DETERMINING INCOME INEQUALITY IN INDONESIA: THE ROLE OF ACCESS TO ELECTRICITY, GDP PER CAPITA, AND EDUCATION

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Abstract

Income inequality between regions is one of the main challenges in economic development in Indonesia. This study aims to analyze the effect of electricity access, Gross Regional Domestic Product (GDP) per capita, and average length of schooling on income inequality in 34 provinces in Indonesia in the 2015–2023 period. Using a panel data regression approach with the Fixed Effect Model (FEM), the results showed that simultaneously the three independent variables had a significant effect on income inequality. However, partially, only GDP per capita and average length of schooling have a negative and significant influence, while access to electricity has no significant effect. These findings show that increasing regional income and community education can reduce the income gap between regions. Meanwhile, electrification has not had a direct impact on income equity without the support of other supporting infrastructure. This research emphasizes the importance of inclusive economic development and equitable access to education as the key to reducing inequality in Indonesia.

Keywords: Income Inequality, Access to Electricity, GDP Per Capita, Average Length of Schooling, Regression Panel Data

1. Introduction

Income inequality is a structural issue in the economy that is closely related to the distribution of resources and economic opportunities. According to Todaro & Smith (2012), income inequality is a condition of unequal income distribution among the population within a country or region, where a small percentage of the population controls most of the national income. This means that only certain groups enjoy the results of development, while other groups remain poor. Within the framework of development economics theory, inequality is often explained through the dual economy approach (Lewis, 1954) which describes the separation between the traditional sector and the modern sector, where the growth of the modern sector is not always evenly distributed to the entire population.

Income inequality between regions is still a crucial problem in Indonesia's economic development. Although national macroeconomic achievements show a positive trend, with Gross Domestic Product (GDP) growth of 5.05% in 2023 (BPS, 2024), the distribution of development results has not been uneven between provinces. This inequality is reflected in the national Gini Ratio value which is at 0.388 as of March 2023, as well as significant differences between rich provinces such as DKI Jakarta and disadvantaged provinces such as Papua or East Nusa Tenggara (NTT) (BPS, 2023). This phenomenon is very relevant in the context of Indonesia, which has high regional disparities, both in terms of infrastructure development, education, and economic productivity.

One of the variables that has a close relationship with income inequality is access to electricity, which can theoretically be explained in the framework Human Capital Externalities and infrastructure-led growth. According to Calderon & Serven (2010), infrastructure such as electricity drives productivity growth and creates spillover effects (spillover effects) between regions, which can narrow income inequality. However, when access to electricity is uneven, the disparity in productivity and income tends to widen. In the context of Indonesia, although national electrification has reached >95%, the distribution is still uneven between provinces (BPS, 2023). For example, some provinces in eastern Indonesia such as Papua and Maluku still have electrification ratios below the national average (ESDM, 2023). Limited access to electricity limits the growth of micro-enterprises, education, and health services, thereby reinforcing socio-economic inequality.

Furthermore, education represented through the indicator of average length of schooling is also an important determinant in income inequality. In the theory of human capital by Becker (1964), education increases labor productivity and contributes to an increase in individual income. However, an unequal distribution of education can create segmented labor market which ultimately widens inequality. Areas with better quality and access to education tend to have a more equitable distribution of income (Barro & Lee, 2013). According to BPS (2023), the average length of national school in 2022 is 8.69 years. However, this figure is still far below the standard of upper secondary education, and there is inequality between regions. Provinces such as DI Yogyakarta have a figure of more than 10 years, while Papua and NTT are still under 7 years. Inequality in access and quality of education creates a gap in labor productivity between regions, which is then reflected in income inequality.

In addition, GDP per capita reflects the economic capacity of a region. The Kuznets Curve theory (Kuznets, 1955) explains the non-linear relationship between economic growth and income inequality. In the early stages of growth, inequality tends to increase along with sector mobility and uneven capital accumulation. However, in the advanced stages, inequality will decrease due to increased redistribution and public access to education and basic services. Therefore, the relationship between GDP per capita and income inequality is highly contextual, depending on the economic structure and redistributive policies in each region.

Provinces such as DKI Jakarta record a GDP per capita of more than IDR 250 million per year, far exceeding provinces such as NTT which is only around IDR 20 million (BPS, 2023). This inequality not only shows a gap in economic output, but also shows unequal access to capital, infrastructure, and the labor market. Without equitable development, economic growth has the potential to widen, not shrink, the inequality gap (World Bank, 2020). In the context of regional autonomy and fiscal decentralization, it is important to analyze how structural factors such as electricity access, education, and regional economic capacity (GDP per capita) contribute to income inequality between provinces. This study aims to empirically identify the influence of these three variables on income inequality in 34 provinces of Indonesia, as the basis for the formulation of more inclusive and equitable development policies.

2. Theoretical Background
2.1 Income Inequality
Income inequality refers to the unequal distribution of income or wealth among individuals or regions. In development economics, this phenomenon has long been

studied through the theory of the Kuznets Curve put forward by Simon Kuznets (1955). This theory states that income inequality tends to increase in the early stages of economic growth, but will decline once per capita income reaches a certain point due to the effects of redistribution and expanded access to education and public services. However, recent developments show that the trend of decreasing inequality does not always occur automatically as the economy grows. According to Piketty (2014), without fiscal policy intervention and equitable access to productive resources, inequality can actually increase even though economic growth occurs.

2.2 Electricity Access and Inequality

Within the framework of infrastructure-led growth theory, infrastructure such as electricity acts as a catalyst for increased productivity, job creation, and regional economic growth (Calderon & Serven, 2010). Equitable access to electricity allows economic actors, especially MSMEs and poor households, to engage in productive activities that were previously impossible.

The absence of access to electricity magnifies spatial disparities, especially between urban and rural areas. Study by Dinkelman (2011) in South Africa found that the electrification of rural areas significantly increased women's labour participation and household income. In the Indonesian context, the disparity in electrification between provinces has been proven to contribute to regional economic inequality (Ikhsan & Amri, 2022).

2.3 Average School Length and Inequality

Education is the main form of human capital that directly affects labor productivity. Becker (1964) stated that investment in education will improve individual skills thus contributing to an increase in income. However, inequality in access and quality of education will widen income gaps between community groups.

Barro and Lee (2013) emphasized that high average length of school is correlated with a more even distribution of income. In a study in Indonesia, disparity in school age between regions has been shown to correlate positively with income inequality, especially in provinces with low urbanization rates (Utami & Wahyuni, 2024).

2.4 GDP Per Capita and Inequality

Gross Regional Domestic Product (GDP) per capita reflects the average output and income in a region. However, a high GDP value does not necessarily reflect equal welfare if the distribution is uneven. In the growth-with-equity theory, economic growth must be accompanied by an equitable policy so that its impact can be widely enjoyed.

Kanbur & Zhuang (2013), emphasizing that non-inclusive growth will increase inequality between regions. In the Indonesian context, the large differences in GDP per capita between provinces indicate structural inequality that is geographical, so it is necessary to examine its direct relationship to income distribution.

3. Methods

This study uses panel data so that the methods used are quantitative descriptive analysis and panel data analysis. The data used in this study is secondary data from 34 provinces in Indonesia with a time span of 2015-2023. The model of the panel data regression equation is as follows:

$$GINI_{it} = \beta_0 + \beta_1 ELEC_{it} + \beta_2 LNGDPC_{it} + \beta_3 LNSCH_{it} + \varepsilon_{it}$$

Where:
GINI   : Gini Ratio (Ratio)
ELEC : Electricity Access (Percentage)
GDPC : Gross Regional Domestic Product (Rupiah)
SCH   : Average School Length (Years)
i   : cross section
t   : Time Series
ε   : Error Term

4. Results and Discussion
4.1 Results of Panel Data Regression Method Selection
    The following is a table of test results for the selection of models to be used:

Table 1. Results of Selection of Panel Data Regression Model

Test	Prob.	α (alpha)	Decision
Chow	0,0000	0.05	FEM
Hausman	0,0270	0.05	FEM

Source: Output EViews, 2025

    Based on the results of the Chow Test and the Hausman Test, it shows that the most appropriate model used in this study is the Fixed Effect Model (FEM). Therefore, the Lagrange Multiplier Test was not used in this study and the Lagrange Multiplier Test can be ignored (Widarjono, 2013).

4.2 Classical Assumption Test Results

Table 2. Normality Test Results

Test	Prob.	α (alpha)	Decision
Normality	0,352358	0.05	Normal Distributed

Source: Output EViews, 2025

Table 3. Heteroscedasticity Test Results

Variable	Coefficient	Std. Error	t-Statistic	Prob.	Conclusion
ELEC	-5.59E-08	2.89E-07	-0.193438	0.8468	Free of Heteroskedasticity
LNGDPC	0.000570	0.005806	0.098090	0.9219	
LNSCH	-0.027272	0.017275	-1.578.686	0.1156	

Source: Output EViews, 2025

    Furthermore, based on the output of EViews, it is known that the results of the Multicollinearity test do not have a coefficient of more than 0.85. It can be concluded that the variables used in this study do not have multicollinearity (Widarjono, 2018).

4.3 Panel Data Regression Results Using the Fixed Effect Model

Table 4. FEM Estimation Results

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.927479	0.078123	1.187.202	0.0000
ELEC	5.49E-09	5.05E-07	0.010856	0.9913
LNGDPC	-0.025338	0.010149	-2.496.537	0.0131
LNSCH	-0.142024	0.030195	-4.703.524	0.0000
R-squared	0.918534		F-statistic	8.425.023
Adjusted R-squared	0.907632		Prob(F-statistic)	0.000000

Source: Output EViews, 2025

Based on the results of the estimate in the table above, the regression equation with a significance of α = 5% is obtained as follows:

$$GINI_{it} = 0.927479 + 5.49909ELEC_{it} - 0.025338LNGPC_{it} - 0.142024LNSCH_{it} + \varepsilon_{it}$$

4.4 Hypothesis Test Results
4.4.1 Test Results t
The hypotheses proposed in this study are as follows:

H0: $\beta 1 = 0$; Access to electricity has no effect on income inequality

Ha: $\beta 1 < 0$; Access to electricity has a negative and significant effect on income inequality

H0: $\beta 2 = 0$; GDP per capita has no effect on income inequality

Ha: $\beta 2 < 0$; GDP per capita has a negative and significant effect on income inequality

H0: $\beta 3 = 0$; The average length of school has no effect on income inequality

Ha: $\beta 3 < 0$; Average length of school has a negative and significant effect on income inequality

Table 5. Test Results t

Variable	t-Statistic	T-Table	Prob.	Alpha (0.05)	Conclusion	Information
ELEC	-0.193438	1.998341	0.9913	0.05	H0 Accepted	Has no effect
LNGDPC	0.098090	1.998341	0.0131	0.05	H0 Rejected	Negative and significant effect
LNSCH	-1578686	1.998341	0.0000	0.05	H0 Rejected	Negative and significant effect

Source: Output EViews, 2025

4.4.2 F Test Results
The hypotheses proposed in this study are as follows:
1) If F calculates > F the table means that H0 is rejected and the variable is declared to be influential.
2) If F calculates < F the table means that H0 is accepted and the variable is declared to have no effect.

Table 6. F Test Results

Variable	F-statistic	F-table	Prob.	Alpha	Conclusion	Information
ELEC, LNGDPC, LNRLS	8.425023	2.634601	0.0000	0,05	H0 Rejected	Have a simultaneous effect

Source: Output EViews, 2025

4.4.3 Result Coefficient of Determination (R2)
Based on the results of the regression of panel data using the FEM model, it is known that the value of the determination coefficient or R2 is 0.918534. This means that the variables of access to electricity, gross regional domestic product per capita, and average length of schooling can explain 91.85% of income inequality in 34 Indonesian provinces in 2015-2023. While the remaining 8.15% is explained by other variables that were not included in the model in this study.

4.5 Discussion

4.5.1 The Effect of Electricity Access on Income Inequality

The results of the analysis showed that access to electricity had no significant effect on income inequality (probability = 0.9913 > 0.05). This finding is surprising considering that infrastructure-led growth theory states that basic infrastructure such as electricity is able to increase productivity and regional economic growth (Calderon & Serven, 2010). However, these results are in line with empirical studies by Ikhsan & Amri, (2022), which states that the effect of electrification on inequality is indirect and depends on its efficiency and synergy with education and local economic policies. Next Jayanthi (2021), stating that electrification increases economic growth and labor absorption, but in the context of unequal distribution, it actually increases income inequality in Indonesia. Zuhri et al., (2019), stating that there is an inequality of access to electricity in Indonesia, especially in urban areas, the variation is greater than in rural areas. Study by Laraibaphy et al., (2023), found that infrastructure such as roads, electricity, water, housing, education, and health had no significant effect on income inequality according to Gini in the eastern region of Indonesia. This indicates the possibility that certain levels of electrification could increase inequality if the benefits are not evenly distributed.

While in international studies by Dinkelman, (2011) research in South Africa found that electrification can increase work participation, but this effect is significant only in the context of areas that have the readiness of other supporting infrastructure. Thus, in the context of Indonesia, high electrification in aggregate (>95%) does not necessarily create income convergence if it is not accompanied by equal distribution of electricity quality, digital connectivity, and local industrialization. In addition, electricity itself may not be enough, so it needs to be supported by road access, communication, training, and other services so that the benefits touch the underprivileged. This shows that access to electricity is not automatically evenly distributed and depends on socio-economic characteristics.

4.5.2 The Effect of Per Capita GDP on Income Inequality

The GDP per capita variable has a negative and significant effect on income inequality (probability = 0.0131 < 0.05). This means that the increase in regional income per capita actually reduces inequality. This result corresponds to the advanced stage of the Kuznets Curve theory (Kuznets, 1955), namely that at some point economic growth will promote equity, especially if accompanied by redistributive policies and the expansion of access to education and social services. Study by Horse et al., (2020), also proves Kuznets' hypothesis that high economic growth in the early stages tends to increase inequality, and in the later stages tends to decrease.

According to several studies, economic growth makes it possible to improve the standard of living of low-income people and reduce income inequality (Fosu, 2017; Iniguez-Montiel & Kurosaki, 2018; Kouadio & Gakpa, 2022). Then real GDP per capita growth lowers Gini significantly in the long run, although the short-term effects are complex and asymmetrical (a decline in GDP per capita does not directly raise Gini at the same rate) (Thye et al., 2022). Study Kanbur & Zhuang, (2013) in publications Asian Development Bank This finding supports the fact that inclusive growth in developing countries can reduce income inequality, especially when growth is accompanied by equitable distribution of public services. In the context of Indonesia, provinces with an increase in GDP per capita accompanied by an expansion of social spending and education tend to experience a decrease in the Gini Ratio (World Bank, 2020). Study by

Agussalim et al., (2024), mentioning that economic growth, measured through GDP per capita, significantly reduces poverty but has little impact on income inequality in Indonesia. Meanwhile, GDP has a negative and significant influence on income inequality on the island of Java in 2014-2018 (Prastiwi et al., 2023).

4.5.3 The Effect of Average School Age on Income Inequality

The regression results showed that the variable of average school age had a negative and significant effect on income inequality (probability = 0.0000). The higher the average length of schooling, the lower the level of income inequality between provinces. These findings corroborate Becker's (1964) theory of human capital, in which investment in education increases individual productivity and reduces income disparity. This is in line with research by Lee & Lee, (2018), stating that human capital has a negative effect on income inequality. Suhendra et al., (2020), stating that human capital (average length of schooling and human development index) has a significant negative effect on income inequality in Indonesia. Thye et al., (2022), mentioning that productivity and length of school contribute to Human Capital proven to reduce the level of income inequality in Indonesia in the long term. Empirical studies by (Utami & Wahyuni, 2024) shows that an increase in the average length of school by one year can significantly reduce the inequality index in areas outside Java. This means that the longer the average length of schooling, the lower the Gini coefficient

This is also consistent with Barro & Lee, (2013), which in its global study showed a positive correlation between school length and a fairer distribution of income. Higher education will make a person earn a greater income so that income inequality will be reduced (Shahabadi et al., 2018); and the narrowing of wage disparities (Wahyuni & Monika, 2016). This research confirms that education introduces more equitable opportunities and potential, thereby supporting a fairer distribution of income.

5. Conclusion

This study analyzed the influence of electricity access, Gross Regional Domestic Product (GDP) per capita, and average length of schooling on income inequality in 34 provinces in Indonesia during the period 2015–2023 using a panel data regression model with a Fixed Effect Model (FEM) approach. The results of the F test show that these three variables simultaneously have a significant effect on income inequality. However, partially, only the variables of GDP per capita and average length of schooling had a negative and significant effect on income inequality, while access to electricity did not show a significant effect.

An increase in GDP per capita can lower the level of income inequality between provinces, supporting the hypothesis of the Kuznets Curve theory that at certain stages of growth, inequality tends to decrease. Average length of school plays an important role in reducing income inequality, in line with human capital theory which states that education increases productivity and a more equitable distribution of income. Access to electricity, while theoretically important, does not have a significant impact on income inequality, likely due to its uneven distribution, the quality of infrastructure that is not yet uniform, as well as the lack of synergy with other sectors such as education and industrialization.

Overall, this study emphasizes the importance of development policies that focus on improving the quality of education and inclusive economic growth as a strategy to reduce income inequality between regions in Indonesia. Meanwhile, a more integrative and

contextual approach is needed in the use of infrastructure such as electricity so that the impact can be felt more evenly by all levels of society.

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