < 0.001$ ) and serially correlated (Wooldridge  $F(1, 13) = 14.46$ ;  $p = 0.002$ ). There is no evidence of cross-sectional dependence (Pesaran CD = −0.169;  $p = 0.866$ ). With standard errors clustered by regency, which correct for heteroskedasticity and serial correlation, the coefficient of schooling remains insignificant (SE = 0.0096;  $p = 0.508$ ). The F-test of the FEM is likewise insignificant ( $F(1, 125) = 0.883$ ;  $p = 0.349$ ), and schooling explains less than 1 percent of the variation in the Gini ratio within regions (within  $R^2 = 0.007$ ). Most of the explanatory power of the model (0.346 in the LSDV form) comes from the regional fixed effects. Therefore, H1 is rejected: mean years of schooling has no significant effect on income inequality in West Kalimantan once persistent regional differences are controlled for.

### Between-Region and Within-Region

## Patterns

Figure 1 shows why the models disagree. Across regions, average schooling and average inequality are strongly and positively correlated ( $r = 0.70$ ; panel a), but this relationship depends almost entirely on Pontianak City; without it, the correlation falls to 0.15. Within regions (panel b), deviations of schooling from each region's average are essentially unrelated to deviations of the Gini ratio. At the regional level, schooling and the Gini ratio moved in opposite directions in 9 of the 14 regions, including Sambas, Mempawah, Landak, Sekadau, and Kubu Raya, but in the same direction in the other five, including Pontianak City, Melawi, and Kayong Utara.

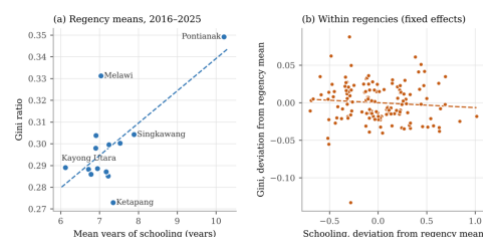


**Fig 1 Schooling and Income Inequality in 14 Regencies and Cities of West Kalimantan, 2016–2025**

The estimated fixed effects confirm that inequality differs systematically between regions for reasons other than schooling. Holding schooling constant, the intercept is highest in Pontianak City (0.416), Melawi (0.377), and Singkawang City (0.356), and lowest in Ketapang (0.321).

## Robustness Checks

Table 4 shows that the main result is robust. The coefficient of schooling remains insignificant when year effects are added to capture province-wide shocks, when the outlying 2016 value for Kayong Utara or the whole of Pontianak City is excluded, and when schooling is lagged by one year to allow for delayed effects. Its sign is negative in four of the five specifications; it becomes positive with year effects because the common upward trend in schooling is then

absorbed by the year dummies, leaving little variation to identify the effect.

**Table 4 Robustness Checks of the Fixed Effect Model**

| Specification                   | OLS coefficient | Cluster-robust SE | p-value | n   |
|---------------------------------|-----------------|-------------------|---------|-----|
| Baseline FEM                    | -0.0065         | 0.0096            | 0.508   | 140 |
| FEM with year effects (two-way) | 0.0285          | 0.0220            | 0.218   | 140 |
| Excluding Kayong Utara 2016     | -0.0091         | 0.0089            | 0.322   | 139 |
| Excluding Pontianak City        | -0.0080         | 0.0101            | 0.443   | 130 |
| FEM with RLS lagged one year    | -0.0084         | 0.0100            | 0.420   | 126 |

## Discussion

The finding that schooling has no significant within-region effect on inequality does not support the redistributive mechanism of human capital theory, under which wider schooling narrows wage differences (Becker, 1993). It is consistent with studies that find insignificant effects of schooling on inequality (Duarsa & Wijaya, 2023; Dai et al., 2023; Yoertiara & Feriyanto, 2022), and it differs from studies that find a significant negative effect at the national or Java level (Ashari et al., 2024; Mumtaz & Amar, 2024; Vionita & Artha, 2024). Most importantly, the comparison of estimators helps to explain the positive and significant effect reported for West Kalimantan by Oktasari and Suradi (2025) using a random effect model. The present data reproduce a positive and significant coefficient under the CEM and REM, but the Hausman test shows that these estimates are driven by differences between regions that are correlated with schooling. Once these are controlled for, the positive association disappears.

The positive cross-regional association is best understood as an urban composition effect. Pontianak City, the provincial capital, combines the highest schooling with the highest inequality because it concentrates both highly educated workers in formal, public, and service jobs and large numbers of low-wage and informal workers. This urban polarisation, together with other persistent factors such as economic structure and access to services, is captured by the

regional fixed effects rather than by schooling itself. In line with Kuznets (1955), the province's more urbanised areas show the greater inequality associated with the transition to modern activities, whereas more rural regencies remain more equal at lower income levels.

Within regions, rising schooling has not yet translated into lower inequality. Mean years of schooling increased by about one year over the decade, but most regencies still average fewer than eight years, which is below completed junior secondary education. Additional years at this level may be insufficient to give lower-income workers access to better-paid jobs, especially where local economies are dominated by plantations and informal activities with limited demand for skilled labour. As noted by Oktaviani et al. (2025), the returns to education may also accrue first to better-off groups, offsetting any equalising effect.

These results imply that expanding school attainment alone is unlikely to reduce income inequality in West Kalimantan in the short run. Local governments should complement it with policies that improve the quality of education and vocational training, link skills to local labour demand, and expand productive employment in rural regencies. In Pontianak City and other areas with high inequality, policies that raise the incomes of informal and low-wage workers are likely to matter more than further increases in average schooling.

This study has several limitations. It examines one explanatory variable, so the estimates may be affected by omitted factors such as unemployment, investment, and economic structure, which are only partly captured by the fixed effects. Ten years is a short period in which to observe the effects of education, which may take longer to work through the labour market. Future research should therefore estimate a multivariate model including unemployment and domestic investment,

consider dynamic specifications, and examine the quality and distribution of education rather than its average level alone.

## CONCLUSION

This study finds that mean years of schooling has no significant effect on income inequality in the 14 regencies and cities of West Kalimantan over 2016–2025. Pooled and random effect estimates suggest that more educated regions are more unequal, but the Chow, Hausman, and Lagrange Multiplier tests favour the fixed effect model, in which the effect of schooling is negative but insignificant ( $\beta = -0.0065$ ; cluster-robust  $p = 0.508$ ). The result is robust to year effects, the exclusion of outliers, and lagged schooling. The positive cross-regional link reflects persistent regional characteristics, especially the urban polarisation of Pontianak City, rather than the effect of rising schooling within regions. Reducing inequality in West Kalimantan therefore requires that the expansion of schooling be accompanied by better education quality, closer links between skills and local employment, and measures that raise the incomes of low-wage and informal workers.

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