Causality Relationship Between Human Capital, Technological Development and Economic Growth

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Abstract

In this research, human capital, technical advancement, and economic growth in Indonesia are examined using vector analysis. In analyzing causality, we use a research period of more than 20 years using secondary data from the world bank. Our findings show that technology development and Human Resources are two important components in economic development. Human resources are an important factor of the industry and the quality of human resources is determined by the human capital owned by these human resources. Technology aids people in their job, allowing them to execute at a higher level of efficiency and quality. Investment in technological development and human capital may increase the speed and quality of human beings, which can lead to increased economic growth and productivity. A strong economy is essential to the long-term viability of human capital and technology investment. Human capital and technology are mutually reinforcing each other in the development of Indonesia as a result of economic progress. The three variables are in a mutually reinforcing relationship so that the three variables are closely related and mutually reinforcing.

***Keywords*:** Causality relationship, Human capital, Technology, Economic growth.

***JEL Classification*:** C10, E04, E44.

1. Introduction

Harnani & Sudarmawan (2021) explain that industrial performance in the real sector is influenced by technological developments. Technological developments are related to the level of education that reflects human capital. Harnani & Sudarmawan's research is strengthened by research from Irawan & Rahayu (2021) and research by Widarni & Bawano (2020) which found that education is a key factor in technological development so that education has a direct and indirect impact on industrial performance.

Education increases human ability to understand and learn new skills and improve human ability to adapt and master technology so that it can improve the performance of human resources (Kholik & Priyanto, 2021). Increasing the performance of human resources which is influenced by human capital in the aggregate in the organization can improve organizational performance (Handayani & Sasongko, 2021).

However, Harnani & Sudarmawan (2021) have different findings with research by Ghosh & Parab (2021) finding that in line with the findings of Handayani & Sasongko, (2021). However, technology has various effects and is not in line with the findings of Harnani & Sudarmawan (2021). However, Arjun et al. (2020) found the same findings as Harnani & Sudarmawan (2021) who found that technology had a positive impact on economic growth and strengthened human capital in promoting economic growth.

Human capital in the form of intangible assets can be developed through learning methods or better known as education mechanisms. The cost of education and health care is an investment in human capital where educated and healthy people tend to be more productive and can increase economic productivity more than those who are not educated and unhealthy (Widarni & Bawono, 2021).

2. Literature Review

In the business aspect, human capital is a vital aspect that is strengthened by the right technology. Because human capital is related to the human ability to contribute to business organizations in the form of performance (Herbes et al, 2021). Human capital includes intellectual capital which is important in creativity and innovation in improving human performance and carrying capacity of competition in increasing organizational competitiveness (Afriani, 2021). Intellectual capital is the key capital in winning the competition and improving performance (Meijerink & Bondarouk, 2017).

Human capital provides human capabilities as business actors and operators in increasing organizational assets, both intangible assets and tangible assets in improving organizational performance and improving business performance (Olarewaju & Msomi, 2021).

Elements in human capital theory such as education level, study area, training, and prior job experience impact women's entrepreneurship (Adom & Yeboa, 2016). (Adom & Yeboa, 2016). To evaluate the conception and assessment of human capital in entrepreneurial research. This research indicates that the link between human capital and venture development is best characterized as multiple presumptive causes, i.e., human capital is relevant via particular combinations of its indicators (Dimov, 2016). (Dimov, 2016).

The impact of general and firm-specific human capital on export trends and intensity demonstrates variances in the effects of general and particular human capital (Guru & Yadav, 2019). (Guru & Yadav, 2019). While a firm's available human capital (education of business workers) influences both the export propensity and intensity, only some aspects of human capital (employee experience at work) affect export propensity and intensity but not employee training. In addition, the available human capital of enterprises creates changes that are bigger than the impact of specialized human capital on export behavior (Rodríguez & Orellana, 2019).

In the light of inconsistent findings in the current research on the efficacy of entrepreneurship education and training, to assess the influence of entrepreneurial activity on students' perceived human capital and entrepreneurial inclinations. A fuller knowledge of the success of entrepreneurship programs is regarded as crucial, given the sizeable legislative support and budget expenditure on entrepreneurship education globally (Aboobaker & D, 2020). (Aboobaker & D, 2020).

Entrepreneurial tendencies may be influenced by a shortage of resources and technology-mediated human capital investment. Technology is a vital role in the human capital investments that people make via school and employment, and it has been discovered that conversational skills development and career preparation are one of the ways that gig work promotes entrepreneurial goals (Jabbari, Roll, Bufe, et al. & Chun, 2021; Lentini & Gimenez, 2019).

The quality of a person's education strongly influences how quickly their human capital is depreciating. When protecting workers against depreciation, academic (concept-based) education is more effective (Weber, 2014). Furthermore, given the level of human capital, lowering children's domestic duty and boosting parents' migration to high-wage nations does

not inevitably increase the number of children's schooling. Additionally, this article discusses the dangers of underdevelopment in a dynamic environment (Shimada, 2014).

Human capital can never be separated from humans who have human capital and are inherent. Human capital can be increased by a good and conducive working environment. A good and conducive work environment can improve human abilities at work (Zhang et al, 2021).

Human capital is a very valuable capital for organizations. Human capital is the basis of competition for human resources in giving their best contribution. Human capital is an intangible asset that provides the ability to develop human performance in organizations (Subramony et al, 2018). Technology makes it possible to make it easier and easier for humans to work and can improve the quality of human work so that technology is a driving factor for human capital which ultimately improves organizational performance. Aggregate organizational performance is a manifestation of economic growth (Shen et al, 2021; Maneejuk & Yamaka, 2020).

Two distinct mechanisms drive economic development: constant or declining returns and growing returns to scale (Qiao, Ke, Zhang, & Feng, 2020). Supply-side structural changes are intended to promote the emergence of mechanisms with higher returns to scale (Ke, Qiao, & Chen, 2019). Due to the dual economic structure, the developing economy's general financial system has been split between sectors with constant or falling returns to scale and sectors with growing returns to rise. Supply-side structural changes, for example, are primarily concerned with decreasing the falling returns-scale industry and enhancing the returns-scale growing industry (Long, 2019). To achieve long-term sustainable growth and modify the pattern of economic development, supply-side structural reforms must be implemented, modern industrial sectors defined by current knowledge and technology must be energetically developed, and modern industry must be encouraged to thrive—an economy based on innovation (Osadume & University, 2021; Ren & Jie, 2019).

Every stage of human history, the energy and resource issue has been a significant obstacle for humanity to overcome. The central theme of sustainable development is the transformation of traditional economic growth models and exploring new economic growth models (Ding, 2021; Sajeev & Kaur, 2020). Energy consumption has a diminishing influence on economic growth as state wealth grows. This demonstrates that energy efficiency is just as crucial as energy consumption, a key determinant of economic progress (Esen & Bayrak, 2017).

When the stock market, bond market, and insurance industry are open, it benefits economic development (Khatun & Bist, 2019; Raies, 2021). Entrepreneurship is defined as the formation of new businesses and entrepreneurial actions that improve production efficiency and may help explain regional economic development variations. Additionally, the human resource base and encouragement of innovation serve as catalysts for regional productivity efficiency. However, the findings indicate that just creating new businesses is insufficient to spur economic development; these businesses also need to be targeted toward areas that foster technological innovation and attain a good size (Rico & Borrás, 2018).

Entrepreneurship in the technology sector has grown in prominence over several decades, and it contributes significantly to modernization and economic progress. The demand for technology entrepreneurship exists due to the fast growth of technology-based enterprises that are displacing conventional sectors (Nikraftar, Hosseini, & Mohammadi, 2021; Liu, 2020).

Based on prior studies, it's possible to hypothesize that (H1) technology enhances human job performance (Shen et al, 2021; 17 Manccjuk & Yamaka, 2020). Economic growth is dependent on the performance of the real sector, and human capital has a direct impact on this sector. (H2) (Afriani, 2021: Olarewaju & Msomi. 2021: Zhang et al, 2021).

3. Research Method

This study uses vector analysis with the following model:

$TD_t = \beta_1 TD_{t1} + \beta_2 TD_{t2} + \beta_3 HCap_{t3} + \beta_4 HCap_{t4} + \beta_5 EG_{t5} + \beta_6 EG_{t6} + e_t$ (equation 1)

$HCap_t = \beta_1 TD_{t1} + \beta_2 TD_{t2} + \beta_3 HCap_{t3} + \beta_4 HCap_{t4} + \beta_5 EG_{t5} + \beta_6 EG_{t6} + e_t$ (equation 2)

$EG_t = \beta_1 TD_{t1} + \beta_2 TD_{t2} + \beta_3 HCap_{t3} + \beta_4 HCap_{t4} + \beta_5 EG_{t5} + \beta_6 EG_{t6} + e_t$ (equation 3)

Information :

HCap = Human Capital

TD = Technology Development

EG = Economic Growth

β = Constant

t = time period

e = error term

As a result, the variables considered in this research have been described as follows:

Table 1. The Description of Variable

No	Variable	The Description of Variable	Unit of Account
1	Human Capital (HCap)	Human capital in this study is calculated based on the total government investment in education and health in Indonesia in a period of one year	USD
2	Technology Development (TD)	Technology Development (TD) in this study is calculated based on all Indonesian government and private investments in technology in a one year or annual period	USD
3	Economic Growth (EG)	Economic Growth in this study is calculated based on the total production of goods and services nationally in Indonesia in a period of one year or annually	USD

This study uses a research period from 1995 to 2020.

4. Result and Discussion

The autoregressive vector test is presented in table 2.

Table 2. Autoregressive Vector Test

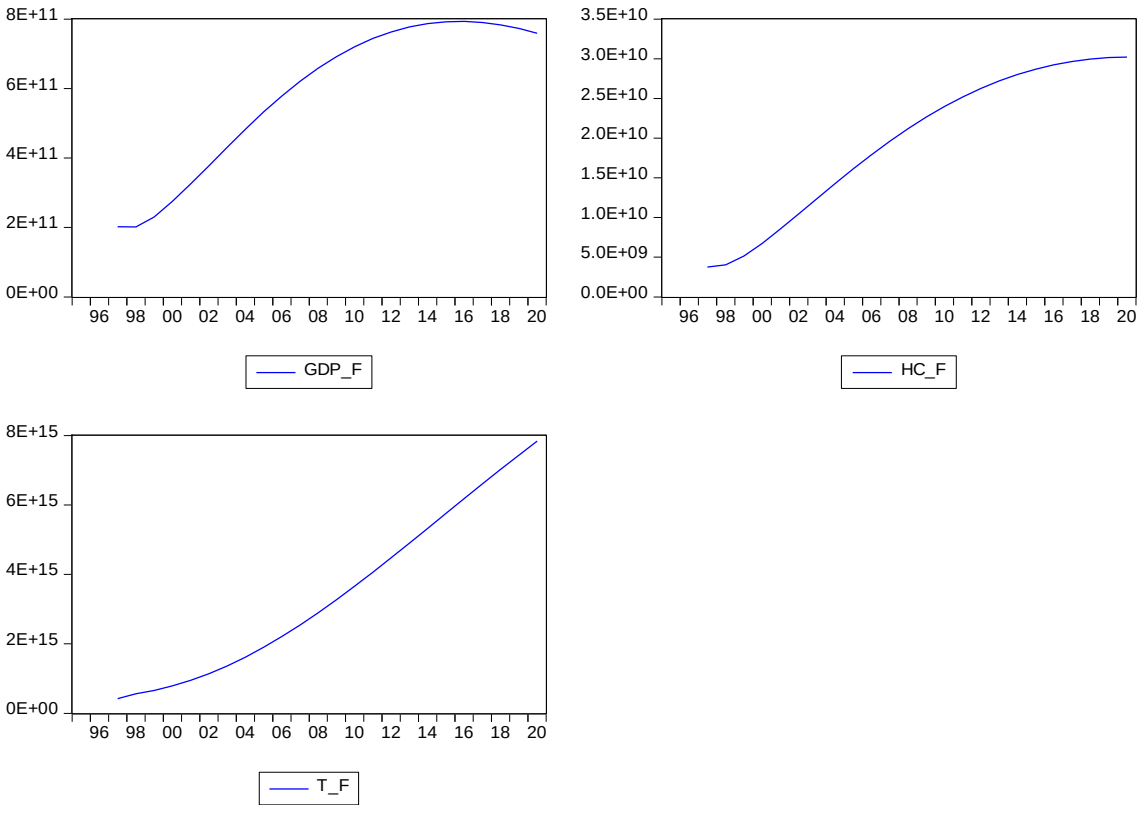
	EG	HCap	TD
EG	0.486572	0.017104	0.52202
	-0.35908	-0.0118	-0.68958
	[1.35504]	[1.44891]	[0.75709]
HCap	2.03798	0.9442	0.20288
	-11.4671	-0.37698	-0.22017
	[2.35787]	[2.50466]	[0.92149]
TD	6.66E-05	4.78E-05	0.058002
	-0.00015	-4.80E-05	-0.27857
	[0.45883]	[0.01002]	[0.20821]
The coefficient of determination	0.880047	0.88526	0.898144
Adjusted R Squared	0.873004	0.880058	0.89749

Economic growth has a causal relationship with itself, Human capital (HCap), and Technology Development (TD) with a coefficient value of 0.486572 for economic growth (EG), 0.017104 for human capital (Hcap), and 0.52202 for Technology Development.

Human capital (HCap) has a causal relationship to economic growth (EG), Human Capital itself, and Technology Development (TD) with a coefficient value of 2.03798 for economic growth, 0.9442 for human capital (Hcap), and 0.20288 for technology development.

Technology Development (TD) has a causal relationship with economic growth (EG) and human capital (HCap) with a coefficient value of 0.00666 for economic growth (EG) and 0.00478 for human capital (Hcap). Technology development also has a causal relationship with technology development itself, which means that technology development is currently influenced by technology development in the past with a coefficient value of 0.058002. The adjusted R-squared is 0.8, which means that the model fit of the tested equation is 80%.

Figure 1. Direction of Movement Forecasting



The results of the vector test concluded that all hypotheses were accepted and in line with Shen et al. (2021), Maneejuk & Yamaka (2020), Widarni & Bawono (2021), Handayani & Sasongko. (2021). However, not in line with Arjun et al. (2020). The direction of movement of each variable is presented in Figure 1.

Based on the forecasting results in figure 1. All variables have a unidirectional direction which illustrates that economic growth (EG), Human Capital (HCap), and Technology Development (TD) have a unidirectional or positive causal relationship. Based on the results of the VECM test and forecasting, it can be concluded that economic growth, human capital and technology development influence and encourage each other.

5. Conclusion and Recommendations

Technology development and Human Resources are two important components in economic development. Human resources are an important factor of the industry and the quality of human resources is determined by the human capital owned by these human resources. Technology helps humans in their work so that they can increase the speed and quality of human performance. Investment in technological development and human capital may increase the speed and quality of human beings, which can lead to increased economic growth and productivity. Human capital and technology need a strong economy to ensure its long-term viability. Human capital and technological advancement are bolstered by monetary expansion, which fosters innovation. The three variables are in a mutually reinforcing relationship so that the three variables are closely related and mutually reinforcing.

Suggestions for the government, technology development must be developed in conjunction with human capital because the two cannot be separated, high technology must also be managed and used by humans with high human capital. Suggestions for academics, this research has data limitations so this research still needs to be developed to reveal more deeply the role of human capital and technology. Human capital and technology are important components of economic growth

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