Determinant of income inequality: empirical study of 34 provinces in Indonesia moderated by investment

Ainul Mardhiyah, Fitrawaty ✉
Medan State University, North Sumatera, Indonesia
✉fitrawaty@unimed.ac.id

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Abstract
Purpose – This study aims to find empirical evidence of the influence of gross regional domestic product, poverty rate and human development index on income inequality in Indonesia from 2016 to 2023 moderated by investment. **Method** – This study uses a quantitative approach with secondary data obtained through the official website of Statistics Indonesia. The population of this study consists of 34 provinces in Indonesia. The sample used is 272 data observations obtained from a combination of the number of provinces and years of research. The data analysis used is the panel data regressions and moderated regression analysis (MRA) method with EViews 12. As a result of the Chow and Hausman tests, the random effect model is the selected model. **Findings** – The research findings indicate that income inequality is positively affected by gross regional domestic product, poverty rate, and human development index. In contrast, investments do not affect income inequality. Investment cannot moderate the influence of gross regional domestic product, poverty rate, and human development index on income inequality. **Implications** – The study findings contribute to the scientific understanding of income inequality determinants in Indonesia as a low-middle income country. The practical implications of these findings for policymakers are expected to increase economic growth, improve education and healthcare quality, reduce income inequality and unemployment, and maintain price stability and purchasing power for the community.
Keywords: gross regional domestic product, poverty rate, human development index, income inequality, investment.

Introduction

The issue of income inequality in Indonesia is a complex problem arising from various economic, social, and policy factors. In this context, the capital disparity is the uneven distribution of financial resources among social groups across the 34 provinces of Indonesia. One of the main factors of capital inequality is unequal access to available financial resources (Juniati, Abdullah, and Wibowo 2022). In Indonesia, this gap between urban and rural areas can be significantly observed. Rural areas are often marginalized in development, while urban areas, such as the capital city and surrounding provinces, have more dominant access to infrastructure and investment. The inequality will then experience a butterfly effect, mainly impacting unbalanced economic growth (Afandi, Rantung, and Marashdeh 2017; Lian, Pei, and Li 2024). Regions with rich access to capital will develop faster, but the opposite happens in capital-poor areas that remain trapped in poverty and underdevelopment. This creates a complex cycle to break because the injustice in capital distribution supports such social and

economic conditions. The Indonesian government has taken various policies to address inequality, including programs to increase investment in underdeveloped peripheral areas and improve infrastructure. However, these results have not yet solved the root of the aggregate capital inequality problem (Gordón and Resosudarmo 2019).

Indonesia has a high rate of inequality, where traits can vary greatly between provinces and islands. Sumatra, Sulawesi, and Maluku-Papua provinces have a Gini ratio above 0.40, higher than other regions, with a crime rate of more than 200 cases per 100,000 people (Sugiharti et al. 2023). The Gini ratio illustrates the degree of income disparity in a region. Gini ratio data, which measures a region's level of prosperity, aids the government in assessing society's economic potential (Anser et al. 2020). Statistics Indonesia shows Indonesia's Gini ratio for income inequality in March 2021 was 0.384. Compared to the September 2020 Gini ratio of 0.381, this value increased by 0.003 points. This indicates that the income distribution is better in 2020 than in 2021. In March 2022, the Yogyakarta Special Region had the highest Gini ratio (0.439) out of all 34 Indonesian provinces (BPS 2022). In contrast, Bangka Belitung had the lowest Gini ratio, namely 0.236. Yogyakarta Special Region (0.439), DKI Jakarta (0.423), Gorontalo (0.418), West Java (0.417), Papua (0.406), and also Southeast Sulawesi (0.387) are the six provinces with higher Gini ratios than the national average of 0.384 (BPS 2023).

The issue of inequality will undoubtedly arise as the government pursues economic growth and development. Some provinces are regarded as advanced because they can effectively manage their resources, while others fall behind because they cannot do so (Thye, Law, and Trinugroho 2022). One type of inequality that may arise during development is income inequality. The disparity in income produced by society leads to glaring income disparities, known as income inequality. High levels of income disparity in society will impede a nation's economic progress. Since income inequality is a chronic issue, a comprehensive and long-term policy is required to improve income distribution (Sari and Falianty 2021). Income inequality in Indonesia is not only between individuals but also between regions. The difference in spending will impact uneven development between regions, which can trigger inequality between regions. This can worsen social conditions, such as increased poverty and limited economic opportunities in remote areas, hindering national development. In the past 10 years, Indonesia's income inequality index has fluctuated, indicating that the government's policy in addressing inequality in Indonesia is inappropriate (Badriah and Istiqomah 2022).

Income inequality can affect economic growth through the gross regional domestic product (GRDP). GRDP is an indicator that illustrates the total amount of goods and services generated in an area over a specific period (Blotevogel et al. 2022). Each province's gross regional product (GRDP) for each sector is utilized to calculate the percentage of the labor force employed in each economic sector. Nine sectors make up the economy, and The GDP share of each of the nine sectors is one of the nine variables that make up the economic structure variable. The degree of financialization is assumed to be represented by one of these variables: the share of finance, real estate, and business services (FREBS) in the GDP. This aligns with research on financialization by Sulistyaningrum and Tjahjadi (2022) on using GDP share in the real estate, insurance, and finance sectors. The proportion of this sector in GDP indicates the growing significance of the financial sector in each Indonesian province, which may have grown at the expense of the non-financial sector, its employees' wages, and other ordinary wage earners in general. Theoretically, a region's income inequality will decrease if its GDP per capita increases. Research by Walujadi, Indupurnahayu, and Endri (2022); Maichal et al. (2024) found that GRDP positively and significantly impacts income inequality. A study by Mustika, Nurjanah, and Wulan (2023); Setiawan, Nawatmi, and Nusantara (2024) found that GRDP did not significantly affect income inequality.

The poverty rate is another element that can characterize income inequality. The poverty rate in Indonesia is measured based on purchasing power, which is set as the poverty line in each region. Individuals are deemed impoverished if their per capita income exceeds the poverty threshold (Hassan et al. 2021; Abdullah and Wibowo 2024). The government frequently employs macroeconomic policies, particularly fiscal policy, regarding taxes and spending to end poverty. Implementing fiscal policy through social protection spending, such as providing low-income groups with fund transfers, has made it easier for those with extremely low incomes to handle daily expenses (Agussalim et al. 2024). As a fiscal policy tool, taxes can reduce poverty by providing funding for programs that directly address the needs of low-income groups and by distributing income fairly through progressive taxes. Prannisa, Muljarijadi, and Wardhana (2023); Rizky, Lubis, and Kesuma (2024) found a positive and significant correlation between the poverty rate and income inequality. In contrast, in a study by Maurilla, Suriani, and Nasir (2023); Ridwan, Lubis, and Tambunan (2024), poverty did not significantly affect income inequality.

Income inequality is also influenced by the human development index (HDI). The HDI is a metric used to evaluate a nation's human development accomplishments and quality of life, which in its analysis combines three main dimensions, namely life expectancy, education, and standard of living (Yektiningsih 2018). When HDI is low, the community has limited access to adequate education and healthcare services. When society perceives itself as marginalized or not benefiting from development, trust in the government and other institutions will decline (Fadly and Chandra 2024). If the HDI falls, the productivity level of the population will also fall, which means that lower productivity will result in lower income. Conversely, if the HDI rises, the productivity level of the population will also rise, which means higher productivity will lead to higher income levels. Research from Maghriza and Hasmarini (2024); Octavia et al. (2024), HDI has a significant positive effect on income inequality. In contrast, in the study by Ersad, Amir, and Zulgani (2022); Yasmin and Syofyan (2024), HDI did not affect income inequality.

Previous research has shown inconsistent results, thus creating a research gap. Therefore, it is important to conduct further research on the relationship between these variables. Previous studies that examine investment as moderation, especially in the influence of gross regional domestic product, poverty rate, and human development index on income inequality, are still limited and rarely found. Therefore, the addition of investment as a moderating variable and differences in estimates between provinces in Indonesia can be used as a novelty in this study. This study aims to find empirical evidence on the influence of gross regional domestic product, poverty rate, and human development index on income inequality in Indonesia from 2016 to 2023, which is moderated by investment. This study guides national and local policymakers on differentiating programs that strive to reduce poverty from those that aim to reduce inequality. Additionally, this study helps local governments create initiatives that address income inequality and poverty alleviation tailored to their regions' unique features.

Literature review

Disparity society theory

Disparity society theory argues that economic inequality harms society because it produces a system of winners and losers (Parsons and Naghshpour 2023). According to this theory, discrepancy results from a strong group in society controlling a weaker group. The competitive nature of this social issue leads to social stratification (Dabić et al. 2023). On the other hand, granted tax breaks and favors are often given to the wealthy and influential in society with the expectation that they will reinvest the money back into the economy. The

wealthy use their power as leverage to keep control over certain facets of society. The system of economic disparity is designed to keep people down. Conflict can disrupt economic activity and raise economic uncertainty, but its impact on income inequality is uncertain (Dogan, Majeed, and Luni 2021). The effect of economic growth on income inequality is contingent upon the degree of economic development (Kim, Kim, and Lee 2025). Sutomo et al. (2024) discover that inequality first gets worse and then gets better as a nation's income rises. Economic growth starts as the nation develops, leading to higher per capita income and income inequality in the region and related economic sectors.

Income inequality

The uneven allocation of income in a community is known as income inequality, which affects social welfare, economic development, and sociopolitical stability (Batuo, Kararach, and Malki 2022). Inequality is exacerbated by globalization and technological automation, which favor highly skilled workers (Weber 2024). Inequality increases in the early stages of industrialization due to labor migration to urban sectors. However, it decreases in later stages due to income retribution, inclusive policies, and equitable access to education. To address inequality, retributive policies such as progressive taxation are needed to create a more inclusive system (Suratman, Mayudi, and Hayet 2022). How evenly or unevenly income is distributed is indicated by income distribution. People whose expenses were previously above the poverty line may now fall below it because of a rise in income inequality brought on by a decline in worker income levels (Sullivan and Hickel 2023). Income disparity between provinces influences the percentage of people living in poverty in each Indonesian region. The Gini ratio is one method for assessing the degree of inequality in population distribution. On a scale of 0 to 1, 0 represents perfect equity, and 1 represents perfect inequality (Rahman et al. 2023).

Gross regional domestic product (GRDP)

Gross regional domestic product (GRDP) is a core indicator used to measure the total value of products and services generated in a region over a given time frame (Buan, Fitriani, and Nurjannah 2021). GDP reflects the economic health of a region and serves as the basis for economic policy analysis (Bilan et al. 2020). GRDP is the total worth of products and services generated in a given area or region over a specific time, usually one year. The high GRDP score indicates a strong economic growth rate, and the region's economy is expanding. According to Statistics Indonesia, GRDP is the total value of final goods and services produced by all economic units or the amount of added value produced by all regional business units. The additional value of products and services determined using prices in each year is described by the GRDP based on current prices, whereas the GRDP is based on constant prices (Ahmad, Wahyudi, and Lestari 2024). GRDP per capita is the result of GRDP divided by population and the average income of individuals. High GRDP does not always mean high per capita income, depending on the population. An is a measure of the average income of a country's population, calculated by dividing national income by population (Angraini, Utami, and Annisa 2024).

Poverty rate

A state of financial inability to maintain the typical standard of living in a community, poverty is defined as a lack of funds to cover necessities like clothing, food, and housing (Pogge 2023). If a person's per capita spending falls below the poverty line, they are deemed impoverished. Poverty arises from the inability of individuals or groups to meet their basic needs in a community setting and to utilize their physical, mental, and energy potential to reach the desired standard of living within that community group (Hassan et al. 2021). Disparities in human resource quality lead to poverty, and low-quality human resources lead

to low wages and low productivity (Sugiharti et al. 2023). Poverty will always exist in people's lives, and poverty leads to social injustice and inequality, which restricts the impoverished access to high-quality healthcare and education. Poverty is frequently concentrated in isolated, marginalized communities that are far from major political hubs (Al-Kez et al. 2024). Poor people in these areas have difficulty accessing healthcare, work opportunities, education, and necessities. Poverty is a complex problem impacted by several variables, including personal circumstances, inheritance, and outside influences like governmental policies and environmental conditions (Al-Aqilah, Muchtar, and Sihombing 2024).

Human development index (HDI)

The human development index (HDI) is essential to raise a nation's standard of living. Human resources are seen as a divine trust for managing the environment and natural resources from the standpoint of economic development (Anasta and Sylviana 2024). The three primary indicators of the HDI are living standards, health, and education. These indicators are assessed using metrics related to income or purchasing power. A person's income or wages from employment are typically correlated with their level of education. Higher levels of education lead to greater productivity, which supports national economic growth if wages are a good indicator of productivity (Goczek, Witkowska, and Witkowski 2021). In addition, health plays a significant role in raising income (Santoso, Rukhviyanti, and Hayati 2023). When the government neglects the consideration of benefit distribution, the concentration of capital in a particular area becomes unavoidable, and the gap between rural areas will widen even further. Specific sectors, such as technology and industry, can attract more investment interest, raising the region's HDI. However, this must also be accompanied by the growth of the same sectors in other regions to avoid widening the inequality gap. The government must implement economic diversification to reduce inequality (Setiawan, Nawatmi, and Nusantara 2024).

Investment

Investment refers to allocating capital to various economic activities to obtain future benefits (Gam, Oanh, and Dang 2023). In order to replace and particularly increase capital goods in the economy, which serve as raw materials for the future production of goods and services, investment is worthwhile or utilized to purchase capital goods and production instruments (Muliadi et al. 2023). Investment in the context of the government connotes public investment, which is defined as government expenditure to finance projects aimed at improving infrastructure and public services for the community (Prannisa, Muljarijadi, and Wardhana 2023). This public investment includes, among others, the construction of bridges, roads, healthcare facilities, and schools. The role of public investment in economic growth can be seen through the improvement in the community's quality of life. Domestic investment is an investment activity business in the territory of the Republic of Indonesia carried out by domestic investors using domestic capital. Investment plays a key role in economic growth by generating income and expanding production capacity through increasing capital stock. Investment is important for economic development because it supports the sustainability of economic activity, increases production, and absorbs labor (Fitriady, Silvia, and Suriani 2022).

Hypothesis development

GRDP is the leading indicator of economic health that reflects the total value of products and services generated in a region over a given time frame. The increase in investment plays a crucial role in boosting a region's GRDP. According to the disparity society theory (DST), static growth could occur because of income inequality. The bigger GRDP leads to smaller inequality, and vice versa. This can be observed through the real condition of the

industrial sector, which contributes to GRDP and attracts the attention of both individuals and large corporations to generate profits. When GDP increases, and this condition occurs through unfair capital investment mechanisms, capital inequality will increase. It is important to consider policies that ensure the benefits of growth are evenly distributed among the community to reduce capital inequality. A study by Walujadi, Indupurnahayu, and Endri (2022); Maichal et al. (2024) found that GDRP positively affects income inequality; uneven economic growth often leads to greater inequality. Based on the previous explanation, the following H_1: GRDP positively affects income inequality.

Poverty is the lowest position on the standard of living scale, which is associated with a low level of material sufficiency among specific individuals or groups compared to the general standard of living in that community. The low standard of living will also result in low health, morality and self-esteem among the poor community. According to the disparity society theory, inequality will increase if economic growth continues to benefit only the top-level income group exclusively. Meanwhile, inequality will decline if the growth relaxes the financial burden on low-income households. The high level of poverty hinders the poor from obtaining education and good job opportunities, which ultimately leads to conditions of capital inequality. A decrease in poverty does not always accompany increased economic indicators but can widen the gap between groups with insufficient and excessive capital distribution. Economic globalization has proven to alleviate income inequality. In this context, high poverty exacerbates capital inequality because poor communities are often hindered from accessing resources and investment opportunities. A Study by Amponsah, Agbola, and Mahmood (2023); Irwan et al. (2023) found a positive intensity in the relationship between poverty rate and inequality. Based on the previous explanation, the following H_2: poverty rate positively affects income inequality.

The escalation of HDI can correlate with improving community welfare, although in the context of inequality. Based on disparity society theory, lack of adequate skills and low levels of education often trap individuals in the informal sector, which does not offer stable income or social security. It can also be assumed that the increase occurs but does not guarantee that all layers of society feel the benefits of that growth. An increasing HDI can reduce inequality when accompanied by wisdom that supports a more equitable distribution. Conversely, low HDI leads to low productivity, low income and a higher prevalence of poverty. Therefore, it can be understood that although the HDI level positively contributes to welfare and economic growth, there remains a probability that its increase is not always accompanied by a reduction in capital inequality, mainly when policy interventions do not occur and are not precise in ensuring distributional justice. A Study by Thye, Law, and Trinugroho (2022); Maghriza and Hasmarini (2024), the human development index positively affects income inequality. Based on the previous explanation, the following H_3: human development index positively affects income inequality.

Investment refers to an effort to allocate capital to various economic activities with the expectation of obtaining benefits in the future. In economics, investment often drives economic growth, but its impact on the distribution of capital and income is complex. Based on the disparity society theory, investment has the potential to contribute positively to economic growth by creating new job opportunities, improving people's lives, and creating a more favorable business climate. When investments are more directed towards regions with significant development, other less developed areas will not receive the same benefits. Although investment can boost overall income, its impact on income and capital inequality can be negative. As an illustration, foreign investment tends to prioritize profits for investors and developed regions, while on the other hand, it can lead to disparities among different social groups. It is important to design inclusive and equitable investment policies so that the entire community can receive benefits regardless of whether they are in marginalized or

urban areas. Research by Gam, Oanh, and Dang (2023); Lian, Pei, and Li (2024) shows that investment positively impacts income inequality. Based on the previous explanation, the following H_4: investment positively affects income inequality.

In terms of the economy, GDRP reflects the total value of goods and services as the result or output of a region, and investment is one of the important factors in GDRP growth. Investment increase favourably affects economic expansion, which is evaluated through the increase in GDRP in each region. According to disparity society theory, investment functions as a lever for economic development; in macroeconomics, investment is one of the components of national income because increasing investment means that production capacity can increase, affecting the growth rate of GDRP. Income inequality can occur as a result of disparities in the allocation of resources and investment opportunities (Widuri, Meviana, and Harianto 2024). When GDRP increases due to higher investment, there is a possibility of benefiting from economic growth because the uneven distribution of the economy leads to inequality. In the context of investment, it can increase GDRP, and distributing the benefits from that growth can lead to inequality. Based on the previous explanation, the following H_5: investment can moderate the effect of GRDP on income inequality.

The high level of poverty hinders community access to facilities related to resources and capital. Community and individuals trapped in the poverty line do not have the opportunity or ability to invest in aspects of education, health, or businesses that could increase their income. This condition will further exacerbate capital inequality because communities with access to capital will continue to receive advantages in contrast to those who do not have access, which in this case are people with low incomes. According to the disparity society theory, good investment from both the government and private sectors can be an instrument that mitigates the impact of poverty. To address this issue, more inclusive government policies can ensure that investment also reaches the less fortunate community. However, capital inequality is predicted to occur if investments are not distributed fairly or directed towards conditions that create justice for people experiencing poverty. Based on the previous explanation, the following H_6: investment can moderate the effect of poverty rate on income inequality.

HDI reflects the quality of life and the capacity of human resources in an area, which can influence the pattern of capital and investment distribution. The availability of adequate access to health, education, and other basic services is a good performance indicator when the HDI shows a significant increase. An increase in individual productivity and competitiveness can be realized, accompanied by the attraction of more investments in the region. According to the disparity society theory, when investment soars and is associated with high HDI, it can increase income inequality, provided that the distribution of the investment is uneven. Investment functions as a catalyst for economic growth and reduces inequality if directed appropriately. The income disparity will increase when investments are predominantly directed towards developed areas. Thus, it is urgent to ensure that investment policies include areas with HDI that are still below standard to create equilibrium. An increase in HDI can attract investment but has the same probability of widening the gap when not accompanied by efforts to increase investment in underdeveloped areas. Based on the previous explanation, the following H_7: investment can moderate the effect of HDI on income inequality.

Referring to the development of the hypothesis, a research model can be described as illustrated in Figure 1.

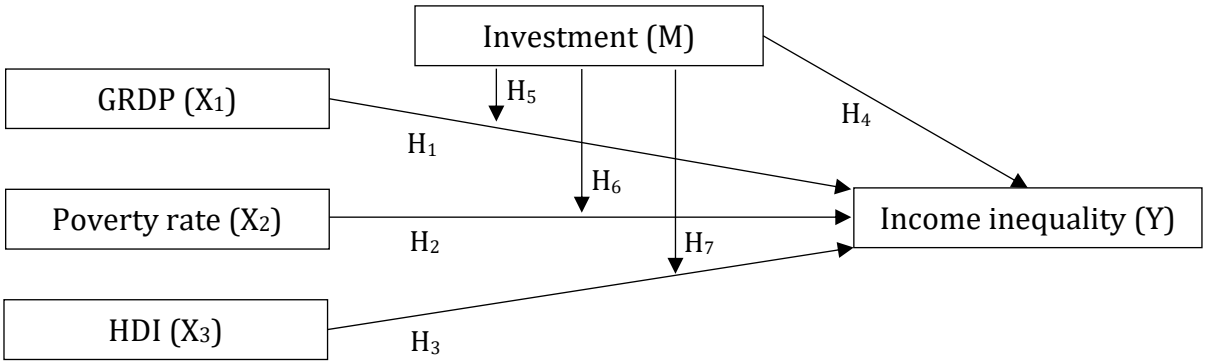

Figure 1 research model

Method

This study employs a quantitative method using panel data regression analyses. Quantitative research tests theories by examining relationships between variables measured through research instruments and analyzed using numerical data (Creswell and Creswell 2018). Statistics Indonesia processed secondary data from 34 Indonesian provinces between 2016 and 2023, which served as the study's data source. Since the Gini coefficient data is only available at the provincial level, the data's time dimension is yearly. As a result, there are 272 observations total from the province-year combinations. The Statistics Indonesia website is the data source (www.bps.go.id). Each variable has a uniform number of provinces and years, so the panel is balanced, using the moderated regression analysis (MRA) method for panel data. A random effect (RE) model is utilized in specific empirical research on income inequality that utilizes panel data. Fixed effects models (FEM) are advantageous because they can reduce omitted variable bias by capturing unobserved effects and are only able to estimate variation within provinces. On the other hand, random effects models (RE) offer the benefit of estimating differences within and between provinces (Afandi, Rantung, and Marashdeh 2017). It considers province-specific features by including province-fixed effects because the provinces in the sample may have varying levels of development, as evidenced by economic growth and per capita income. However, the Chow and Hausman tests also help choose the panel data model.

The first step in analyzing this study is to use descriptive statistics. Descriptive analysis is used to comprehend the characteristics of every variable. The generalized least squares (GLS) model and the static panel data approach are used in this study.

Approach common effect model (CEM):

The common effect model combines cross-sectional and time series data to create pooled data. This combination produces more reliable results than multiple regression or simple regression testing. The common effect model is as follows:

$$Y_t = \beta_0 + \beta_1 X1_{it} + \beta_2 X2_{it} + \beta_3 X3_{it} + \cdots + \beta_n Xn_{it} + \varepsilon_{it}$$

Approach fixed effect model (FEM):

The fixed effect model also incorporates dummy variables into panel data estimation to account for interception differences. The regression slope coefficient is assumed to be constant in this model over time and across various units (Widarjono 2018). The following is a representation of the fixed effect model:

$$Y_t = \beta_0 + \beta_1 X1_{it} + \beta_2 X2_{it} + \beta_3 X3_{it} + \beta\, D13_i + \beta_5 D23_i + \beta_6 D33_i + \beta_n Dn_{mi} + \varepsilon_{it}$$

Approach random effect model (REM):

The error terms that may result from changes over time and between individuals are considered by this method. The REM generates two residual components based on the

assumption that each person's intercepts are unique (Gam, Oanh, and Dang 2023). The following is a representation for the random effect model:

$Y_t = \beta_0 + \beta_1 X1_{it} + \beta_2 X2_{it} + \beta_3 X3_{it} + \cdots + \beta_n Xn_{it} + \varepsilon_{it}$

With,

Y : Income inequality
X1 : Gross regional domestic product
X2 : Poverty rate
X3 : Human development index
ε_{it} : error

The Hausman and Chow tests are used to choose between common, fixed, and random effect models. To determine which model is better to use, the fixed effect model (FEM) or the random effect model (REM), the Hausman test is employed. The FEM is recommended if the Hausman statistics are higher than the critical value. The REM is considered more appropriate if it is less than the critical value. While the common effect (CE) and fixed effect models are compared using the Chow test. If the null hypothesis (Ho) is rejected, the fixed effect model is more appropriate than the CE model.

Table 1 operational variables

Variables	Formulation	Scale
Gross regional domestic product	GRDP = C + I +G + (X –M) (Nugraha et al. 2020)	Nominal
Poverty rate	POV = $\sum_{i=1}^{H}$ Yp − Yi (Ersad, Amir, and Zulgani 2022)	Ratio
Human development index	HDI = $\sqrt{IHealth + IEducation + IExpenses\ X\ 100\%}$ (Muhtar 2023)	Ratio
Investment	INV = GDP - C - G - (X –M) (Lian, Pei, and Li 2024)	Nominal
Income inequality	GINI = 1 – 2 $\int_0^1 L(X)dX$ (Amponsah, Agbola, and Mahmood 2023)	Ratio

Results and discussion

Table 2 displays descriptive statistics of the correlation between Indonesia's 34 provinces gross regional product, poverty rate, human development index, income inequality, and investment from 2016 to 2023.

Table 2 descriptive statistics

	Income inequality	GRDP	Poverty rate	HDI	Investment
Mean	0.352934	10.74419	11.85699	70.937022	8.406838
Median	0.351000	8.935000	10.95000	70.285000	8.370000
Maximum	0.449000	28.17000	36.50000	82.50000	11.31000
Minimum	0.236000	3.470000	3.300000	57.30000	5.990000
Std. Dev.	0.040755	5.584172	6.094198	4.146711	0.991143
Observations	272	272	272	272	272

Source: secondary data (processed, 2025)

Income inequality in a region can illustrate the level of development success. Table 2 presents descriptive data, the Gini coefficient, which measures income inequality distribution among Indonesian provinces. Compared to rural areas, where the average value of income inequality is 0.352, urban areas have a more significant value. The Indonesian regions with the most tremendous income inequality are Java, Sulawesi, Papua, and Kalimantan. On the other hand, provinces like Bali and West Nusa Tenggara have lower levels of income inequality.

Indonesia's average gross regional domestic product by province is 10.74%, with the highest GRDP in DKI Jakarta and East Kalimantan and the lowest value being 3.47% in East Nusa Tenggara and West Nusa Tenggara province. Papua and several Sulawesi and Nusa Tenggara provinces have the highest poverty rates. On the other hand, poverty rates are typically lower in the western provinces, such as Java and Southern Sumatra. This trend points to the necessity of focused programs to reduce poverty in the eastern provinces. Meanwhile, the mean value of HDI was 70.93 indices. The HDI was classified as high at this level, indicating an improvement in Indonesia's HDI. This increase is also attributed to improvements in the HDI across the Indonesian provinces. The maximum value for the HDI variable is 82.50 indices, achieved by the DKI Jakarta and DI Yogyakarta province. A minimum value of 57.30 indices was recorded for Papua and East Nusa Tenggara province. Apart from that, the functioning of the economy depends on investment, which ought to have raised the degree of income inequality.

Many tests are conducted on model specification to ensure the optimal model is utilized in panel data analysis to approximate panel data regression. The Chow test aims to identify which common and fixed effect models best fit the data. The fixed effect model is approved if the Chow test probability cross-section value is less than 5% (0.05).

Table 3 the Chow-test results

Effects test	Statistic	d.f	Prob.
Cross-section F	67.427987	(33.234)	0.0000
Cross-section Chi-square	639.809055	33	0.0000

Source: secondary data (processed, 2025)

Table 3 shows that the Chow test findings indicate that prob. 0.0000 is less than 0.05, so the fixed effect model is selected. The Hausman test can determine the optimal fixed effect or random effect model. The model is considered acceptable if the random probability cross-section value of fixed effect models is less than 5% (0.05). For the random effect model to be accepted, the random probability cross-section value must be higher than 5% (0.05).

Table 4 Hausman-test results

Test summary	Chi-sq. statistic	Chi-Sq. d.f	Prob.
Cross-section random	50.342715	4	0.4203

Source: secondary data (processed, 2025)

Table 4 shows the probability value of 0.4203, which indicates that the Hausman test is greater than 0.05, the random effect model was accepted. Based on the results of the Chow and Hausman tests, the model goodness test revealed that the random effect model was the best.

If the probability value is prob < 0.05, then the effect of an exogenous variable on the endogenous variable is significant. If the probability value is prob > 0.05, then exogenous variables do not affect endogenous variables.

Table 5 estimation of panel data regression coefficient values

Variables	Coefficient	Std. Error	t-Statistic	Prob.
GRDP	0.024393	0.028801	2.846953	0.0219
Poverty rate	0.248937	0.017976	4.232993	0.0000
HDI	0.206385	0.113243	4.184838	0.0001
Investment	0.016643	0.029074	0.219374	0.8265
GRDP * Investment	0.024393	0.028801	0.846953	0.3979
Poverty rate * Investment	0.026385	0.113243	0.232993	0.8160
HDI * Investment	0.026430	0.029315	0.293740	0.8318
C	9.571699	1.580220	6.057193	0.0000
R-squared	0.938918			
Adjusted R-squared	0.929260			
F-statistic	97.21374			
Prob(F-statistic)	0.000000			

Source: secondary data (processed, 2025)

Table 5 shows that the constant (α) is a positive value (9.571699); if the GRDP, poverty rate, HDI and investment are 0 per cent or unchanged, then the income inequality distribution is 9.571699. The gross regional domestic product positively and significantly affects income inequality. This is demonstrated by the probability value of 0.0219 < 0.05 and the positive coefficient value of 0.024393, which means that H_1 is accepted. The poverty rate significantly and positively affects income inequality, with a probability value of 0.0000 < 0.05 and a positive coefficient value of 0.248937, so H_2 is accepted. The human development index positively and significantly affects income inequality, demonstrated by the probability value of 0.0001 < 0.05 and coefficient value of 0.206385, which means that H_3 is accepted. Investment does not affect income inequality. This is demonstrated by the probability value of 0.8265 > 0.05 and the positive coefficient value of 0.016643, so H_4 is rejected.

Investment cannot moderate the relationship between GRDP and income inequality, with a coefficient value of 0.024393 and probability of 0.3979 > 0,05, which means that H_5 is rejected. Investment cannot moderate the relationship between poverty rate and income inequality with a coefficient value of 0.026385 and probability value of 0.8160 > 0,05, so H_6 is rejected. On the other hand, investment cannot moderate the relationship between HDI and income inequality with a coefficient value of 0.026430 and a probability value of 0.8318 > 0,05, which means that H_7 is rejected.

Effect of gross regional domestic product on income inequality

Based on the results, gross regional domestic product positively affects income inequality in Indonesia. Economic growth in Indonesia widens the gap between low and high-income groups. The results are consistent with the disparity society theory, which states that the widening gap in income inequality can be conditioned by GDP growth that is not in line with equitable income distribution. In economic studies, when GDRP does not run parallel with the increase in people's purchasing power, it means that from the producer's side, there will be a devaluation of profit margins, leading to instability in investment and income distribution (Maichal et al. 2024). Although GDRP contributes to economic growth, the government needs to ensure that growth is not concentrated in a particular group (inclusive) so that capital in society remains preserved, allowing GDRP to be supported by the community's purchasing power. This research's results align with findings by Walujadi, Indupurnahayu, and Endri (2022); Maichal et al. (2024), that GRDP positively and significantly impacts income inequality. On the other hand, a study by Mustika, Nurjanah, and Wulan (2023); Setiawan, Nawatmi, and Nusantara (2024) showed that GRDP did not

significantly affect income inequality. This can be reflected in the economy of urban areas, which is growing faster than rural areas, meaning there is a gap in access to income and resources. When GRDP increases but income inequality increases, growth does not automatically produce equal prosperity. Therefore, it is necessary to evaluate the type of economic growth occurring, adjust policies to be more pro-vulnerable groups, and make concrete efforts to ensure that every level of society feels the benefits of development.

Effect of poverty rate on income inequality

Based on the result, the poverty rate positively affects income inequality in Indonesia. This indicates that efforts to address the issue of poverty are linked to issues that arise in the equitable distribution of income, and poverty can exacerbate income inequality. The limitation of access to public services and economic resources such as capital, training and education can threaten the poor community's ability to invest in these components, which fosters the growth of income inequality among people with low incomes in 34 provinces in Indonesia. Based on disparity society theory, the high level of poverty can be assumed to result in the accumulation of wealth among handfuls of individuals who are more capable in terms of access to resources and capital. The increase in income in urban areas but not met with similar conditions in rural areas indicates the occurrence of capital inequality, which is visible through increasing public opinion that ultimately creates a cycle of poverty that is difficult to break. This uneven income distribution can be exacerbated by government development policies that do not consider the conditions in other areas that similarly require support of development policies (Kaplinsky and Mbula 2022). The soaring poverty rate can be correlated with a low human development index, which includes conditions such as inadequate health and education that do not meet the community's needs, which should enable the community to enhance its competitiveness and productivity to participate in economic activities. This can contribute because individuals with low levels of education and health will be eliminated from opportunities that should be available to them, thus having limitations in accessing capital. The results of this study are consistent with previous research that shows a positive and significant correlation between the poverty rate and income inequality (Prannisa, Muljarijadi, and Wardhana 2023; Rizky, Lubis, and Kesuma 2024). In contrast, research by Maurilla, Suriani, and Nasir (2023); Ridwan, Lubis, and Tambunan (2024), poverty did not affect income inequality. These findings suggest that development inequality remains a problem faced by all 34 provinces in Indonesia, especially those in marginalized areas far from the capital. When poverty levels are high, income inequality will worsen. This means that poverty alleviation is not only about social justice but also an important prerequisite for realizing a fairer income distribution and sustainable development.

Effect of human development index on income inequality

Based on the results, the human development index (HDI) positively affects income inequality in Indonesia. This indicates that increasing human development is accompanied by increasing income inequality between community groups. This is contrary to reality because the greater government spending allocated to education should contribute to reducing income inequality. The improvement of human resource quality can be linked to the HDI because its indicators include income, education, and health, which reflect the quality of HR intended to be achieved (Nawaz et al. 2021; Erlyn et al. 2022). The human resources of certain regions can contribute to the achievement of their respective areas to compete, thereby increasing the productivity of their regions (X. Wang 2022). Based on the disparity society theory, when the quality of human resources in a region improves, its attractiveness to investment will increase, reducing the gradient of capital inequality between regions in the 34 provinces of Indonesia. The tendency of good investments has a high HDI level that

contributes to economic growth, which in turn helps reduce disparities in capital distribution between provinces. Moreover, the increase in the HDI enhances welfare and improves social and environmental conditions, making them more stable. This stability can attract investment in a region, creating more economic opportunities. The results of previous research align with this study that the human development index contributes to income inequality (Maghriza and Hasmarini 2024; Octavia et al. 2024). In contrast, a study by Ersad, Amir, and Zulgani (2022); Yasmin and Syofyan (2024) found that HDI does not affect income inequality. These findings suggest that a high HDI is associated with good access to basic services such as health and education. However, this is correlated with high levels of income inequality as well. The increase in HDI, accompanied by an increase in income inequality, indicates that human development is not inclusive enough. This is a warning that the quality of human resources alone is not enough if a fair distribution of the economy does not accompany it. The solution is to increase the HDI and ensure that its benefits are distributed fairly to all groups in society.

Effect of investment on income inequality

Based on the results, investment does not affect income inequality in Indonesia. This indicates that government investment still has specific problems in improving the income inequality of low-income groups. The results are consistent with the disparity society theory; although investment's impetus for economic growth can be initiated, its implications for income distribution are not always linear. Other factors, such as the overall economic conditions, access to resources, and government policies, may influence. These factors may be more prominent in determining the distribution of capital rather than investment. The concentration of investment in specific sectors dominated by urban areas will create an imbalance in capital distribution (Zhuang and Ye 2023). This pattern often occurs when total investment increases in the aggregate. However, it is not supported by policies that can direct the equitable distribution of capital, leading to widening disparities between urban and rural areas. Local governments can subsidize low-income communities and invest in regional infrastructure projects to mitigate inequality and hope for a more equitable future. This result is consistent with previous research that found that investment does not affect income inequality (Yuldashev et al. 2023; Lian, Pei, and Li 2024). In contrast, research by Gam, Oanh, and Dang (2023); Lian, Pei, and Li (2024) shows that investment significantly positively impacts capital inequality. These findings suggest that if investment is limited to specific regions, it may cause inequality in other areas that are not given priority. These findings bring several important implications that need to be considered in terms of the effectiveness of development policies, economic structure, and the direction of investment itself. The function of investment as a tool for economic equality has not been running effectively. This shows that not all investments bring equality. Without the right direction, investment can strengthen the status quo.

Effect of GRDP on income inequality moderated by investment

The study's findings demonstrated that investment cannot moderate the effect of GDRP on income inequality. This indicates that when investment opportunities rise or fall, the effect of GDRP on income inequality cannot be strengthened or weakened. According to the disparity society theory, the failure of investment to moderate the impact of GDP on inequality indicates that the development system still favors the economic elite. Development without distributive justice will only deepen the social gap, and inequality will become more entrenched without structural correction (Lee and Han 2025). Although GDRP is important in estimating regional economic growth, its contribution to capital inequality in 34 provinces in Indonesia is not always significantly impactful with the investment. This assumption can be validated through the performance of an unevenly distributed investment because a potential

profit is used as a benchmark for capital investment, causing peripheral and rural areas to be eliminated from that potential profit when the comparison is made with urban areas. This is an antecedent of capital distribution inequality because provinces with high GDRP cannot be assured that investment is evenly distributed in those areas. Regions with more developed infrastructure and broader market support tend to attract more investment; however, areas without adequate access become underdeveloped regions (Kaiser and Barstow 2022). Regarding investment quality, not all investments can influence the reduction of capital inequality. Investments that are more extractive or do not absorb labor and are not sustainable contribute to inequality. When investments cannot be controlled to enhance local community empowerment, the value of investments will become minimal, thus not affecting the relationship between GDRP and capital inequality. These results imply that large-scale economic activity does not benefit smaller economies in other regions and that investment activities are concentrated only in urban areas. Investment has not worked as a tool for equality. It has only become a "passenger" in economic growth, not a "director" of social justice. This means that development policies must be more strategic and selective in attracting and directing investment to impact income equality truly.

Effect of poverty rate on income inequality moderated by investment

The study's findings demonstrated that investment cannot moderate the effect of the poverty rate on income inequality. This indicates that when investment opportunities rise or fall, the effect of the poverty rate on income inequality cannot be strengthened or weakened. This means that even if investment increases, it cannot weaken or change the impact of poverty on inequality. In other words, poverty still worsens income inequality, and the presence of investment does not reduce this effect (Sakamoto 2021). This phenomenon can be interpreted as other factors overshadowing its influence on income inequality. The factors include education level, government policies, and access to resources. Disparity society theory views that when investment cannot weaken the influence of poverty on inequality, the economic system is still working to maintain inequality, not reduce it. When foreign and domestic investment increases (short term), income inequality distribution has no effect. Additionally, the government's appropriate policies in responding to expenditures and investments are very influential (Hu et al. 2023). Even though poverty may decrease, income disparity can still occur without proper intervention from the government as the public policyholder. The policies to boost economic expansion and reduce poverty must be mutually beneficial (Buhalis et al. 2023). Economic expansion must be felt, particularly by the impoverished, or the growth policies must be pro-poor. These findings suggest that if the government does not allocate its funds evenly or does not consider the more disadvantaged areas, the gap in capital inequality will widen even though the poverty rate is calculated to decrease. This finding shows that investment has not been an effective tool to balance the economic structure. This means that economic growth driven by investment has not directly touched the poor or reduced poverty's central role in creating inequality.

Effect of HDI on income inequality moderated by investment

The study's findings demonstrated that investment cannot moderate the effect of HDI on income inequality in Indonesia. This indicates that when investment opportunities rise or fall, the effect of the HDI on income inequality cannot be strengthened or weakened. It indicates that when investment opportunities decrease, as reflected in the lower government spending allocated for education, it cannot guarantee the equitable distribution of income among the 34 provinces in Indonesia. According to the disparity society theory, human development is not enough to correct structural inequalities, and investment fails to be a tool to equalize access to the benefits of development. Income inequality is likely to occur when

access to income does not increase across all regions in the context of investment (E. Wang and Lee 2023). Provinces in Indonesia with moderate and low HDI and investment have limited handling and manage financial development to reduce income inequality. The advantages in a handful of urban areas cause capital to be concentrated in certain provinces, making access available to the affluent (Haque and Sharifi 2024). At the same time, other limited communities suffer shortages and become trapped in poverty. The inequality of opportunity causes the disparity in most regions, especially in border areas such as East Indonesia and regions bordering Malaysia in Kalimantan. Government policies and external factors such as unstable global economic conditions can condition income inequality (Batuo, Kararach, and Malki 2022; Shen and Zhao 2023). Therefore, it can be said that although HDI is an indicator that calculates welfare, the HDI does not directly drive income inequality through investment. Factors such as unevenly distributed investments, government policies, and overall economic conditions can dominate inequality in the 34 provinces of Indonesia. These findings imply that transforming a fair and equitable economic structure has not been accompanied by improvement in human quality (HR). Human development without economic justice will result in new inequalities. Investment must be directed and redesigned to become a tool for equality, not just growth.

Conclusions

Based on the result analysis, income inequality in Indonesia is positively affected by the gross regional domestic product, poverty rate, and human development index. The higher GRDP is associated with improved welfare, increasing purchasing power, and allowing individuals to meet their basic and non-essential needs. Economic expansions raise the standard of living for those with low incomes. Since human capital development increases labor force productivity and efficiency, it is seen to raise wages. In contrast, investment does not influence income inequality. Investment cannot moderate the effect of gross regional domestic product, poverty rate, and human development index on income inequality. Low income, due to low productivity, traps individuals in poverty. This income growth empowers individuals to fulfill their needs and improve overall welfare, potentially reducing poverty.

In theory, the conflicting results of earlier research on the relationship between macroeconomic factors and income inequality are resolved by this research. This study adds to the practical focus on the significance of inclusive economic growth. Income equality should be prioritized because economic growth may exacerbate poverty in the absence of income equality. These findings suggest that to combat poverty and inequality, policymakers should encourage inclusive growth that helps lower-income groups. Spending on health and education should continue to rise, with improvements made to target social safety nets better so that the most vulnerable can access these resources.

This research is limited to provincial-level data, which may mask the nuanced effects of rural income inequality at a more localized level. Future research should explore these variations at the regency/city level. Further study can be conducted through case studies in several provinces in Indonesia that have different economic characteristics. This will provide insights into the local context that affects the relationship between the studied variables, such as comparing provinces with low investment levels to those with high investment levels to observe the extent of regional inequality. In addition, moderating variables that can be used besides investment, which can have an impact, such as education level, access to technology, and community participation in the development process, can provide a different perspective on other factors contributing to income inequality.

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