

The role of education and life expectancy in improving the quality of human resources in Indonesia, Malaysia, and Thailand

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Abstract: In the human and economic development context, this study examines the relationship between human capital, life expectancy, labor force participation rate, and education level in Indonesia, Malaysia, and Thailand. The World Bank's 2001–2021 data are examined using a panel vector autoregressive model. The findings demonstrate the substantial influence of health expenditure from the prior period on present health expenditure. Though not significantly different, life expectancy and education levels from earlier periods also impact present health spending. A slight positive correlation exists between prior labor force involvement and present healthcare costs. An increase in current health expenditure supports an increase in life expectancy. Health expenditure in the previous period had a significant positive effect on education, although insignificant. Life expectancy in the previous period harms current education but is also insignificant. Education in the previous period significantly positively affects current education, indicating a sustained impact of education investment. Labor force participation in the previous period also positively affected education, although not significantly. The prior period's health spending, life expectancy, and educational attainment impact the current labor force participation rate. The length of life has a significant favorable impact on entering the labor sector. Currently being in the job field has a good correlation with prior education as well. These findings support that higher education levels lead to higher labor force participation rates. Life expectancy, health care costs, education level, and prior work experience all influence current life expectancy. While prior life expectancy significantly influences current life expectancy, health expenditures have a negligible negative impact. Prior education positively impacts life expectancy but negatively impacts prior labor force engagement. These results reject the hypothesis that increasing life expectancy causes current health expenditure to increase.

Keywords: human resources; life expectancy; labor force participation rate; education level

JEL Classification: I15; I25; J24; J21

1. Introduction

Enhancing a nation's workforce quality and competitiveness is closely linked to human resource management and national human resource development. Human resource management focuses on the administration of personnel inside a business, including hiring, training, development, and performance reviews. By using efficient management practices, organizations can guarantee that workers have the abilities and know-how to meet company objectives. This increases productivity and creates a positive and supportive work environment (Ngoc and Tien, 2023).

On the other hand, national human resource development includes broader efforts involving the government, education sector, and industry to improve the overall quality of the workforce. This includes education and training programs designed to meet the needs of the evolving labor market, as well as policies that

support innovation and skills development. The synergy between human resource management at the organizational level and human resource development at the national level in a country can create a competent, adaptive workforce ready to face global challenges (Indrawati and Kuncoro, 2021). In addition, investment in human resource development also has an impact on improving community welfare. Skilled and knowledgeable employees contribute more to the company and have a better chance of getting decent and high-paying jobs. This can reduce unemployment and poverty rates, improving the overall quality of life. Therefore, effective human resource management and comprehensive national human resource development are crucial to achieving sustainable economic growth and social welfare (Akdere and Egan, 2020). On the other hand, National Human Resource Development is a broader and more comprehensive effort involving various stakeholders, including the government, education sector, industry, and society (Mukhuty et al., 2022).

The main objective of national human resource development is to improve the quality of the workforce across the country so that it can compete in an increasingly competitive global market. This effort includes various education and training programs designed to meet the needs of the evolving labor market. For example, the government can work with educational institutions to develop curricula relevant to industry needs and provide vocational and technical training for workers (Tri, 2022). In addition, effective employment policies are also an essential part of national human resource development. These policies can cover various aspects, such as protecting workers' rights, increasing minimum wages, and providing social security. Supportive policies assure workers that they can feel more secure and motivated to improve their skills. Another equally important initiative is programs to improve workers' health and wellbeing. This can be in the form of providing health facilities in the workplace, mental wellbeing programs, and campaigns for a healthy lifestyle (Knies et al., 2024).

National human resource development also aims to create a competent workforce ready to face global challenges. A country can increase its competitiveness in the international market by having a skilled and knowledgeable workforce. This has a positive impact on economic growth and improves the quality of life of the community as a whole. Therefore, synergy between various stakeholders in national human resource development is essential to achieve this goal. With coordinated and sustained efforts, national human resource development can become a significant pillar in a country's economic and social development (Knies et al., 2024).

The collaborative efforts to develop a skilled and competitive workforce demonstrate the relationship between National Human Resource Development and Human Resource Management. Effective human resource management at the organizational level is essential to achieving the goals of national human resource development by guaranteeing that workers receive training and development that is in line with industry and labor market demands (Akdere and Egan, 2020).

Programs related to effective recruitment programs, ongoing training, and objective performance appraisals, human resource management can improve employee skills and knowledge to contribute optimally to achieving organizational goals. Conversely, effective national policies and programs can provide a framework

that supports human resource management at the organizational level (Kalyanamitra et al., 2020). The government can create an environment conducive to human resource development through various initiatives and regulations. Education and training programs organized by the government can form a workforce ready to use and with skills relevant to industry needs. In addition, fair and inclusive employment policies can ensure that all individuals have equal opportunities to develop and contribute. Thus, synergy between human resource management at the organizational level and human resource development at the national level is essential to improve workforce quality and a country's overall competitiveness (Piwowar-Sulej, 2021).

Collaboration between the public and commercial sectors in human resource development can result in a skilled, productive workforce flexible enough to respond to new ideas and changes. This will ultimately boost the nation's competitiveness in the international market, promote steady economic growth, and enhance societal welfare. Thus, all stakeholders should place a high premium on funding human resource management and national human resource development (Sadikin et al., 2023).

Human resource management encompasses a variety of essential activities aimed at managing the workforce in an organization. One of the main activities is recruitment, which involves finding and attracting suitable candidates to fill available positions. This process is critical because selecting suitable candidates can significantly impact the organization's performance and productivity. Furthermore, human resource management must guarantee that recently hired staff members receive sufficient orientation to rapidly and successfully adjust to their new work environment (Anwar and Abdullah, 2021). Another essential component of human resource management is employee training and development. Employees receive training to enhance their abilities and knowledge to improve their jobs. On the other hand, development is more concerned with enhancing long-term capacities and getting workers ready for positions of greater responsibility. Organizations may guarantee that their personnel are capable and prepared to tackle the ever-changing issues through wise investments in training and development (Amjad et al., 2021).

Performance appraisal is one of the essential activities in Human Resource management that significantly impacts the organization's success. Organizations can regularly measure employee contributions to achieving company goals through performance appraisal. This process involves evaluating various aspects of employee performance, such as target achievement, work quality, skills, and workplace behavior. Regular performance appraisals help organizations identify areas for improvement and provide constructive feedback to employees (Alsafadi and Altahat, 2021). Effective performance appraisals serve as a tool for measuring performance and as a basis for decision-making regarding promotion, compensation, and career development. Employees who demonstrate outstanding performance can be considered for promotion or increased compensation, while employees who need improvement can be given additional training or guidance. Thus, performance appraisals help ensure that every employee has the opportunity to develop and reach their full potential (Aburumman et al., 2020). In addition, transparent and fair performance appraisals can increase employee motivation and commitment.

Employees who feel their contributions are appreciated and recognized are more motivated to work hard and contribute to the organization. It also creates a positive work environment where employees feel supported and valued. Good human resource management, through effective performance appraisal, can ensure that the organization has a motivated, committed workforce and is ready to achieve its strategic goals. Thus, performance appraisal is an evaluation tool essential to sustainable human resource development (Thneibat and Sweis, 2023).

Organizations that successfully implement effective performance appraisal will have a competitive advantage in creating a quality workforce ready to face future challenges. Therefore, investing in a sound performance appraisal system is an important strategic step for any organization to achieve long-term success (Agustian et al., 2023).

National human resource development includes various policies and programs designed to improve the quality of education, health, and skills of the workforce throughout the country. The government invests in education from elementary to higher education to ensure everyone can access quality education. In addition, vocational training is also a significant focus to provide practical skills needed in the job market. Public health programs are also implemented to ensure the workforce remains healthy and productive (Indrawati et al., 2021).

From elementary to higher education, investment in education is crucial in creating an educated and competent workforce. Quality education not only serves to improve individual knowledge and skills but also plays a vital role in shaping good character and work ethics. Education provides individuals access to moral values, responsibility, and cooperation, all of which are essential elements in the world of work (Lauder and Mayhew, 2020). On the other hand, vocational training provides technical and practical skills that can be directly applied in the world of work. This training allows individuals to master specific skills needed by the industry to contribute effectively and efficiently. The combination of formal education and vocational training is essential because it can produce a workforce with theoretical knowledge and practical skills ready to face the challenges of the ever-evolving industry and technology. Thus, investment in these two aspects of education will ensure that the future workforce is ready to compete in an increasingly competitive global market (Widarni and Bawono, 2021).

Public health programs play a vital role in developing national human resources. Good health is the main foundation for high productivity because healthy individuals tend to be more able to work efficiently and effectively. Therefore, the government strives to implement comprehensive health programs (AlHamad et al., 2022).

These programs include disease prevention through vaccination and health campaigns, promoting healthy lifestyles through education and counseling, and ensuring equitable access to quality health services, including medical facilities and competent health workers. This increase in productivity positively impacts individuals and the economy as a whole (Truong et al., 2022).

A healthy and productive workforce can contribute more to economic growth, increasing the national economy's competitiveness on the global stage. In addition, good health also reduces the burden of long-term health costs so that existing funds

can be allocated to the development of other vital sectors (Abdeldayem et al., 2021). Comprehensive and integrated human resource development, including health, education, and training, is critical to achieving sustainable economic growth and global competitiveness. By investing appropriately in public health programs, governments can ensure that the future workforce is healthy and ready to face the challenges and opportunities of the era of globalization. This will create a positive cycle where good health supports productivity, supporting more substantial and sustainable economic growth (Stofkova and Sukalova, 2020).

Life expectancy is one of the critical indicators that reflects the quality of public health in a country. This figure shows the average age the population is expected to reach, reflecting the effectiveness of the health system and overall living conditions. High life expectancy usually indicates that people have good access to health services, adequate nutrition, a clean environment, and effective health education, so these factors contribute to improving the quality of life of individuals. Health quality impacts individual wellbeing and workforce productivity (Chen et al., 2021). Healthy individuals tend to be more productive, have lower absenteeism rates, and can work more efficiently. This is important for a country's economy because a productive workforce can drive faster and more sustainable economic growth. Therefore, increasing life expectancy is often associated with increasing a country's economic competitiveness (Patel et al., 2022). Countries with high life expectancy usually have a healthier and more productive workforce, which can contribute significantly to global competitiveness. In addition, high life expectancy also reflects social and economic stability that can attract foreign investment and encourage industrial development. Life expectancy is a comprehensive indicator that reflects the community's health conditions and the general quality of life. The government can ensure that its people not only live longer but also live with better quality. This will create a positive cycle where good health supports productivity, supporting a country's more vital and sustainable economic growth (Sarabia et al., 2021).

When evaluating the caliber of human resources, the labor force participation rate and educational attainment are also crucial variables. The percentage of the population actively seeking employment is measured by the labor force participation rate, which indicates the availability of a labor force that is prepared for work. In the meantime, the population's average level of education, including literacy and higher education achievement, is measured by the education level. These two metrics give an overview of the workforce's abilities and skills, essential for fostering innovation and economic progress (Heslina and Syahrini, 2021). Government, business, and the community must work closely together for effective human resource development. The government is essential in providing policies and regulations supporting education and training. In addition, the government can also provide the funds and resources needed for human resource development programs. A favorable atmosphere for personal development can be produced by the government enacting the appropriate policies (Masuda et al., 2022). Getting a good education is essential to developing one's knowledge and abilities. With the proper education, a person can acquire the skills necessary to create and operate effectively. In general, nations with higher levels of education have greater competitiveness in the international market.

This results from a workforce that is more skilled and quick to adjust to technological changes (González-Salamanca et al., 2020).

Furthermore, high-quality education substantially contributes to raising the caliber of human resources. These excellent human resources can enhance the wellbeing of society as a whole, and support sustained economic growth. Thus, investing in education is an investment in individuals and the progress and stability of a country's economy (Werdhiastutie et al., 2020).

Human resources are an essential indicator that reflects a country's quality of human resources. Life Expectancy, which shows the population's average life expectancy, is also an important indicator in assessing the community's quality of life. The Labor Force Participation Rate describes how much of the population is economically active, while the Education Level reflects the population's knowledge and skills (Bãndoi et al., 2020). This study investigates the relationship between human resources, life expectancy, labor force participation rate, and education level in Indonesia, Malaysia, and Thailand. This study aims to understand how these variables influence each other in the context of human and economic development. The three countries, Indonesia, Malaysia, and Thailand, were chosen due to their participation in the triangle growth cooperation in Southeast Asia, which is why our focus is on these nations.

2. Literature review

Human capital improvement can be measured through the Human Capital Index. In Indonesia, the increase in the Human Capital Index from 0.50 to 0.54 between 2010 and 2020 reflects improvements in the education and health sectors (Sari and Tiwari, 2024). However, Indonesia still lags behind its neighbors, such as Malaysia and Thailand. In 2018, Malaysia had a higher Human Capital Index score of 0.62, indicating that the country has better levels of education and health. Thailand also performed better than Indonesia, scoring 0.60 in the same year. This difference shows that although Indonesia has made progress, much work still needs to be done to catch up (Dura, 2022). Improvements in education and health are essential because these two factors contribute directly to the quality of human resources. Good education improves an individual's skills and knowledge and prepares them to adapt to technological changes and the global job market demands. On the other hand, good health ensures that individuals can contribute optimally to economic and social activities (Mulang, 2021).

Sustainable investment in the education and health sectors is essential to improve Indonesia's Human Capital Index. Improving the quality of Indonesia's human resources can increase its competitiveness in the global market, support sustainable economic growth, and improve the welfare of society as a whole (Widarni and Bawono, 2023). This will also help Indonesia to approach or even surpass the Human Capital Index levels of its neighboring countries in the future. Life expectancy in Indonesia has increased, and improvements have occurred in the health sector. However, Malaysia and Thailand have higher life expectations, reflecting better health systems in both countries. The increase in life expectancy in

Malaysia and Thailand shows that investment in the health sector can positively impact society's quality of life and productivity (Widarni and Bawono, 2021).

Life expectancy is one of the critical health indicators, which shows the average age a person can expect to live based on current health and socio-economic conditions. Increases in life expectancy usually reflect improvements in health services, access to medical care, and overall quality of life (Chen et al., 2021). In Indonesia, life expectancy has increased significantly in recent decades. This indicates that Indonesians increasingly gain better access to health services, nutrition, and healthier living environments. This increase in life expectancy has broad positive impacts, including labor productivity. Healthier individuals tend to have more adequate energy and capacity to work, increasing their productivity. In addition, with a longer life expectancy, individuals have more time to contribute to the economy and society. This also allows them to develop more profound skills and knowledge throughout their lives, which can increase efficiency and innovation in the workplace (Gibson and Olivia, 2020). Neighboring countries such as Malaysia and Thailand have also experienced similar increases in life expectancy. In Malaysia, the increase in life expectancy reflects a better health system and broader access to quality medical services. Thailand also shows a similar trend, with increasing life expectancy reflecting improvements in health services and the quality of life of its people. This increase supports individual wellbeing and contributes to these countries' economic growth (Ogawa et al., 2021).

A healthier and more productive population in Malaysia and Thailand can maintain and improve their economic competitiveness in the global market. Increasing life expectancy is a positive indicator of progress in the health sector and quality of life. Increasing life expectancy is an essential goal for Indonesia, as it improves individual welfare and supports sustainable economic growth. By improving health services, access to medical care, and quality of life, Indonesia can continue to increase life expectancy and workforce productivity and support more substantial and sustainable economic growth. Thus, increasing human resources will impact life expectancy (Jayawardhana et al., 2023). Based on previous literature, we construct hypothesis 1 as follows:

Hypothesis 1: Increasing Current Health Expenditure leads to increasing Life Expectancy.

The level of education in Indonesia, Malaysia, and Thailand plays a vital role in various social and economic indicators. In Indonesia, the Human Capital Index shows that children born there will achieve about 54% of their maximum productivity if they receive adequate education and health services. Despite progress, there is still much room for improvement in Indonesia's education and health systems (Seda et al., 2020).

Quality education is the foundation for developing superior human resources to support economic growth and social welfare. In Malaysia, the Human Capital Index is higher, reflecting better investment in education and health. Children in Malaysia have a greater chance of reaching their full potential due to better access to quality education and adequate health services. This increases individual productivity and the country's competitiveness in the global arena (Stofkova and Sukalova, 2020).

Good education allows individuals to develop the skills needed to innovate and adapt to technological change, while good health services ensure that they remain healthy and productive (Haleem et al., 2022). Despite having a slightly lower Human Capital Index than Malaysia, Thailand still performs better than Indonesia. This shows Thailand has also significantly invested in education and health (Pramana et al., 2021).

Children in Thailand have better access to education and health services, allowing them to reach their full potential. As in Malaysia, these investments increase Thailand's economic productivity and competitiveness. Overall, a comparison between Indonesia, Malaysia, and Thailand shows that investment in education and health is vital to improving society's productivity and wellbeing, the productivity and wellbeing wellbeing of society (Lantion et al., 2023).

Indonesia needs to continue improving the quality of education and health services to catch up with its neighbors. In doing so, Indonesian children can reach their full potential, supporting sustainable economic growth and improving society's overall wellbeing (Shaturaev, 2021).

A high level of education plays a vital role in improving the quality of the workforce. In Indonesia, the government has made improving access and quality of education a top priority. These steps aim to improve the Human Capital Index, which is an essential indicator in assessing the capabilities and skills of the workforce. Improvements in education are expected to make the Indonesian workforce more productive and competitive in the global market. Improving access to education means that more individuals can get a decent education, from basic to higher education (Kawuryan et al., 2021).

The government has launched various scholarship and education assistance programs to ensure that education is accessible to all levels of society. In addition, the development of educational infrastructure, such as schools and universities, is also continuously improved to support a better teaching and learning process. The quality of education is also a significant focus. Curricula relevant to industry needs and technological developments continue to be developed. Good education can reduce unemployment rates, increase per capita income, and reduce social disparities. Therefore, efforts to improve access and quality of education must be made to achieve sustainable and inclusive development (Esquivias et al., 2021). The labor force participation rate is also influenced by education. In Indonesia, the labor force participation rate is around 67.7%, and higher education usually increases employment opportunities and participation in the labor force. Malaysia has a slightly higher labor force participation rate, around 68.4%, with good education helping to improve the skills and competitiveness of the workforce. Thailand has the highest labor force participation rate among the three countries, at around 69.2%, with good education contributing to increased skills and labor productivity (Li et al., 2021). Based on previous literature, we construct hypothesis 2 as follows:

H2: Increased Education Level leads to increased Labor Force Participation Rate.

Numerous factors, including household spending, minimum salaries, and the expansion of Micro, Small, and Medium Enterprises (MSMEs), impact Indonesia's labor force participation rate. For instance, as MSMEs expand, more jobs become

available to the community, encouraging more people to enter the workforce. Moreover, rising household consumption may spur demand for products and services and increase employment. Furthermore, if there is a sufficient minimum wage, more people will choose to work because they believe the position offers a respectable salary (Jannah et al., 2021).

The fact that the labor force participation rate is rising and can affect the Human Capital Index makes it noteworthy. However, although Indonesia has demonstrated an increase in its labor force participation rate, the country still lags behind its neighbors, such as Malaysia and Thailand. In 2022, Indonesia's labor force participation rate reached 69.06%, while Malaysia and Thailand had higher labor force participation rates, contributing to a higher Human Capital Index (Dirapradja and Wandebori, 2022).

Due to their high rates of labor force participation, Malaysia and Thailand are more competitive and productive due to having a more significant percentage of working-age citizens actively participating in the labor market. Therefore, Indonesia must keep promoting the expansion of MSMEs, raising household spending, and ensuring that the minimum wage is set moderately to raise the labor force participation rate and Human Capital Index. By doing this, Indonesia can raise the standard of its human resources, promote steady economic growth, and enhance societal welfare (Kikkawa and Gaspar, 2023).

Investments in better education and health will improve the quality of life of individuals, which in turn will increase life expectancy. Countries with a higher Human Capital Index tend to have healthier and more educated populations, contributing to longevity (Triatmanto et al., 2023). Higher education provides the skills and knowledge needed to enter the labor market. Thus, countries with higher levels of education will have higher labor force participation rates as more individuals are eligible to work (Raghupathi and Raghupathi, 2020). A healthier and longer-lived population will be more productive and able to contribute to the economy for longer. Thus, an increase in life expectancy will increase the Human Capital Index, as healthier and longer-lived individuals tend to be more productive and educated (Wang et al., 2021). Based on previous literature, we construct hypothesis 3 as follows:

H3: Increased Life Expectancy leads to an increase in Current Health Expenditure.

3. Research method

This study explores the relationship between human resources, life expectancy, labor force participation rate, and education level in Indonesia, Malaysia, and Thailand. We use data from the World Bank for 2001–2021. Furthermore, the data obtained will be analyzed using a panel vector autoregressive to determine the influence between variables (see **Table 1**).

Table 1. Variable description.

Variable	Description	Source	Unit Analysis
Current Health Expenditure	The present amount of health spending as a percentage of GDP can be explained by this variable. Estimates of current health expenditures include the goods and services utilized in healthcare each year. This index does not include health-related capital expenses such as buildings, equipment, IT, and vaccine reserves for emergencies or pandemics.	World Bank	Percent
Life Expectancy	This variable indicates that the life expectancy at birth is the number of years a newborn would live if the death rates at the time of the infant’s birth remained unchanged.	World Bank	Percent
Education	This variable indicates that the primary completion rate or gross intake ratio to the final grade of primary education is defined as the number of new entrants (enrollments minus repeaters) in the last grade of primary education, regardless of age, divided by the population at the entrance age for the final grade of primary education.	World Bank	Percent
Labor Force Participation	The labor force participation rate is the percentage of people in the 15–64 age range who are economically active or all those who work to produce goods and services within a specific period.	World Bank	Percent

A Panel Vector Autoregressive (PVAR) statistical technique examines the dynamic connection between many variables in panel data. Panel data allows for a more thorough examination by combining time series and cross-sectional data. Panel data and the Vector Autoregressive (VAR) idea are combined in PVAR. Every variable in a VAR model may be expressed as a linear function of its lags (previous values) and the lags of the other variables in the system. By considering panel data—that is, several cross-sectional units seen across multiple periods—PVAR expands on this idea. The PVAR model may be expressed using the following equation:

$$Y_{it} = A_0 + A_1Y_{i,t-1} + A_2Y_{i,t-2} + \dots + A_pY_{i,t-p} + \epsilon_{it}$$

where:

Y_{et} is a vector of dependent variables for the unit (i) at the time (t);

A_0 is a constant vector;

A_1, A_2, \dots, A_p is a coefficient matrix that measures the lag effects of the variables in the system;

ϵ_{it} is a vector of error terms assumed to have a normal distribution with zero mean and constant covariance.

We use the panel vector equation in our study as follows:

$$CEE_{ti} = \beta_0 + \beta_1CHE_{ti} + \beta_2LFE_{ti} + \beta_3EDU_{ti} + \beta_4LFP_{ti} + e_{ti} \quad (1)$$

$$CHE_{ti} = \beta_0 + \beta_1LFE_{ti} + \beta_2EDU_{ti} + \beta_3LFP_{ti} + \beta_4CEE_{ti} + e_{ti} \quad (2)$$

$$LFE_{ti} = \beta_0 + \beta_1LFE_{ti} + \beta_2EDU_{ti} + \beta_3LFP_{ti} + \beta_4CEF_{ti} + e_{ti} \quad (3)$$

$$EDU_{ti} = \beta_0 + \beta_1LFP_{ti} + \beta_2CEE_{ti} + \beta_3CHE_{ti} + \beta_4LFE_{ti} + e_{ti} \quad (4)$$

$$LFP_{ti} = \beta_0 + \beta_1CEE_{ti} + \beta_2CHE_{ti} + \beta_3LFE_{ti} + \beta_4EDU_{ti} + e_{ti} \quad (5)$$

Description:

CEE = Current Education Expenditure;

CHE = Current Health Expenditure;

LFE = life Expectancy;

EDU = Education;
 LFP = Labor Force Participation;
 β = the magnitude of the effect of causality;
 e = Error term.

The steps of PVAR analysis include selecting the optimal lag using information criteria such as AIC or BIC, estimating model parameters using methods such as the Generalized Method of Moments (GMM), and Granger causality tests to test whether one variable can be used to predict another variable, Forecast Error Variance Decomposition (FEVD) measures the percentage of a variable’s variability that can be accounted for by shocks to another variable. Impulse Response Function (IRF) analysis measures how a variable responds to a shock to another variable in the system.

4. Results and discussion

In vector analysis, the research data is first tested stationary to ensure the data is stationary at the same level. The stationary test uses the ADF test explained in **Table 2** below:

Table 2. Stationary test or unit root test.

Variables	Unit Root	Statistics for the Augmented Dickey-Fuller	Probability	Description
Current Health Expenditure	Level	-1.770983	0.3808	No Stationary
	First Different	-3.750569	0.0131	Stationary
Life Expectancy	Level	-1.559048	0.4831	No Stationary
	First Different	-4.119339	0.0055	Stationary
Education	Level	-1.825133	0.3583	No Stationary
	First Different	-5.221311	0.0005	Stationary
Labor Force Participation	Level	-1.343966	0.5854	No Stationary
	First Different	-3.634115	0.0157	Stationary

Based on **Table 2** above, all research variables are stationary at the same level, so further testing can be conducted to determine the optimum lag. The optimum lag test is explained in **Table 3**:

Table 3. Optimum lag test lag length criteria.

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-105.3797	NA	0.661528	10.93797	11.13712	10.97685
1	-63.10979	63.40489*	0.049925*	8.310979*	9.306711*	8.505356*

The optimum lag test through the Lag Length Criteria test produces an optimum lag at lag 1. Therefore, a cointegration test is carried out to ensure that the vector method can be carried out, as explained in **Table 4**:

Table 4. Cointegration test.

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistics	0.05 Critical Value	Prob.**
None*	0.870702	68.00550	47.85613	0.0002
At most 1	0.681524	29.13847	29.79707	0.0594
At most 2	0.298454	7.398505	15.49471	0.5318
At most 3	0.034324	0.663603	3.841466	0.4153
None*	0.870702	68.00550	47.85613	0.0002

The cointegration test described in **Table 4** concluded that the vector method can be used. This is based on the absence of significant factors and indications of cointegration.

According to the analysis results in the **Table 5**, it is known that the current health expenditure vector has a strong correlation with health expenditure from the previous period, as indicated by the coefficient 0.962811, with a significant influence indicated by the t-statistic value of [4.05835]. The life expectancy in the prior era had a beneficial impact on present health spending, but it is not statistically significant, as indicated by the coefficient 0.016749 (t-statistic [0.19967]). The coefficient -0.010516 indicates that education in the previous period had a small negative effect on current health expenditure but was insignificant (t-statistic [0.53284]). The coefficient 0.022269 indicates that labor force participation in the previous period has a small positive effect on current health expenditure. These results accept hypothesis 1 that an increase in Current Health Expenditure causes an increase in life Expectancy. In the EDU (Education) vector, the coefficient of 1.643118 indicates that health expenditure in the previous period had a significant positive effect on current education but was insignificant (t-statistic [0.71610]). The coefficient of -0.259842 indicates that life expectancy in the previous period harms current education but is insignificant (t-statistic [-0.32028]). The coefficient of 0.714848 indicates that education in the previous period significantly positively affects current education (t-statistic [3.74499]). The coefficient of 0.391949 indicates that labor force participation in the previous period positively affects current education but is insignificant (t-statistic [0.63490]). In the LFP (Labor et al.) vector, the coefficient of -0.169177 indicates that health expenditure in the previous period harms current labor force participation but is insignificant (t-statistic [-0.26696]). The coefficient of 0.729642 indicates that life expectancy in the previous period significantly positively affects current labor force participation (t-statistic [3.25636]). The coefficient of 0.057547 indicates that education in the previous period positively affects current labor force participation.

Table 5. P VAR Test.

	CHEE	LFE	EDU	LFP
	0.962811*	-0.408373	1.643118	-0.169177
CHE(-1)	(0.23724)	(0.0087)	-229.454	(0.63371)
	[4.05835*]	[-0.50991]	[0.71610]	[-0.26696]

Table 5. (Continued).

	CHEE	LFE	EDU	LFP
LFE(-1)	0.016749 (0.08388) [0.19967]	0.615058* (0.28317) [2.17203*]	-0.259842 (0.81130) [-0.32028]	0.729642* (0.22407) [3.25636*]
EDU(-1)	-0.010516 (0.01974) [0.53284]	0.108279 (0.06662) [1.62522]	0.714848* (0.19088) [3.74499*]	0.057547 (0.05272) [1.09160]
LFP(-1)	0.022269 (0.06383) [0.34889]	-0.121584 (0.21547) [-0.56427]	0.391949 (0.61734) [0.63490]	0.338788* (0.17050) [1.98705*]
C	-1.419222 -474.715 [-0.29896]	2.478650 -160.253 [1.54671]	161.239 -459.131 [0.35118]	11.719556 -126.804 [0.13561]

Note: * significant.

The results of this study prove that hypothesis 2, Increasing Education Levels causes an increase in the Labor Force Participation Rate, is accepted. The coefficient of 0.338788 indicates that labor force participation in the previous period significantly positively affects current labor force participation (t-statistic [1.98705]). In the LFE (Life Expectancy) vector, the coefficient of -0.408373 indicates that health expenditure in the previous period harms current life expectancy but is insignificant (t-statistic [-0.50991]). The coefficient of 0.615058 indicates that life expectancy in the previous period significantly positively affects current life expectancy (t-statistic [2.17203]). The coefficient of 0.108279 indicates that education in the previous period negatively affected current life expectancy but is insignificant (t-statistic [1.62522]). The coefficient of -0.121584 indicates that labor force participation in the previous period harms current life expectancy. This result rejects hypothesis 3, which states that an increase in life expectancy causes an increase in current health expenditure.

Table 6. Granger causality test.

Null Hypothesis	Obs	F-statistic	Prob
LE does not Granger Cause CHE	19	2.17880	0.1500
CHE does not Granger Cause LE		7.80227	0.0053
EDU does not Granger Cause CHE	19	0.95464	0.4086
CHE does not Granger Cause EDU		0.51862	0.6063
LFP does not Granger Cause CHE	19	1.84731	0.1941
CHE does not Granger Cause LFP		2.01502	0.1702
EDU does not Granger Cause LE	19	2.15874	0.1523
LE does not Granger Cause EDU.		0.02135	0.9789
LFP does not Granger Cause LE	19	0.37281	0.6954

Table 6. (Continued).

Null Hypothesis	Obs	F-statistic	Prob
LE does not Granger Cause LFP.		6.61538	0.0095
LFP does not Granger Cause EDU	19	0.41437	0.6686
EDU does not Granger Cause LFP		1.33263	0.2953
HLT does not Granger Cause GDP		1.01057	0.3268
GDP does not Granger Cause UEM	23	0.08300	0.7762
UEM does not Granger Cause GDP		0.06865	0.7960

Based on the Granger test in **Table 6**, a one-way causal relationship exists between CHE and LE with a probability value of 0.0053. In addition, a one-way causal relationship also occurs between LE and LFP with a probability value of 0.0095. To understand more about the influence of each variable, it is explained in **Figure 1** below:

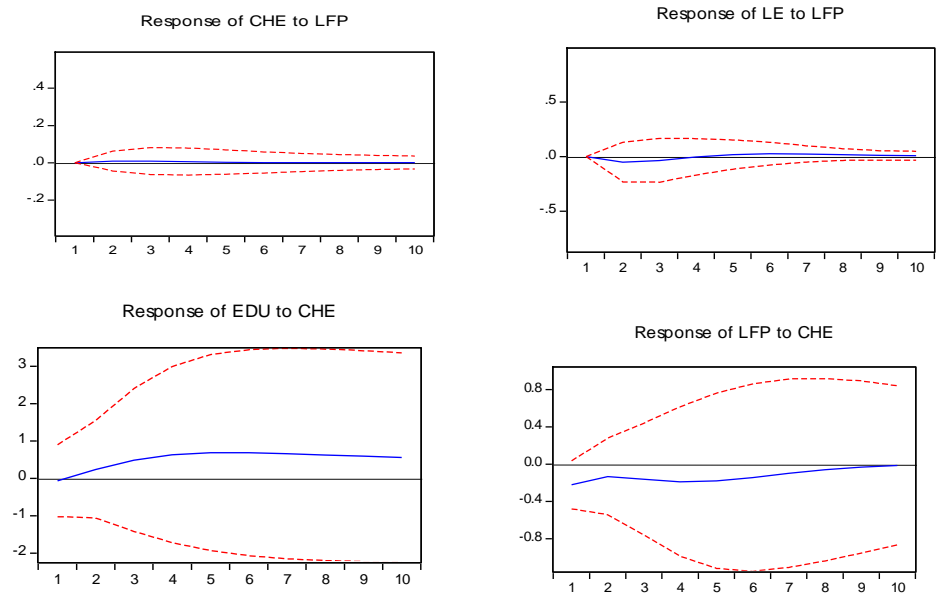


Figure 1. Highlights of impulse response function.

Table 7. Variance decomposition.

Period	SE	CHEE	LE	EDU	LFP
1	2.152923	0.086987	9.262719	90.65029	0.000000
2	2.700843	0.856705	7.853601	90.92265	0.367047
3	2.962616	3.429169	8.311912	87.49416	0.764756
4	3.132864	7.130232	9.720298	82.17742	0.972049
5	3.271776	10.93783	11.34156	76.70213	1.018479
6	3.389297	14.29558	12.65275	72.05457	0.997101
7	3.486424	17.11032	13.50855	68.41948	0.961645
8	3.565888	19.46388	13.99276	65.61388	0.929484
9	3.631428	21.45246	14.24036	63.40365	0.903527
10	3.686249	23.14537	14.35692	61.61484	0.882876

In this research case, it is essential to examine the relationship between the research variables CHE, LE, EDU, and LFP, which change when there is a shock to one of the variables. The CHE response to LFP was stable, with an increase in period two until period 10. The LE response to LFP was similar to before; the stable response was indicated by an increase in period two and was stable until period 10. The EDU response to CHE was positive, drastically increasing from period 2 to period 5. Furthermore, the variable response was stable until period 10. Finally, the LFP response to CHE drastically increased from period 2 to period 6 and remained stable until this period. The response variable was observed to be stable. Variance decomposition is presented in **Table 7**.

The variance decomposition test explains how each variable contributes to explaining its variability. Education level explains the most significant role with a percentage of 90.65% and decreases to period ten by 61.61%. Unfortunately, human resources in the first period explain the variability of education level with a percentage of 0.08%, which increases to period ten by 23.14%. In addition, life expectancy contributes 9.26% in the first period, which increases to 14.35% in the tenth period. These results explain that education level is the most critical factor in explaining variability. In addition, life expectancy and human resources factors explain the variability of education level.

5. Conclusion

This study demonstrates the substantial impact of health spending from the prior era on present health spending. Although life expectancy and education in the previous period also affect current health expenditure, the effects are insignificant. Labor force participation in the previous period has a small positive effect on current health expenditure. These results support the hypothesis that an increase in current health expenditure leads to an increase in life expectancy. Regarding education, health expenditure in the previous period had a positive effect, although insignificant. Life expectancy in the previous period harms current education but is also insignificant. Education in the previous period has a significant positive effect on current education, indicating that investment in education has a sustainable impact. Labor force participation in the previous period also positively affected education, although insignificantly. Several factors, including health expenditure, life expectancy, and education in the previous period, influence current labor force participation. Life expectancy greatly influences labor force participation, whereas health spending has a minor negative effect. Education from the preceding time positively impacted present labor force involvement, while prior labor force participation significantly impacted current labor force participation. These findings support the idea that higher education levels correlate with higher labor force participation rates. Finally, factors such as life expectancy, health care costs, education, and labor force involvement from the prior era all impact contemporary life expectancy. While life expectancy in the past has a significant favorable influence on present life expectancy, health expenditure has a negligible negative effect on life expectancy, and labor force participation has a negative effect. These

results reject the hypothesis that increased life expectancy increases health expenditure.

5.1. Limitation and originality

The World Bank statistics in this study may not fully represent the subtleties of human capital and economic growth in Indonesia, Malaysia, and Thailand. Furthermore, even though panel vector autoregressive models are reliable, they might not wholly account for all possible endogeneities and biases from missing variables. This study is unique in that it examines the dynamic links between health spending, life expectancy, education, and labor force participation across a two-decade period in three Southeast Asian nations. By integrating these factors, the study offers policymakers valuable knowledge of the intricate relationship between human capital investment and economic results to enhance sustainable development in the region.

5.2. Suggestions and policy contribution

To enhance human and economic development in Indonesia, Malaysia, and Thailand, policymakers should prioritize increasing health expenditure, as it significantly impacts life expectancy and education. Investing in education is crucial, given its sustained positive effect on future educational outcomes and labor force participation. Policies to improve life expectancy should also be explained, as higher life expectancy significantly boosts labor force participation. Additionally, efforts to increase labor force participation should consider the indirect benefits of improved health and education. By focusing on these areas, governments can create a virtuous development cycle, where improvements in one aspect of human capital lead to broader economic benefits. This integrated approach can help the achievement of the sustainable development goals and improve the overall quality of life in the region.

Conflict of interest: The author declares no conflict of interest.

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