

## The Nexus Between Health and Economic Growth: Empirical Evidence from Indonesia

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### Abstract

The controversial debate about the relationship between health and economic growth nexus has become one of the most contentious issues in the last two decades of scientific development. The inconsistency of research results that occur makes this hypothesis very interesting to study, especially in developing countries such as Indonesia. This study aims to determine the relationship between health variables such as healthcare expenditure, human development index, life expectancy, and mortality on economic growth with the Indonesian case study as the object of analysis. This study uses secondary data from Indonesia in the period 1985-2021 using the Engle-Granger Error Correction Model and Granger Causality. Based on the estimation of the Engle-Granger Error Correction Model, both in the long term and in the short term, all health variables have a significant influence on economic growth. To prove the causal relationship between health variables and economic growth, a causality granger analysis was used, it was found that healthcare expenditure had a causal (bidirectional) relationship with economic growth. Another causal relationship is also found in the human development index, the rest there is a unidirectional relationship between mortality and economic growth. This finding proved that health plays a crucial role on economic growth. Therefore, the government must be able to take several policies to improve the quality of public health including: prioritize development budget allocations for health infrastructure, implementing cash-transfer and health subsidies program to reduce cost-barriers that limiting healthcare access of poor people.

**Keywords:** Causality Granger, Economic Growth, Error Correction Model, Healthcare Expenditure.

**JEL classification:** C22, I15, O11, O41

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### 1. Introduction

Economic development is a process of increasing total income and per capita income by taking into account population growth accompanied by fundamental changes in the economic structure of a country and the distribution of income for the population of a country (Bloom et al., 2018). Economic development cannot be separated from economic growth, economic development encourages economic growth, and vice versa, economic growth

facilitates the process of economic development. Furthermore, economic development is defined as a process that causes the income per capita of the population to increase in the long run.

One indicator of economic performance is economic growth that represented by gross domestic product. Gross Domestic Product is characterized by a long-term increase in per capita output due to economic and non-economic factors (Piętak, 2014). According to Kramp (2013), gross domestic product is also an indicator of human

welfare. In cross-country data, gross domestic per capita is strongly associated with other welfare-related measures. It is particularly related to life expectancy and negatively related to infant mortality and inequality (Fan et al., 2018). Since parents inherently grieve for their lost children, infant mortality could be considered a measure of happiness. This concept is further explained by Piętak (2014) explains that gross domestic per capita became important component of the socio-economic welfare through availability and access of health facilities, because socio-economic welfare increases along with the quality of health. This means that low levels of health, such as malnutrition, have a major impact on population quality and productivity in a region, especially in developing countries (Bhargava, 2001).

An empirical study conducted by Assan (2020), found the relationship between the level of health and economic conditions in Indonesia,

explains that the 1998 currency crisis in Indonesia had a significant impact on the level of health, which was exacerbated by a decline in government health spending. Furthermore, the increase in health spending contributes to the development of human resources which also leads to an increase in labour productivity. Health Sector Expenditure to GDP ratio in Indonesia from 2000-2018 showed no significant increase. However, there is a positive signal in the trend of life expectancy in Indonesia which has increased in this study period. This condition is also supported by a decrease in infant mortality in the period of this study. A study on the importance of the three variables above has been carried out by Genoni (2012), with research results showing a significant effect of the three variables above. Figure 1 shows the trend of economic growth through gross domestic product per capita in Indonesia.

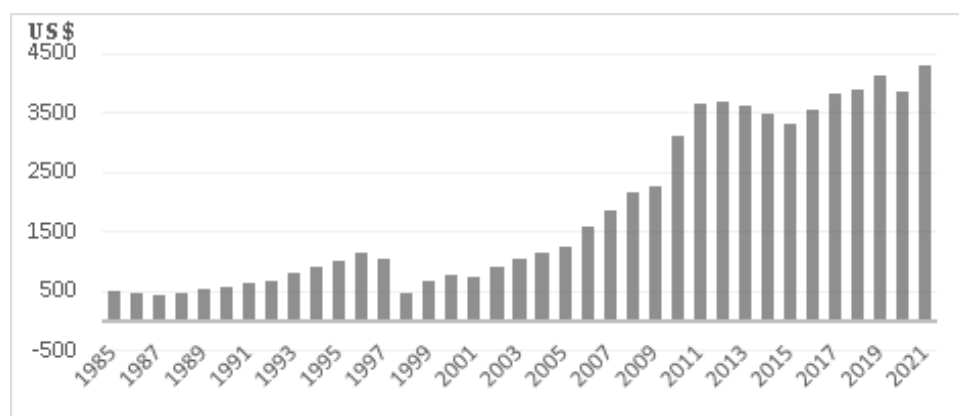
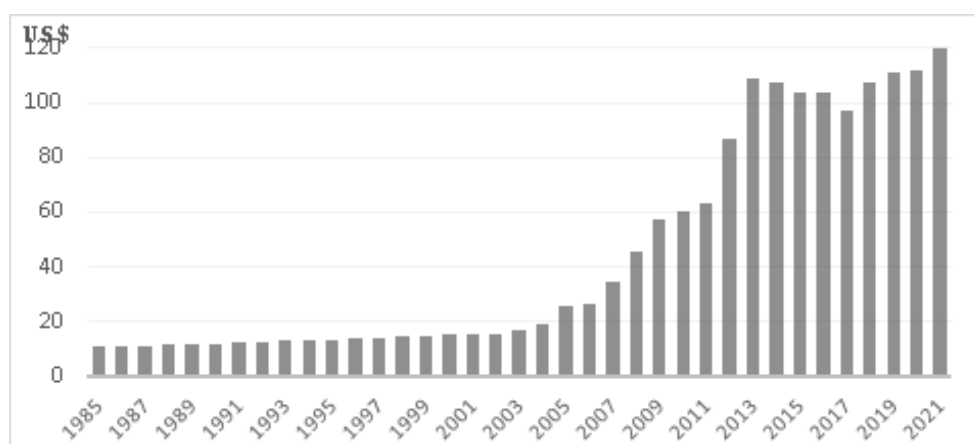


Figure 1. Indonesian Gross Domestic Product per capita 1985-2021

Source: Worldbank, 2022 (Processed)

Figure 1 depicts the trend of economic growth in Indonesia, as represented by gross domestic product per capita, from 1985 to 2021. Although there was a fairly strong economic contraction in 1998 due to the Asian monetary crisis at the time, the trend of economic growth in Indonesia was very positive. Positive growth in the Indonesian economy is also the result of

good performance in economic sectors as well as periodic improvements in the quality of competent human resources. Hypotheses about the relationship between health care spending and economic growth should be investigated further using trend data on health care expenditures in Indonesia, as shown in Figure 2.



**Figure 2. Indonesian Healthcare Expenditure 1984-2021**

Source: Knoema, 2022 (Processed)

Figure 2 represents the growth of Indonesian healthcare expenditure from 1985 to 2021. according to the graph, healthcare expenditure in Indonesia is increasing in a positive trend. In 1985, healthcare expenditure in Indonesia was only US\$ 10.9 per capita, but this figure is expected to rise to US\$ 120 by 2021. The most significant increase began in 2011, and this result reinforces the suspicion that there is a link between healthcare expenditures and economic growth.

Although there have been many studies that explain that the quality of labor, in the form of human capital, clearly contributes significantly to productivity growth, few studies exist have shown interest in discovering the growth potential of human capital outside of education. In line with this, several studies have examined the effect of health spending on economic growth. A study conducted by Anochiwa et al. (2019) in the form of human capital, clearly contributes significantly to productivity growth, but very few analysts have been interested to locate potential human capital growth outside education. Such interest will help ascertain the effectiveness of public health expenditure on health and the impact of good health to economic growth in Nigeria. This research empirically attempts to analyze health outcome and economic growth; proxied by life expectancy at birth and gross domestic product per-capita respectively using quantitative analysis. To avoid the possibility of encountering

simultaneity error, we use the three stage -least -square (3SLS, shows that health sector spending is significant in explaining health output, but not significant for economic growth. Different results were found in a study conducted by Sari & Cahyadin (2021), which found that health expenditure had a significant positive effect on economic growth in Indonesia. Furthermore, using the extended slow growth model, Bala et al., (2021) state that health expenditure per capita proved to have a positive effect on economic growth at the same time also affecting the convergence velocity of countries. Wang (2015) with the World Health Organization raising concerns over the effects of this, in particular among the poor and vulnerable. With the provision of appropriate health care, the population of a country could have better health, thus strengthening the nation's human capital, which could contribute to economic growth through improved productivity. How much should countries spend on health care? This study aims to estimate the optimal health care expenditure in a growing economy. Applying the experiences of countries from the Organization for Economic Co-Operation and Development (OECD empirically found the existence of a cointegration relationship between health expenditure and economic growth.

Empirically, positive relationship between economic growth and health expenditure was revealed for the first time by Mushkin (1962), who established the health-led growth hypothesis which continues to be developed in the existing

literature studies to date. This theory basically says that healthcare expenditure is able to stimulate a country's economic growth, assuming that health is capital, so that investment in health will increase human capital, and in the end be able to boost economic growth (Ertugrul & Mangir, 2015). In fact, health possibly affect economic growth through its impact on human and physical capital accumulation (Boussalem et al., 2014).

The main point of the health-led growth hypothesis is that a healthier population leads to an increase in total factor productivity; healthier populations can work longer hours, can be more productive, can earn higher incomes, can have higher learning abilities and, possibly increase the efficiency of economic human resources (Artekin & Konya, 2020). The health-led growth hypothesis is also closely related to the endogenous growth model theory developed by Romer (1986) which emphasizes the importance of human capital accumulation or health investment in economic growth. The high number of healthy individuals in society has a positive effect on economic productivity by preventing the loss of labour and increasing productivity. Therefore, increasing spending on health plays an important role in the economic growth and development of the country by increasing human resources every day (Atilgan et al., 2017).

Life expectancy also became one of the health indicators that are very important in the measurement of people's welfare. The endogenous growth postulation model developed by Piabuo & Tieguhong (2017), states that there is a positive effect of life expectancy on economic growth. It was explained that health is an integral part of health which directly becomes the main component of economic growth through capital improvement (Bashir et al., 2022). One important thing in this model is that increased production is the main output of improving health so that improving health, one of which is indicated by life expectancy, will increase productivity, and will encourage people to invest in human capital to achieve a better future (Lawanson & Umar, 2021). Furthermore, by Preston Curve by Samuel H. Preston in 1975 established the model that

explained positive relationship between life expectancy and economic growth. Empirically, research on the relationship between life expectancy and economic growth has been carried out by Cervellati et. al (2009), who found that a higher life expectancy significantly triggers sustainable and stable economic growth. In line with this, using the Box-Cox power transfer model, Okunade & Osmani (2020) also found the same empirical evidence regarding the relationship between life expectancy and economic growth.

Economic growth and income inequality are important components in development and welfare creation, so they cannot be separated in the development process. The Human Development Index is one indicator of community welfare as well as one of the parameters of public health in a country (Öztürk & Suluk, 2020). The Human Development Index is formed through three main components, namely income, education, and health, thus enabling the existing relationship between human development index to economic growth (Maqin & Sidharta, 2017). A high Human Development Index will trigger the achievement of community welfare, in which the welfare parameters in question cover many things starting from the health aspect as seen through life expectancy, the education aspect as seen through the average length of schooling and literacy rate, as well as the income aspect represented through per capita real expenditure (Nainggolan & Siregar, 2022). Pradana & Sumarsono (2018), states that the human development index has a positive influence on economic growth, so the increase in the human development index is also an indication of a country's economic growth. Using the natural concept of the human development index, Sušnik & Van der Zaag (2017), reveals the causality relationship between the human development index and economic growth.

Furthermore, mortality is one of the important indicators in determining the total population of a country. Conceptually, mortality has a negative effect on the population, as it is known that mortality is the death rate, which means that the higher the mortality, the lower the population will also decrease. According

to the International Monetary Fund (2004), mortality is one of the important components that can affect the development process of a country. Basically, the mortality rate of the population at a certain time can affect the process of economic development in the future (Corman et al., 2016). Furthermore, Bloom, et al., (2018) found that mortality has an adverse effect on a country's economic growth, and provides other empirical evidence that human capital and technology have a major role in determining the direction of development of a country, especially in developing countries.

Basically, there are several reasons why a bilateral relationship or causality between health and the per capita economic growth of a country can emerge. An increase in health spending in a country will increase social security, peace, safety, and welfare, which leads to an increase in labor efficiency (Bloom & Schünemann, 2018). Government spending helps people with terminally ill conditions to be able to recover and work and specific people with chronic disease conditions (such as diabetes, HIV-AIDS, etc.) to be able to stay at work thanks to the handling and availability of medical equipment. In line with this Canning & Pedroni (2008) stated that people with good health conditions will be able to work harder and be able to think clearly, so they are able to work productively. Mccoskey & Selden (1998) tried to examine it from a micro perspective by examining government spending proxied through health insurance, it was able to reduce the risk of morbidity in a country. However, from a macro perspective, there are not many studies that discuss the relationship between health and economic growth per capita.

The rapid development of technology, creates a new phenomenon and anomaly in social life, including in the aspect of health and development dilemmas. The emergence of the hypothesis of bidirectional causality between health and economic growth has become one of the topics of great debate for economists and researchers in the last two decades. Positivists believe that there is a positive relationship between economic growth and health, their main argument is that exogenous push through increased access

to health and efforts to fulfilled health can ultimately help people get out of the poverty trap (Berthélemy & Thuilliez, 2013). However, on the other hand, some researchers sceptically believe that health problems are evidence of the state's inability to deal with a variety of state structural problems that arise from institutional problems, not from poverty traps or development dilemmas that are thought to create health improvements or vice versa (Bloom et al., 2004). These two points of view eventually created another point of view from economists, who argued that proving the relativity and direction of the causal relationship between health and economic growth required empirical studies, surveys, and in-depth social experiments to provide answers to these questions in the context of microeconomics and economics. macroeconomics in certain countries and time conditions. This emerging research bias can basically be easily explained by the phenomenon of malaria which has become a catalyst for debate in the last two decades, but it will also limit the context of Health which is seen from a narrower perspective.

The existence of research bias and inconsistency of the relationship between healthcare expenditure and economic growth in previous studies, as well as the debate about the alleged causal relationship in it, became one of the bases for compiling this study to provide more empirical results, especially in Indonesia as one of the developing countries with highest population in the world. This research is an attempt to fill up this existing literature gap, because there is no research regarding the link between health expenditure to economic growth conducted in Indonesia. Based on the endogenous growth model and health-led growth hypothesis, this study aims to investigate the empirical cointegration, long and short-run dynamics, and causal relationships between economic growth and health indicator including health expenditure, life expectancy, human development index, and mortality rate in Indonesia.

## 2. Research Method

This research aims to analyze the link between health and economic growth in Indonesia.

This study tries to reveal is that health can encourage economy, through indicators of the development of the level of public health in a country. Health indicators are often seen as an output of successful development, but basically there is also a development hypothesis that states that economic development is also

influenced by a country's health indicators. The data used in this study was collected from World Bank, Knoema, and World Life Expectancy in the period 1985-2021. Several variables used in this study were arranged according to the health and economic growth proxies shown in table 1.

**Table 1. Variables Descriptions.**

Variables	Descriptions	Unit
Economic Growth	The value of gross domestic product divided by the number of country population in certain period of time.	Current US\$
Health Expenditure	Total healthcare expenditure in the health sector for both individual and collective services is divided by the total population in a country.	Current US\$
Human Development Index	A composite index that covers three areas of human development that are considered very basic, which is used as an indicator, namely health: longevity; education sector: knowledge; and economics: decent living.	Index
Life Expectancy	Estimated average additional age a person is expected to live	Number
Mortality Rate	The number of deaths occurring in a given population at risk during a specific period.	Total (death per 1000 person)

Source: Data Processed, 2022

To explain the relationship between health and economic growth in Indonesia, this study uses a quantitative approach using one of the econometric methods, namely the Engle-Granger Error Correction Model. The Engle-Granger Error Correction Model is used to carry out the analysis process because this model is able to provide complete information about the dynamic short-term and long-term relationships between variables integrated with the research model (Salmon, 1988). The basic model, or long-term capital of Engle-Granger ECM, is formulated as follows.

$$\begin{aligned} \ln YCAP_t = & \beta_0 + \beta_1 \ln Hex_t + \beta_2 \ln HDI_t + \\ & \beta_3 \ln LE_t + \beta_4 \ln Mor_t + \varepsilon_t \end{aligned} \quad (1)$$

Next, the basic model is converted into an error correction model, or a short-term model, as follows:

$$\begin{aligned} D(\ln YCAP)_t = & \alpha_0 + \alpha_1 D(\ln Hex)_t + \alpha_2 D(\ln HDI)_t + \\ & \alpha_3 D(\ln LE)_t + \alpha_4 D(\ln Mor)_t + \varepsilon_t \end{aligned} \quad (2)$$

Where Ln is natural logarithmic form, YCAP is Gross Domestic Product per capita, HDI is human development index, LE is Life Expectancy, and Mor is mortality rate, and is residual, t is time.  $\beta_0, \beta_1, \beta_2, \beta_3, \beta_4, \beta_5$  are parameters for the long-term model,  $\alpha_0, \alpha_1, \alpha_2, \alpha_3, \alpha_4, \alpha_5$  are parameters for ECM, D is the difference between observations  $N_t$  to observation  $N_{t-1}$ . This model was adopted by Hartwig (2010). Hence, in this study the model would be improved by the inclusion of mortality rate and causality analysis. In explaining economic growth, several previous research models used per capita gross domestic product as conducted by Piabuo & Tieguhong (2017); Sharma (2018), Ali et al. (2018), Artekin & Konya (2020); and Bashir et al. (2022) economic growth, and life expectancy in Indonesia. The observation period during 1985-2019 used time-series data obtained from the World Bank. Quantitative approach by applying two main models, namely the autoregressive distributed lag (ARDL), hence this study used the same measurement concept to determines the economic growth

The conditions of the Engle-Granger Error Correction model are (1) all variables are not stationary at the level,  $I(0)$ ; (2) all variables are stationary at the first difference,  $I(1)$ ; (3) all variables must be integrated together (cointegration), (4) and in the short-term estimation model the value of  $ECT(-1)$  must be negative and significant (Gujarati, 2004). The stationary test was performed using the Augmented Dickey-Fuller Unit Root Test (ADF) and the cointegration test was performed using the Engle-Granger Cointegration test for residues. The Engle and Granger cointegration test is carried out by running the basic model using OLS, and then testing whether the residuals in the estimated equation are stationary at the level or first difference using the Augmented Dickey Fuller test (Dickey & Fuller, 2012). If the residual is stationary at the level,  $I(0)$ , it indicates that the variables in the integrated model or all variables in the model have a long-term relationship or long-term equilibrium relationship between the variables in the model. If these three conditions are met, ECM analysis can be used. Specifically, in estimating the relationship of economic variables there are often shock conditions, especially in the short term, which can cause disequilibrium, the Engle-Granger ECM model is used to detect how much and quickly the adjustment of the short-term relationship of cointegrated variables to return to equilibrium conditions (Studentmund, 2016).

The second method of analysis is Granger Causality analysis. Granger Causality analysis is used to determine the relationship between the dependent variable and the independent variable and the opposite effect as well, or what is often known as a two-way reciprocal relationship (Kurozumi & Yamamoto, 2007). The Granger Causality model can produce an empirical effect between research variables by making all variables in the research model (Shojaie & Fox, 2021). The first step that must be done is to select the optimum lag. To be able to develop a time series data analysis model through a good Variance Auto-regression (VAR) model, determining the time lag becomes very influential and important (Bressler & Seth, 2010). In the

autoregressive model, time has an important role in determining the results of the analysis, so time lags are something that must be considered. The procedure for determining the optimal lag length can be done by looking at the values of the Schwarz Criterion (SC), Akaike Information Criterion (AIC), Final Prediction Error (FPE), and Hannan-Quinn (HQ) (Rambaldi & Doran, 1996). The most asterisks in each criterion can make the most optimal lag length indication (Granger, 1969). After determining the optimum lag length, Granger Causality analysis can be performed. Granger's Causality approach adapts the VAR model to the variable level, thereby minimizing the risk associated with the possibility of incorrect identification of the serial integration sequence (Enders, 1995). The econometric model of the Granger Causality analysis method according to Granger (1969) are as follows:

$$X_t = \sum_{i=1}^m a_i X_{t-i} + \sum_{j=1}^n b_j Y_{t-j} + \mu_t \quad (3)$$

$$Y_t = \sum_{i=1}^r c_i Y_{t-i} + \sum_{j=1}^s d_j X_{t-j} + v_t \quad (4)$$

Where  $\mu_t$  dan  $v_t$  represents error terms which in the model are assumed to contain serial correlation and  $m = n = r = s$ . Through the regression results of the two equations above, 3 possible patterns of relationships can be obtained as a result of the values of the respective regression coefficients. First, there is a bidirectional relationship when independent has a significant effect on dependent and vice versa. Second, Unidirectional relationship occurs if dependent variable has a significant effect on independent or independent has a significant effect on dependent. The third is no causal relationship occurs when both independent and dependent have no significant effect relationship that indicates by the significance value  $\alpha > 0,05$ .

### 3. Results and Discussion

As a developing country with one of the world's largest populations, Indonesia's economic situation will be heavily influenced by the behavior of its people. One aspect that plays an important role in a country's population is health, and one of the health indicators that is frequently

used to measure the quality of public health access is healthcare expenditure. Supported by the development of hypotheses about the relationship between health and economic growth, which has become one of the research topics on which researchers have concentrated their efforts up to this point. Figures 1 and 2 in the introduction provide empirical evidence that the Indonesian

economy is growing in alongside with the country's healthcare expenditure. This study attempts to visualize the sequence of the relationship between health and economic growth using a variety of supporting health variables such as life expectancy, the human development index, and the mortality rate. Table 2 displays descriptive statistics for the variables examined in this study:

**Table 2. Summary Descriptive Statistics**

Variables	Obs	Mean	Min	Max	Std. Dev	Kurtosis	Skewness
E c o n o m i c Growth	37	1857.619	442.2155	4291.813	1378.392	1.604298	0.558545
Health Expenditure	37	44.55159	10.92435	120.1250	40.48635	1.874367	0.784900
Human Development Index	37	0.613189	0.471	0.722	0.075198	1.882460	-0.276961
Life Expectancy	37	41.55308	19.50	74.51	16.93635	1.925380	0.444340
Mortality Rate	37	2.678405	2.26	3.684	0.374880	3.419617	1.229856

Source: Data Processed, 2022

According to the descriptive statistics in table 2, the data used in this study is time-series data with 37 data observations that is annual in nature. Economic growth, as measured by Indonesia's GDP per capita, is worth an average of US\$ 1857 per year for each population. Furthermore, health expenditure increased significantly from US\$10.9 to US\$120, with an average of US\$44.5. While the human development index in Indonesia has also been quite good, that is 0.722 in 2021, the life expectancy rate has also continued to rise alongside the human development index, reaching a high of 74.51 years. Finally, the mortality rate in Indonesia is still quite under control, the highest mortality rate ever recorded is 3,684 per 1000 population.

### 3.1 Engle Granger Error Correction Model Result

The analytical method used in this study is the Engle-Granger error correction model, this model is used to estimate the long-term relationship and short-term relationship of a variable at a certain time period. The first step that must be taken to analyze the Engle-Granger error correction model is to perform a unit root test on all research variables at level I(0) and first difference I(1). In

conducting the unit root test, Augmented Dickey-fuller calculation is used, with a significance level of value of 5 percent. The first requirement of the Engle-Granger error correction model is that the variable must be stationary at first difference I(1) and not stationary at level I(0).

**Table 3. Unit Root Test for Level and 1st Difference**

Variables	Unit root test in level	Unit root test in 1 <sup>st</sup> difference level
LnYCAP	0.9881	0.0029*
LnHex	0.9817	0.0171*
LnHDI	0.9977	0.0024*
LnLE	0.9959	0.0000*
LnMor	0.0964	0.0000*

Note: \*Significance at p-value  $\leq 0,05$

Source: Data processed, 2022

Based on the results of the unit root test in table 3, it can be seen that at level I (0) all variables in the study have a probability value above value 5 percent (0.05) so that all variables are not stationary at the level level. Whereas



in the first difference the probability value of all variables is below the value of 5 percent (0.05), so it can be concluded that all variables are stationary in the first difference. This shows that this model has met the first requirements of the Engle-Granger Error correction model, the next step of analysis is to perform a cointegration test.

**Table 4. Cointegration Test**

	T-statistic	Prob.
ADF test statistic	-5.313020	0.0001
Test Critical Values		
1% level	-3.626784	
5% level	-2.945842	
10% level	-2.611531	

Source: Data Processed, 2022

The cointegration test results in table 4 show that the ADF statistical test value is greater than the critical value test value at 1 to 10 percent, and the probability value is below value 5 percent, so it can be concluded that the residual variable is stationary at level I (0). Cointegration test shows that all variables in the model have been integrated, so this model is said to have a long-term relationship. Cointegration test results show that this model has met the third requirement of the Engle-Granger error correction model. The next step is to analyze the estimation of the long-term effect of the model using the Engle-Granger Error correction model.

Table 5 represents the short-run estimation results of the Engle-Granger Error Correction Model. The results in the table above show that in the short term the parameters of healthcare expenditure have a positive and significant impact on gross domestic per capita as an indicator of economic growth. This output implies that, if healthcare expenditure increases by 1%, economic growth will increase by 0.05%, assuming *ceteris paribus*. Furthermore, this result implies a positive and significant effect of the human development index on economic growth, an increase of 1 human development index by 1% will increase 0.99% of income per capita with the assumption of *ceteris paribus*. It is empirically proven that in the short-term life expectancy also has a significant positive effect on per capita income, a 1% increase in life expectancy will be followed by a 0.0009% increase in

per capita income. While mortality has a negative and significant effect on per capita income, a 1% increase in the mortality rate will reduce per capita income by 0.12%. The coefficient of  $ECT_{t-1}$  shows the speed of adjustment toward equilibrium and negative sign and statistically significant implies a convergence from short run to long run. The speed is 0.1463 means that 14.63% of this disequilibrium is corrected within 1 year.

**Table 5. Short-run Estimation Result of Engle-Granger Error Correction model.**

Explained Variable: D(Ln of GDP per capita (YCAP))	
D(Ln (Hex))	0.055865 (2.905547)***
D(Ln (HDI))	0.997412 (10.88490)***
D(Ln (LE))	0.000957 (3.568788)***
D(Ln (Mor))	-0.126777 (-2.363086)**
$ECT_{t-1}$	-0.146378 (-2.332933)**
Constant	-0.008884 (-18.41798)***
Adjusted R <sup>2</sup>	0.859973

Note: \*\*\*significance at p-value  $\leq 0,01$ ; \*\*significance at p-value  $\leq 0,05$ ;  
t-statistics are stated in parentheses.

**Table 6. Long-run Estimation Result of Engle-Granger Error Correction model**

Explained Variable: Ln of GDP Percapita (YCAP)	
Ln (Hex)	0.119983 (5.844415)***
Ln (HDI)	0.956596 (5.350500)***
Ln (LE)	0.453318 (2.820461)***
Ln (Mor)	0.191903 (-2.430361)**
Constant	-2.727450 (-6.005937)***
Adjusted R <sup>2</sup>	0.859973

Note: \*\*\*significance at p-value  $\leq 0,01$ ; \*\*significance at p-value  $\leq 0,05$ ;  
t-statistics are stated in parentheses.

Table 6 represents the estimation results of long-run Engle-Granger Error Correction Model. The above results indicate that there is a positive and significant effect between healthcare expenditure and income per capita, a 1% increase in healthcare expenditure will provide a 0.11% increase in per capita income assuming *ceteris paribus*. The human development index is also proven to have a positive and significant effect on per capita income, an increase of 1 unit measurement in the human development index will be followed by an increase in per capita income of 0.95% with the assumption of *ceteris paribus*. Consistent results are also found in life expectancy which has a positive and significant effect on per capita income, an increase in life expectancy of 1% will create an increase of 0.45% in per capita income. Finally, with a negative and significant direction, a 1% increase in mortality will reduce per capita income by 0.19%. This result implies that the increase in healthcare expenditure and health indicators affect triggering inclusive economic growth, this is because health expenditure is the most important component in the creation of good human capital formation (Prasetyo et al., 2019). Through increasing healthcare expenditure, it can also create an increase in human productivity and ultimately be able to provide greater output to the economy.

It is known that healthcare expenditure, both in the short and long term, is able to drive economic growth in Indonesia, similar findings were also obtained from research conducted by (Astuti & Lestari, 2020). Ye & Zhang (2018) provide empirical evidence in OECD countries, by increasing the amount of government spending on the health sector able to provide health protection, services, and equity for the community, the more allocation of health sector expenditures will also increase the effectiveness and variety of policies offered by the government. In creating social welfare. In line with that, Mayer & de Investigacion (2001) state that increasing welfare, population health, and quality of life will encourage the growth of the country's human development index, which is also correlated

with indicators of the country's development success and will create greater economic growth (Amiri & Ventelou, 2012). Furthermore, based on the Granger Causality analysis, health sector expenditure from the government has a bidirectional relationship to economic growth. Similar findings were also found by Devlin & Hansen (2001), they state that the higher allocation of government spending for healthcare sector will be able to promote economic growth through increased productivity and quality of life of the population through the role of capital investment (Yun & Yusoff, 2015).

This study also confirmed the relationship between life expectancy and economic growth, which is consistent with previous research (Mahyar, 2016). Endris (2008) states that a prolonged life expectancy represents a higher standard of living, which ultimately exemplifies an individual's high productivity. This outcome is consistent with the classical theory of economic growth., The workforce, as one of the factors of the production function, has a substantial impact on the nation's economic growth (Gürler & Özsoy, 2018). Interestingly, Sirag et al., (2020) found empirical evidence regarding the u-shape relationship between life expectancy and economic growth in 112 countries around the world. Contradictory findings were found by Lønstrup & Hansen (2016), who found that there was a negative effect between life expectancy and economic growth in developing countries. According to Misango (2022), low-income developing countries have a lower life expectancy at birth, whereas high-income developing countries perform well. As a result, there was a positive correlation between Life Expectancy at Birth and Gross National Income per capita, although the effect was not significant in middle-income countries. Furthermore, Castelló-Climent & Doménech (2008) suggest that the life expectancy mechanism has a close relationship with inequality and human capital accumulation. These findings confirm that global efforts to alleviate poor health conditions in developing countries can be remarkably efficient, however,

they also cast doubt on claims that poor health conditions are the root cause of some nations' poverty (Acemoglu, 2006).

Theoretically, the relationship between life expectancy and per capita income as an indicator of economic growth is described in the Preston Curve by Samuel H. Preston (1975). This result confirms the existence of the Preston Curve in Indonesia. In line with the result, Omotor & Osakede (2021), prove that evidence of the Preston Hypothesis exists in Africa, the rises in life expectancy are due more to investment, immunization, and fertility rate than to per capita income. The speed and breadth of health transitions influenced aggregate tendencies and the distribution of life expectancy (Leandro, 2022). The existence of the Preston Curve in Indonesia is an essential fact that the government and policymakers must consider when developing policies to improve public health and encourage life expectancy in order to increase the country's economic output (Jetter et al., 2019).

The result implies the positive and significant correlation between the human development index and economic growth. The same result obtained by Ali et al. (2018), using the 2SLS technique proved that the human development index is highly correlated and able to boost economic growth. In line with this result, Bhowmik (2018) found the same result in India using province-level panel data. The study's findings and results suggest that more government efforts should be focused on human capital development. Policymakers should provide good and better policies regarding health care and facilities for both the poor and the rich in terms of lifespan (Appiah et al., 2019). Furthermore, Iskandar (2017) found that that human development index had negative effect to economic growth using special autonomy approach.. Runtuuwu & Kotib (2021) states that the use of special autonomy funds for the human development index is still getting higher, so the future is expected to necessitate redistribution based on regional needs so that the special autonomy funds can be utilized effectively and efficiently.

Furthermore, based on the results of the analysis above, mortality is estimated to have a

significant negative effect on Indonesia's economic growth in the long term, the same result was also found by (Wardhana et al., 2020). In line with this result Rocco et al., (2021) also stated that reducing mortality and morbidity could increase gross domestic per capita growth. According to Li et al. (2018) the government needs to pursue policies in reducing mortality, considering mortality is able to increase economic growth in the long term. Wyckoff & Clark (2002), suggest that in addressing the impact of economic efforts in promoting economic growth, a payoff is needed in the form of improving the health and quality of the population. This concept can also be seen as a benefit-cost analysis on a priority scale and the formulation of health policies at the national level. national and international (Ranganathan et al., 2015).

Even more deeply, the economic crisis that occurred due to the decline in the country's economic performance had a major impact on health through public health behaviors such as impaired sleep hours, mental problems, and decreased body endurance (Corman et al., 2016). In line with this, several studies have shown that people will tend to have deteriorating health (countercyclical effect) during periods of economic crisis (Palència et al., 2020). The recession that occurred in developing countries, namely Brazil, significantly contributed to the increase in mortality. However, increased spending on social protection and health from the government is able to reduce the risks and impacts that occur, especially for vulnerable population groups (Hone et al., 2019). This evidence provides support for stronger and consistent health and social protection systems globally. The outcome emphasizes the importance of investing in health technology and infrastructure, as well as enhancing the capacity of the public health service system in a sustainable manner, particularly for developing countries like Indonesia in order to boost economic growth (Spiteri & Brockdorff, 2019). The following Table 7 presents the results of optimum lag test. In time series data analysis, the optimum lag test is carried out to eliminate autocorrelation problems in time series data and is very useful in testing stability tests.

### 3.2 Optimum Lag Test

Table 7. Lag Optimum Selection Criteria

Lags	LogL	LR	FPE	AIC	SC	HQ
0	219.9742	NA	2.22e-12	-12.64554	-12.42108	-12.56899
1	553.7238	549.7052	2.93e-20	-30.80728	-29.46049	-30.34799
2	617.2363	85.92874*	3.36e-21*	-33.07272*	-30.60361*	-32.23069*

Source: Data Processed, 2022

Based on the optimum lag selection test, it is known that lag (-2) is the optimal lag length for this research model, because it is the most

asterisks in each criterion. By using the lag length (-2), Granger Causality analysis can be carried out which is shown in table 8 below.

### 3.3 Granger Causality Result

Table 8. Causality Granger Analysis Result of Gross Domestic Product per capita

Null Hypothesis	Obs	F-Statistics	Probability
LnHex does not Granger Cause LnYCAP	34	3.33101	0.0499**
LnYCAP does not Granger Cause LnHex		3.38615	0.0477**
LnHDI does not Granger Cause LnYCAP	34	4.74710	0.0165**
LnYCAP does not Granger Cause LnHDI		4.81137	0.0157**
LnLE does not Granger Cause LnYCAP	34	1.91021	0.1662
LnYCAP does not Granger Cause LnLE		0.07199	0.9307
LnMor does not Granger Cause LnYCAP	34	1.93199	0.1631
LnYCAP does not Granger Cause LnMor		9.28374	0.0008***

Source: Data Processed, 2022

Based on the results of the Granger causality estimation, the result implies that there is a causal relationship between healthcare expenditure and per capita income, this means that the two variables influence each other. This result is in line with the results of research from which states that economic growth will also affect the size of the government's health sector allocation, the higher the gross domestic product per capita of a country, the government will have more options and a portion of government fund allocation that can be used for expansion. economy, infrastructure development, capital formation, fiscal policy formulation, and others.

Furthermore, the human development index is also empirically proven to have a two-way causal relationship with per capita gross domestic product as a proxy for economic growth. This result implies that these two variables have the ability

to influence each other. The same result was obtained by Sušnik & Van der Zaag (2017), using the national wealth and resource exploitation approach. Furthermore, Clark (2013), states that at the micro level there is great potential for a positive causality between human development index and economic growth. Individual and household consumption can be an essential element in widening human development and may respond more closely to the real needs of the population than safety nets do at the micro level. At micro level the distribution of increased income from economic growth will also have a significant impact on human development at the macro level. Because poorer households spend a higher proportion of their income on goods that directly promote better healthcare and education, economic growth that benefits the poor will have a greater impact on human development, both

through increased food expenditure and education (Gulcemal, 2020). This evidence confirms that the causality between human development index and economic growth had been in line and well-explained theoretically.

While mortality has a one-way influence unidirectional relationship to economic growth. However, the estimation results above suggest that the life expectancy variable does not have a causal effect. These results provide empirical evidence that basically mortality and life expectancy are variables that have a major influence on the formation of per capita income, and these two variables have not been able to provide a strong influence on the formation of per capita income, so it is only proven that these two variables have a significant effect. significant in the long and short term.

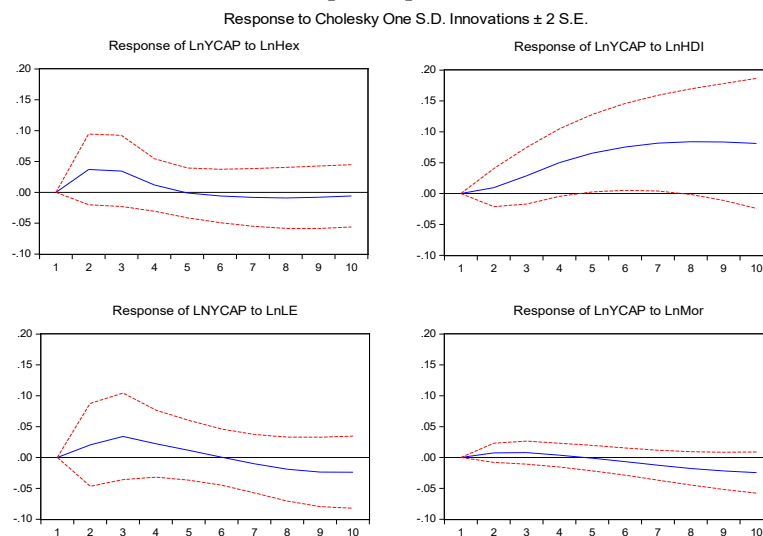
To obtain more empirical findings, Impulse Response Function (IRF) analysis was used to see the shock response of the healthcare expenditure, human development index, life expectancy, and mortality rate to per capita income as a proxy for economic growth. According to (sensors) using the Impulse Response Function, it can be seen how long the shock effect is experienced by the variable per capita income. The vertical line shows the magnitude of the response given when the shock occurs, while the horizontal line shows

the period or how long the response is given when the shock occurs (Beyer & Farmer, 2021).

### 3.4 Impulse Response Function Result

Based on the estimation results in table 7, the result implies that there is a shock arising from healthcare expenditure which resulted in an increase in economic growth in the period 1-3 years by 4 percent. However, in the long term, the shock will continue to decline until it is recorded at -1 percent. A fairly large shock will occur in the human development index, and a fairly stable and significant increase will occur until the 8th year period until a shock of 9 percent is recorded at the end of the period. Meanwhile, life expectancy will provide a volatile shock, in the first 3 periods, it will give a positive shock of up to 3 percent but will continue to decline to -2 percent in the final period. Last, mortality tends to have a relatively small shock, which is below one percent, with an increasing trend in the first 3 periods and continued with a decreasing shock until the end of the period. Overall, it can be concluded that the government also needs to maintain the stability of the existing health indicator variables, especially on healthcare expenditure, human development index, and life expectancy to minimize the potential for a recession or excessive shock in economic growth.

**Table 9. Results of Impulse Response Function (IRF) Analysis of Gross Domestic Product per capita.**



#### 4. Conclusions

This study succeeded in confirming the endogenous growth model and the health-led growth hypothesis in Indonesia as a developing country. This finding also provides evidence that health plays a vital role in economic growth, and it settles the debate over inconsistent research findings in previous studies. Overall, this study was successful in demonstrating that health expenditure, human development index, and life expectancy have a positive and significant impact on economic growth in the short and long term. Meanwhile, the mortality rate has a negative and significant impact on both short and long-term economic growth. Granger causality analysis reveals empirical findings in which health expenditure and the human development index have a causal relationship with economic growth. The use of the Engle Granger error correction model, Granger causality, and Impulse Response Function contributes to filling up the research bias and inconsistency that occurred in previous studies and provides more empirical results regarding the impact of health on economic growth.

This finding proved that health plays a crucial role on economic growth. Therefore, the government must be able to take several policies to improve the quality of public health in an effort to create a more inclusive economy. The government should prioritize development budget allocations for health infrastructure development in order to improve community access to health services. Furthermore, the government also recommends to implement cash-transfer policies and improve healthcare subsidies to reduce cost-barriers that limiting healthcare access of poor people. The government should also prioritize programs for dealing with dangerous diseases in term of decreasing mortality rate. Through the health-led growth hypothesis, this study only proves the relationship between healthcare expenditure and economic growth in Indonesia. This is a limitation of this study, so it is suggested that future research on this topic be conducted on a larger scale, differs variables, and more advanced research approach.

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