

## Human Capital, Technology, and Economic Growth: A Case Study of Indonesia

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### Abstract

This study discusses the effect of human capital and technology on economic growth in Indonesia using annual time series data over the 35-year research period (1984–2019). This study uses an autoregressive distribution gap to the cointegration approach to understanding the relationship between human capital, technology, and economic growth. Human capital is inherent in humans and becomes capital in providing the best performance that has an impact on their own income. We use the human capital framework in this study where education is one mechanism to increase human capital. Based on the results of our estimation, we find that the increase in human capital using the education mechanism affects economic growth. This shows the role of human capital investment is very important in economic growth. Technology shows a significant positive effect on economic growth. Increasing human resources and technology are important factors in efforts to increase economic growth in Indonesia. Educational development is the key to the success of increasing human capital and technological development because education plays a role in improving the quality of human resources. Increasing human resources here is in the form of increased knowledge, mastery of technology, innovation, and the ability to develop technology to encourage technology development.

**Keywords:** Indonesia, Human Capital, Technology, Economic Growth

**JEL Classification Code:** C01, E44, E51

### 1. Introduction

Economic growth is an increase in the production of economic goods and services, compared from one period of time to another. Economic growth is commonly measured in terms of the increase in the aggregated market value of additional goods and services produced, using estimates such as Gross Domestic Product (GDP) (Greenhalgh & Rogers, 2010). Human capital is an intangible asset or quality not listed on a company's balance sheet. It can be classified as the economic value of a worker's experience and skills. This includes assets like education, training, intelligence, skills,

health, and other things employers' value such as loyalty and punctuality. Education is one of the mechanisms that is considered good in increasing human capital, especially formal education which has been measured and standardized by the government, which is authorized to increase the human capital of the population. Education is an important thing to be developed to encourage economic growth, especially in developing countries like Indonesia, where remarkable results have been achieved. A country's economy becomes more productive as the proportion of educated workers increases since educated workers can more efficiently carry out tasks that require literacy and critical thinking. As of now, Indonesia struggles to provide inclusive, high-quality education to its citizens. The country has much lower literacy levels than those of other Southeast Asian nations. Education promotes technological innovation by improving the quality of workers, and, thus, effectively boosts economic growth. Educational development is the key to the success of increasing human capital and technological development because education plays a role in improving the quality of human resources. Education development policies determine the success of technology skills, technology development, and economic growth in Indonesia (Machado, 2015).

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The existence of human resources (human resources) is very important in supporting company operations (Martin & Whiting, 2016). However, not all companies understand the importance of the role of human resources, so they ignore the rights of existing employees. Human resource is important because some level of human knowledge and skills is necessary for an organization to accomplish anything. Human resources development is vital to the growth and productivity of the organization. The people that make an organization run are an asset to be invested in. If they can become more productive on an individual level through development, the organization in turn will begin seeing productivity gains. At present, with the rapid development of knowledge economy and technology, innovative human capital is an important factor. Now, employees are no longer seen as mere resources but are an important asset for the continuity and development of the company. This is the era of changing human resources into human assets known as human capital.

Human Capital is a measure of the skills, education, capacity, and attributes of labor that influence their productive capacity and earning (Serrat, 2017). Human capital in principle is part of human resource management; it's just that the management and development of human capabilities as a resource focuses more on increasing knowledge and skills that can support the development of an organization or company. Human capital places human resources at a higher degree level than just resources that is human resources are valuable assets that are beneficial to the organization or company. As a valuable asset, human resources can even be compared to an investment portfolio in which their performance can be developed and multiplied. Therefore, human capital does not view human resources as a liability or expense that reduces the profitability of the organization. The emergence and development of the concept of human capital are triggered by the maximum use of employees as resources. This means that employees must be ready to "squeeze" their knowledge, expertise, skills, and creativity for the benefit of organizational development and progress. Because, as a resource, employees will experience a decrease in productivity as they get older. Before these human resources "run out", organizations or companies try to add and create value to develop their human resources.

In the modern industrial environment, where technological development is outpacing all other things, there is a continuous need for systematic training and development of the employees. The company manages employees in such a way as to improve workability so that they can achieve higher level performance (Jones & Jenkins, 2018). Human resource management is the strategic approach to the effective management of people in a company or organization such that they help their business gain a competitive advantage. It is designed to maximize employee performance in the

service of an employer's strategic objectives. Training and development are one of the key human resource management functions. Most organizations look at training and development as an integral part of the human resource development activity. Training may be described as an endeavor aimed to improve or develop additional competency or skills in an employee on the job one currently holds to increase the performance or productivity. Through 'training' employees are taught specific skills while through 'development' employee's personality and management skills are enhanced.

Along with the development of employee knowledge and performance, the company also does not neglect to provide rewards to increase employee loyalty. Providing attractive rewards and benefits such as allowances, annual bonuses, and other facilities will not only motivate employees but also trigger their awareness to stay in the company. Human capital has a central role in economic development. Human capital is the central driving force for the sustainable growth of the country (Ricciardelli, 2017). Organizational culture affects employee performance. Organizational culture plays a significant role in motivating employees. Only a strong organizational culture enables to improve employees' motivation. As a result, it leads to improvements in employee performance (Kustono, 2020). The performance of a teacher plays a role in the success of education. Where education is an important mechanism in increasing human capital (Ingsih et al., 2020). Educated personnel with high motivation can help the organization achieve organizational goals and objectives. Hence, these personnel or human resources can be said to be organizational assets (Rahaman et al., 2020).

The link between economic growth and human capital growth is a key combination in the efforts to improve the economy. This development does not only contribute to one aspect, namely economic growth but can contribute to other aspects such as welfare and poverty reduction (Hess, 2016). Technology and human capital are two important factors driving the economy along with production factors, namely financial capital and labor. Human Capital and Technology are in the form of non-physical assets but have a major effect on production. Human capital is the stock of habits, knowledge, social, and personality attributes (including creativity) embodied in the ability to perform labor to produce economic value. Theoretically, the initial approach to analyzing economic growth according to the theory of neoclassical economic growth is interpreted as a function of labor, physical capital, and the existence of exogenous factors from technology. The role of human capital in understanding the economic growth of a country or region within a country is a development of the modern economic theory, namely the endogenous growth model (Felipe et al., 2019).

Early studies of economic growth always refer to research conducted by Solow in 1956 which provided a

basic model of economic growth in which savings were the main driver of economic growth. The development of economic growth analysis provides a basis for the role of human capital as an important part of increasing economic growth (Hahn et al., 2016).

Micro and macro perspectives can be used to see the contribution of human capital to economic growth. Where on a micro level, human resources are a key factor in improving employee performance so that it affects production. Knowledge can have an impact on technological skills and innovations made in the production process. The result of this knowledge is efficiency in the production process which has the potential to increase productivity. On the other hand, the presence of expertise will make individuals more competent in the production process, thereby encouraging productivity. At the macro level, human capital is seen in aggregate as a quality of human resources from the population that encourages general or aggregate economic growth (Jia & Tomasic, 2017). Human capital, both micro and macro, is understood as an important element of economic growth. Increasing welfare has implications, namely reducing poverty and unemployment levels that may occur from the existence of continuously developing human capital. An investment in human capital means investing in education or some form of on-the-job training to improve workforce quality. Such investments provide returns to the individual as well as to the economy as a whole. Individuals benefit from higher earnings and the economy as a whole benefit from higher productivity.

In developing countries such as Indonesia, the role of the government is very much needed in developing the quality of human resources. This will have implications for an increase in the level of social welfare which is then followed by an increase in economic growth at the macro level. Indonesia has heterogeneous conditions in which each region has a different style. This study of the contribution of human capital provides an initial and further analysis of economic conditions in Indonesia. When human capital becomes one of the factors that has a central role, the government can then issue policies that can increase and accelerate the development of human capital (Duffield et al., 2019).

Economic growth is an important thing in the economy of Indonesia and other countries (Rodionov et al., 2020). Economic growth is something that is strived to occur for the welfare of the entire population. Technology and human capital are the driving forces that determine the success of efforts to improve the economy and efforts to increase economic growth.

## 2. Literature Review and Hypotheses

Human capital is a very important factor in determining the productivity of an economy. It is believed that the

different qualities of human capital can cause two economies that have identical amounts of labor, physical capital, natural resources, and technology to produce different outputs (Denis, 2017).

Humans are a form of capital, like physical capital and technology. Human capital is a qualitative dimension of human resources. Qualitative dimensions of human resources, such as expertise and skills, possessed by a person will affect that person's productive ability. Skills and knowledge can be improved through good education and health condition (Calkin, 2018).

Spending on education and health is an investment because, like investing in buildings or land, it will generate future returns. Expenditures on education, training, and health will improve a person's health and knowledge so that the productivity and income of that person will increase in the future. Education and health have an impact on human productivity which has an impact on production. When production increases in aggregate, economic growth will also increase. Hence, education and health, which are important components of human capital, have an impact on economic growth (Rajan, 2020).

Previous empirical studies on human capital, technology, and economic growth, both at the country and cross-country levels have been carried out by many economic researchers including Xu and Li (2020), concluding that human capital and economic growth are positively and significantly related, while, the quality of human resources is a reflection of human capital which is an important element inherent in humans that affects work performance or success consisting of knowledge, mastery of technology, skills or expertise, health, and morals.

The quality of human resources affects economic growth where economic growth will have an impact on increasing population income and increasing population welfare. As such, human capital is an important key element in increasing economic growth (Morris & Oldroyd, 2020).

In the 1960s, many scholars found that differences in capital formation and other input factors did little to explain why so many differences in economic growth occurred. It was only recently realized that many factors previously considered "residual", play a role in increasing economic growth. Residual here is associated with an investment in the quality of human capital and technological advances. Investments contribute to human resource development through a learning and training process. This term is later known as "Human Capital" in temporary economic studies. Human capital like other production capital such as equipment and machinery need to be increased and developed where human capital is increased through training and education. Training and education will produce a skilled and professional workforce. Businesses also invest in human capital, through the hiring of a workforce to produce goods

and manage operations. The true asset, however, is the quality of the skills and knowledge held by those employees and how they utilize them for the benefit of the company where they work. Human capital is a very important production element; where human capital cannot be transferred like a machine or equipment because it is attached to humans. If we replace human capital, it is necessary to replace the people themselves. Human capital is non-physical in nature, so it can only be seen from changes in performance after training and education in humans. Training and education are important ways of increasing production. Human resource development contributes to increased productivity and builds manpower abilities. More educated people find work faster, and conversely, people with less education find it difficult to get a job, and even if they get a job, they are usually laid off more often because they are unskilled and not proficient at work. Empirically, it turns out that human capital with a good level of education can reduce unemployment (Felipe et al., 2019).

More educated workers are engaged in more complex work activities, which require more training in their workplace. Employers see a return on investment when they hire an educated workforce. Some of the benefits of a well-educated workforce can be having highly skilled and happy employees, new and creative ideas, and even increased profits and investment. Businesses with an educated workforce are also more efficient, capable of contributing new and valuable innovations. Education investment is an important factor for a country in its efforts to reduce unemployment. This means that if a country wants to increase the positive trend of its workforce rate, that country must allocate more human development investment, especially human capital investment in education. This investment in human capital in education cannot only reduce the rate of unemployment but also increase the number of labor force participation which has a direct impact on increasing workers' wages which in turn has an impact on the positive trend of economic growth in the country (Billett, 2020).

Alfada (2019) concluded that human capital and economic growth have a positive and significant effect in Indonesia. Banerjee and Roy (2014) concluded that human capital and technology had a positive effect on economic growth in India. Han and Lee (2020) concluded that there was a strong cointegration between health services and education in improving the quality of human resources and economic growth. Health is part of human capital, so the quality of health and education is an important factor in human capital. Therefore, it can be interpreted that health and education are important factors behind human capital that have an impact on economic growth. The quality of education and health services has a positive effect on improving human capital, thereby affecting levels of economic growth and levels of human capital.

One of the basic assets of Indonesia's development is its large population. If the full potential of the population can be developed through a development program and subsequently utilized in productive economic activities, prosperity will be created which is the goal of development. If a country does not immediately develop the skills and knowledge of its people and does not utilize its potential effects in economic development, then in the future the country will not be able to develop anything. Besides, this large population is also a challenge for national development, because it will result in a larger workforce. The problem that often becomes an obstacle in development is the limited number of job opportunities to accommodate the ever-increasing workforce. In most countries, economic development planning is initially oriented towards growth, not income distribution. For a country like Indonesia with a large population, economic growth is very important as a short-term development priority. Population growth can be a challenge in itself. If high population growth is not balanced with an increase in human resources, it will have a severe impact, as such, economic growth cannot keep up with population growth which has an impact on inflation and also decreases welfare. However, if population growth can be managed properly through education and training, then population growth will be the growth of human resources and work participation. Therefore, in this case, population growth will be a blessing because of the additional workforce that can be used as a driver of economic growth so that economic growth can keep pace with and be higher than population growth. Hence, population growth can increase the income and welfare of the population (Cornock, 2018).

Economic growth in Indonesia as a short-term development priority place too much emphasis on high growth and pay relatively little attention to long-term interests, for example, attention to the field of education to develop human resources. Even when compared to countries in the Asian environment, Indonesia is still very behind in terms of budget allocations for its education sector (Leibo, 2018). Economic development and improvement of population welfare can be achieved by increasing work participation by increasing human capital so that population growth can encourage economic growth with adequate levels of work participation and the development of good human capital. With the increase in population every year, the daily consumption needs also increase, as such, an increase in national income is needed every year. Apart from the demand side (consumption), from the supply side (production), population growth also requires the creation of employment growth. Economic growth that is not matched by growth in work participation in the form of employment growth and human capital development can have an impact on income inequality and have a negative impact on the economy because it can increase poverty. Work participation and

employment are created from economic growth followed by the development of human resources through the education and training system (Wirth et al., 2018). An increase in work participation is the impact of an increase in aggregate output (goods and services) or Gross Domestic Product (GDP). As far as macroeconomics is concerned, economic growth is the change in GDP (Felipe et al., 2019).

Human capital and economic growth have a strong correlation. Human capital affects economic growth and can help to develop an economy by expanding the knowledge and skills of its people. Human capital and knowledge factors are important contributors to economic growth. The higher the quality of human capital, the higher its effect on economic growth. Similar to physical wealth, quality human capital is also an asset that can generate economic benefits for individuals, households, businesses, and the country (Wensley & Evans, 2020).

Technology facilitates human performance and increases human productivity so that it becomes a natural thing if technology encourages economic growth. It is widely accepted that technology is the key driver of the economic growth of countries, regions, and cities. Technological progress allows for the more efficient production of more and better goods and services, which is what prosperity depends on. Human capital is needed to master technology and improve performance so that human capital is the key to increasing economic growth. The investigation is based on the following hypotheses:

*H1: Technology has an effect on economic growth.*

*H2: Human Capital has an effect on economic growth.*

### 3. Research Methods and Materials

This study uses an Autoregressive Distributed Lag (ARDL) approach with cointegration techniques to test long-term cointegration relationships between variables and obtain an error correction version (ECM) version of the ARDL specification to determine short-term dynamics. The estimation method used in this study uses the Autoregressive Distributed Lag (ARDL) approach because the ARDL approach method can see the effect of the dependent variable and independent variable over time, as well as the influence of the past. The dependent variable is the current dependent variable. ARDL model is a combination of the Autoregressive (AR) model with Distributed Lag (DL). The advantage of the ARDL model is that it is unbiased and efficient because it can be used with a small sample. By using ARDL, long-term and short-term estimates can be obtained simultaneously, which will avoid the problem of autocorrelation. Besides, the ARDL method is also able to distinguish between independent variables and connected variables based on human capital theory. Where in human

capital theory, economic growth is influenced by human capital, financial capital, and labor in the following equation:

$$Y_t = f(K_t, L_t, H_t)$$

where  $Y_t$  is output,  $K_t$  is financial capital or capital or investment,  $L_t$  is labor and  $H_t$  is human capital. Introducing technology explicitly into the following models:

$$Y_t = f(K_t, L_t, H_t, T_t)$$

Converts the equation function to the following econometric model:

$$\ln Y_t = \beta_0 + \beta_1 \ln K_t + \beta_2 \ln L_t + \beta_3 \ln H_t + \beta_4 \ln T_t + e_t$$

where  $Y_t$  is output,  $K_t$  is financial capital or capital,  $L_t$  is human resources or labor,  $H_t$  is human capital and  $T_t$  is technology. Where  $t$  is the symbol for time. Human capital can be proxied for education or educational services that provide knowledge, develop innovation and creativity as well as mastery of technology so that through the education mechanism the human capital inherent in the workforce can be improved properly.

Secondary data used in this study were obtained from the World Bank and the database of the Indonesian Central Bank (Bank Indonesia or BI) from 1984 to 2019 (35 years) based on data availability. The gross domestic product or real GDP is used to represent economic growth, education services in Indonesia are used to represent human capital in Indonesia, labor force or work participation is used to represent labor, gross fixed capital formation is used to represent capital, and government spending on research and technology development is used to represent technology.

### 4. Results and Discussion

Human capital indicators in the form of educational services as a form of work participation in Indonesia have a significant positive effect on Indonesia's economic growth. More specifically, increasing human capital will have an impact on increasing economic growth in accordance with theoretical provisions. These results corroborate the findings of other similar studies conducted for Indonesia (Alfada, 2019). The relationship between technology and economic growth based on the estimation results is a significant positive. This is in accordance with the theory where technology has an influence on economic growth. Theoretically, technology is able to accelerate production, increase productivity or the performance of labor or human resources, improve the quality of the products produced. Technology also plays a role in improving communication between producers and consumers as well as all stakeholders, where information and communication technology is currently developing

very rapidly. There are many other things that are influenced by technology in increasing production. All things that are influenced by technology in increasing aggregate production affect economic growth. Our estimation results are in accordance with this, namely, technology can affect economic growth or have a significant positive relationship. Our research results are in line with the research of Banerjee and Roy (2014). Other theoretical variables in human capital theory which are used as the basis for equations in the model, namely labor and human capital, in the long run, based on the estimation results, have a significant positive effect on economic growth. However, human capital in the short term has a negative and insignificant effect. This is because human capital investment is needed for improving workforce performance in the long-term. As such, in the short term, human capital has a negative and insignificant effect because human capital investment is still in the process of encouraging employee performance. As such, human capital will be effective in stimulating the economy in the long term and less effective in driving economic growth in the short term. The technology variable is the most effective in driving economic growth both in the long and short term. Based on our estimation results, we find that technology is effective in the long and short term in driving economic growth. However, to master technology and encourage technological development, human capital is needed. And to improve the welfare of the population and increase economic growth, it is necessary to increase labor participation for workers who are ready to contribute to the economy, which of course requires human capital to improve their performance. The estimation results are presented in Table 1.

Table 1 presents the long and short-run results of the Model, which include human capital, labor, financial capital, and technology. In the long term, human capital based on estimates has a significant positive effect. This proves that education participation and the quality of education services in Indonesia have a significant positive effect on long-term economic growth. As such, education is important in economic development. The increase in work participation in Indonesia continued during the study period. This result is in line with Alfada (2019) who stated that human capital and economic growth are positively related in Indonesia. Based on the results of technology-based estimates, it has a positive relationship with economic growth both in the short and long term, therefore, technology is an important factor in Indonesia's economic growth. The factors of labor and financial capital also show a positive relationship both in the long and short term with economic growth in Indonesia. Although in the short-term human capital does not have a positive relationship, in the short-term human capital has a positive and significant relationship. The technology variable remains positively and significantly related in the short and long term.

**Table 1:** Estimated Long Run and Short Run Coefficients

Variables	Coefficient	T ratio (p-value)
<b>Long Term Results</b>		
$\ln K_t$	0.776	4.259*** (0.000)
$\ln L_t$	3.255	4.184*** (0.000)
$\ln T_t$	0.516	4.924*** (0.000)
$\ln TE_t$	0.51	3.336*** (0.002)
Constant	-120.257	-6.405*** (0.000)
<b>Short Term Results</b>		
$\Delta \ln Y_{t-1}$	-0.204	-3.074** (0.045)
$\ln K_t$	0.377	3.148*** (0.004)
$\ln L_t$	5.729	5.002*** (0.000)
$\ln T_t$	0.504	8.501*** (0.000)
$\ln TE_t$	0.262	3.318*** (0.003)
Constant	-60.748	-3.809*** (0.001)
Adjusted R		0.842
Durbin-Watson statistic		1.755

Information: 5% probability.

## 5. Conclusion

Human capital has an effect on economic growth. However, based on the estimation results, human capital is effective in driving the economy in the long run with technology and labor as key factors driving economic growth. Based on the estimation results in this study, the impact of human capital and technology on economic growth in Indonesia during the period 1984 to 2019 is significant in the long term. Using annual data for 35 years, the ARDL approach with cointegration techniques is used to examine the long-term relationship between economic growth and its determinants, as well as to ascertain the impact of human resources and technology on economic growth both in the long and short term. The estimation results concluded that human capital is effective in promoting long-term economic growth. And effective technology drives economic growth in the long and short term.

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