

The Influence of Democracy, Technology, and Investment on the Human Development Index in Indonesia

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ARTICLE INFO

Keywords: Human Development Index, Democracy, ICT, Domestic Investment, Foreign Investment

Received : 16, September

Revised : 30, September

Accepted: 22, October

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ABSTRACT

Human development is an essential measure of societal quality, reflected in education, health, and economic well-being. This study investigates the influence of democracy, technology, and investment on Indonesia's Human Development Index (HDI) during 2019–2023, using panel data regression with 38 provinces. Chow and Hausman tests indicate that the fixed effects model is most appropriate. The results reveal that information and communication technology access, information and communication technology skills, and domestic investment significantly and positively impact HDI, while democracy and foreign investment show no significant effect. These findings highlight digital transformation and domestic investment as key drivers of human development. Therefore, policies should focus on strengthening digital literacy and fostering a supportive domestic investment climate to accelerate human development progress.

INTRODUCTION

The Human Development Index (HDI) is an important indicator for assessing the success of a country's development in improving the quality of life of its citizens. The HDI measures three main dimensions: a long and healthy life, access to education, and a decent standard of living (Yeni Yulianti & Siti Qomariah, 2025). This is in line with research that states that national development is a process of planned change to improve various aspects of people's lives in the desired direction, through policies, strategies, and plans (Fitriyani & Rasaili, 2019). The human development process is a process of planned change through policies, strategies, and plans that improve aspects of education, health, and the standard of living, as explained in the framework of the 2020-2024 National Medium-Term Development Plan (RPJMN) regarding human resource development and Information and Communication Technology (ICT) (Indonesia et al., 2024). In Indonesia, the HDI is one of the benchmarks for the success of national development, as well as a tool for evaluating central and regional government policies (Badan Pusat Statistik, 2022). In line with the view that development is a process of planned change through policies, strategies, and plans to improve various aspects of people's lives, the HDI is not only an outcome indicator, but also a compass for cross-sectoral public policy (Fitriyani & Rasaili, 2019).

From 2019 to 2023, Indonesia's Human Development Index (HDI) continued to show an upward trend, from 71.92 in 2019 to 72.91 in 2022, and reaching 74.39 in 2023, reflecting socio-economic recovery following the COVID-19 pandemic (Badan Pusat Statistik, 2024). This increase was supported by government policies focused on human development, including improving access to education and health in various provinces (Saputra et al., 2024). Research reports also show that the knowledge and standard of living dimensions were the largest contributors to the increase in the HDI, while health dimensions such as life expectancy experienced significant improvements since the pandemic subsided (Sari & Sciences, 2024). Development economic studies confirm that equal access to public services such as education and health has become a primary focus of local governments in improving the quality of human resources and narrowing disparities between regions (Naila et al., 2024). With an average increase of around 0.75% per year during 2020 - 2023, analysis of structural factors such as the quality of democracy, access to technology, and investment is crucial to understanding the main drivers of HDI improvement in Indonesia (Jawak et al., 2024).

The quality of democracy through civil liberties, political participation, and government institutions plays a crucial role in promoting human development by strengthening the accountability and responsiveness of public policies (Sabardin & Muhammad Ghafur Wibowo, 2024). Research shows that democracy can increase fiscal capacity and equitable access to social services, thereby strengthening the welfare dimension of the Human Development Index (HDI) (Witianti, 2016). Empirical studies also confirm that a democratic system supports the reduction of social inequality and a more equitable distribution of income, contributing to the stability of human development (Anggelo, 2021). This

strengthens the argument that democracy is a crucial variable in predicting HDI improvement in Indonesia (Novanto & Prabowo, 2024).

The role of information and communication technology (ICT) in human development is increasingly recognized, particularly in expanding access to basic services and improving the efficiency of education and health (Saputra et al., 2022). Research shows that digital technology has a positive and significant impact on improving the Human Development Index (HDI), particularly in underdeveloped regions such as eastern Indonesia (Saputra et al., 2021). Other studies also point to a digital divide in rural Indonesia that widens inequalities in education and HDI between regions (Akbar & Wijaya, 2024). Furthermore, information technology is also the backbone of social innovations such as community empowerment through digital portals that support the strengthening of collective capabilities (Istiqomah et al., 2025).

Both foreign and domestic investment are crucial resources for human development, as they not only create jobs but also strengthen educational, health, and socio-economic infrastructure (Sabardin & Wibowo, 2024). Research shows that FDI drives job creation, while DI strengthens the local economy and public services (Jawak et al., 2024). Another study confirmed that direct investment had a significant impact on improving Indonesia's Human Development Index (HDI) during 2018-2022 (Sari et al., 2025). Studies in Indonesia and its surrounding region indicate that a conducive investment climate facilitates broader social interventions and helps reach vulnerable populations, further strengthening the standard of living dimension of the HDI (Alvinda et al., 2025).

This study aims to examine the influence of democracy, technology, and investment on the Human Development Index (HDI) from 2019 to 2023. The 2019-2023 period is highly contextualized because it encompasses the pre, during, and post pandemic phases a period during which democracy was tested, digital transformation accelerated, and investment revived. A cross-time analysis during this period allows for the identification of critical moments for strategic policy implementation that can significantly impact the HDI, while also providing insights into assessing the resilience and adaptability of Indonesia's human development system.

LITERATURE REVIEW

Democracy is seen as a crucial factor in improving human development because it creates space for participation, transparency, and accountability, encouraging governments to be more responsive to public needs (Napitupulu, 2024). Research by Hakim et al. (2025), shows that democracy is positively related to social welfare and human development indicators through inclusive institutions. Liotti et al. (2018), also found that democratic countries consistently have higher HDI scores than authoritarian regimes, especially in developing countries. Furthermore, Liotti et al. (2018) demonstrated that lagged democracies still have a positive impact on HDI, albeit a small one, underscoring the importance of political institutions in long-term development.

Human capital theory states that Skills, including ICT Skills, are part of human capital that increases productivity, access to education and health that

have a positive effect on the HDI, this is reinforced in the study of Ježić et al. (2022) who found that the use of ICT and higher education significantly increased the HDI, with different effects depending on the country's income level. Research in Indonesia by Sari et al. (2025) also found that ICT Skills and ICT Access simultaneously had a significant positive impact on human development in 34 provinces in the period 2016-2022, supporting the theory that access to infrastructure & the ability to use technology drives human development. The capability approach theory by Amartya Sen is also relevant because it sees access and freedom to use technology as part of the freedom needed to obtain basic services and expand human life choices (Bahr et al., 2025). In addition, the study "Impact of Poverty, Economic Growth, and Information and Communication Technology on Human Development" in Indonesia (2014-2020) shows that ICT positively and significantly influences the quality of human development, emphasizing that the benefits of technology are not only theoretical but also empirically proven (Komariyah et al., 2023).

Capital theory in development economics (including the Harrod - Domar model) assumes that both foreign (FDI) and domestic investment (DI) spur growth by increasing capital accumulation, which in turn can improve living standards and quality (Kurniasari et al., 2024). Empirically, the study "Analysis of the Effect of Investment, Agglomeration, and Human Development Index on Regional Inequality in Eastern Indonesia" shows that although DI has an influence on disparities, the HDI is negatively correlated with inequality, indicating that increasing human development through investment has the potential to narrow gaps between regions (Aditya et al., 2025). The study "The Effect of Population, HDI, Poverty, and DI Investment on Economic Growth in Bali" also found that DI investment positively contributes to economic growth, indirectly supporting an increase in HDI through income and social access channels (Anggun & Fadlli, 2024). Furthermore, the study "Analysis of the Influence of Domestic Capital Investment and Foreign Investment" found that PMDN strengthens the local economic base while PMA brings new capital and technology that can increase productivity and welfare (Anwar & Salmah, 2024).

METHODOLOGY

The method used in this study is static panel regression, with data consisting of time series and cross-sectional data from 38 provinces in Indonesia during the period 2019-2023. The data are sourced from the Central Statistics Agency (BPS). The dependent variable is the Human Development Index (HDI), while the independent variables are the Indonesian Democracy Index (IDI), Access to Information and Communication Technology (ICT), Information and Communication Technology (ICT) Skills, Foreign Direct Investment (FDI), and Domestic Direct Investment (DI). Table 1 details the specific variables used in this analysis.

Table 1. Table Description

Variable	Information	Symbol	Source
Human Development Index (HDI)	Human Development Index by Province	<i>HDI</i>	Central Bureau of Statistics
Democracy	Indonesia Democracy Index (IDI) by Province	<i>IDI</i>	Central Bureau of Statistics
ICT Access	The proportion of individuals who own mobile phones by province (percentage).	<i>ICTAccess</i>	Central Bureau of Statistics
ICT Skills	The proportion of adolescents and adults aged 15-59 years with ICT Skills by province (percentage)	<i>ICTSkills</i>	Central Bureau of Statistics
Foreign Direct Investment (FDI)	Realization of Foreign Direct Investment by Province (Million US\$)	<i>FDI</i>	Central Bureau of Statistics
Domestic Investment (DI)	Realization of domestic investment by province (in billions of rupiah).	<i>DI</i>	Central Bureau of Statistics

Three approaches are used to test panel data: common effects models, fixed effects models, and random effects models. According to Gujarati & Porter (2009), panel data offer several advantages: 1. They provide more information and increase degrees of freedom; 2. They identify and measure effects that cannot be captured by cross-section or time series data; 3. They enable the construction and testing of more complex models; 4. They minimize bias in regression results; and 5. They reduce multicollinearity between variables while controlling for heterogeneity between data units.

Each panel data regression approach has distinct characteristics. Common effects models assume that the intercept and slope are constant. Fixed effects models introduce dummy variables, which can reduce degrees of freedom but produce consistent equations. In contrast, random effects models assume that parameters vary over time and space, and this variation is captured in the error term. Further testing is necessary to determine the most appropriate model. The Chow test selects between common and fixed effects models, while the Hausman test selects between fixed and random effects models. Finally, the Lagrange Multiplier (LM) test is used to decide between common and random effects models. The model in this study is built based on previous research, such as Sari et al. (2025). The variables analyzed in this study are detailed in Table 1, and the research model is represented below (1), (2), and (3).

$$HDI_{it} = \alpha_0 + \beta_1 IDI_{it} + \beta_2 ICTAccess_{it} + \beta_3 ICTSkill_{it} + \beta_4 FDI_{it} + \beta_5 DI_{it} + \epsilon_{it} \dots \dots \dots (1)$$

$$HDI_{it} = \alpha_1 + \beta_1 IDI_{it} + \beta_2 ICTAccess_{it} + \beta_3 ICTSkill_{it} + \beta_4 FDI_{it} + \beta_5 DI_{it} + u_{it} \dots \dots \dots (2)$$

$$HDI_{it} = \alpha_0 + \beta_1 IDI_{it} + \beta_2 ICTAccess_{it} + \beta_3 ICTSkill_{it} + \beta_4 FDI_{it} + \beta_5 DI_{it} + W_{it} \dots \dots \dots (3)$$

Model (1) represents the Common Effects Model (CEM), while model (2) denotes the Fixed Effects Model (FEM), and model (3) describes the Random Effects Model (REM). The panel regression model above explains the relationship between the Human Development Index (HDI) and several explanatory variables. The dependent variable, HDI represents the Human Development Index. The independent variables consist of: IDI the Indonesian Democracy Index; ICT Access which indicates Access to Information and Communication Technology; ICT Skills which indicates Information and Communication Technology Skills; FDI which represents Foreign Direct Investment; and DI which indicates Domestic Direct Investment. The coefficients β_1 , β_2 , β_3 , β_4 , and β_5 indicate the magnitude of each independent variable's influence on the HDI. The constant α_0 is the intercept in the Common Effects and Random Effects models, while α_1 is the intercept specific to each region in the Fixed Effects model. Meanwhile, ε , u , and W are error terms that capture the influence of other factors outside the model. i indicates the cross-sectional unit (38 Province) while t indicates the time dimension (2019-2023). Model (1) represents the Combined OLS or Common Effects Model (CEM), while equation (2) represents the Fixed Effects Model (FEM), and equation (3) represents the Random Effects Model (REM).

RESEARCH RESULT

This study involved 38 provinces observed over five years, resulting in 69 data entries. The research methodology consisted of descriptive statistical tests, multiple linear regression analysis, multiple tests, and classical assumption tests. The results of the descriptive statistical analysis are:

Table 2. Descriptive Statistics of Variables

Variabel	Obs.	Mean	Stad.dev	Min.	Max.
HDI	178	71.26	4.48	51.7	82.46
IDI	170	76.22	5.44	57.62	89.21
ICT Access	171	76.87	149.93	35.33	2023
ICT Skill	170	66.07	13.82	26.45	93.98
FDI	170	1094.04	1658.42	5.9	8283.7
DI	174	14222.93	19011.86	121.8	95202.1

Source: Result of data processing using Stata ver. 17

Descriptive statistics provide an overview of the estimated data. Descriptive statistics provide an overview of the estimated data. The average IDI is 76.22, while the average ICT Access is 76.87% and ICT Skills is 66.07%, indicating that the level of public ICT access is slightly higher than the Skills in using it. The average FDI was recorded at 1,094.03 million US dollars, while DI was much higher with an average of 14,222.93 billion rupiah. Meanwhile, the

average HDI is 71.26, reflecting relatively good human development achievements.

Table 3. Model Selection

Model Selection	Effect Test	Prob	Conclusion
Uji Chow	Prob > F	0.0000	Fixed Effects Model (FEM) is more appropriate than Common Effects Model (CEM)
Uji Hausman	Prob>Chi2	0.0000	Fixed Effects Model (FEM) is preferred over Random Effects Model (REM)
Uji Lagrange Multiplier (LM)	Prob > chibar2	0.0000	Random Effects Model (REM) is preferred over Common Effects Model (CEM)

Source: Result of data processing using Stata ver. 17

Based on the results of the model selection test in Table 3, it can be seen that the probability value in the Chow Test of 0.0000 indicates that the Fixed Effect Model (FEM) is more appropriate to use compared to the Common Effect Model (CEM). Furthermore, the results of the Hausman Test with a probability value of 0.0000 indicate that the FEM model is more appropriate than the Random Effect Model (REM) because there is a significant correlation between the individual effect and the independent variable. In addition, the results of the Lagrange Multiplier (LM) Test which also shows a probability value of 0.0000 confirm that the panel model is more appropriate to use compared to the pooled model. Thus, based on these three tests, the most appropriate model for this study is the Fixed Effect Model (FEM).

Table 4. Normality Test

Normality	Obs.	Prob>chi2
Resid	169	0.2557

Source: Result of data processing using Stata ver. 17

Based on the results of the normality test in Table 4, the probability value (Prob > chi2) is 0.2557. This value is greater than the 0.05 significance level, indicating that the residuals in the regression model are normally distributed. Thus, the normality assumption is met, and the model can be used for further analysis. This result indicates that the data do not exhibit any significant deviations from a normal distribution that could affect the validity of the statistical test.

Table 5. Multicollinearity Test

Variable	VIF	Tolerance (1/VIF)
DI	2.18	0.4594
FDI	1.86	0.5382

ICT Skill	1.60	0.6232
IDI	1.47	0.6824
ICT Access	1.01	0.9963
Mean VIF	1.62	

Source: Result of data processing using Stata ver. 17

Based on Table 5 above, it shows that all independent variables have a VIF value <10 and a Tolerance value >0.10 . Thus, this research model is free from multicollinearity problems.

Table 6. Heteroscedasticity Test

Chi2(35)	64591.48
Prob>chi2	0.0000

Source: Result of data processing using Stata ver. 17

Based on Table 6, the results of the heteroscedasticity test show that the Chi2(35) value is 64591.48 with a probability of 0.0000. A probability value less than 0.05 indicates the presence of heteroscedasticity in the regression model. Thus, the homoscedasticity assumption is not met, resulting in a non-constant error variance. Then it is necessary to adjust the model using an estimation method that is able to overcome these problems, such as applying robust standard errors so that the estimation results remain valid and reliable.

Table 7. Autocorrelation Test

F(1, 33)	14.245
Prob>F	0.0006

Source: Result of data processing using Stata ver. 17

Based on the results of the autocorrelation test in Table 7, the F (1, 33) value is 14.245 with a probability of 0.0006. Since the probability value is less than 0.05, it can be concluded that the regression model experiences an autocorrelation problem. This indicates a correlation between residuals in different periods, which can affect the validity of the estimate. Because the classical assumption test above found heteroscedasticity and autocorrelation, to address the problems of heteroscedasticity and autocorrelation, re-estimation was performed using the Fixed Effect method with robust standard error (Polselli, 2023). The robust test results are presented in Table 8.

Table 8. Hasil Robust Fixed Effects Model

Variabel	Coefficient	Std. Error	t-statistik	P> z
IDI	0.01	0.009	1.10	0.280
ICT Access	0.000	0.000	6.07	0.000
ICT Skill	0.056	0.003	19.63	0.000
FDI	0.000	0.000	0.85	0.402
DI	0.000	3.491	5.86	0.000
Constant	66.905	0.657	101.9	0.000
R-square (within)	0.331	F-statistic	510.19	
		Prob>	0.000	

Source: Result of data processing using Stata ver. 17

Thus, although the initial model experienced heteroscedasticity (Prob = 0.0000) and autocorrelation (Prob = 0.0006), the robust FEM model remained valid for use. The robust results indicate that the Prob. value is 0.000, concluding that the IDI, ICT Access, ICT Skills, FDI, and DI simultaneously influence the Human Development Index in Indonesia from 2019 to 2023. The results show the following regression equation: The variables ICT Access, ICT Skills, and DI have a positive and significant effect on HDI. A 1% increase in ICT access can increase the HDI, albeit with a relatively small coefficient value. ICT Skills have the greatest impact, with a 1% increase in ICT Skills increasing the HDI by 0.056. These results confirm that people's ability to utilize digital technology is a key factor in driving improvements in quality of life. Meanwhile, DI also has a significant positive effect, indicating that increased domestic investment drives human development growth through job creation and economic activity in the region.

On the other hand, the IDI and FDI variables do not have a significant effect on HDI because their probability values are greater than 0.05. This indicates that although democracy plays a role in governance, its influence does not directly improve the quality of human development at the provincial level. The Foreign Direct Investment variable is not significant so its contribution to human development is not proven strong in the period and sample of this study. Overall, the R-square (within) value of 0.331 indicates that the variation in human development can be explained by 33% by the independent variables used in the model. In addition, the F-statistic value of 510.19 with a p-value = 0.000 indicates that the estimated model as a whole is significant at the 1% level.

DISCUSSION

The estimation results show that the Indonesian Democracy Index does not significantly influence the Human Development Index in the 2019-2023 period. This indicates that the quality of democracy in Indonesia is not yet fully capable of driving human development. This finding is in line with research by Halleröd & Ekbrand (2023). They also emphasized that democracy is not always consistent in improving social welfare indicators in developing countries, because democratic policies are often hampered by short-term political interests. Thus, the insignificance of the Indonesian democracy index in this study indicates that other factors, such as education, health, and resource distribution policies, are more dominant in determining the increase in the Human Development Index.

Meanwhile, the ICT Access and ICT Skills variables showed a significant positive effect on the Human Development Index. These results indicate that digital transformation and increased technological literacy can improve people's quality of life. This finding aligns with research showing that technological capabilities and ICT skills have a significant positive effect on the HDI in Indonesia (Setyowati et al., 2024). Furthermore, ICT and domestic investment significantly contribute to human development at the provincial level ((Suliswanto & Rofik, 2024).

Based on estimates, foreign direct investment has no significant impact on the Human Development Index in Indonesia. Similar findings were also presented by Maharani & Setyowati (2024), who emphasized that the impact of FDI on social development tends to vary and is insignificant when investment is concentrated primarily in extractive or capital-intensive sectors, thus limiting its contribution to improving the quality of life. Therefore, the success of FDI in boosting the HDI depends heavily on policy direction, investment distribution, and the readiness of the local workforce to absorb its benefits.

On the other hand, Domestic Investment also shows a positive impact on the Human Development Index. Consistent with research by Septiningrum et al. (2022), which shows that domestic investment significantly influences economic growth, economic growth itself is positively correlated with the HDI. This confirms that local investment plays a crucial role in supporting the education, health, and public service sectors, which directly improve public welfare. Therefore, strengthening the domestic investment climate through incentives, conducive regulations, and policy stability is a crucial strategy for promoting human development.

Based on these findings, the emerging policy recommendations include prioritizing improvements in the quality of education as the primary foundation of human development, and strengthening digital skills training programs so that technology (ICT Access) becomes a real supporter of the Human Development Index. Furthermore, encouraging productive foreign investment with regulations that ensure technology transfer and inclusiveness, and strengthening domestic investment in social sectors, ensure equitable distribution of human development benefits across regions, are crucial. The government also needs to address equity across provinces to prevent widening disparities in the HDI. Fiscal policies and investment incentives must be aligned to ensure that both foreign and domestic investment truly impacts human development (HDI).

CONCLUSIONS AND RECOMMENDATIONS

This study concludes that ICT Access, ICT Skills, and Domestic Investment have a positive and significant effect on the Human Development Index in Indonesia for the 2019–2023 period. In contrast, the Indonesian Democracy Index and Foreign Investment do not show a significant effect on the HDI. These results confirm that digital technology and domestic investment are the main drivers of improving people's quality of life, while the role of democracy and foreign investment is still not optimal in driving human development. Overall, this research variable is able to explain 33% of the variation in the HDI, so there are other factors outside the model that also influence human development.

Based on the research findings, it is recommended that the government strengthen digital literacy and skills training programs to optimize technology's contribution to human development. Furthermore, policies are needed to foster a domestic investment climate through fiscal incentives, regulatory streamlining, and a focus on the education, health, and public service sectors. For FDI, policies

should be directed toward productive and inclusive investment, emphasizing technology transfer and job creation.

ADVANCED RESEARCH

Future research is recommended to include other variables such as government spending, income distribution, or urbanization levels to provide a more comprehensive analysis and a more comprehensive picture of human development dynamics. Furthermore, further research could consider institutional factors or the quality of governance, which also have the potential to influence development outcomes. The scope of the research should also be expanded to include different economic sectors or regions to obtain a more representative picture of national conditions. Expanding the research timeframe will help test the consistency of the results and examine changes in the relationships between variables over the long term.

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