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ECONOMIC GROWTH, LABOR INFORMALITY, EDUCATION, AND INCOME INEQUALITY: EVIDENCE FROM DYNAMIC PANEL DATA ACROSS INDONESIAN PROVINCES

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Abstract

This study investigates the main determinants of income inequality across Indonesian provinces by employing dynamic panel data from 34 provinces over the 2015-2023 period. The study is motivated by the persistent disparity in regional income distribution despite continuous economic growth in Indonesia. Income inequality is proxied by the Gini ratio, while the explanatory variables consist of Gross Regional Domestic Product (GRDP), Provincial Minimum Wage (PMW), Labor Force Participation Rate (LFPR), percentage of informal workers, and Mean Years of Schooling (MYS). Considering the dynamic nature of inequality and the possibility of endogeneity among variables, the analysis applies a dynamic panel regression approach estimated using the System Generalized Method of Moments (System GMM). The empirical results indicate that lagged income inequality, GRDP, and the percentage of informal workers positively and significantly influence income inequality, implying that regional growth and labor market conditions remain uneven and less inclusive. Conversely, Mean Years of Schooling exerts a negative and significant effect, highlighting the important role of education in reducing inequality. Meanwhile, PMW and LFPR are found to have no significant impact on income inequality in Indonesia.

Keywords: *Income inequality, Gross Regional Domestic Product (GRDP), Provincial Minimum Wage, Labor Force Participation Rate (LFPR), percentage of informal workers, mean years of schooling, dynamic panel data*

INTRODUCTION

Income inequality remains a major challenge in Indonesia's economic development agenda, despite the country consistently recording positive economic growth over the past two decades. Economic growth that is not accompanied by equitable income distribution will lead to disparities among individuals and regions, potentially causing social instability, triggering political polarization, and weakening the foundations of the welfare state. High levels of income inequality can hinder poverty alleviation efforts, weaken human capital accumulation, and reduce public trust in institutions (OECD, 2021); (Milanovic, 2016); (World Bank, 2023). In Indonesia,

data from the Central Statistics Agency (BPS) indicate an increasing trend in income inequality over the last three years (2021-2023), although inequality had declined during the 2015–2019 period. This condition indicates that income remains concentrated among a relatively small segment of the population.

Income inequality also occurs spatially or across provinces, reflecting the accumulation of structural inequalities resulting from differences in development history, the quality of local institutions, and regional economic capacity in developing productive sectors. Studies by (Kanbur & Venables, 2005), as well as (Gennaioli et al., 2014), emphasize that spatial inequality in developing countries is not merely economic in nature, but is also influenced by asymmetries in public budget allocation, regional bureaucratic capacity, and disparities in social capital. In Indonesia, although regional autonomy has been implemented since 2001, interprovincial development inequality persists. Most investment and economic infrastructure remain concentrated in the western region, particularly on Java Island, while provinces in eastern Indonesia continue to experience prolonged economic and social stagnation.

One of the fundamental determinants of income inequality is Gross Regional Domestic Product (GRDP) per capita, which reflects the economic capacity of a region to generate value added. Interprovincial disparities in GRDP not only indicate differences in output, but also differences in economic sector structures and labor productivity. As the national business and financial center, DKI Jakarta records a GRDP per capita exceeding IDR 241 million, while provinces such as East Nusa Tenggara remain below IDR 30 million (BPS, 2022). This disparity cannot be separated from the concentration of high value-added industries and the limited economic integration of underdeveloped regions into national value chains (Barro & Sala-i-Martin, 1992). The higher a region's GRDP, the greater its potential for income redistribution; however, when other regions lag behind in GRDP growth, national income inequality tends to worsen.

Provincial minimum wage (PMW) is an important instrument within the labor market policy framework; however, in practice, disparities in PMW levels actually reflect interregional inequality. Indonesia's PMW policy is decentralized and based on the economic capacity of each province, resulting in extreme differences in minimum wage standards across regions. For example, the PMW in DKI Jakarta reached nearly IDR 5 million in 2023, while in Central Java it remained below IDR 2 million. Studies by (Neumark, 2007) and (Belman & Wolfson, 2014) indicate that minimum wages that are too low are unable to function effectively as a redistribution instrument, whereas excessively high wages without adequate productivity may instead increase labor informality. In regions where PMW levels are low and not proportional to decent living needs, interprovincial income inequality becomes increasingly difficult to address.

Another important factor in explaining income inequality is the Labor Force Participation Rate (LFPR). Provinces with high LFPR levels indicate a more optimal

utilization of labor in productive economic activities, whereas low LFPR levels reflect limited participation of the working-age population, either due to low labor demand or constraints on labor supply caused by educational and social barriers. According to the (ILO, 2021), labor force participation is strongly influenced by gender, age, and geographic location. In Indonesia, provinces with low LFPR levels, such as Papua and Maluku, face limited access to formal labor markets, while more developed provinces such as Bali and East Kalimantan possess more mature labor market structures. These disparities in LFPR directly affect people's ability to earn income, which ultimately widens regional income inequality.

Indonesia's labor market structure, which is still dominated by the informal sector, also contributes to widening interprovincial income inequality. Informal workers, most of whom are employed in small-scale trade, subsistence agriculture, and non-formal services, tend to earn unstable incomes, lack social protection, and face limited opportunities for upward economic mobility. Data from the Central Statistics Agency (BPS) indicate that more than 59% of Indonesia's workforce is still employed in the informal sector, with a higher proportion found outside Java. Studies by (Chen et al., 2004) and (IMF, 2020) emphasize that high levels of informality hinder equitable income distribution because the productivity of the informal sector is substantially lower than that of the formal sector. When the proportion of informal workers dominates in a province, opportunities for escaping poverty become increasingly limited.

Education, as a form of human capital investment, plays a strategic role in improving income distribution. Better education enables individuals to obtain higher-quality jobs and earn higher wages, while also contributing to increased national productivity. Nevertheless, the mean years of schooling in Indonesia still show striking disparities across provinces. In developed provinces such as DKI Jakarta, the average has exceeded 11 years, whereas in Papua and East Nusa Tenggara it remains below 8 years. This educational inequality not only affects current labor market outcomes, but also perpetuates disparities across future generations (Hanushek & Woessmann, 2012); (Psacharopoulos & Patrinos, 2018). Therefore, education should be positioned as a long-term variable in the analysis of income inequality.

Limited infrastructure, market access, and regional connectivity also constitute important determinants that exacerbate interprovincial income inequality. Regions with adequate road, port, and digital infrastructure are better able to attract investment and expand employment opportunities, whereas regions with limited infrastructure tend to lag behind in economic growth. In the Indonesian context, disparities in regional development are strongly correlated with the distribution of infrastructure and regional fiscal capacity. Reports by (World Bank, 2020) and (OECD, 2021) emphasize that equitable infrastructure development is a prerequisite for inclusive growth. Therefore, income inequality should be understood not merely as a

household-level microeconomic issue, but also as a reflection of structural disparities across regions.

By considering key variables such as GRDP, minimum wages, labor force participation, the level of informality, and education, this study aims to analyze the effects of these factors on interprovincial income inequality in Indonesia. This study employs a quantitative approach using dynamic panel data econometric techniques at the provincial level in Indonesia over the period from 2015 to 2023. The findings of this study are expected to provide empirical contributions to the formulation of appropriate policies aimed at reducing income inequality and promoting inclusive and equitable development.

RESEARCH METHOD

The data used in this study are panel data combining cross-sectional and time-series observations. The cross-sectional units consist of 34 provinces in Indonesia, while the time-series dimension covers the period from 2015 to 2023. The data are obtained from Statistics Indonesia (BPS) and other official government publications. The dependent variable in this study is income inequality, proxied by the Gini Ratio (Ineq). The independent variables include Gross Regional Domestic Product (GRDP), Provincial Minimum Wage (Wage), Labor Force Participation Rate (Workforce), the percentage of informal workers (Informal), and Mean Years of Schooling (Edu).

This study applies the Generalized Method of Moments (GMM) as the main estimation technique. GMM is selected because it is capable of addressing endogeneity, heteroskedasticity, autocorrelation, and the correlation between the lagged dependent variable and the error term, which commonly occur in dynamic panel models. The estimation is conducted using two main approaches, namely First Difference GMM (FD-GMM) developed by Arellano and Bond (1991), and System GMM (SYS-GMM) developed by Blundell and Bond (1998). System GMM is considered more efficient because it combines equations in first differences and levels, thereby generating stronger instruments, particularly when the time dimension is relatively short and the data exhibit high persistence.

The stages of analysis in this study are carried out systematically as follows: 1) The dynamic panel model is estimated using the FD-GMM and SYS-GMM approaches. The inclusion of the lagged dependent variable is intended to capture the persistence effect of income inequality over time; 2) The Sargan or Hansen test is conducted to examine the validity of the instruments used in the GMM estimation. The null hypothesis states that the instruments are valid and uncorrelated with the error term. The model is considered valid if the probability value exceeds the 5 percent significance level; 3) The Arellano-Bond test is employed to detect residual autocorrelation at the first-order AR(1) and second-order AR(2). In dynamic panel models, first-order autocorrelation may still be tolerated, whereas the model is

considered consistent if no second-order autocorrelation is detected, indicated by an AR(2) probability value greater than 0.05; 4) The best model is selected by comparing the estimation results of FD-GMM and SYS-GMM. The preferred model is determined based on instrument validity, model consistency, and the coefficient value of the lagged dependent variable that lies between the estimates of the Common Effect Model (CEM) and the Fixed Effect Model (FEM). This approach is used to ensure that the estimator is unbiased and efficient; and 5) The final stage involves analyzing the direction of the relationship, statistical significance, and the magnitude of the coefficients of each independent variable on income inequality in Indonesia. The interpretation of the results is also linked to economic theory, Indonesia's structural conditions, and findings from previous relevant studies.

RESULT AND DISCUSSION

Model Selection Results

The results of the model selection test to determine the most appropriate model between First Difference GMM (FD-GMM) and System GMM (SYS-GMM) can be identified by first conducting the Sargan test to examine instrument validity, as follows:

Table 1. Sargan Test

Sargan test of overidentifying restrictions H_o: overidentifying restrictions are valid		
Dependent Variable = INEQ		
	First Different GMM	System GMM
Statistic	28,79106	25,08523
P-value	0,5801	0,9468

Source: Statistics Indonesia (BPS), processed by the author

Table 1 presents the results of the Sargan test used to examine instrument validity. It can be observed that the probability values for First Difference GMM (FD-GMM) and System GMM (SYS-GMM) are 0.5801 and 0.9468, respectively, both of which are greater than the alpha (α) value of 0.05. These results indicate that both models fail to reject the null hypothesis (H0) and successfully pass the Sargan test, meaning that the models are valid and free from correlation problems. Subsequently, the Arellano-Bond test was conducted to examine model consistency, as follows:

Table 2. Arellano-Bond Test

Arellano-Bond test for zero autocorrelation in first-differenced errors H_o: no autocorrelation				
Dependent Variable = INEQ				
Order	First Different GMM		System GMM	
	Statistic AB-Test	P-value	Statistic AB-Test	P-value
1	-4,3987	0,0000	-4,3187	0,0000

2	-0,19563	0,8449	-0,27904	0,7802

Source: Statistics Indonesia (BPS), processed by the author

Table 2 presents the results of the Arellano-Bond test used to examine model consistency. It can be observed that the probability values for the first-order test in First Difference GMM (FD-GMM) and System GMM (SYS-GMM) are both 0.000, which are smaller than the alpha (α) value of 0.05. Meanwhile, the probability values for the second-order test are 0.8449 for First Difference GMM (FD-GMM) and 0.7802 for System GMM (SYS-GMM), both of which are greater than the alpha (α) value of 0.05. These results indicate that both models fail to reject the null hypothesis (H0) and successfully pass the Arellano-Bond test, meaning that the models are free from autocorrelation problems.

After conducting the model specification tests, both models were found to be valid and free from correlation problems based on the Sargan test, and free from autocorrelation based on the Arellano-Bond test. Subsequently, the best model selection test was carried out by comparing the models with the Fixed Effect Model (FEM) and the Common Effect Model (CEM), as follows:

Table 3. Model Selection

Variable	FEM	FDGMM	SYSGMM	CEM
L1,INEQ	0,04733632	0,18748748***	0,19820082***	0,96796316***
	(0,484)	(0,000)	(0,000)	(0,000)
LNPDRB	-0,03481868*	0,0050766	0,71374533***	0,0004948
	(0,019)	(0,529)	(0,001)	(0,613)
LNWAGE	-0,00869279	-0,01731563	0,1167028	-0,0053617
	(0,679)	(0,098)	(0,668)	(0,262)
WORKFORCE	0,00128138	0,00128523**	0,00304296	0,00063807*
	(0,065)	(0,004)	(0,097)	(0,038)
INFORMAL	0,0002871	0,00105952***	0,00094377***	-0,00003803
	(0,484)	(0,000)	(0,000)	(0,769)
EDU	-0,01165573	0,0004389	-0,01066912**	0,00080666
	(0,261)	(0,949)	(0,009)	(0,621)
Constant	1,1197683***	0,05768428	-0,25679219*	0,02776529
	(0,000)	(0,777)	(0,023)	(0,710)
Observations	238	204	238	238
Groups	34	34	34	34
R-squared	0,24359953			,86433734
Adjusted R-squared	0,09461156			,86081364

Legend: * p<0,05; ** p<0,01; *** p<0,001

Source: Statistics Indonesia (BPS), processed by the author

Based on the results of the best model selection test conducted to determine the most appropriate model between First Difference GMM (FD-GMM) and System

GMM (SYS-GMM), it can be observed that the lagged endogenous coefficient in the System GMM (SYS-GMM) model lies between the lagged endogenous coefficients of the Fixed Effect Model (FEM) and the Common Effect Model (CEM), and is greater than that of the First Difference GMM (FD-GMM) model. Therefore, the System GMM (SYS-GMM) model was selected as the best model because it satisfies the unbiasedness requirement.

Panel Data Regression Results

Table 3 shows that the best model selected for this study is the System GMM (SYS-GMM) model. Based on this model, the regression equation and its interpretation are presented as follows:

$INEQ_{i,t}$ = -0,25679219 + 0,19820082 $INEQ_{i,t-1}$ + 0,71374533 $LNPDRB_{i,t}$ + 0,1167028 $LNWAGE_{i,t}$ + 0,00304296 $WORKFORCE_{i,t}$ + 0,00094377 $INFORMAL_{i,t}$ - 0,01066912 $EDU_{i,t}$ + $\varepsilon_{i,t}$

The Effect of Lagged Income Inequality (Ineqt-1) on Income Inequality

Based on the results of the partial statistical test, lagged income inequality has a positive and significant effect on income inequality, with a probability value of 0.000, which is smaller than the alpha (α) value of 0.05; therefore, H0 is rejected. This means that lagged income inequality has a significant effect, and the coefficient value of 0.19820082 indicates that lagged income inequality positively affects income inequality in Indonesia.

The findings of this study are consistent with previous studies conducted by (Deyshappriya, 2017) and (Sabir et al., 2021), which found a positive and significant relationship between income inequality in the previous period (t-1) and income inequality in the current period (t). This indicates that an increase in income inequality in the previous year will lead to an increase in income inequality in the current year. This occurs because, as long as the underlying determinants do not change significantly, income inequality persist over time.

The Effect of Gross Regional Domestic Product (GRDP) on Income Inequality

Based on the results of the partial statistical test, Gross Regional Domestic Product (GRDP) has a positive and significant effect on income inequality, with a probability value of 0.001, which is smaller than the alpha (α) value of 0.05; therefore, H0 is rejected. This means that Gross Regional Domestic Product (GRDP) significantly affects income inequality, and the coefficient value of 0.71374533 indicates that GRDP has a positive effect on income inequality in Indonesia.

The findings of this study indicate that increases in GRDP in Indonesia have not yet been accompanied by a more equitable distribution of income. Rising GRDP tends to remain concentrated among a small segment of society and within certain regions.

Structural change theory explains that the development process, characterized by increasing output or GRDP, may lead to or be accompanied by income inequality among different groups in society. Structural transformation during the development process can generate uneven economic growth across geographical regions. As a result, concentrated economic growth centers and urbanization emerge, potentially widening income disparities between rural and urban areas, as well as between more developed and less developed regions.

This study is consistent with previous research conducted by (Litwin, 2015), (Deyshappriya, 2017), (Ananda & Pulungan, 2019) and (Kum, 2024), which found a positive and significant relationship between Gross Regional Domestic Product (GRDP) and income inequality. These findings imply that when GRDP increases, the level of income inequality also tends to increase, and conversely, when GRDP declines, income inequality also decrease.

The Effect of Provincial Minimum Wage (Wage) on Income Inequality

Based on the results of the partial statistical test, the Provincial Minimum Wage (Wage) does not significantly affect income inequality, with a probability value of 0.668, which is greater than the alpha (α) value of 0.05; therefore, H0 is accepted. This means that the Provincial Minimum Wage (Wage) has no significant effect, while the coefficient value of 0.1167028 indicates a positive relationship between the Provincial Minimum Wage and income inequality in Indonesia, although the effect is not statistically significant.

The findings of this study indicate that increases in the Provincial Minimum Wage do not contribute significantly to reducing income inequality in Indonesia. The growing dominance of informal labor is one of the main reasons why the Provincial Minimum Wage has not improved income distribution within society. Consequently, although the Provincial Minimum Wage increases, these wage adjustments do not benefit informal sector workers, who constitute the majority of Indonesia's labor force structure.

The results of this study are inconsistent with previous studies conducted by (Belman & Wolfson, 2014), (Kusnandar dan Zulfikar (2021), (Litwin, 2015), (Gulaliyev et al., 2023), (Carrasco & Duran-Bustamante, 2022) and (Jaumotte & Osorio, 2015), which found that wages have a negative and significant effect on income inequality. However, this study is consistent with the findings of (Guo, 2024), (Istanti et al., 2021) and (Bastian Lubis et al., 2019), which reported that the Provincial Minimum Wage (Wage) has a positive but insignificant relationship with income inequality. This implies that when wage levels increase, income inequality also tends to increase, and vice versa; however, the effect is not strong enough to conclude that wages significantly influence income inequality.

The Effect of Labor Force Participation Rate (Workforce) on Income Inequality

Based on the results of the partial statistical test, the Labor Force Participation Rate (Workforce) does not significantly affect income inequality, with a probability value of 0.097, which is greater than the alpha (α) value of 0.05; therefore, H0 is accepted. This means that the Labor Force Participation Rate (Workforce) has no significant effect, while the coefficient value of 0.00304296 indicates a positive relationship between the Labor Force Participation Rate and income inequality in Indonesia, although the effect is not statistically significant.

The findings of this study indicate that increases in the Labor Force Participation Rate (Workforce) do not contribute significantly to reducing income inequality in Indonesia. The dominance of informal employment within the labor market structure is one of the main reasons underlying this condition. The increase in labor force participation largely occurs within the informal sector, where income levels are generally unstable and relatively low. Therefore, even though the Labor Force Participation Rate increases, it does not necessarily improve income inequality conditions in Indonesia.

The findings of this study differ from those obtained by (Rahmawati & Priyono, 2023), (Tran et al., 2020), (Litwin, 2015), (Deyshappriya, 2017), (Tridico, 2018), and (Jaumotte & Osorio, 2015), which found a negative and significant relationship between the Labor Force Participation Rate (Workforce) and income inequality. Conversely, this study is consistent with previous findings by (Kum, 2024) and (Bastian Lubis et al., 2019), which stated that the Labor Force Participation Rate (Workforce) has a positive relationship with income inequality, although the effect is not statistically significant. This implies that when the Labor Force Participation Rate increases, income inequality also tends to increase, and vice versa. However, these results are not sufficiently strong to conclude that the Labor Force Participation Rate significantly affects income inequality.

The Effect of the Percentage of Informal Workers on Income Inequality

Based on the results of the partial statistical test, the percentage of informal workers has a positive and significant effect on income inequality, with a probability value of 0.000, which is smaller than the alpha (α) value of 0.05; therefore, H0 is rejected. This means that the percentage of informal workers has a significant effect, and the coefficient value of 0.00094377 indicates that the percentage of informal workers positively affects income inequality in Indonesia.

This study supports the applicability of the informal sector subsistence theory, which explains that informal workers generally work to fulfill their basic needs, such as food, shelter, and other necessities. Individuals employed in the informal sector often

have limited opportunities to obtain stable incomes, social protection, and adequate job security. Informal workers also tend to receive relatively low and insufficient incomes. Consequently, as the number and percentage of informal workers increase, it becomes increasingly difficult to reduce income inequality; in other words, income inequality tends to rise.

The findings of this study are consistent with previous studies conducted by (Kum, 2024), (Bastian Lubis et al., 2019), (Kumar & Pandey, 2021) and (Lukiyanova, 2015), which found that an increase in informal labor has a positive and significant effect on income inequality. This implies that when the level of informal employment increases, income inequality also tends to rise, and conversely, when the level of informal employment decreases, income inequality tends to decline.

The Effect of Education (Mean Years of Schooling) on Income Inequality

Based on the results of the partial statistical test, Mean Years of Schooling (MYS) has a negative and significant effect on income inequality, with a probability value of 0.009, which is smaller than the alpha (α) value of 0.05; therefore, H0 is rejected. This means that Mean Years of Schooling (MYS) has a significant effect, and the coefficient value of -0.01066912 indicates that Mean Years of Schooling negatively affects income inequality in Indonesia.

This study is consistent with the Human Capital Theory proposed by Gary Becker, which states that investment in education and training can enhance workers' skills and productivity, thereby increasing income and reducing income disparities among workers (Yunita & Supriadi, 2023). Improvements in human resource quality resulting from higher Mean Years of Schooling imply that workers with longer educational attainment are likely to receive higher wages upon entering the labor market compared to workers with lower educational attainment. This condition affects productivity, which indirectly influences income disparities across regions (Nuraini, 2017). Workers with higher levels of human capital are generally more productive and possess greater capacity to generate higher output, which can lead to increased earnings and reduced income disparities among workers. In addition, individuals with higher levels of human capital usually have greater opportunities to obtain higher-paying jobs and escape the cycle of poverty (Amaliyah & Arif, 2023). The findings of this study also support previous research conducted by (Litwin, 2015), (Deyshappriya, 2017), (Sabir et al., 2021), (Wani, 2021), and (Guo, 2024), which found that Mean Years of Schooling (MYS) has a significant effect in reducing income inequality.

CONCLUSION

Based on the findings of this study, income inequality in Indonesia exhibits a persistent nature, meaning that inequality in previous periods tends to influence

inequality in subsequent periods. This finding indicates that without structural changes and effective policy interventions, income inequality will continue to persist. In addition, Gross Regional Domestic Product (GRDP) was found to have a positive and significant effect on income inequality. This suggests that regional economic growth has not yet been fully inclusive, as the benefits of growth remain concentrated in certain regions and among specific groups of society, resulting in persistently high interregional disparities.

This study also found that the Provincial Minimum Wage (PMW) and the Labor Force Participation Rate (LFPR) do not have significant effects on income inequality. These findings indicate that increases in minimum wages and labor force participation have not been sufficient to substantially reduce inequality because Indonesia's labor market structure continues to be dominated by the informal sector. Most additional workers are absorbed into informal employment characterized by low and unstable incomes as well as limited social protection, making wage policies and labor participation improvements less effective in improving income distribution.

On the other hand, the percentage of informal workers was found to have a positive and significant effect on income inequality, while education, proxied by Mean Years of Schooling (MYS), had a negative and significant effect. These findings demonstrate that the high level of labor informality is one of the primary sources of income inequality in Indonesia, whereas improvements in education can enhance the quality of human resources, increase productivity, and expand access to better employment opportunities. Overall, income inequality in Indonesia is influenced by structural economic factors, labor market conditions, and educational quality. Therefore, more inclusive development, strengthening of the formal sector, and improvements in access to and quality of education are essential to reducing income inequality in a sustainable manner.

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