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Analysis The Effect Of Investment, Poverty, And Information And Communication Technology (ICT) On Income Inequality In Indonesia Period 2017-2023

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Abstract

This study aims to analyze the effects of investment, poverty, and information and communication technology (ICT) on income inequality across provinces in Indonesia during the period before and during the covid-19 pandemic (2017–2023). The analytical method used in this study is panel data analysis across 34 Indonesian provinces, using a quantitative approach. The dependent variable is income inequality, measured by the Gini Ratio, while the independent variables include Gross Fixed Capital Formation (GFCF) as an indicator of investment, the poverty rate, and the ICT Development Index (IDI) as an indicator of information and communication technology (ICT). The results show that investment, ICT, and the covid-19 dummy variable have a negative and significant effect on income inequality. In contrast, poverty has a positive and significant effect on income inequality in Indonesia during the 2017–2023 period.

Keywords: Income Inequality, Investment, Poverty, ICT, Covid-19 Pandemic

INTRODUCTION

In the development process, income inequality between regions is a classic problem that is difficult to avoid, especially in developing countries such as Indonesia. Economic activity and leading sectors tend to be concentrated in certain regions, while other regions lag behind. This inequality can be influenced by various factors such as physical investment, human resource development, and infrastructure development

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(Fleisher et al., 2010). High inequality not only reduces the attractiveness of investment and regional productivity, but also increases poverty levels and worsens national economic stability (Abdila et al., 2022). However, on the other hand, inequality can also trigger positive effects, such as encouraging underdeveloped regions to compete more and strive to increase their economic growth rates in order to achieve better welfare (Todaro, 2011). Income distribution inequality is a common problem faced by developing countries, including Indonesia (Bantika et al., 2015).

Empirically, Indonesia's economic structure in recent decades has been dominated by the Java and Sumatra regions, which contribute the majority of the national Gross Regional Domestic Product (PDRB). During the 2018–2021 period, the Java region contributed around 60% of the total national PDRB. This disparity is also reflected in the very high GRDP per capita in these regions compared to other areas.

The level of income inequality is measured using the Gini index, which ranges from 0 (perfect equality) to 1 (absolute inequality).

Income distribution has two important aspects, namely improving the overall welfare of society and income equality. Success in addressing these two aspects can be seen from the even distribution of income and a decrease in the Gini ratio between regions (Permana, 2016). Data from the Central Bureau of Statistics (BPS) shows that the Gini Ratio declined from 2016 to 2019, reflecting an improvement in income distribution. However, when the Covid-19 pandemic hit the world in early 2020, the trend reversed. The pandemic caused a deep economic contraction, with restrictions on mobility, disruption of supply chains, and rising unemployment, which had the greatest impact on low-income groups. As a result, income inequality increased again.

In an effort to overcome inequality, investment has become a strategic factor. In this context, Gross Fixed Capital Formation (GFCF) is used as the main indicator that reflects physical capital investment such as buildings and production machinery. GFCF is an important component in the formation of Gross Domestic Product (GDP) and has a direct influence on production capacity and development distribution. However, the uneven distribution of investment in Indonesia is the main cause of regional inequality. This inequality has negative impacts, such as reduced investment attractiveness, increased poverty, and decreased productivity in the region (Firdaus, 2013).

In addition to investment, poverty is an important variable that is closely related to income inequality. When the number of poor people increases, access to education, health services, and productive employment becomes increasingly limited, thereby widening the economic gap. Suboptimal investment in relatively underdeveloped

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provinces can cause them to lag behind other provinces in terms of economic growth and development. If this situation continues, income distribution inequality in Indonesia will increase, so it is necessary to focus on the development of other provinces to support equity (Febriyani & Anis, 2021; Maesza et al., 2022; Pramesti & Yasa, 2019; Harahap, 2022).

Studies by Sari et al., (2021) and Hindun et al., (2019) show that an increase in poverty has a significant impact on high income inequality.

Another important factor influencing income inequality is the development of Information and Communication Technology (ICT), which in this study is measured using the ICT Development Index (IP-TIK). This index was developed by the International Telecommunication Union (ITU) and adopted by BPS to measure the progress of digital development in various provinces. The gap in IP-TIK has become more pronounced during the Covid-19 pandemic, when digitalization has become a primary need in the education, economic, and public service sectors. Regions with weak ICT infrastructure have become increasingly marginalized, deepening social and economic inequality. Indonesia, as an archipelagic nation with 38 provinces (34 provinces were used in this study), faces significant challenges in achieving equitable development. Four newly established provinces in Papua were not included in the study due to limitations in continuous serial data.

Based on this background, this study aims to analyze the effect of investment (PMTB), poverty, and the ICT Development Index (IP-TIK) on interprovincial income inequality in Indonesia, with a focus on the period before and during the Covid-19 pandemic (2017–2023). This study is expected to provide empirical contributions to the formulation of more inclusive and socially just regional development policies, especially in facing the post-pandemic recovery period.

LITERATUR REVIEW

Income inequality is defined as an imbalance in the distribution of income between individuals or regions. The main indicators used to measure it are the Gini Ratio and the Williamson Index. High inequality can reduce economic efficiency, undermine social stability, and widen the poverty gap. The causes include uneven development, high population growth, concentrated investment, and low social mobility (Arsyad, 1999).

Investment, measured through Gross Fixed Capital Formation (GFCF), is the driving force behind economic growth (Harrod-Domar). Investment can increase production capacity and create jobs. However, investment that flows only to certain

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regions tends to widen regional disparities. Poverty is a multidimensional condition that includes the inability to meet basic needs, including access to education, health services, and employment. According to the poverty cycle theory (Ragnar Nurkse), poverty is intertwined with low productivity, low income, and limited capital, forming a poverty cycle that is difficult to break. Amartya Sen's capability theory (1999) also states that poverty hinders society's substantive freedom to improve the quality of life.

Information and Communication Technology (ICT) plays a strategic role in economic equality. The ICT Development Index (IP-TIK) is used to measure the digital progress of a region. ICT can be a tool to reduce inequality if access and usage are equitable. However, digital inequality can exacerbate income inequality if only certain groups can access the benefits of technology.

METHODOLOGY

This research uses a panel data regression model, which is a combination of cross section and time series data. The cross section data in this study used 34 provinces in Indonesia, leaving four provinces that were not included in the study. This is because the four provinces (Southwest Papua, Central Papua, South Papua, and Papua Pegunungan) are newly formed provinces in Indonesia.

Table 1 Variables and Operational Definitions

Variable Type	Variable Name	Measurement Indicator	Source
Dependent	Income Inequality	Gini Ratio (0–1)	BPS
Independent	Investment	PMTB (in billion Rupiah)	BPS
	Poverty	Percentage of poor population (%)	BPS
	ICT Development	ICT Development Index (0–10)	BPS
Dummy	Covid-19	Dummy (0 = before, 1 = during pandemic)	Calculated by year

Estimation Methods

Generally, there are a number of methods that are often used to estimate panel data regression models (Widarjono, 2018). There are three different approaches, namely Common Effects Model (CEM), Fixed Effects Model (FEM), and Random Effects Model

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(REM). There are three tests used to determine the best technique in estimating panel data regression (Widarjono, 2018). First, using the F statistical test in determining between the Common Effect Model or Fixed Effect Model method. Second, using the Lagrange Multiplier (LM) test in determining between the Common Effect Model or Random Effect Model method. Third, using the Hausman test in determining between the Fixed Effect Model or Random Effect Model method. Next, classical assumption testing is carried out which consists of normality test, heteroscedasticity test, multicollinearity test, and autocorrelation test. Finally, hypothesis testing is carried out which consists of t statistics, F statistics, and the coefficient of determination.

The panel data regression model related to inflation, TPT, NTP, UMP on poverty in the poorest provinces in Indonesia is transformed into :

$$Yit = \beta 0 + \beta 1\ X1it + \beta 2\ X2it + \beta 3\ X3it + \beta 4\ X4it + \varepsilon it$$

Description:
Y : Income Inequality
X1 : Investment
X2 : Poverty
X3 : ICT Development
X4 : Covid-19
ε : Error term
i : Individual number (a cross-section)
t : Period (a time-series)

RESULT AND DISCUSSION

Descriptive Statistical Analysis

Descriptive statistical analysis in this analysis intends to explain the statistical data of the variables used.

Tabel 1. Descriptive Statistical Analysis

Variabel	*Obs*	*Mean*	*Median*	*Max*	*Min*	*Std. Dev.*
RG	238	0.348840	0.341000	0.459000	0.245000	0.040378
PMTB	238	39.69093	30.50000	1905.000	3.420000	123.2824
KEMISKINAN	238	10.46844	8.660000	27.76000	3.420000	5.416784
IPTIK	238	5.472278	5.580000	7.730000	2.950000	0.850877

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DUMMY	238	0.569620	1.000000	1.000000	0.000000	0.496177

Source: Data Processing Results with Eviews 12

Based on descriptive statistics, the average Gini ratio is 0.348840, the average investment in this case measured through PMTB is 39.69093, the average poverty rate is 10.46844 percent, the average TIK is 5.472278, and the average Covid-19 pandemic dummy is 0.569620.

Model Specifications Test

1) Chow Test

The Chow test was conducted to determine the best model between the Common Effect Model (CEM) and the Fixed Effect Model (FEM). If the probability is less than 0.10, then the selected and best model is FEM. Conversely, if the probability is more than 0.10, then the selected and best model is CEM.

Table 2. The Chow Test's Summary

Effects Test	Statistic	d.f.	Prob.
Cross-section F	72.114445	(33,199)	0.0000
Cross-section Chi-square	607.138443	33	0.0000

Source: Data Processing Results with Eviews 12

Based on Table 2, a Chi-square statistic value of 607.138443 with a probability of 0.0000 < α 0.10 was obtained, so H_0 was rejected and FEM was selected.

2) Hausman Test

The Hausman test is conducted to compare between the Random Effect Model (REM) and the Fixed Effect Model (REM). If the probability is less than 0.05, then the selected and best model is FEM. Conversely, if the probability is more than 0.05, then the selected and best model is REM.

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Table 3. The Hausman Test's Summary

Test Summary	Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Cross-section random	26.777458	4	0.0000

Source: Data Processing Results with Eviews 12

Based on Table 3, a Chi-square statistic value of 26.777458 with a probability of 0.0000 > α 0.10 was obtained, so H_0 was rejected and FEM was selected.

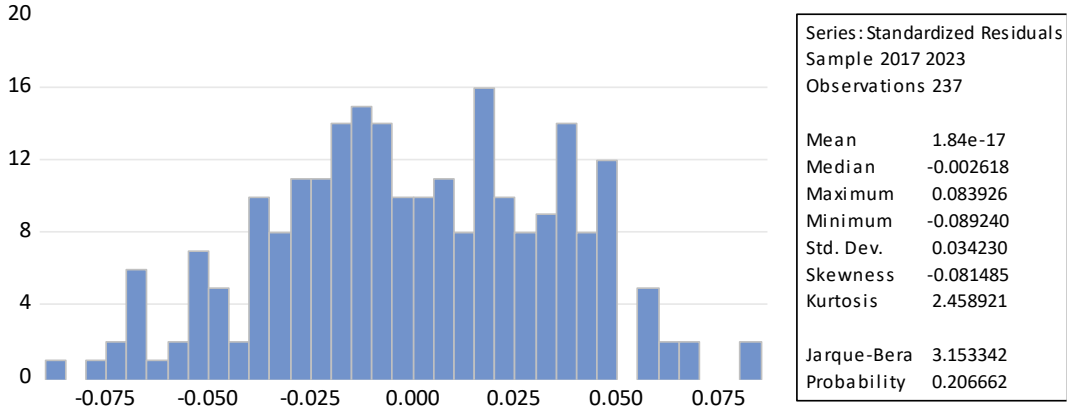
The Lagrange Multiplier test was not performed in this study because the Chow test and Hausman test showed that the selected method was the Fixed Effect Model (FEM). The Lagrange Multiplier test is performed to compare and select the best model between the Common Effect Model (CEM) and the Random Effect Model (REM).

Classical Assumption Tests

This study uses three classical assumption tests, namely normality test, multicollinearity test, and heteroscedasticity test :

1) Normality Test

The normality test is carried out to ensure that the data is normally distributed or not. The t test used to see the impact of the independent variable on the dependent variable will only be valid if the residuals are normally distributed.



Source: Data Processing Results with Eviews 12

Figure 1. The Normality Test's Summary

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From Figure 1, it can be seen that the Jarque-Bera value (3.153342) < Chi-square table (9.49) and prob. (0.206662) > α = 0.10, so H_0 is accepted or the data is normally distributed.

2) Multicollinearity Test

Multicollinearity test is conducted to observe whether there is a correlation between the independent variables and the regression model. In this study, the multicollinearity test was carried out using the correlation coefficient matrix.

Table 4. The Multicollinearity Test's Summary

	PMTB	KEMISKINAN	IPTIK	DUMMY
PMTB	1.000000	-0.062260	0.104438	0.069654
KEMISK...	-0.062260	1.000000	-0.562453	-0.020920
IPTIK	0.104438	-0.562453	1.000000	0.453074
DUMMY	0.069654	-0.020920	0.453074	1.000000

Source: Data Processing Results with Eviews 12

From Table 4, it can be seen that the correlation values of each independent variable, namely investment, poverty, ICT, and the COVID-19 pandemic dummy variable, are < 0.85, meaning that there is no multicollinearity problem.

3) Heteroscedasticity Test

Heteroscedasticity test intends to review whether the resulting residual model is stationary or not. This research applies the white method to test heteroscedasticity.

Table 5. The HeteroscedasticityTest's Summary

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.025152	0.022537	1.116056	0.2657
PMTB	-4.39E-06	3.92E-06	-1.121383	0.2635
KEMISKINAN	-0.001107	0.001279	-0.865206	0.3880
IPTIK	-0.000550	0.002259	-0.243487	0.8079
DUMMY	-0.001628	0.001838	-0.885681	0.3769

Source: Data Processing Results with Eviews 12

Based on Table 5, it can be seen that the value of prob > α = 0.10. It can be concluded that there is no heteroscedasticity in the data, so it is suitable for use in testing.

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Estimation Of Panel Data Regression

Based on the results of the model determination test, it shows that the best model is the Fixed Effect Model (FEM). The Fixed Effect Model (FEM) panel data regression estimation results and the interpretation of the equation are as follows

Table 6. Regression Results of the FEM

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.327439	0.034235	9.564473	0.0000
PMTB	-1.11E-05	5.95E-06	-1.863204	0.0639
KEMISKINAN	0.005453	0.001944	2.805883	0.0055
IPTIK	-0.006100	0.003432	-1.777446	0.0770
DUMMY	-0.003272	0.002792	-1.171935	0.2426
Effects Specification				
Cross-section fixed (dummy variables)				
R-squared	0.944542	Mean dependent var		0.348840
Adjusted R-squared	0.934231	S.D. dependent var		0.040378
S.E. of regression	0.010355	Akaike info criterion		-6.156738
Sum squared resid	0.021339	Schwarz criterion		-5.600678
Log likelihood	767.5734	Hannan-Quinn criter.		-5.932610
F-statistic	91.60335	Durbin-Watson stat		1.453326
Prob(F-statistic)	0.000000			

Source: Data Processing Results with Eviews 12

From Table 6, the following equation is obtained:

$RG = 0.327439 - 0.000011\ PMTB_{it} + 0.005453\ KE_{it} - 0.006100\ IPTIK_{it} - 0.003272\ DP_{cit} + \varepsilon it$

The following is the interpretation of the output from the panel data regression estimation using the Fixed Effect model:

1. The constant of 0.327439 represents the income inequality value of the province when all independent variables (investment, poverty, and information and communication technology (ICT)) are zero.
2. The investment coefficient (PMTB) of –0.000011 indicates a negative relationship, meaning that if investment increases by 1 percent (ceteris paribus), it will reduce provincial income inequality by –0.000011.

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3. The poverty coefficient (KE) is 0.005453, indicating a positive relationship, meaning that if the poverty rate increases by 1 percent (ceteris paribus), it will increase provincial income inequality by 0.005453.
4. The Information and Communication Technology (ICT) coefficient is –0.006100, indicating a negative relationship, meaning that if ICT increases by 1 percent (ceteris paribus), it will reduce provincial income inequality by –0.006100.
5. The DPc coefficient is – 0.003272, indicating a negative relationship, meaning that if the COVID-19 pandemic dummy increases (confirmed COVID-19 cases increase and impact the implementation of government regulations related to social restrictions) (ceteris paribus), it will reduce provincial income inequality by – 0.003272.

Hypothesis Test

There are three types of hypothesis testing, namely the T-test, F-test, and coefficient of determination. The following are the results of hypothesis testing, including:

1) Individual Parameter Significance Test (T-test)

The t-test is a method for testing the effect of each independent variable on the dependent variable partially. This test is conducted by comparing the t-statistic value with the t-table value at a significance level of α = 0.10 and degrees of freedom (df) of (n – k – 1) = 233. Based on these calculations, the t-table value obtained is 1.282. The results of the t-test are as follows:

Table 7. The T-statistic Test's Summary

Variabel Statistic	t- Statistic	t-tabel	Probabilitas	Keterangan
PMTB	-1.863204	1.282	0.0639	H0 ditolak
KE	2.805883	1.282	0.0055	H0 ditolak
TIK	-1.777446	1.282	0.0770	H0 ditolak
DUMMY	-1.171935	1.282	0.2426	H0 diterima

Source: Data Processing Results with Eviews 12

According to the t-test results table explaining the t-test results and the results obtained show that the variables of investment, poverty, and tik reject H_0, meaning that the three independent variables have a significant effect on income inequality in Indonesia. Meanwhile, the test results for the Covid-19 Pandemic Dummy variable accept

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H_0, meaning that the dummy variable does not have a significant effect on income inequality in Indonesia.

2) F-statistic Test

The F-test is conducted to see the effect of the independent variables on the dependent variable together.

F- statistic	Probabilitas	Kesimpulan
91.60335	0.000000	H0 ditolak

Source: Data Processing Results with Eviews 12

Based on Table 8, the F-test results obtained an F-statistic of 91.60335 > F-table 2.15 and a probability of 0.000000 < α = 0.10, so H_0 is rejected, meaning that the independent variables (investment, poverty, information and communication technology, and the COVID-19 pandemic dummy variable) collectively have an effect on income inequality in Indonesian provinces.

Analysis Of Coefficient Of Determination (R2)

The coefficient of determination shows how much of the total variation in the dependent variable (Y) can be explained by the independent variable (X) through the regression line. The closer the value is to one, the more accurate the regression line is considered to be in representing the actual data. Conversely, if the value is close to zero, the regression line's ability to explain the actual data is low. Based on the estimation results using the Fixed Effect Model (FEM) approach, the R^2 value obtained was 0.944542 or approximately 94.45%. This means that the independent variables, which include Investment, Poverty, Information and Communication Technology, and the COVID-19 pandemic dummy variable, can explain approximately 94.45% of the variation in the dependent variable, namely income inequality in Indonesian provinces. Meanwhile, the remaining 5.55% is explained by other factors outside the model.

The Effect of Investment (PMTB) on Income Inequality

Based on the analysis results, the investment variable (PMTB) has a negative regression coefficient of -0.000011 with a p-value of 0.0639 < α = 0.10. This means that an increase in investment can be statistically confirmed to have a direct impact on

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reducing income inequality between provinces in Indonesia. This finding is in line with the Harrod-Domar theory, which states that investment is the main driver of economic growth and plays a role in expanding production capacity and creating jobs. However, this effect will be optimal if investment is spread evenly across all regions, not just concentrated in developed provinces such as DKI Jakarta or West Java. These results are reinforced by a study conducted by (Nur et al., 2023) that examined the impact of investment, TPAK, and TIK on income inequality in Indonesia during the period 2018–2021 using a panel data approach. The study found that investment (PMTB) and ICT have a negative and significant effect on income inequality, while the TPAK variable is not significant. This means that investment and technology play a crucial role in reducing inequality if their distribution is fair and targets productive sectors that absorb a significant amount of labor.

The Impact of Poverty on Income Inequality

The analysis results indicate that the poverty variable has a positive and significant impact on income inequality (coefficient = 0.005453, p-value = 0.0055 < α = 0.10). This finding reinforces the theory that high poverty levels widen the income distribution gap between social groups. Areas with a high concentration of poor people tend to have more limited access to basic services, education, and economic opportunities. Therefore, reducing poverty rates should be a key focus in strategies to reduce inequality.

These results are supported by Todaro, (2011), who explain that structural poverty tends to exacerbate inequality because the poor are unable to participate in the modern economy. Meanwhile, a study by Nur et al., (2023) reveals that high poverty rates are correlated with low social mobility and limited formal employment opportunities, which ultimately widen the gap between economic classes.

The Impact of IP-TIK on Income Inequality

Based on the analysis results, the variable used in this study is IP-TIK. It shows a coefficient of (-0.006100) with a probability value of 0.0770 < α = 0.10. This indicates that although ICT has the potential to reduce inequality, its impact remains limited, possibly due to the uneven distribution of ICT, especially in remote and underdeveloped areas.This finding aligns with the research by Jaumotte et al., (2013), which explains that technological development has dual potential: accelerating growth while also increasing inequality if access is limited to highly educated or high-income groups. In Indonesia, Sari et al., (2021) revealed that the impact of ICT on inequality remains limited due to uneven digital infrastructure development outside Java Island.

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The Impact of the COVID-19 Pandemic on Income Inequality

The Covid-19 Pandemic Dummy Variable has a negative coefficient of -0.003272 with a probability value of 0.2426 > α = 0.10. This means that statistically, the pandemic does not show a significant effect on changes in income inequality, although the negative direction indicates that the pandemic tends to reduce the level of inequality. This can be explained by the fact that during the pandemic, many government social assistance programs were distributed on a large scale, which relatively increased the income of the poor and distorted the normal distribution of income. The dummy variable in the model represents the COVID-19 pandemic period and shows that more than half of the data falls within that period. This data is important for observing structural shifts. In general, the pandemic exacerbated income inequality, particularly in urban areas, due to the loss of informal jobs, reduced investment, and limited access to education and technology.

CONCLUSION

The analysis results indicate that the variables of gross fixed capital formation, information and communication technology, and the COVID-19 pandemic dummy have a significant negative effect on income distribution inequality in 34 provinces in Indonesia during the period 2017 to 2023. Meanwhile, the poverty variable has a significant positive effect on income inequality. And the simultaneous test results indicate that all independent variables, namely gross fixed capital formation, poverty, and information and communication technology, collectively affect income inequality in Indonesia from 2017 to 2023.

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