

Analysis of the Impact of Infrastructure Development on Economic Growth in Eastern Indonesia

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Abstract

Economic growth is defined as a continuous process toward improved economic conditions, reflected in a long-term increase in output per capita and recognized as part of the modern economic growth framework. This study employs a quantitative approach with an associative-causal design to analyze the influence of education, health, electricity, and water infrastructure on economic growth in Eastern Indonesia.

Secondary data were obtained from Statistics Indonesia (BPS), including indicators of education, health, Susenas, and real GRDP (ADHK) across 13 provinces during 2020–2023. The analysis was conducted using panel data regression in Stata. Model selection was performed through the Chow and Hausman tests, resulting in a Fixed Effect Model with cluster-robust standard errors as the most appropriate specification.

The estimation results show strong explanatory power ($R^2 = 0.72$) and a significant F-test, indicating that all independent variables jointly affect economic growth. Partially, education and health infrastructure exhibit negative and insignificant coefficients, suggesting their benefits are long-term and influenced by graduate quality, labor-market alignment, and productivity improvements. Electricity infrastructure shows a positive effect significant at the 10% level, although its impact remains limited due to the dominance of the primary sector and small-scale enterprises. Drinking water infrastructure emerges as the strongest determinant, with a positive effect significant at the 5% level, as it improves public health, reduces household time and costs, and directly enhances productivity and economic activity.

Keywords: Economic growth, infrastructure, panel data

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INTRODUCTION

Economic growth represents a continuous improvement in a country's economic conditions over time and is commonly reflected in a sustained increase in output per capita. An economy is considered to be developing when its level of economic activity is higher than in previous periods. According to Sukirno (1996), economic growth differs from economic development; growth refers specifically to a long-term increase in per capita output, while development encompasses broader structural and welfare changes. Economic growth is also widely regarded as one of the primary indicators of development success, as higher growth

rates generally correspond to improved societal welfare, although income distribution and inequality remain important complementary indicators.

In Indonesia, regional development disparities remain substantial, particularly between Western and Eastern Indonesia. Previous studies (Fitanto, 2024) show that Eastern Indonesia continues to lag behind in economic performance. Existing research on the region largely concentrates on poverty, inequality, labor quality, and differences in regional economic structures. However, relatively limited attention has been given to the direct role of basic infrastructure development – especially education, health services, electricity, and clean water – in driving regional economic growth.

Recent data from the Ministry of Health and Statistics Indonesia (BPS) indicate gradual improvement in health infrastructure in Eastern Indonesia during the 2020–2023 period. For example, the ratio of hospital beds per 1,000 population has increased in most provinces, reflecting expanding access to healthcare services through the construction of new hospitals and capacity upgrades of existing facilities. Although the ratio still remains below that of several western provinces, the trend suggests increasing equality in service provision.

Economic growth is influenced by several fundamental factors, including labor, capital, technology, and natural resources (Hapsari, 2018; Sugiharto, 2019; Hanum et al., 2025). Labor quality determines productivity, technological progress enhances production efficiency, and optimal utilization of natural resources with appropriate technology supports sustainable growth. Within this framework, infrastructure acts as an enabling input that improves both human capital and production efficiency.

The theoretical relationship between infrastructure and economic growth can be explained by the neoclassical growth model (Solow, 1956), which emphasizes capital accumulation as a key driver of long-term output expansion. Public infrastructure, as part of physical capital, increases the productivity of labor and private capital (Aschauer, 1989), thereby creating a positive causal relationship between infrastructure provision and economic performance.

Based on this perspective, this study analyzes the impact of education, health, electricity, and clean water infrastructure on economic growth in Eastern Indonesia during 2020–2023. Infrastructure development is assumed to influence human resource quality and facilitate economic activities across sectors. This argument is supported by previous empirical findings (Calderón & Servén, 2010; Mahardika & Hayati, 2024; Syahputra et al., 2024), which demonstrate that infrastructure quality significantly affects economic growth, although the magnitude varies across regions. Therefore, improving basic infrastructure is expected to be a key strategy for accelerating economic growth and reducing regional disparities in Eastern Indonesia.

RESEARCH DESIGN AND METHODOLOGY

This study employs a quantitative method with an associative-causal approach to analyze the effect of basic infrastructure development – education, health, electricity, and clean water – on economic growth in Eastern Indonesia. The quantitative approach is selected because the research relies on numerical data and statistical hypothesis testing using panel data regression. The dataset consists of secondary panel data from 13 provinces in Eastern Indonesia covering the 2020–2023 period, combining cross-sectional and time-series

observations obtained from Statistics Indonesia (BPS), including education statistics, health statistics, Susenas, and Gross Regional Domestic Product at constant prices (GRDP ADHK). The independent variables include education infrastructure (availability of schools relative to the school-age population), health infrastructure (hospital bed ratio), electricity infrastructure (percentage of households using electricity as the main lighting source), and clean water infrastructure (percentage of households with access to safe drinking water), while the dependent variable is economic growth measured by GRDP growth rate. The analysis is conducted using panel data regression in Stata software, with model selection through the Chow test and Hausman test to determine the most appropriate model, and robust standard errors are applied to address heteroskedasticity and autocorrelation, allowing more reliable estimation of the relationship between infrastructure provision and economic growth.

RESULTS AND DISCUSSION

This section is the main part of a research article and is usually the longest section of an article. The research results presented in this section are "clean" results. Data analysis processes such as statistical calculations and hypothesis testing do not need to be presented. Only the analysis and hypothesis testing results need to be reported. Tables and graphs can be used to clarify the verbal presentation of research results. Tables and graphs should be commented on or discussed.

Panel Data Model Selection

The Chow test is used to choose between two models, namely CEM and FEM, by considering the ρ -cross section F value. Meanwhile, the Hausman test is used to choose between FEM and REM by considering the random ρ -cross section value.

Table 1 Panel Model Selection

Test Type	Test Statistic Value	Probability	Decision	Selected Model
Breusch-Pagan Lagrange Multiplier (xttest0)	$\text{chibar}^2 = 8.41$	0.0019	Reject H_0 The OLS model is more appropriate, there is no individual RE effect	RE > OLS
Hausman Test	$\chi^2(4) = 25.11$	0,0000	Reject H_0 The RE model is consistent and efficient, individual effects are not correlated with the independent variables.	Fixed Effect
Fixed Effect F Test ($u_i = 0$)	$F(12,35) = 7.06$	0,0000	Reject H_0 There is no individual effect, the intercept of all	Fixed Effect

provinces is the same

(Source: Stata output, processed)

2.1 Results of Fixed Effect Panel Data Regression Analysis - Cluster Robust

After conducting a regression analysis and selecting a panel data model, the analysis results indicate the use of fixed effects. The following are the estimation results using fixed effects, presented in Table 2:

Table 2 Results of Fixed Effect Panel Data Regression Analysis with Cluster-robust

Variables	Coefficient	Standard Error (Robust)	t-Statistic	Probability
SMA Ratio	-0.0027	0.00 18	- 1.45	0, 172
Hospital Bed	-4,7599	3.6133	-1.3 0	0, 218
Electricity	0.8152 *	0.2544	3.20	0.0 08***
Safe Drinking Water	1,405 0	0.3 361	4.18	0.001 ***
Constant	-187,0590	30,1758	- 6.20	0,000 ***
R-squared (within)	0.3824			
F-statistic	10.51			0.00 07

Description: ***) significant at 1%, **) significant at 5% and *) Significant at 10%, NS) Not significant Significant

(Source: Stata output, processed)

Goodness of Fit Test R^2

Goodness of fit or coefficient of determination (R^2) is a measure of how good or bad the estimated regression model is. This test describes how much variation in the dependent variable can be explained by the independent variable. If the value of $R^2 = 0$, it means that the variation in the dependent variable cannot be explained at all by the independent variable. However, if the value of $R^2 = 1$, it means that the variation in the dependent variable can be completely explained by the independent variable.

Table 2 Results of the Goodness of Fit R^2 Test

Types of R-squared	Mark
R-squared Within	0.3824
R-squared Between	0.0734
R-squared Overall	0.0222

(Source: Stata output, processed)

F Test (Simultaneous Test)

The F-test is used to evaluate whether all independent variables input into the regression model simultaneously influence the dependent variable, namely economic growth in Eastern Indonesia. In this study, the independent variables analyzed include infrastructure in the areas of education, health, electricity, and clean water.

Table 3 Simultaneous F-Test Results for Fixed Effect Model (Cluster Robust)

Information	Mark
F-statistic	10.51
Degrees of Freedom	(4, 12)

Probability F	0.0007
Number of Observations	52
Number of Provinces	13

(Source: Stata output, processed)

2 T-Test (Partial Test)

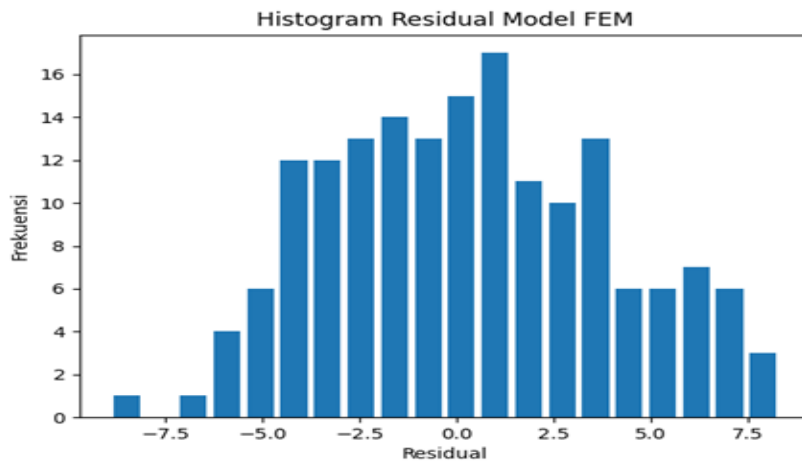
- 1) The effect of educational infrastructure (high school ratio) on economic growth from the results of the analysis that has been conducted shows that educational infrastructure has a coefficient of -0.0027 with a probability of 0.172. The probability value is greater than the 5 percent significance level, so the null hypothesis is accepted and this variable is declared to have no positive and significant effect on economic growth in Eastern Indonesia during the 2020-2023 period.
- 2) The effect of health infrastructure (hospital beds) on economic growth. The analysis found that health infrastructure has a coefficient of -4.7599 with a probability value of 0.218. This probability value is greater than 0.05, indicating that this variable does not significantly influence economic growth in Eastern Indonesia during the 2020-2023 period.
- 3) The influence of electricity infrastructure on economic growth, from the results of the analysis that has been conducted, electricity infrastructure has a coefficient of 0.8152 with a probability of 0.008. This probability value is smaller than 0.10 so that the null hypothesis is rejected at a significance level of 10 percent and the electricity variable is declared to have a positive and significant effect on economic growth in Eastern Indonesia during the period 2020-2023.
- 4) The influence of Clean Drinking Water Infrastructure has a coefficient of 1.4050 with a probability of 0.001. This probability value is less than 0.01, so the null hypothesis is rejected at the 1 percent significance level, and this variable is declared to have a positive and significant effect on economic growth in Eastern Indonesia during the 2020-2023 period.

Based on the partial test results, it can be concluded that the first and second hypotheses, stating that education and health infrastructure have a significant positive effect on economic growth in Eastern Indonesia during the 2020-2023 period, are rejected, as the probability value is greater than 0.05%. Meanwhile, the third and fourth hypotheses, stating that electricity and drinking water infrastructure have a significant positive effect on economic growth, are accepted, with a significance level of 10% and 5%, respectively.

a. Normality Test

The normality test aims to determine whether the residuals in a regression model are normally distributed. This test is essential to ensure that the statistical inference process, particularly in the T-test and F-test, is conducted under ideal conditions, ensuring reliable coefficient significance test results.

Value Description
Shapiro-Wilk Test Method
F statistic 0.86036
Prob > F 0,0000



b. Autocorrelation Test

The autocorrelation test aims to determine whether there is a correlation between errors at different time periods within a single cross-section. In this study, the autocorrelation test was conducted using the Wooldridge Test for Autocorrelation in Panel Data, which is commonly used in panel data analysis because it can effectively detect the first autocorrelation.

Table 4. Autocorrelation Test Results

Value Description
Wooldridge Test Method
F statistic 18.069
Prob > F 0.0011

(Source: Stata output, processed)

c. Heteroscedasticity Test

The heteroscedasticity test aims to determine whether the error variance is constant or differs between cross-sectional units. In this study, the heteroscedasticity test was conducted using the Modified Wald Test for Groupwise Heteroskedasticity, which is specifically used in the Fixed Effects model.

Table 5 Heteroscedasticity Test Results

Value Description
Modified Wald Test (xttest3) Test Method
Chi-square 1332.14
Prob > Chi-square 0.0000

(Source: Stata output, processed)

d. Multicollinearity Test Results

The multicollinearity test aims to determine whether there is a high correlation between the independent variables in a regression model. High levels of multicollinearity can cause the regression coefficients to become unstable and difficult to interpret. In this study, the multicollinearity test was conducted by examining the Variance Inflation Factor (VIF) value.

Table 6 Multicollinearity Test Results

Variables	VIF	Tolerance
SMA Ratio	1.06	0.944
Hospital Bed	1.08	0.928
Electricity	2.03	0, 492
Safe Drinking Water	2.04	0, 489
Mean VIF	1.55	

(Source: Stata output, processed)

After testing the estimation hypothesis in this research model, further analysis of the influence of infrastructure development on economic growth in Eastern Indonesia can be conducted. Based on the results of the Fixed Effect Model estimation with cluster-robust standard errors, simultaneously all infrastructure variables have a significant effect on economic growth, but partially only the electricity and clean drinking water variables are significant, while education and health are not yet significant in the 2020-2023 period. Below are the test results of each independent variable on economic growth in 2020-2023.

These results demonstrate that adequate drinking water infrastructure is a highly effective form of basic infrastructure in driving economic growth, particularly in developing regions. Its direct impact on health and productivity makes clean water a crucial element in local economic development. This research aligns with research (Dillon et al., 2012) which states that access to clean water and sanitation has a significant impact on increased productivity and economic growth in developing countries.

Previous research according to (Aziz et al., 2025) also revealed similar results that clean water distribution has a real contribution to regional economic growth, with access to clean water improving public health, reducing the time needed to find water, and helping efficiency in the economic sector.

CONCLUSION

Based on panel data regression estimation using the Fixed Effect Model with cluster-robust standard errors for 13 provinces in Eastern Indonesia during 2020–2023, the model demonstrates strong explanatory power ($R^2 = 0.72$) and a significant F-test, indicating that all independent variables jointly influence economic growth. The findings suggest that basic infrastructure development in Eastern Indonesia still faces challenges related to unequal distribution and suboptimal utilization. Clean water and electricity infrastructure show a more immediate contribution to economic growth, while education and health infrastructure tend to produce long-term effects that depend on service quality, labor productivity, and alignment with economic sector needs.

Accordingly, infrastructure policy in Eastern Indonesia should not only focus on expanding the quantity of education, health, electricity, and drinking water facilities, but also prioritize service quality improvement, equitable distribution of skilled personnel, governance reform, and stronger linkages with labor market demand and productive sector development. Efforts should include expanding reliable infrastructure networks, improving public spending effectiveness, strengthening local institutions such as regional water utilities (PDAM), and implementing integrated cross-sector and cross-regional planning based on economic clusters and priority growth areas. By balancing efficiency and equity considerations, infrastructure

investment can generate measurable medium- and long-term economic benefits while reducing interregional disparities.

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