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# The Impact of Health on Per Capita GDP in Indonesia

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## Abstract

The purpose of this study was to estimate the influence of health on per capita GDP in Indonesia in 1986-2018. Health was proxied by three variables including health expenditure, infant mortality rate and life expectancy. The variables expressed a significant indicator to assess health level in a country. Furthermore, the estimation was carried out in the short-run and long-run based on the ARDL-ECM model. The results showed that the feasible ARDL model was ARDL (2, 0, 0, 0). In long-run, per capita GDP was significantly influenced by health expenditure, infant mortality rate and life expectancy. This expressed significant implication of the health level for increasing the economic performance and welfare in Indonesia. Meanwhile, in short-run, it was only influenced by infant mortality rate and (ECT (-1)). Further, Cusum and CusumQ tests showed the empirical model was stable. The policy implication directs that the government can improve the quality of public health, increase health expenditure as a fiscal stimulus, and support increasing public income.



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## INTRODUCTION

Humans are one of the production factors that can produce a high amount and high-quality output. The expected final result is an increase in the economic level. This means that the economic level cannot be achieved without the availability of quality human resources. The human resource quality can be measured based on education level, mental and physical health, and work productivity. Several scholars stated that healthy and productive humans will encourage better economic performance (see Bloom, Canning & Sevilla, 2001; Akram, Padda, & Khan, 2008; Sharma, 2018; Mihalache, 2019; and Gavurova, Rigelsky & Ivankova, 2020).

One of the economic performance indicators is economic growth. Economic growth is characterized by an increase in output per capita in the long run due to economic and non-economic factors. In general, Piętak (2014) described that economic growth measures community socioeconomic welfare. Socio-economic welfare increases along with health quality. This means a low level of health such as malnutrition significantly influences workforce productivity in underdeveloped countries (Bhargava, 2001).

Empirically, the public health level has direct and indirect effects on economic growth (Lustig, 2006). The improvement of health services has a direct effect on the level of public health and an indirect effect on strengthening economic growth (Nishiura, 2004). Furthermore, public health levels can increase workforce productivity and per capita GDP (Akram, Padda & Khan, 2008), the quality of human capital and economic growth (Sharma, 2018 and Mihalache, 2019), high productivity and income (Schultz, 2005; Weil, 2007; and Husain, 2010). Bloom, Canning & Sevilla (2001) stated that education, experience, and health are inputs of human capital. In addition, Aisa & Pueyo (2004) stated that the education level will strengthen human capital to increase productivity, so it is necessary to provide public health services and infrastructure for long-term growth.

Nordhaus (2002) stated that the public health level can be used as a standard measurement of national income. This means there is a relationship between income and health (Deaton, 2002). This is in line with a study by Lustig (2006) that health as human capital has a direct effect on economic growth and an indirect effect on the health of children which can affect their income as an adult.

Empirical studies on the relationship between levels of health and economic conditions in Indonesia had been conducted by Waters, Saadah & Pradhan (2003) and Genoni (2012). Waters, Saadah & Pradhan (2003) explained that the monetary crisis in Indonesia in 1998 had a significant influence on the level of health which was exacerbated by a decrease in government health expenditure. In addition, Genoni (2012) found that the condition of Indonesian society at a productive age which has decreased health can reduce productivity and household consumption level.

The health expenditure to GDP ratio in Indonesia in 1986-2018 showed no significant increase. However, there was a positive signal that life expectancy had an increase during the study period. This condition was supported by decreased infant mortality during study period. Identification of the important role of the three variables on the economy had been conducted by Akram, Padda, & Khan (2008). Thus, this study adopted their empirical model by selecting these three variables as determinants of per capita income in Indonesia in 1986-2018.

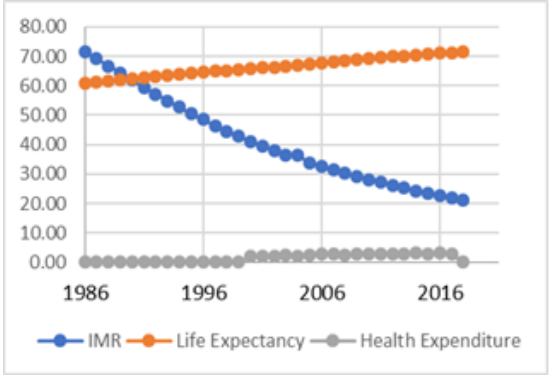



**Figure 1**. The Development of IMR, Life Expectancy, and Health Expenditure in Indonesia (%).
Source: The World Bank (2020)

Sharma (2018) confirmed that life expectancy is an indicator of health quality. In addition, Husain (2010) described the most important factor in health is the mortality rate, where the mortality rate is a demographic problem in both developed and developing countries. A country with a high mortality rate and the low fertility rate is likely to undergo a heavy demographic transition because it will produce many old-age dependency ratios. Therefore, mortality rates should be directed toward decreasing trends. Decreased mortality rates can occur because of the supply of food and nutrition (Fogel, 1994).

The purpose of this study was to estimate the influence of health on per capita GDP in Indonesia in 1986-2018. In 1986, there were health issues that received serious attention from the government, especially in Eastern Indonesia, such as malaria, dengue fever, and leprosy. This condition also occurred before and after 1986 but can be controlled by the government. For this reason, a study on the relationship and influence of health on the Indonesian economy is appropriate.

The contribution of this study to the literature includes the analysis of health variables on per capita GDP, the ARDL-ECM analysis method, and the policy implications of increasing health allocations to increase the national economy. The three health variables including infant mortality rate, life expectancy, and health expenditure are variables that are widely used in empirical studies. Meanwhile, the ARDL-ECM analysis method is relatively rarely used in the analysis of the relationship between health and the economy. Furthermore, the significant implications of health quality policy on per capita GDP occur in the long run, whereas in the short run it was insignificant.

Economic theory to explain the relationship between human capital and output is the economic growth by Solow. Solow (1956) assumed only one commodity, denoted as Y (t). Income is divided into 3 parts, namely consumption, saving, and investment. Saving is assumed to be constant, so the saving rate is expressed in sY (t). The public capital stock is expressed in K (t). In economic growth theory, it is assumed that constant returns to scale.
The result is:

$$K = sF(K, L) \quad (1)$$

As a result of population growth which causes an increase in the workforce and technology which is considered constant, it is obtained:

$$L(t) = L_0 e^{nt} \quad (2)$$

L stands for total employment, in (2) L stands for the available supply of labor. Assuming that full employment is constant, substitute (2) in (1) so the basic equation which determines the time path of capital accumulation that must be followed if all available labor employed is:

$$K = sF(K, L_0 e^{nt}) \quad (3)$$

The Cob Douglas aggregate production function is notated as follows (Weil, 2007):

$$Y_i = A_i K_i^{\alpha} (H)^{1-\alpha} \quad (4)$$

Where Y is output (GDP), K is physical capital, A is country specific productivity term, and I is indexes country. Thus, the labor composite: $H_i = h_i v_i L_i$. Where $h_i$ is per worker human capital in the form, $v_i$ is health, $L_i$ and number of workers. The Cobb-Douglas can be written as follows:

$$Y = Ak^{\alpha} L^{1-\alpha} = LAK^{\alpha} L^{1-\alpha} L^{-1}$$

$$LAK^{\alpha} L^{1-\alpha} = LAK^{\alpha} \quad (5)$$

By assuming the market is in full employement conditions, then the marginal product at each factor of production is obtained. This means share of the total output produced by capital will be equal to the amount of capital multiplied by the marginal product, based on the equation (4) and (5), capital to total output is:

$$K (MP_K)/Y = (KA\boldsymbol{\alpha} k^{\alpha-1}) = LAK^{\alpha}$$

$$= A(A)^{-1} \boldsymbol{\alpha} (k)(k)^{\alpha} (k)^{-\alpha} (k)^{-1}$$

$$= \boldsymbol{\alpha} \quad (6)$$

K L = k and the share of labor is the number of workers multiplied by the marginal product and divided by the total output, it could be concluded that the share of each K and L inputs are α and 1-α which shows the contribution of each input factors to the Y.

$$L (MP_L)/Y = [LA(1-\boldsymbol{\alpha}) k^{\alpha}] / LAK^{\alpha}$$

$$= 1- \boldsymbol{\alpha} \quad (7)$$

Arora (2001) stated that in neoclassical theory, productivity is the key to growth, while health as an endogenous factor which refers to theories that explore how productivity changes from within the economy, or productivity affects growth permanently, the specification of the theory states that:

$$\Delta \ln y_t = \mu + \xi \ln h_t + e_t \quad (8)$$

where Δln yt is the first difference of the natural logarithm of Per capita GDP, μ and ξ are parameters, lnht is the natural logarithm of the health related variable under consideration, and et is an error. This study was divided into several sections. The sections are the introduction, method, result and discussion, conclusion and policy implication, and references.

## RESEARCH METHODS

This study used per capita GDP, infant mortality rate, life expectancy, and health expenditure data. Data were collected from statistical publications of the World Bank in

1986-2018. This study period reflects the health outbreak cases in Indonesia especially before 2000. This means the determination of data series was not only related to the fulfillment of observations or time series but also health issues during the study period.

Per capita GDP is the gross domestic product divided by the mid-year population (constant 2010 US $). This data reflects Indonesian community welfare during the study period. Meanwhile, there were three explanatory variables reflecting health conditions in Indonesia, namely health expenditure, infant mortality rate, and life expectancy. Health expenditure is the current level of health expenditure expressed as a percentage of the gross domestic product including annual health care in % of GDP. The infant mortality rate is the number of infants who die before one year of age per 1,000 live births. Meanwhile, life expectancy describes the life expectancy at birth expressed in the total population.

**Table 1.** Definition of Operational Variable

| Data/Variable | Definition of Operational Variable | Data Source |
|---|---|---|
| Per capita GDP (GDPC) | The gross domestic product divided by the mid-year population (constant 2010 US$). | World Bank |
| Infant Mortality Rate (IMR) | The number of infants who die before one year of age per 1,000 live births (per 1,000 live births). | World Bank |
| Life Expectancy (LE) | The period for a newborn to survive if the pattern of death at birth remains the same throughout the life (total population). | World Bank |
| HealthExpenditure to GDP ratio (HE) | Estimated health expenditures including expenditure on health care goods and services each year, excluding capital expenditures for health, vaccines, emergencies, or epidemics (% of GDP) | World Bank |

Akram, Padda & Khan (2008) estimated influencing health and economic factors on Per capita GDP. Health factors consist of health expenditure, life expectancy, mortality rate, population per bed, and age dependency. Meanwhile, several economic factors include openness and investment. To explain the relationship between health and Per capita GDP, this study specified three health variables as independent variables namely health expenditure, infant mortality rate, and life expectancy. Thus, this study showed a model for estimating health impact on Per capita GDP in Indonesia in 1986-2018. In particular, the econometric model applied by Akram, Padda & Khan (2008) was the ECM model while this study used ARDL-ECM to produce robust estimation.

This study used the ARDL-ECM model developed by Pesaran & Shin (1995). Based on the basic ARDL-ECM model, the estimation model is:

$$GDPC_t = \alpha + \sum_{i=1}^{n} b_i \Delta GDPC_{t-i} \sum_{i=1}^{n} c_i \Delta IMR_{t-i} + \sum_{i=1}^{n} d_i \Delta LE_{t-i} + \sum_{i=1}^{n} e_i \Delta HE_{t-i} + \beta_i GDPC_{t-1} + \beta_2 IMR_{t-1} + \beta_3 LE_{t-1} + \beta_4 HE_{t-1} + \varepsilon_t \quad (9)$$

ΔGDPC is change of Per capita GDP, (constant 2010 US$). ΔIMR is change of infant mortality rate (%). ΔLE is change of life expectancy (%). ΔHE is change of health expenditure to GDP ratio (%). $\alpha$ is constant or intercept of ARDL estimation. Furthermore, b; c; d; e; and βs are parameters of independent variables. Those parameters will exhibit the impact of IMR, LE, and HE on per capita GDP both in the long- and the short-run.

From the Equation 1, The ARDL model to be addressed is as follows (Equation 2):

$$\mathrm{GDPC_t} = \alpha + \sum_{i=1}^{n} b_{i\,GDPC_{t-i}} + \sum_{i=1}^{n} c_i\, IMR_{t-i} + \sum_{i=1}^{n} d_i\, LE_{t-i} + \sum_{i=1}^{n} e_i\, HE_{t-i} + \varepsilon_t \quad (10)$$

The Equation 2 describes the long-run impact of IMR, LE, and HE on Per capita GDP. In order to examine the short-run impact of IMR, LE and HE on per capita GDP, the ECM model can be employed as follows (Equation 3):

$$\Delta \mathrm{GDPC}_t = \alpha + \sum_i^n \gamma_{1i}\, \Delta GDPC_{t-i} + \sum_{i=1}^n \gamma_{2i}\, \Delta IMR_{t-1} + \sum_{i=1}^n \gamma_{3i}\, \Delta LE_{t-1} + \sum_{i=1}^n \gamma_{4i}\, \Delta HE_{t-i} + \gamma_5\, ECT_{t-1} + \varepsilon_t \ldots (11)$$

ECT is an error correction term that exhibits ECM Model in the short-run. Meanwhile, γ is parameter of ECM estimation under value of a negative.

## RESULTS AND DISCUSSION

Unit root tests were carried out on time series data to analyze the data stationary level. The stationary data both Level I (0) and 1st difference I(1) resulted in BLUE and robust estimation. This study used the Augmented Dickey-Fuller (ADF) test and Philips-Perron (PP) test.

**Table 2.** Result of Unit Root Test

| Variables | Augmented Dickey-Fuller (ADF) test | | | Phillips-Perron (PP) test | |
|---|---|---|---|---|---|
| | Level | | 1st Difference | Level | |
| | Intercept | Intercept and Trend | Intercept | Intercept | Intercept and Trend |
| GDPC | 1.961 | -0.205 | -3.671*** | 1.961 | -0.456 |
| IMR | -7.009* | -1.156 | -0.673 | -13.009* | -0.913 |
| LE | -2.567 | -3.519* | -3.001** | -2.392 | -1.811 |
| HE | -1.338 | -0.059 | -3.972*** | -1.378 | -0.229 |

Source : Author Estimation

Table 2 describes the results of the ADF test that Per capita GDP, life expectancy, and health expenditure were stationary at 1st difference I (1) while the infant mortality rate was stationary at Level I (0). This means the model can estimate the relationship between the health variable and per capita GDP. On the other hand, the results of the PP test showed that only the infant mortality rate was stationary at Level I (0).

Pesaran, Shin & Smith (2001) developed the ARDL Bound Test analysis to estimate long-run cointegration. This analysis can be used to identify time series data cointegration. The initial step for Bound Test estimation is to determine the optimal lag of the ARDL estimation. Based on estimation with Eviews 9, the best estimate was ARDL (2, 0, 0, 0). This can be explained in Table 3.

**Table 3**. ARDL Estimation (2, 0, 0, 0,)

| Variables | Coefficient | Std. Error | T-Statistic | P-value |
|---|---|---|---|---|
| GDPC (-1) | 0.87 | 0.19 | 4.55 | 0.00 |
| GDPC (-2) | -0.36 | 0.18 | -1.98 | 0.06 |
| IMR | 44.55 | 12.78 | 3.48 | 0.00 |
| LE | 329.62 | 94.90 | 3.47 | 0.00 |
| HE | -26.22 | 19.54 | -1.34 | 0.19 |
| C | -22395.34 | 6424.40 | -3.49 | 0.00 |
| | | | | |
| Adj. R-square | 0.9916 | | | |
| F-statistic | 708.2787 | | | |
| Prob(F-statistic) | 0.0000 | | | |
| Observations | 31 | | | |

Source : Authors Estimation

Note : The lag optimal of ARDL is ARDL (2, 0, 0, 0)

Per capita GDP (GDPC) was determined significantly and positively by lagged 1 of GDPC as well as significantly and negatively by lagged 2 of GDPC. This shows that the GDPC levels towards in the same direction by lagged 1 of GDPC. Furthermore, two health variables had a significant and positive influence on GDPC. Both of these variables were infant mortality rate (IMF) and life expectancy (LE). In contrast, the health expenditure variable had a significant influence on GDPC. This means an expenditure for health services had no contribution on community welfare.

Table 4 informed the results of the ARDL Bound Test. The value of F-statistics was 3.71 or within the range of values of I0 Bound and I1 Bound. This means the estimation results indicated no long-run cointegration. However, the robustness checking with Wald Test showed that F-statistics and Chi-square were 3.69 and 14.76 respectively and significant at α 5%. The results showed that there was long-run cointegration under Wald Test.

**Table 4**. ARDL Bound Test

| Test Statistic | Value | K |
|---|---|---|
| F-statistic | **3.714393** | 3 |
| Critical Value Bounds | | |
| Significance | I0 Bound | I1 Bound |
| 10% | 2.72 | 3.77 |
| 5% | 3.23 | 4.35 |
| 2.50% | 3.69 | 4.89 |
| 1% | 4.29 | 5.61 |

Source : Authors Estimation

The ARDL estimation results showed a long-run relationship between the independent variable and the dependent variable. To prove the long-run relationship, Equation 2 was estimated. The estimation results of ARDL long-run coefficient can be seen in Table 5.

In general, all health variables had a significant influence on per capita GDP in Indonesia in 1986-2018. This shows a positive signal for the government to improve, expand, and sharpen quality health policies to improve Indonesian community welfare.

**Table 5.** Estimated Long-run Coefficient Using ARDL Model

| Variables | Coefficient | Std. Error | T-Statistic | P-value |
|---|---|---|---|---|
| Constant | -45612.69 | 5029.60 | -9.07 | 0.00 |
| IMR | 90.73 | 14.33 | 6.33 | 0.00 |
| LE | 671.35 | 67.33 | 9.97 | 0.00 |
| HE | -53.41 | 29.33 | -1.82 | 0.08 |

Source: Authors Estimation

The infant mortality rate (IMR) had a positive contribution to GDPC. The results should receive great attention from the government because an increase in IMR has implications for the problem of community regeneration. Causes of infant mortality need to be assessed whether due to the quality of food and nutrition consumed or inadequate health facilities for pregnant and childbirth mothers.

Life expectancy (LE) had a positive influence on GDPC. This condition makes sense. This means, the higher the LE, the more LE will contribute to income because the younger generation to the old will continue to contribute

to economic activities to improve welfare. However, health expenditure (HE) had a negative influence on GDPC. This means an increase in HE will decrease the GDPC. This encourages the government to increase attention to health allocations. In addition, this condition can be caused by the limited allocation of health to serve all Indonesian people so that it is unable to promote community welfare.

Sharma (2018) stated that life expectancy had a significant influence on per capita GDP in developed countries. Aisa & Pueyo (2004) stated that life expectancy, health, and economic growth are three important determinants of human welfare. Akram, Padda, & Khan (2008) identified that life expectancy and mortality rate had an influence on per capita GDP in the long-run in Pakistan, whereas health expenditure had no influence. Mihalache (2019) described that human health reflects social welfare, where the level of consumption will increase if people are healthy and there is an increase in income and the rate of investment. In America, (Engelgau, Zhang, Jan, and Mahal, 2019) and in Europe (Jutz, 2015) showed that high income had a correlation with good health.

In the short run, the ARDL-ECM analysis could explain the relationship between health variables and Per capita GDP. Therefore, Equation 3 was estimated. The results of the estimation can be seen in Table 6.

One of the important variables in Equation 3 is ECT (-1). ECT (-1) was negative and significant which means the ARDL-ECM model in the short-run was robust. In addition, ECT (-1) can also be referred to as the speed of adjustment. Table 5 confirms that ECT (-1) was significant and negative. This means in the short-run, the health variable had a significant influence on Per capita GDP in Indonesia during the study period.

However, only the infant mortality rate (IMR) had a significant and positive influence on per capita GPD in the short-run. Thus, the government is expected to pay more attention to the condition of babies who are about to be born or have just been born (less than 1 year). This aims to ensure sustainable regeneration and improve community welfare.

**Table 6.** Estimated Short-run Estimation Using ARDL-ECM Model

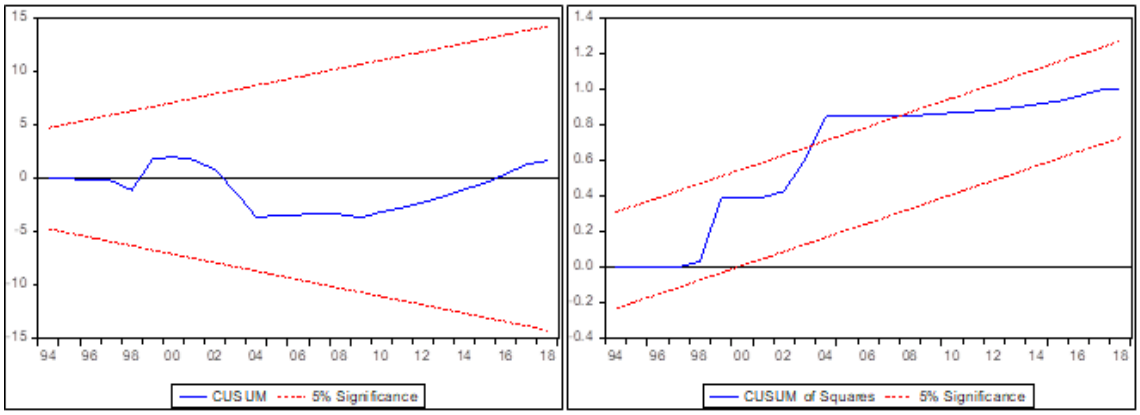
| Variables | Coefficient | Std. Error | T-Statistic | P-value |
|---|---|---|---|---|
| C | 27.15 | 89.04 | 0.30 | 0.76 |
| ECT (-1) | -0.39 | 0.16 | -2.41 | 0.02 |
| D(IMR) | 56.16 | 25.97 | 2.16 | 0.04 |
| D(LE) | 395.87 | 309.15 | 1.28 | 0.21 |
| D(HE) | -26.66 | 18.63 | -1.43 | 0.16 |
| | | | | |
| Adj. R-square | 0.2255 | | | |
| F-statistic | 3.2563 | | | |
| Prob(F-statistic) | 0.0265 | | | |
| Observations | 32 | | | |

Source: Authors Estimation

Akram, Padda, & Khan (2008) stated that health factors had no influence on per capita GDP in the short-run in Pakistan. This condition shows the relationship between health and economic growth in the long-run. Szreter (1997) stated that economic growth can be seen in a broader perspective covering social and public health conditions. There was a long-run relationship (Arora, 2001) between human capital and economic growth, health, and education as key indicators of productivity. According to Bhargava (2001), there was a difference in the total health expenditure in underdeveloped and developed countries, public health starts from nutrition of pregnancy, infancy, childhood, to adulthood. Community welfare can be seen in the improvement of public health (Nordhaus, 2002).

The last stage of ARDL-ECM is a stability test. This stage used two analysis namely CUSUM and CUSUM of Square. The results of the CUSUM indicated that the ARDL estimation was stable. However, the results of CUSUM of Square showed that ARDL estimation was unstable especially in 2004-2007.

**Figure 2**. Stability Test Under CUSUM and CUSUMSQ




## CONCLUSION

Healthy humans are the basic capital of national development. Improving the quality of public health is expected to improve the economy. Therefore, the purpose of this study was to estimate the influence of health on Per capita GDP in Indonesia in 1986-2018. The empirical model used is a simplification from the empirical model applied by Akram, Padda & Khan (2008). This can be seen in the selection of the independent variable which only chooses health variables. This study used three health variables namely: health expenditure, infant mortality, and life expectancy. Furthermore, ARDL-ECM was used to describe study purposes.

The results showed that in long run, all health variables had a significant influence on per capita GDP in Indonesia in 1986-2018. This means the government should pay more attention to the quality of health in Indonesia to improve welfare. Furthermore, in the short run, ECT (-1) had a significant influence on per capita GDP. This indicates that the short-run estimation of health variables had an influence on per capita GDP in Indonesia. However, in the short run, the IMR variable had a significant influence on Per capita GDP.

Policy implications can be directed at improving the quality of public health. Improving the quality of health consists of (a) controlling the infant mortality rate which may have implications for community regeneration and their welfare; (b) maintaining and improving the life expectancy of the community to boost their welfare level; and (c) improving the quality of health allocation to GDP to positively increase per capita GDP. Technically, the involvement and synergy between the Ministry of Finance and the Ministry of Health is a determining factor for the successful implementation of national health policies.

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