

## Determinants of Labor Productivity in Indonesia: Education, Health, and Economic Infrastructure

Rasendriya Tsabitah Syabanna<sup>1</sup>, Herman Sambodo<sup>1\*</sup>, Goro Binardjo<sup>1</sup>,  
Barokatuminalloh<sup>1</sup>

Affiliation <sup>1</sup>Universitas Jenderal Soedirman

Email [herman.sambodo@unsoed.ac.id](mailto:herman.sambodo@unsoed.ac.id)\*

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### ABSTRACT

Labor productivity in Indonesia has experienced steady growth but disparities remain and the level is still relatively low compared to neighboring ASEAN countries. This study analyzes the influence of education, health, and economic infrastructure on labor productivity using panel data from 33 provinces over the period 2010 to 2023. The analysis applies the Fixed Effect Model. The findings reveal that simultaneously, all three variables significantly impact labor productivity. However, when assessed individually, only health and economic infrastructure show a significant positive relationship while education has no statistically significant effect. These outcomes highlight the urgency of enhancing health services and expanding access to ICT, particularly in less-developed regions. At the same time, it suggest the need to refine educational policies by improving curriculum relevance to labor market demands and expanding vocational training programs to more effectively support productivity growth.

Keywords: Labor Productivity, Education, Health, Economic Infrastructure

JEL Classification: D73, O47, F21, I15, F13

## INTRODUCTION

Productivity serves as a crucial indicator of a country's economic performance. It plays a vital role in driving substantial economic development and acts as a catalyst for sustaining long-term national growth. Consequently, numerous countries are actively striving to enhance their productivity levels (Firmansyah, 2015). According to the data by International Labor Organization Statistic, Indonesia's labor productivity has experienced fluctuating growth over the years. In 2023, Indonesia recorded a productivity level of 26,328 international dollars per worker although the growth rate was not as high as in previous periods. Despite this, labor productivity in Indonesia remains relatively low when compared to other ASEAN countries. Among ASEAN nations, Indonesia ranks fifth in terms of labor productivity and still behind more advanced ASEAN economies like Singapore, Brunei, Malaysia, and Thailand which demonstrate significantly higher productivity levels.

This national issue is further intensified by considerable differences in productivity among provinces. Labor productivity varies widely across provinces mainly due to differences in open unemployment rates. A key issue for Indonesia is the uneven spread of productivity throughout its regions (Yuniasih et al., 2013). In 2023, these differences remain evident with notable gaps in productivity from one province to another. DKI Jakarta recorded the highest productivity level at 404.21 million rupiah per worker while East Nusa Tenggara showed the lowest at just 25.98 million rupiah per worker. As highlighted by Fadilla & Triani (2022), this regional imbalance contributes to Indonesia's relatively low labor productivity when compared to other developing nations.

These disparities in productivity point to deeper structural issues within the economy. Low levels of labor productivity indicate not only limited labor competitiveness but also the risk of perpetuating a vicious cycle that obstructs long term economic development. According to Todaro & Smith (2020), insufficient income combined with minimal investment in key sectors such as education, health, and infrastructure can halt productivity improvements and trigger a poverty trap that worsens economic conditions. These perspectives suggest that low productivity is not an isolated issue but is deeply embedded within a broader network of structural challenges affecting the economy.

Labor productivity is measured by dividing total output such as GDP or GRDP by the number of workers (Puspasari & Handayani, 2020). Mankiw (2019) states that productivity is the amount of goods and services produced per unit of labor. It is influenced by physical capital (tools and buildings), human capital (skills and knowledge from education, training, and experience), natural resources, and knowledge of effective production methods.

Productivity is largely shaped by the quality of human capital. Becker's human capital theory states that human capital encompasses various dimensions such as education level, health, and productive habits which influence an individual's performance both

financially and physically. It is built through the accumulation of skills and knowledge obtained from education and health, meaning a person's human capital grows as their education and health improve (Ramadanisa & Triwahyuningtyas, 2022). These human capital factors align with Solow's neoclassical growth theory. Solow states that economic growth is driven by increases in capital, labor, and technological progress. Labor is considered a factor of production that can substitute physical capital (Hidayati et al., 2022). Furthermore, labor productivity is reflected in  $A(t)$ , which represents technological efficiency and the quality of work that evolves over time (Todaro & Smith, 2020).

Education is a crucial factor in enhancing the quality of the workforce. As stated by Faritz & Soejoto (2020), The average length of schooling reflects how long individuals are engaged in formal education. Essentially, a higher average means that people have spent more years pursuing education. According to data from Statistics Indonesia, by 2023 the average years of schooling reached 8.77 years which corresponds to the junior high school level. (Hasanah, 2024) explains that a higher level of education enhances critical thinking, creativity, and adaptability to change, which in turn positively influences productivity.

In addition to education, health also contributes to shaping labor productivity. When people are in good health, they are more motivated and capable of working efficiently (Astutik & Aisyah, 2023). Ginting (2020) explains that life expectancy refers to the estimated average age a person is expected to live which serving as an indicator of overall health. Based on data from Statistics Indonesia, life expectancy in Indonesia has shown a consistent upward trend reaching 72.13 years in 2023. Puspasari & Handayani (2020) confirms that better health conditions as reflected in higher life expectancy, contribute to improved labor productivity.

In addition to human capital, infrastructure especially technology is also a crucial determinant of productivity. Data from Statistics Indonesia shows that Mobile phone ownership used as a proxy for infrastructure reached 67.29% in 2023. According to Widayati (2010), mobile phones enable communication without geographical or time limitations thereby enhancing efficiency and productivity. Fadillah et al. (2020) also state that mobile phones as an economic infrastructure contribute to output growth and help reduce production costs.

However, empirical findings on these factors remain inconsistent. Zahari et al. (2022) found that education significantly improves productivity but Wulandari & Sultan (2024) argued that education systems focused heavily on theory might not meet the demands of the labor market. Similarly, while Puspasari & Handayani (2020) linked life expectancy to better productivity, Fadilla & Triani (2024) found an insignificant relationship suggesting that health by itself may not suffice without complementary experience or skills.

The infrastructure variable also reveals mixed results. While Sabillah et al. (2024) found mobile phone boosts productivity via improved coordination and entrepreneurship,

Edwina (2024) found no significant impact on industrial productivity which possibly due to the personal rather than industrial orientation of mobile use or data limitations regarding service quality and cost.

Given Indonesia’s relatively low labor productivity compared to other ASEAN countries, persistent regional disparities, and the inconclusive findings of previous research, a more comprehensive analysis is warranted. This study aims to examines how education, health, and economic infrastructure contribute to labor productivity in Indonesia.

## METHOD

This research adopts a quantitative approach utilizing secondary data obtained from Statistics Indonesia covering 33 provinces in Indonesia from 2010 to 2023. The study explores the impact of three main independent variables such as education, health, and economic infrastructure on labor productivity. The data used is obtained from Statistics Indonesia as explain below:

**Table 1.** Operational Variable

Variable	Indicator	Unit	Source
Labor Productivity	The calculation of GRDP per working population	Million Rp/Worker	Statistics Indonesia
Education	Average years of schooling	Year	Statistics Indonesia
Health	Life Expectancy	Year	Statistics Indonesia
Economic Infrastructure	Population who owns or uses mobile phones	Percent	Statistics Indonesia

Source: Statistics Indonesia

The analysis is carried out using panel data regression techniques, as the dataset combines cross-sectional information across 33 provinces and time-series observations from 2010 to 2023. This approach allows the study to control for unobserved province specific effects that may otherwise bias the estimation results. The following is the formulation of the regression equation for this study:

$$Ln\_LP_{it} = \beta_0 + \beta_1 Ln\_EDU_{it} + \beta_2 Ln\_HLT_{it} + \beta_3 EI_{it} + \varepsilon_{it} \dots \dots \dots (1)$$

Description:

- LP : Labor Productivity
- EDU : Education
- HLT : Health
- EI : Economic Infrastructure
- $\alpha$  : Constant
- Ln : Natural Logarithm
- $\beta_1, \beta_2, \beta_3$  : Regression Coefficient
- i : 33 Provinces in Indonesia
- t : Time (2010-2023)
- $\varepsilon$  : Error term

The hypotheses tested are as follows:

H<sub>1</sub>: Education has a positive effect on labor productivity.

H<sub>2</sub>: Health has a positive effect on labor productivity.

H<sub>3</sub>: Economic infrastructure has a positive effect on labor productivity.

## RESULT

The descriptive analysis indicates that labor productivity ranges from a minimum value of 3.06 to a maximum of 6.00, with an average level of 4.23 over the observation period. Education that represented by average years of schooling shows values between 1.72 and 2.44 with a mean of 2.10. The health variable that proxied by life expectancy varies from 4.14 to 4.32 and records an average value of 4.24. In addition, economic infrastructure that measured by mobile phone ownership exhibits considerable variation with values ranging from 18.96 to 82.47 and an average of 55.83.

**Table 2.** Descriptive Analysis

	Labor Productivity	Education	Health	Economic Infrastructure
Mean	4.231190	2.098463	4.239567	55.82950
Median	4.145000	2.100000	4.240000	58.25500
Maximum	6.000000	2.440000	4.320000	82.47000
Minimum	3.060000	1.720000	4.140000	18.96000
Std. Dev	0.556491	0.127417	0.038381	12.98519
Observations	462	462	462	462

Source: Data Processed, 2025

The selection of the most appropriate model in panel data regression involves conducting the Chow test, Hausman test, and Lagrange Multiplier test.

**Table 3.** The Result of Chow Test

Effect Test	Statistic	d.f.	Prob.
Cross-section F	463.538032	(32,426)	0.0000
Cross-section Chi-square	1653.266837	32	0.0000

Source: Data Processed, 2025

The Chow test in Table 3 shows a Cross-section F probability below 0.05 (0.0000) indicates that Fixed Effect Model is more appropriate than the Common Effect Model. Thus, the analysis proceeds with the Hausman test to compare Fixed and Random Effects.

**Table 4.** The Result of Hausman Test

Test Summary	Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Cross-section random	13.991523	3	0.0029

Source: Data Processed, 2025

Based on the Hausman test results in Table 4, the probability value (0.0029 < 0.05) indicates that the Fixed Effect Model is more appropriate for this study. Consequently,

the Lagrange Multiplier test is not required, and the analysis moves forward to the next stage.

**Table 5.** The Result of Panel Data Regression Use FEM

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-4.876569	3.489921	-1.397329	0.1630
Ln_EDU	-0.040006	0.205635	-0.194550	0.8458
Ln_HLT	2.060229	0.881674	2.336724	0.0199
EI	0.008190	0.000971	8.433816	0.0000

Source: Data Processed, 2025

The regression equation obtained through the panel data estimation using the fixed effect model can be formulated as follows:

$$Ln_{LP}_{it} = -4.876 - 0.040Ln_{EDU}_{it} + 2.060 Ln_{HLT}_{it} + 0.008EI_{it} + \epsilon_{it} \dots (2)$$

Based on the estimation results, the health variable has a coefficient of 2.060 meaning a 1% increase in health is estimated to raise labor productivity by 2.060%. Meanwhile, the economic infrastructure variable has a coefficient of 0.008 indicating that a 1% increase in economic infrastructure is estimated to increase labor productivity by 0.008%.

**Table 6.** Statistical Summary of the Regression Model

Variable	t-Statistic	t-table
C	-1.397329	1.965
Ln_Edu	-0.194550	1.965
Ln_Hlt	2.336724	1.965
EI	8.433816	1.965
R-squared		0,981570
Adjusted R-squared		0,980056
F-statistic		648.2481
Prob (F-statistic)		0.000

Source: Data Processed, 2025

As shown in Table 6, the Adjusted R-squared value is 0.980056 meaning 98.00% of the variation in labor productivity in Indonesia is explained by education, health, and economic infrastructure while the remaining 2% is influenced by other factors outside the model. The F-statistic value of 648.2481 exceeds the F-table value of 2.6244 at the 5% significance level and the Prob (F-statistic) is 0.000 (< 0.05). Thus, education, health, and economic infrastructure are concluded to have a significant simultaneous effect on labor productivity in Indonesia. The t-test evaluates the individual effect of each independent variable on the dependent variable. The education variable has a t-statistic of -0.194, which is less than the t-table value of 1.965, indicating no significant effect on labor productivity. In contrast, the health variable (t = 2.336) and economic infrastructure variable (t = 8.433) both exceed the t-table value, showing that they have a positive and significant effect on labor productivity at the 5% significance level.

As noted by Basuki & Prawoto (2016), regression analysis using the Ordinary Least Squares (OLS) approach generally requires only multicollinearity and heteroskedasticity tests. Following the model selection results, this study adopts the

Fixed Effect Model with the OLS method. Therefore, only these two diagnostic tests are applied.

**Table 7.** Summary of Classical Assumption Tests

Assumprion Test	Indicator	Result
Multicollinearity Test	Correlation Values < 0.80	No Multicollinearity
Heteroskedasticity Test	Residual Distribution within -500 to 500	No Heteroskedasticity

Source: Data Processed, 2025

As shown in table 7, the results indicate that the regression model fulfills the required assumptions. The multicollinearity test shows that all correlation values among the independent variables are below 0.80 indicating that the regression model is free from multicollinearity. In addition, all residual values fall within the acceptable range of –500 to 500. Referring to the criterion proposed by [Napitupulu et al. \(2021\)](#), this indicates that the model does not suffer from heteroskedasticity.

## DISCUSSION

The panel data regression results show that the education variable measured by average years of schooling does not significantly affect labor productivity in Indonesia. This suggests that improvements in educational attainment do not necessarily lead to productivity gains possibly due to an education system that prioritizes schooling duration over instructional quality and practical skills. For example, in 2023 DKI Jakarta had an average of 11.45 years of schooling while Papua lagged behind at 7.15 years which reflecting unequal access. Additionally, the 2022 PISA results [OECD \(2023\)](#) show low performance among Indonesian students with only 18% meeting minimum proficiency and few excelling in critical thinking. It also shows that the quality of education in Indonesia is still low with average scores of 366 in math, 359 in reading, and 383 in science where all below the OECD average. Contributing factors include misaligned curricula, inadequate infrastructure, and a disconnect between education and job market needs evident as many graduates work in fields unrelated to their studies. [Khoiruddin et al. \(2024\)](#) found 27% of workers are overeducated and 9% undereducated highlighting a mismatch between qualifications and job roles. According to [Putranto et al. \(2024\)](#) vocational education could better align skills with market demands. But it still remains underutilized. These issues limit education's contribution to productivity and contradict with human capital theory which views education as a key driver of labor efficiency. However, the findings are consistent with studies by [Putri & Kusreni \(2017\)](#), [Chairunnisa & Juliannisa \(2022\)](#), [Wulandari & Sultan \(2024\)](#), and [Jayananda & Marhaeni \(2023\)](#), which also found no significant effect of education on labor productivity.

In contrast, health variable measured by life expectancy has a positive and significant effect on labor productivity in Indonesia. This indicates that improved public health correlates with increased productivity as healthier workers tend to have greater energy, endurance, and concentration. The rising life expectancy trend across 33 provinces

from 2010 to 2023 reflects progress in health services and overall quality of life enhancing the population's capacity to contribute productively. These findings align with human capital theory, which states that health is a crucial component of human capital and enhances labor efficiency. Empirical support also comes from studies by [Dirgantara & Santoso \(2024\)](#), [Puspasari & Handayani \(2020\)](#), and [Wulandari & Sultan \(2024\)](#) which highlight the role of health in improving attendance, work consistency, and overall productivity.

Similarly, economic infrastructure measured by mobile phone ownership has a positive and significant effect on labor productivity in Indonesia. Increased access to communication technology enhances workers' efficiency through faster communication, easier access to information, and smoother work processes. From 2010 to 2023, mobile phone ownership rise significantly across 33 provinces reflecting improved telecommunications infrastructure that supports connectivity, online training, digital business, and remote work key drivers of productivity in the digital era. These findings align with [Solow \(1956\)](#) economic growth model which highlights technology as an external factor that boosts production efficiency and output per worker. Mobile phones as a form of technology enable better communication and task execution, thus enhancing labor efficiency. This is supported by [Fadillah et al \(2020\)](#) and [Sabillah et al \(2024\)](#) who also found that mobile phone usage contributes to increased labor productivity and entrepreneurial activity in Indonesia.

## CONCLUSION

This study finds that education as measured by the average years of schooling does not have a statistically significant impact on labor productivity in Indonesia. This finding suggests that longer formal schooling does not necessarily lead to higher productivity levels. Possible reasons include unequal education quality, misalignment between curricula and labor market demands. Therefore, upcoming education policies should prioritize not just extending the duration of schooling, but also enhancing curriculum relevance to labor market demands, expanding access to vocational training, and promoting equal quality of education across different regions.

In contrast, the health variable measured by life expectancy shows a significant and positive influence on labor productivity. This indicates that better public health conditions tend to enhance the productivity of the labor force. This result emphasizes the importance of enhancing healthcare infrastructure and services as a key aspect of national development, particularly in areas where life expectancy is relatively low.

Similarly, economic infrastructure, proxied by mobile phone ownership, is found to have a positive and significant effect. Broader access to communication technologies appears to improve work efficiency and overall productivity. Hence, it is essential for the policymakers to continue expanding access to information and communication technology (ICT), especially in areas where ownership remains limited.

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