

ICT expansion and human development: Empirical evidence from Indonesia

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Abstract

Human development is a central focus and objective for countries worldwide. Comprehensive human development is reflected in rising living standards and easier access to essential services like education and health. Accelerating human development requires adopting technology, particularly ICT (Information and Communication Technologies), which is increasingly utilized by societies. The main objective of this study is to estimate the impact of ICT Skills, ICT Access, domestic investment, and the democracy index on the Human Development Index (HDI) using provincial-level data in Indonesia. The study employed panel data from 34 provinces from 2016-2022. Based on the Chow and Hausman test results, the fixed effect model was the best fit compared to the common and random effect models. The findings demonstrate that ICT Skills and ICT Access significantly positively affected human development throughout the research period, with their coefficients being almost equal. This highlights the rapid advancement of ICT and its vital role in the lives of the Indonesian population. The results further revealed that democracy was insignificant, while domestic investment positively and significantly impacted human development. Based on these findings, ICT development policies are essential, particularly in investment, infrastructure improvement, and the effective implementation of ICT initiatives. The use of ICT should be tailored to each province's unique characteristics and potential to promote equality and reduce disparities. A key recommendation from this study is the adoption of ICT in societal activities to enhance equality across all regions of Indonesia.

Keywords: *Democracy, Human development, ICT access, ICT skills*

JEL Classification: B55, I31, O15, O33

INTRODUCTION

Discussions on a country's development extend beyond economic growth to encompass a broader goal: achieving social welfare (de La Hoz-Rosales et al., 2019). This aligns with the development concept introduced by the United Nations Development Program (UNDP), which emphasizes human development based on three main criteria: a long and healthy life, economic prosperity, and access to education (Saragih, 2022). Sustainable human development is the primary target for all countries globally (Nchofoung & Asongu, 2022).

Sustainable development has become central to the global discourse (Nchofoung & Asongu, 2022). Human development occurs dynamically across various nations, transcending spatial boundaries and facilitating socio-economic progress (Hidayat et al., 2023). It encompasses three basic aspects: health, education, and economic growth (Farooqi et al., 2020; Filippidis & Katrakilidis, 2015; Saragih, 2022). The transformation of global and regional development is characterized by shifts in social, cultural, political, environmental, infrastructural, and economic dimensions, driven by advancements in ICT (Information and Communication Technologies). ICT is crucial in enhancing human mobility and development at both national and regional levels (Fahmi & Mendrofa, 2023). It is a pillar of sustainable human development that raises living standards through economic growth, improves access to health services, and enhances education (Hussain et al., 2023). ICT contributes to economic growth by facilitating the widespread use of mobile phones and the internet, which offer broad, flexible, and easy access to information and mobility (Kim et al., 2021). Moreover, ICT fosters innovation and technology to reduce regional development disparities (Li et al., 2023). In greater detail, Bapna et al. (2010) highlight the benefits of ICT in enhancing capital efficiency, promoting industrial innovation, streamlining distribution, mitigating market asymmetries, and accurately disseminating information.

According to Untari et al. (2019), rapid technological development, particularly in ICT, significantly drives progress. Many experts agree on the crucial role of ICT in enhancing government governance towards sustainable development (Sabani et al., 2019). People worldwide utilize ICT daily (Untari et al., 2019; Vargas-Montoya et al., 2023). Yushkova (2014) emphasizes the high demand for ICT goods and services from households, companies, and governments. Various studies underscore the importance of ICT in strengthening government-citizen relations (Silal & Saha, 2021), balancing social and political dynamics (Shirazi et al., 2010), fostering economic activity and productivity (de La Hoz-Rosales et al., 2019; Hussain et al., 2023; Kim et al., 2021; Rath & Hermawan, 2019; Zafar et al., 2022), promoting industrialization (Acheampong et al., 2022), and improving quality of life (de La Hoz-Rosales et al., 2019). ICT advances significantly impact various aspects of people's lives, including social, political, environmental, financial, and health sectors. Consequently, ICT is expected to enhance living standards, reduce poverty, provide more equitable access to educational, social, and health services, and strengthen international relations (Thapa & Saebø, 2014). Comprehensive development requires leveraging potential resources, with ICT mastery being one such resource. The balanced use of ICT can help society facilitate its activities and enhance its development capabilities (de La Hoz-Rosales et al., 2019).

Indonesia has considerable potential in ICT utilization. ICT promotes ease of activity and efficiency, ultimately improving the quality of life (de La Hoz-Rosales et al., 2019). According to the Central Bureau of Statistics (2023), ICT skills and access distribution are increasing relatively evenly across all provinces in Indonesia. DKI Jakarta has shown the fastest growth, while Bali, a major tourism hub, is also experiencing rapid ICT development. Notably, West Papua has seen significant growth in ICT distribution. Overall, ICT development in Indonesia is widespread, with the government making efforts to accelerate equal access and skill enhancement across all provinces. This significant development occurred between 2016 and 2022. Figure 1 illustrates the trend of ICT development in Indonesia.

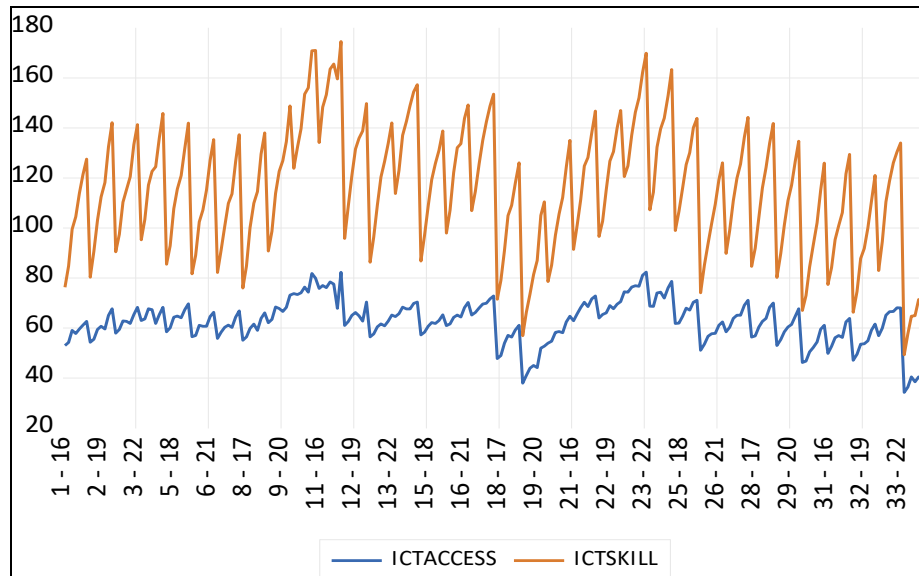


Figure 1. ICT development in Indonesia
Source: Central Bureau of Statistics, 2023

Rath et al. (2023) identified human resources with technological expertise, investment, and per capita income distribution as driving ICT growth in emerging markets. Acheampong et al. (2022) highlighted the substantial influence of internet access, mobile phone penetration, and broadband on human development in developing countries. Similarly, research by Dzator et al. (2023) revealed the impact of mobile phone penetration and ICT goods imports on poverty reduction in Sub-Saharan Africa. Asongu and Le Roux (2017) further emphasized ICT's positive influence on regional human development. Other studies, such as Farooqi et al. (2020), corroborated the beneficial effects of ICT on human development. In Indonesia, Rath and Hermawan (2019) and Mukhtar et al. (2020) provided evidence of ICT's positive impact on the country's economic performance. Numerous studies have demonstrated the positive effects of ICT on the Human Development Index (Asongu & Le Roux, 2017; Niebel, 2018; Rath & Hermawan, 2019; Untari et al., 2019; Mukhtar et al., 2020; Acheampong et al., 2022; Nchofoung & Asongu, 2022), though Kim et al. (2021) argued that ICT could have both positive and negative effects.

This study seeks to answer the following research question: What are the effects of ICT skills, ICT access, domestic investment, and democracy on the Human Development Index across 34 provinces in Indonesia? Previous studies have largely focused on ICT's national or cross-country impact, often grouping countries into developed and developing categories. Many studies have also employed specific ICT-related variables. This study aims to estimate the effects of ICT skills, ICT access, democracy levels, and domestic investment on human development in 34 Indonesian provinces between 2016 and 2022. In this study, ICT variables are proxied by ICT skills and ICT access, as the quality and mastery of ICT are essential in improving human life.

Given that ICT studies are multidisciplinary, this study contributes to the literature by focusing on the impact of ICT on the standard of living at the provincial level in Indonesia. A control variable—namely, the democracy index, which reflects institutional efforts to achieve prosperity—is considered. This study explores the role of ICT in informing policymakers about formulating ICT policies and interventions at the provincial level in Indonesia.

METHODS

The estimation method used in this study was static panel regression, with data comprising both time series and cross-sectional elements from 34 provinces in Indonesia over the 2016-2022 period. The data was sourced from the Central Bureau of Statistics (BPS). The dependent variable was human development, represented by the Human Development Index (HDI), while the independent variables were ICT Skill, ICT Access, democracy level, and domestic investment realization. The primary objective of this research was to analyze the impact of ICT Skills, ICT Access, the democracy index, and domestic investment on human development in Indonesia.

Three approaches were applied to panel data testing: the common effect model, the fixed effect model, and the random effect model. According to Gujarati (2003), panel data offers several advantages: 1) it provides more information and increases degrees of freedom; 2) it identifies and measures effects that cannot be captured by cross-sectional or time series data alone; 3) it enables the construction and testing of more complex models; 4) it minimizes bias in regression results; and 5) it reduces collinearity between variables while controlling for heterogeneity across data units.

Each panel data regression approach has distinct characteristics. The common effect model assumes that both the intercept and slope are constant. The fixed effect model introduces dummy variables, which can reduce the degrees of freedom but yield a consistent equation. The random effect model, by contrast, assumes that parameters vary across time and space, and these variations are captured in the error term. Further testing is required to determine the most suitable model. The Chow test chooses between the common and fixed effect models, while the Hausman test selects between the fixed and random effect models. Finally, the Lagrange Multiplier (LM) test is employed to decide between the common and random effect models. The model in this study builds on previous research, such as de La Hoz-Rosales et al. (2019) and Farooqi et al. (2020). The variables analyzed in this study are detailed in Table 1, and the study's models are represented in equations (1), (2), and (3).

This research employed static panel data estimation with a balanced panel based on neoclassical production theory. The data was analyzed using three main models: the pooled OLS (Ordinary Least Squares) model, the fixed effect model, and the random effect model. The best model selection was conducted using the Chow, Hausman, and Lagrange Multiplier tests. The estimated model is expressed as follows:

$$HD_{it} = \alpha_0 + \beta_1 ICT Skill_{it} + \beta_2 ICT Access_{it} + \beta_3 Democracy_{it} + \beta_4 DI_{it} + \varepsilon_{it} \dots\dots\dots (1)$$

$$HD_{it} = \alpha_0 + \alpha_1 D_{ni} + \beta_1 ICT Skill_{it} + \beta_2 ICT Access_{it} + \beta_3 Democracy_{it} + \beta_4 DI_{it} + \varepsilon_{it} \dots\dots (2)$$

$$HD_{it} = \alpha_0 + \beta_1 ICT Skill_{it} + \beta_2 ICT Access_{it} + \beta_3 Democracy_{it} + \beta_4 DI_{it} + w_{it} \dots\dots\dots (3)$$

Equation (1) represents the Pooled OLS or Common Effects Model (CEM), while Equation (2) denotes the Fixed Effects Model (FEM), and Equation (3) describes the Random Effects Model (REM). In these equations, α_0 , and $\beta_1, \beta_2, \beta_3$ are the slope coefficients for each independent variable. The subscript 'i' represents the cross-sectional units (34 provinces), and 't' denotes the time series (2016-2022).

Table 1. Operational definition of variables

Variable	Definition of operational variable	Data source
Human Development Index (HD)	Human Development Index by province.	Central Bureau of Statistics.
ICT Skill	The proportion of adolescents and adults aged 15-59 years with ICT skills by province (percentage).	Central Bureau of Statistics.
ICT Access	The proportion of individuals who own mobile phones by province (percentage).	Central Bureau of Statistics.
Democracy	Indonesian Democracy Index (IDI) by province.	Central Bureau of Statistics.
Realization of Domestic Investment (DI)	Realization of domestic investment by province (in billions of rupiah). The data was transformed into natural logs.	Central Bureau of Statistics.

RESULTS AND DISCUSSION

Descriptive statistics provided an overview of the estimated data. The average ICT Skill level was 52.7%, while the average ICT Access was 62.5%, suggesting that the ability to use ICT was relatively comparable to the ownership of ICT devices. The correlation between ICT Skills and the Human Development Index (HDI) was 0.7, indicating a fairly strong relationship. Meanwhile, the correlation between ICT Access and HDI was 0.8, indicating a higher correlation between these two variables. These figures suggest that ICT Access was more readily available to the Indonesian population, while ICT Skills still required improvement to match the rapid progress of ICT adoption.

The correlation between democracy and HDI was 0.5, indicating a moderate association. Similarly, the correlation between the realization of domestic investment and HDI was also 0.5, suggesting a moderate correlation between these variables. These correlations highlight the various degrees of influence each factor has on human development in Indonesia. Descriptive statistics of the variables are presented in Table 2, and the correlation matrix is presented in Table 3.

Table 2. Descriptive statistics of variables

Variabel	Obs.	Mean	Stad.dev	Min.	Max.
HD	238	70.696	4.051	58.05	81.65
ICT Skill	238	52.738	17.882	15	92.36
ICT Access	238	62.457	8.788	34.24	82.37
Democracy	238	74.753	5.903	54.41	89.21
DI	238	8.393	1.583	2.174	11.398

Table 3. Correlation of variables

	HD	ICT Skill	ICT Access	DEMOCRACY	DI
HD	1	0.702	0.800	0.546	0.494
ICT Skill	0.702	1	0.783	0.500	0.482
ICT Access	0.800	0.783	1	0.436	0.427
Democracy	0.546	0.500	0.436	1	0.296
DI	0.494	0.482	0.427	0.296	1

According to the Central Bureau of Statistics (2023), there has been a significant increase in ICT Skills and ICT Access in Indonesia. The trend in ICT Access during the research period was generally aligned with improvements in human development. Notably, there was a substantial rise in ICT Access, especially in 2020, despite a decline in the Human Development Index due to the impacts of COVID-19. ICT Skills, on the other hand, remained relatively stable throughout the research period.

It is also important to note the ongoing disparities between ICT Skills and ICT Access between Indonesia's western and eastern regions. The government has responded by providing internet access to public facilities, such as schools, village offices, and community health centers, especially in remote and disadvantaged areas. This effort to expand ICT infrastructure is expected to boost the potential of the digital economy, which, in turn, could support overall national output.

Table 4 presents the estimation results of the impact of ICT Skill, ICT Access, democracy, and domestic investment (DI) on the Human Development Index (HDI) using three different models: Pooled OLS, Fixed Effects, and Random Effects. The coefficients and standard errors for each variable are shown, along with the adjusted R-squared values and the results of the Chow and Hausman tests, which were used to select the most appropriate model.

Table 4. Estimation result

Variable	Pooled OLS	Fixed Effects	Random Effects
Dependent variable: HD			
ICT Skill	0.011 (0.013)	0.048 (0.003)***	0.043 (0.003)***
ICT Access	0.278 (0.026)***	0.053 (0.014)***	0.078 (0.013)***
Democracy	0.146 (0.028)***	0.002 (0.007)	0.006 (0.007)
DI	0.380 (0.103)***	0.077 (0.035)***	0.091 (0.035)***
Constant	38.558 (2.165)***	63.992 (0.940)***	62.268 (0.000)***
Adj- R-square:	0.70	0.99	0.82
F-statistics	142.590***	729.887***	276.587***
Chow Test		233.046***	
Hausman Test			77.237***
Observations	238	238	238

Note: [] denotes standard error; ***, ** and * denote significant levels at 1%, 5% and 10%, respectively

Based on the common effect (pooled OLS) model results, ICT Skill was found to be insignificant, while ICT Access had a significant positive impact on human development. Specifically, a 1% increase in ICT Access led to a 0.3 increase in human development. This outcome reflects that while the mastery of information technology is not evenly distributed across Indonesia, ICT Access has a broader reach, helping to facilitate people's daily needs. Additionally, democracy had a significant positive effect on human development, aligning with findings by Amate-Fortes et al. (2017), who emphasized the importance of democracy for human development, effective government administration, and political stability. Domestic investment was also significant, with a 1% increase leading to a 0.4 rise in human development, highlighting the critical role of investment in various sectors in improving welfare.

The fixed effect model showed that ICT Skill and ICT Access positively impacted human development. A 1% increase in ICT Skills raised human development by 0.05,

while a 1% increase in ICT Access led to a 0.05 increase. In contrast to the common effect model, democracy was insignificant in the fixed effect model. Domestic investment, however, continued to have a positive impact on human development.

Similarly, the random effects model indicated that ICT Skills and ICT Access positively influenced human development. A 1% increase in ICT Skills improved human development by 0.04, and a 1% increase in ICT Access raised it by 0.05. As with the fixed effect model, democracy was found to be insignificant in the random effects model, differing from the common effect model. Domestic investment again showed a positive relationship with human development.

The estimation results show that the Chow Test yielded a p-value below the 1% significance level, indicating that the fixed effect model outperforms the common effect model. Similarly, the Hausman Test also returned a p-value below 1%, suggesting that the fixed effect model is superior to the random effect model. Therefore, the best model for this study is the fixed effect model, which accounts for varying intercepts across cross-sections and includes dummy variables to distinguish between provinces.

The lives of the Indonesian people have undergone significant transformation due to the presence of ICT technology. This transformation has impacted nearly all regions of Indonesia. According to Fahmi & Mendrofa (2023), regional development relies on ICT, and many regions are prepared to embrace ICT to enhance the quality of life. The Central Bureau of Statistics (2022) reports that ICT development in Indonesia has shown a positive trend over the past five years, encompassing ICT access, infrastructure, expertise, and usage. One important indicator is the increasing number of households accessing information through computer ownership and internet penetration. During 2021-2022, the most rapid growth in ICT occurred in DKI Jakarta, followed by Java, parts of Sumatra, Kalimantan, and eastern Indonesia. However, disparities remain between provinces, necessitating further ICT development to ensure equitable distribution across Indonesia. Sabani et al. (2019) emphasized that as a large country, Indonesia can leverage ICT to support government operations.

ICT enables more effective and transparent interaction between the government and citizens (Silal & Saha, 2021; Wagner et al., 2016). It helps residents access quality public services and supports government policies to achieve comprehensive development goals. Kim et al. (2021) highlight that internet speed enhances ICT quality, which drives sectors such as industry, public services, and welfare improvement. Advanced ICT also supports industrialization by allowing producers to understand consumer preferences better, enabling them to meet market demands and compete locally and internationally (Acheampong et al., 2022).

This study's fixed effect model revealed that ICT Skills and ICT Access positively affect human development. The coefficient values for ICT Skill and ICT Access were identical, indicating that ICT plays a vital role in improving the living conditions of Indonesians. These results align with findings by Asongu & Le Roux (2017), who demonstrated that ICT penetration boosts human development in Sub-Saharan Africa, and by De La Hoz-Rosales et al. (2019), who found that ICT positively impacts human development indices in 145 countries. Other supporting research includes Mukhtar et al. (2020), which emphasized the role of ICT in driving micro, small, and medium enterprises (MSMEs) in Indonesia, and Rath & Hermawan (2019), who demonstrated

the contribution of ICT to Indonesia's economic performance. Similarly, Farooqi et al. (2020) found that investment in ICT positively influences human development.

ICT in Indonesia helps connect people regardless of location, benefiting households, communities, and businesses, particularly MSMEs, which are instrumental in improving social and economic conditions. Untari et al. (2019) found that provinces with robust ICT infrastructure experience higher economic impacts, while those with limited facilities risk economic inequality. Another challenge is the gap in cellular penetration growth between provinces (Purnama & Mitomo, 2018). Despite this, the rapid development of ICT has led to increased capital inflows and business opportunities, helping reduce unemployment.

According to the study's estimates, democracy was found to be insignificant, supported by Silal & Saha (2021), who also discovered that democracy does not significantly impact human development. This finding contrasts with Amate-Fortes et al. (2017), who reported that civil liberties and political stability positively affect human development, while political rights have a negative effect. Shirazi et al. (2010) explained that ICT impacts political activities, such as the level of democracy, though the digital divide remains a challenge, especially in developing countries. One possible reason for democracy's insignificance is the limited societal engagement in fostering national unity. While democracy facilitates freedom of speech and rapid information dissemination, it has not yet strengthened the collective awareness of national unity.

Amate-Fortes et al. (2017) noted that human development involves health, education, and per capita income improvements, supported by good institutions such as democracy, which fosters security and political stability. In Indonesia, democracy increases citizen participation and cultural interaction, while ICT facilitates e-government, improving governance at local and national levels. ICT has also been widely adopted in rural areas, making it easier for people to access public services and stay informed about government policies.

The study found that the realization of domestic investment positively impacted human development. More investment is needed in ICT development, particularly in software, communication infrastructure, and technology mastery. However, creating a conducive investment climate in Indonesia remains a challenge. Farooqi et al. (2020) observed that developing countries invest less in ICT. A lack of research and development hinders the optimization of ICT in improving human development and strengthening human resource capabilities. The Indonesian government is focusing on human development. With a large pool of human resources, there are great opportunities to direct efforts toward ICT mastery, which could generate new economic opportunities and improve social conditions.

ICT investment can take various forms, such as spending on software, hardware, cables, communication systems, and research and development. Farooqi et al. (2020) highlighted that many countries have experienced rapid economic growth due to ICT investment. Given Indonesia's large population and the rapid growth of ICT infrastructure, investment in the sector requires close attention. ICT investment has long-term growth potential (Rath & Hermawan, 2019).

The effective use of ICT can also contribute to reducing energy consumption (Razzaq et al., 2020). Input substitution in production activities can lead to environmentally friendly economic practices. ICT benefits creative workers and

enhances income (Akerman et al., 2015). However, not all literature agrees that ICT consistently improves living standards. Moll et al. (2022) argued that ICT can exacerbate income inequality and poverty, as business owners with more capital benefit disproportionately, leading to wage stagnation and unequal income distribution. Technology can also replace labor, necessitating policies that balance development, energy consumption, and environmental protection (Hussain et al., 2023). As such, ICT must continue to promote sustainable social development. Previous research has shown varying impacts of ICT in developed and developing countries. Niebel (2018), Papaioannou & Dimelis (2007), and Yousefi (2011) found that ICT had a greater impact in developed countries due to obstacles in developing countries, such as an unfavorable business environment, lack of ICT investment, and insufficient infrastructure.

Niebel (2018) examined the impact of ICT on economic growth in 59 emerging and developing countries from 1995-2010 using panel data regression. The study found that ICT investment positively correlates with economic growth, with the greatest effects seen in developing countries. Overall, ICT continues to impact productivity levels in these countries. De La Hoz-Rosales et al. (2019) analyzed the impact of ICT on human development in 145 countries, finding that ICT boosts entrepreneurship and improves social and economic conditions.

Untari et al. (2019) explored the impact of ICT in Indonesia using the Two-Stage Least Square method for the 2011-2016 period, revealing that internet access and mobile phones significantly boosted the economy. However, ICT spending was found to be insignificant, and ICT indirectly impacted income inequality through economic growth. Farooqi et al. (2020) examined 67 countries, concluding that investments in ICT, particularly software and hardware, promote human development across countries. Faizah et al. (2021) used OLS and 2SLS regression methods to study the impact of ICT in 514 regencies and cities in Indonesia, finding that ICT mastery can reduce social inequality, particularly in more developed regions where ICT use is higher. Acheampong et al. (2022) studied ICT's impact on human development in 79 countries and found that internet access, mobile phones, and broadband significantly improved the quality of life.

Nchofoung & Asongu (2022) explored ICT's role in sustainable development in 140 countries, showing that ICT boosts economic activities, increases trade, and fosters a more informative investment climate. Kim et al. (2021) assessed ICT's effects in 32 developed and developing countries, finding that fast internet access boosts industry, healthcare, education, and public goods in developing countries, though wired ICT had no significant effect. Li et al. (2023) analyzed the impact of ICT on the human development index in BRIC and N-11 countries, finding that ICT promotes industrialization and international cooperation.

CONCLUSION AND RECOMMENDATIONS

Conclusion

This study analyzed the effects of ICT Skill, ICT Access, the democracy index, and domestic investment on the Human Development Index (HDI) across 34 provinces in Indonesia during the 2016-2022 period, using static balanced panel data estimation. The findings demonstrate that ICT positively contributes to human development, with ICT Skill and ICT Access being significant and positively associated with HDI during

the research period. These results underscore the need for government intervention to ensure that ICT usage is balanced with Indonesia's cultural values, energy conservation, and environmental goals and aligned with the principles of sustainable development. Policymakers should carefully adapt technologies from developed countries to suit Indonesia's cultural norms and characteristics.

The democracy index, a control variable reflecting institutional importance, did not significantly impact human development during the research period. However, good governance and democracy are essential to achieving national prosperity. ICT plays a crucial role in providing information about government policies at both regional and central levels, facilitating public engagement through constructive ideas and opinions.

Domestic investment significantly and positively impacted human development, reinforcing the importance of investment in advancing welfare. The Indonesian government must prioritize ICT investment to support the digital transformation of public services. Collaborating with local investors can further enhance national welfare through targeted investment strategies.

Recommendations

The policy implications of this study can be implemented through several stages at the local government level. Local governments should design productive and innovative programs that leverage technology and ICT to promote employment and equitable income distribution, as such initiatives can stimulate local economies and drive development. Additionally, investment strategies based on local values and ICT should be developed to attract investors, especially local ones. Customized investment designs can create more opportunities for regional development and economic growth, fostering an environment conducive to sustainable advancement.

Expanding ICT use in strategic sectors like health, education, and social services will also significantly improve living standards. Localized designs should be tailored to optimize regional potential, increase labor absorption, and reduce inequality. Moreover, the government should implement digital inclusion strategies for disadvantaged populations in rural and underserved areas. ICT development should be affordable and adapted to the capacity and readiness of each region to ensure that access is widespread and equitable.

A limitation of this study is the lack of analysis of regional disparities using endogeneity methodology. Future research should focus on exploring the effects of ICT on the Human Development Index by incorporating more detailed data, particularly comparing urban and rural areas. This would provide a better understanding of the dynamics of ICT utilization across different regions in Indonesia and help tailor policies to address specific regional challenges.

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