



## Impact of Indonesia's ICT Development on Economic Growth

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### Abstract

This study examined the influence of Indonesia's Information and Communication Technology (ICT) Development on the country's Economic Growth both in the short-run and long-run using a systematic literature review. The data were collected from several databases, such as Springer, Scopus, Science Gate, Science Direct, Sinta, Routledge-Francis & Taylor, and other International Conferences. During its process, it included 24 peer-reviewed papers for further analysis. The results showed a positive impact of ICT development in Indonesia on economic growth both in the short-run and long-run periods. The impact is also indicated by total factor productivity, human capital resources, and capital per worker. However, there is an inequality of income found in Indonesia regarding the development of ICT.

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### Abstrak

Penelitian ini mengkaji pengaruh Perkembangan Teknologi Informasi dan Komunikasi (TIK) di Indonesia terhadap Pertumbuhan Ekonomi pada jangka pendek dan jangka panjang dengan menggunakan metodologi tinjauan literatur yang sistematis. Pencarian sistematis di beberapa database (Springer, Scopus, Science Gate, Science Direct, Sinta, Routledge Francis & Taylor, dan Konferensi Internasional lainnya). Artikel yang disertakan adalah 24 studi peer-review. Hasil penelitian menunjukkan adanya dampak positif perkembangan ICT di Indonesia terhadap pertumbuhan ekonomi dalam jangka pendek maupun jangka panjang. Dampaknya juga ditunjukkan oleh faktor produktivitas total, sumber daya manusia, dan modal per pekerja. Namun, terdapat ketimpangan pendapatan yang ditemukan di Indonesia terkait perkembangan ICT.

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## INTRODUCTION

The development of technology and information (ICT) is currently inseparable in all aspects of human life, including in the economic field. One of the key indicators determining the country's economic success is ICT as a driver for progress. The widespread application of more efficient methods in the distribution, production, and consumption of goods and services demonstrates the widespread impact of ICT utilization in the economic sector (Agustina & Pramana, 2019).

The International Telecommunication Union (ITU) developed the Information and Communication Technology Development Index (ICT-DI), which shows the development and expansion of ICT in Indonesia. The ICT Development Index is a standardized assessment of a region's level of ICT development that can be compared over time and between regions. Furthermore, the ICT Development Index assesses the rise of ICT development, the digital divide across areas, and the potential of ICT development 2023 is the eighth year that BPS has calculated using the latest method published by the ITU. Indonesia's ICT Development Index in 2022 reached 5.85, an increase compared to 2021 of 5.76 on a scale of 0–10 (BPS, 2023).

The rapid development and growth of ICTs have an impact on a country's economic growth. ICT investment has a significant impact on Indonesian economic growth. A high rate of investment growth will drive Indonesia's economic growth. Economic growth will be boosted if government expenditure on the information and communication industries has a significant impact on capital production factors, corporate institutions, and labor (Michael Edison Nata, 2007). The contribution of the communication sector to total gross domestic product (GDP) is one technique to determine and measure the influence of ICT development on economic growth. The GDP of the ICT based on current prices reached IDR 748.75 trillion in 2021 (BPS, 2023). Meanwhile, according to GDP on a constant price base in 2010, the information and communication sector will grow 6.81% to IDR 696.46 trillion in 2021 compared to the previous year, while investment in Transportation, Warehouse, and Telecommunications will be IDR 120.0 trillion in 2023 (Kominfo, 2023).

The significant contribution of communication to GDP and the increase in the GDP value of the communication subsector demonstrate the importance of ICT in the national economy. The ICT sector can be one of the primary drivers of economic growth in Indonesia. According to Economic Growth Theory, investment in ICTs drives economic growth. Researchers have established a link between ICT and economic growth, mostly through the use of two theoretical frameworks that refer to two economic methods, such as Exogenous Theory (Solow, 1956; Swan, 1956) and Endogenous Theory (7–9) (Lucas, 1988; Romer, 1986, 1990). The two postulates emphasize the importance of technical development in economic growth, but they are not the same. In the case of the Exogenous Theory, technical change is not described in the model, giving birth to "Solow residue," which is the part of economic growth that does not explain the model. Endogenous Theory, on the other hand, explains technological change and eliminates the condition of external variables (outside the model).

There are three main motivations for this study. First, Indonesia as a part of The South East Asian country, seems not moving from an economic condition as a developing country to a developed country in the last 25 years. One of the indicators of a country's economic growth is the use of information technology, as Solow argued to support productivity. Second, previous studies found that middle-income Asian country leads to the technology gap. Indonesians are known as information technology users instead of investors, for example, personal computer and mobile phone users with internet connection. The last was Indonesia's pathway to a more dynamic and productive economy—and undertook to achieve its goal of climbing from middle-income status to high-income status by 2045 marked by GDP growth.

Based on Solow's growth theory, this article seeks to examine the impact of ICT development in Indonesia on economic growth in the short and long-run. The impact of ICT development focused on the productivity, human resources and the capital.

Economic growth is the result of an increase in the quantity of factors of production or productivity in a country (García, 2016). Solow (1988) explained that ease in technological change can be obtained from the results of the multiplication of production functions. The amount of output at each amount produced by isoquants will be multiplied by  $A(t)$  in this case is technology. Here's

the equation in question:

$$Y = A(t) F(K, L)$$

The expected condition is when higher output indicates more savings and investment owned, thus increasing the rate of growth. Meanwhile, the capital-labor ratio eventually increases indefinitely, so wages must also increase. According to Solow, the technical progress factor in the economic growth model is carried out exogenously. At the macroeconomic level, productivity was indicated by the relationship between GDP and all other inputs such as capital and labor combined. The combination of inputs depends on the technology used, technological progress was associated with increased productivity and economic growth (De-huang & En-jun, 2013).

Solow argues that technology is the application of scientific knowledge as a result of practical purposes, used to support productivity and increase growth (Kumar et al., 2019). The impact of technology on production occurs when technology is available at affordable prices for effectiveness in various sectors. Although in the beginning technology was considered as a thing that could not increase productivity. Each technology has flaws so investment shows diminishing returns. There are two limitations of technology, including (1) this tool is designed only for communication between humans and (2) it is intended for access through a computer.

ICT is a General Purposes Technology (GPT). GPT has some primary characteristics including (1) can be widely applied and affect several sectors, (2) has complementary innovations and aims at cost efficiency, and (3) encourages new design innovations (Kumar et al., 2019). Almost all companies use this form of ICT to support their organizational goals. Capital assets consist of six types, namely: computer hardware, computer keel devices, communication equipment, buildings and structures, transportation equipment, and machinery that are not classified as ICT (Laitsou, Kargas, & Varoutas, 2017). Assets in the form of computer hardware, computer paid-off devices, communication equipment including ICT asset types, and all other assets including non-ICT assets. The design of this paper is as follows. The first part describes the background including the main idea of this study and the theory underlying the writing of this paper. The second part of this paper describes a method, results and discussion, and the rest is the conclusions and suggestions.

## METHOD

This research used a literature study to determine the problem of economic growth in Indonesia associated with the use of ICT. The collection of data and information was the basis for conducting this research so the method used was a literature study continuing with triangulation methods, using multiple datasets, methods, and theories to address the goals of the study. The purpose of the literature study was to find out the theories related to this research. Theories were collected according to the relevance of research that supported the goal of the study. The theories studied were related to ICT in increasing economic growth in Indonesia from the perspective of Solow's theory. Research sources were obtained from national, and international journal articles, international conference results, books, and other writings that can be used as the sources of the references.

The results of data collection in the form of theory were then analyzed with triangulation methods, in the form of finding in-depth information about the impact of ICT on economic growth in Indonesia. The procedure in analyzing data consists of several stages, including: (1) determining the purpose of writing, (2) identifying the topic sought and database, (3) processing data to be written and reducing search results according to scientific principles, and (4) presenting findings and conclusions.

## RESULTS AND DISCUSSION

Technology is defined as the application of scientific knowledge for practical purposes, supporting productivity and increasing growth (Solow, 1956), lowering production costs by simplifying supply chain processes, and providing access to information in decision-making and product manufacturing. The development of ICT could stimulate short and long-run economic

growth.

Solow assumed a continuous relationship between capital and labor, resulting in the following production function:  $Y = f(K, L)$  Where Y denotes production, K denotes capital or capital, and L denotes labor. By incorporating technology into the production function,  $Y = f[(K, L) E]$ , where E is a new variable referred to as labor and capital efficiency as a result of the technology utilized throughout the manufacturing process. In labor efficiency, technology here can be in the form of public knowledge about various methods that can be used in the production process. Workforce efficiency will be achieved if there are improvements in midwives' education, health, and skills for each community. This can then also have an impact on the level of productivity produced by the workforce, in the form of capital efficiency, and technology in the form of machines or tools used during the production process. Technological progress was established as a residual factor to explain economic growth in the long-run (Mankiw, 2012).

Short-term economic growth was triggered by consumption, government spending, exports, and investment. "In the short term, the economy was driven by public consumption, government spending, exports, and investment. Investment demand, which has a short-term as well as long-run impact, was useful for increasing production capacity or long-run economic growth (Arnold, Bassanini, & Scarpetta, 2007). The results of the analysis related to the impact of ICT development on economic growth in Indonesia in terms of the Solow model are presented in Table 1.

**Table 1. Combinations of Articles Used in the Literature Review**

Journal Database	Related Articles
Springer	9
Scopus	2
Science gate	2
Science Direct	1
Sinta	2
Routledge Francis & Taylor	1
International Conference	7
<b>Total</b>	<b>24</b>

As shown in Table 1, it can be seen that Springer publisher articles dominated the sources of the data related to the ICT development on economic growth in Indonesia, besides Science Direct and Routledge Francis & Taylor were the lowest. The inclusion and exclusion criteria that we apply to select the articles are provided in Table 2.

**Table 2. Inclusion and Exclusion Criteria**

Criteria	
Inclusion	<ul style="list-style-type: none"> <li>- Publications in peer-reviewed journals</li> <li>- The article discusses ICT and economic</li> <li>- Papers written in the English language</li> <li>- The open-access articles</li> <li>- Theses, books, and book titles</li> </ul>
Exclusion	<ul style="list-style-type: none"> <li>- White papers, technical reports, and non-peer-reviewed research publications</li> <li>- An editorial, an abstract, or a brief paper (four pages or fewer)</li> <li>- Articles involve ICT and economic growth in a strong case</li> </ul>

After the application of the inclusion and exclusion criteria, we obtained 13 qualified articles that became the main references in completing the literature review, as shown in Table 3.

Table 3. List Article Distribution

Publication Media	Number of Articles
Periodical Journal Q1	5
Periodical Journal Q2	1
Periodical Journal Q3	2
Sinta	3
Conference Proceedings	2

### ***Impact of ICT Development on Indonesia's Short-Term Economic Growth***

Short-term economic growth through capital and labor investment was measured from the ratio between capital-labor that has a transitional. In addition, investment and export activities have a significant impact on economic growth in the short term (Arnold et al., 2007). Short-run growth requires the assumption that technological progress and population growth coincide, as well as the existence of the same progressive tax rate in a country (Kurniasih, 2019). The adjustment for short-run output growth lies in the guarantee when the capital/labor ratio adjusts to the next equilibrium value. However, the use and advancement of technology is difficult to align with significant differences in multifactor productivity growth forecasts. Higher levels of savings, labor force participation, and technological change positively impact per capita output growth at equilibrium conditions. Several articles reviewed provide information related to the impact of ICT development on Indonesia's short-term economic growth described in Table 4.

Table 4. Impact of ICT Development on Indonesia's Short-Term Economic Growth

Literature Study Findings	Elements of Short-Term Economic Growth	Authors
The growth of fixed broadband has shown a significant and positive effect on two indicators of financial development. A 1% increase in fixed broadband usage resulted in a 2% rise in financial development, while the growth of variable internet users increased by about 0.09%.	To make informed decisions and build effective shared information systems, it needs to focus on developing efficient sectors of the economy.	Alshubiri, Jamil, and Elheddad (2019)
The study shows that technology and the internet have impacted Indonesia's economy from 2001 to 2016. Broadband subscriptions and internet users have improved GDP but with a lag.	This has created new business models, and jobs, and expanded marketing networks through e-commerce and e-business, leading to an overall improvement in economic performance and growth.	Lubis and Febrianty (2018)
There is a positive and significant correlation between digital education, education openness, the Islamic Human Development Index (IHDI), and education with the growth of Indonesia's Gross Domestic Education (GDE) in the	Macro policy instruments can be implemented to support national economic growth and improvement.	Imsar, Nurhayati, and Harahap (2023)

Literature Study Findings	Elements of Short-Term Economic Growth	Authors
long term. However, in the short term, none of these variables have a significant impact on the GDE growth of the Indonesian economy.		
Factors such as Education (EDU), utilization of potential sectors (PSU), Political Stability and Security (STAB), and several others, play a significant role in encouraging Direct Investment (FDI) and affecting the economic growth in Indonesia.	Invest in the sectors that are more productive to achieve sustainable economic growth, especially on the six major islands.	Leasiwal (2013)

After conducting a literature review, it has been found that the development of ICT in various sectors can boost productivity, leading to economic growth. One of the notable ICT developments in Indonesia is the widespread adoption of the Internet, which has given rise to new business models such as e-commerce and e-business. This, in turn, has created new job opportunities and enabled entrepreneurs to expand their marketing networks with ease. All of these factors have contributed to an improvement in economic performance, increasing income, and economic growth (Lubis & Febrianty, 2018). Not only in the economic sector, education was also a growing sector with the development of ICT (Aghion & Howitt, 1992). The government should use macro instruments to encourage sustainable ICT use, creating positive impacts in the short term (Imsar et al., 2023).

Productivity is the key factor that drives a country's economic growth and success. This is because more productive workers earn higher incomes and enjoy better living conditions. Hence, identifying the main driver of productivity is a crucial subject for academics and politicians. Innovation has been identified as a significant source of productivity. Most importantly, Solow (1956) stated that sustained increases in GDP per capita over the long-run depend on technological advances; the New Improvement Theory literature (Aghion & Howitt, 1992; Grossman & Helpman, 1993; Romer, 1990) emphasized the mechanisms that drive technological change.

The basic concept of this literature was that long-term sustainable economic growth requires more effective utilization of available resources through technical development and innovation processes. Research and development, in particular, drives innovation. The economy will flourish as long as there is sufficient innovation potential in the economy and there are no major distortions in the creation of new goods. Based on the analysis of the article, several articles that support the writing on the impact of ICT development on economic growth in Indonesia in the long-run can be seen in Table 5.

Table 5. Impact of ICTs on the Economy in the Long-Run

Literature Study Findings	Elements of Long-Term Economic Growth	Authors
Countries with relatively high ICT investment may be able to raise TFP growth rates by 0.1 to 0.3% per year when compared to those with moderate investment levels.	Investment and use of ICT in industry promotes higher productivity through: <ul style="list-style-type: none"> <li>• Accelerated transmission of information</li> <li>• Reduced transaction costs</li> <li>• Enhanced efficiency of market transactions</li> <li>• Raised operational effectiveness</li> </ul>	Hawash and Lang (2020)

Literature Study Findings	Elements of Long-Term Economic Growth	Authors
Research conducted in Indonesia, Malaysia, Thailand, and Singapore reveals that the level of development of a country, as measured by per capita income, does not always determine the benefits it receives from the development of information and ICT. The degree to which the economy is impacted by ICT depends on the level of utilization of ICT and the structure of the ICT sector.	ICT plays a vital role in driving innovation both in products and processes. It is also used to promote entrepreneurship in the ICT sector while ensuring that it is environmentally sustainable. To facilitate greater collaboration and exchange of ideas among ASEAN Member States, a network of Centers of Excellence (COEs) is being established to accelerate innovation.	Irawan (2014)
Digital supply chain platforms facilitate the impact of digital technologies on economic and environmental performance. The effects of such mediation increase under a high level of environmental dynamism.	Companies can leverage digital technologies such as the Internet of Things, Cloud computing, and Big Data analytics to enhance the processing of enterprise data for decision-making purposes.	Li, Dai, and Cui (2020)
This paper uses the endogenous economic growth model (EGT) in Indonesia. The results of the model estimation and data run show that gross fixed capital formation (K), the number of internet users (A), and the number of productive age population (L) have a positive and significant effect on economic growth in 2017.	The utilization of ICT evenly and in various fields such as education, entrepreneurship, and trade increases efficiency.	Prawidya Hariani (2017)
The study found that the development of ICT has a positive but small impact on Indonesia's economic growth. This impact is statistically significant, meaning that it is not due to chance. Other measures, such as capital per worker, TFP, and human resources, also have a positive impact on economic growth.	The priority is not only the increase in ICT use but also the expansion of ICT-related investments. The central government has always played an important role in encouraging the adoption of ICT-related metrics; consequently, an effective plan to harness the benefits of ICTs will promote increased economic growth.	Rath and Hermawan (2019)
The notion of the ICT effect highlights the influential role of the ICT sector in facilitating the expansion and advancement of other sectors. Despite being relatively modest in terms of	Enhancing connections between the ICT industry and other sectors, particularly the key sectors that heavily rely on ICT services, such as professional, scientific, and technical	Maryana and Djamaluddin (2021)

Literature Study Findings	Elements of Long-Term Economic Growth	Authors
output, the ICT industry possesses the ability to act as a catalyst for economic growth.	activities, financial and insurance activities, and education.	
Investment and technical innovation have a major positive impact on the economy.	The creation of a digital ecosystem has an impact on improving the economy.	Vikia (2023)
Although ICT is harmful to developing countries, a strong ICT industry combined with a sophisticated financial sector will drive growth.	Prioritizing ICT development while ensuring a strong financial sector to do so secures economic growth.	Aziz et al. (2023)

Some of the literature that has been studied shows that the development of ICT has a positive impact on economic growth, this is reflected in investment in ICT (Hawash & Lang, 2020), digital supply chain platforms (Rath & Hermawan, 2019), the intensity of technology use (Irawan, 2014) the combination of ICT with the financial sector will drive growth (Aziz et al., 2023). The existence of investments in the ICT sector, including the development of digital infrastructure, communication technology and digital services that are increasingly widespread in many sectors, has increased efficiency in various fields. In addition, the development of a digital supply chain platform allows companies to be more efficient in managing the supply and distribution of goods or services through digital integration. The use of ICT technology in the financial sector such as fintech, digital payments and electronic banking systems is able to accelerate economic growth. This will encourage easier access to financial services and drive broader financial inclusion.

## CONCLUSIONS AND SUGGESTIONS

Based on the literature review that has been performed, the conclusion of this research shows that ICT development has an impact on economic growth in Indonesia. This seems to be felt in various aspects of life, both short and long-term. The impact of ICT development can be seen from the indicators of total production factors, human resources, and capital per capita. However, in practice, there is still income inequality in Indonesia as a result of ICT. In the short term, the impact of ICT leads to decisions to build effective information systems and efficient economic sectors, encouraging new business models such as e-commerce and e-business, providing new jobs, and expanding marketing networks via the internet which will have an impact on increasing economic performance that increases income and economic growth, macro policy instruments to increase national economic growth and economic growth should be encouraged by sectors that are considered more productive.

Meanwhile, in the long-run, it was found that investment and use of ICT in industry increases higher productivity consisting of fast dissemination of information, low costs, organizational efficiency; use of ICT for product and process innovation; utilization of the Internet of Things, Cloud, Big Data to increase company data storage for decision making; the use of digital technology to transmit information in the form of digitally enabled infrastructure, and various data sources allows companies to adapt to customer demands and seek new markets; use of ICT evenly and in various fields such as education, entrepreneurship, trade increases efficiency; expand investment in the central government so that an effective plan will encourage increased economic growth.

These findings imply that the Indonesian government can implement policies to continue pursuing a lower economic growth path than in previous years to achieve a higher growth path, including avoiding a decline in labor force participation through aggressive spending in secondary and higher education, employment training, and increasing skills towards a digital economy, stable real wage increases in line with labor productivity, strong labor market activity participation, and greater



tax benefits, as well as overcoming the negative impact of pensions.

These findings imply that the Indonesian government can implement policies to continue to pursue a lower economic growth path than in previous years to achieve a higher growth path, among others, avoiding a decline in labor participation through aggressive spending in secondary and higher education, job training, and upskilling towards a digital economy, a steady increase in real wages in line with labor productivity employment, strong labor market participation activity and greater tax benefits, as well as overcoming the negative impact of pensions. The limitation of this study lies that research was not carried out directly on aspects of ICT users, both government and private. Future scholars are suggested to look at several companies using ICT in their development.

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