The influence of health on economic growth from the perspective of sustainable development: a case of OECD countries

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Seda Yıldırım
Department of Business Administration, Tekirdag Namik Kemal University, Tekirdağ, Turkey and
Tekirdag Namik Kemal University, Tekirdağ, Turkey, and
Durmus Cagri Yildirim and Hande Calıskan
Department of Economics, Tekirdag Namik Kemal University, Tekirdağ, Turkey

Abstract

Purpose – This study aims to explain the role of health on economic growth for OECD countries in the context of sustainable development. Accordingly, the study investigates the relationship between health and economic growth in OECD countries.

Design/methodology/approach – This study employed cluster analysis and econometric methods. By cluster analysis, 12 OECD countries (France, Germany, Finland, Slovenia, Belgium, Portugal, Estonia, Czech Republic, Hungary, South Korea, Poland and Slovakia) were classified into two clusters as high and low health status through health indicators. For panel threshold analysis, the data included growth rates, life expectancy at birth, export rates, population data, fixed capital investments, inflation and foreign direct investment for the period of 1999–2016.

Findings – The study determined two main clusters as countries with high health status (level) and low health status (level), but there was no threshold effect in clusters. It was concluded that an increase in the life expectancy at birth of countries with higher health status had no significant impact on economic growth. However, the increase in the life expectancy at birth of countries with lower health status influenced economic growth positively.

Research limitations/implications – This study used data that including period of 1999–2016 for OECD countries. In addition, the study used cluster analysis to determine health status of countries, and then panel threshold analysis was preferred to explain significant relations.

Originality/value – This study showed that the role of health on economic growth can change toward country groups as higher and lower health status. It was proved that higher life expectancy can influence economic growth positively in countries with worse or low health status. In this context, developing countries, which try to achieve sustainable development, should improve their health status to achieve economic and social development at the same time.

Keywords Health, Economic growth, Health indicators, Sustainable development, Clustering, Panel threshold analysis

Paper type Research paper

Introduction

Health issues and economic development are always popular themes in the literature. Grossman (1999) determined that health was extended to long life and disease-free life, and it

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was a concept that was both demanded by the consumers and produced. Health is a choice because it is a source of benefit. It is also related to the individual's income or wealth levels. According to Ersöz (2009), when the health level of the public is improved, it appears to be accompanied by economic benefits. In this context, there is a dynamic relationship between countries' health indicators and economic development levels. Because this relationship is positive, various macroeconomic indicators will also improve. For this purpose, investments in health services are expected to increase with the right channels. Health, which is considered as an important component of human capital, is based on three interrelated developments to create a dynamic and evolving space as (Becker, 2007):

(1) Analysis of optimal investments of individuals, pharmaceutical companies and governments in the field of health;

(2) Analysis of how much people want to improve in terms of quality of life and healthy life; and

(3) Importance of complementarities in connecting health to education and other human capital components to advance other resources related to changes in the rates of subsistence and the fight against different diseases.

Sustainable development in economic and environmental issues will be achieved by social development, and sustainable health policies will help countries to improve social conditions for people (Adshead *et al.*, 2006). All countries focus on health problems to achieve Sustainable Development Goals (SDGs) because bad health conditions influence economic development negatively and prevent achieving sustainable development (Buse and Hawkes, 2015). The sustainable health system is a key for sustainable development; that's why current health system should be transformed into sustainable health system (Seke *et al.*, 2013; Borowy, 2014). According to sustainable development perspective, reducing poverty is related with promoting health and well-being of people. Poor health conditions and environmental pollution cause negative outputs in natural and social capital in economies (Boischio *et al.*, 2009). Kieny *et al.* (2017, pp. 537–538) summarized the contribution of health for sustainable development as follows:

(1) There is a strong relationship between health development and economic development. When there is an investment in health system, life expectancy will be higher and so people (workers) will get healthier. Healthier workers contribute economic productivity in the long term.

(2) Investments in health system contribute economic outputs through increasing the number of jobs, the number of infrastructure projects and the number of purchasing supplies.

(3) The health development is related with social protection and so it promotes sustainable development. Higher employment in the health sector will contribute social protection systems as well as financial system in an economy.

(4) The health development brings social cohesion and creates more equal societies. When there is more equal society, the economy can also have more economically productive society.

(5) Medical products and pharmaceuticals are all important items in many countries' economic development through their production and exporting values. That's why, the investment and innovation in health sector's products will promote country's economy.

(6) Strong health system can provide human security in the long term. For example, people can be protected from infectious diseases and fatal diseases much better with the help of strong health system in a country.

Recently, it has been seen that there was a strong relationship between health and economic development in low-income countries (Suhrcke *et al.*, 2005). In addition, the importance of health is shining in the context of sustainable development since acceptance of 2030 SDGs. By 2012, Millennium Development Goals (MDGs) recognized the role of health in sustainable development at first. 2030 SDGs included health title as *Goal 3 – Good Health and Well-Being* (Acharya *et al.*, 2018). It is a fact that environmental pollution and bad economic conditions increase poor population with suffering from hunger and diseases. Most of global health problems were improved in the last decades, but the development process, political chaos, environmental pollution and so on still cause negative life conditions for people in developing and less developed countries (WHO, 2002). Poor health population cannot work efficiently and unsustainable health status threatens humanity. Without human well-being, there is no economic growth or development (Furie and Balbus, 2012, p. 1428). Sustainable development aims to provide balance between economic, social and environmental issues as much as possible (Munasinghe, 2000; Yıldırım *et al.*, 2016; Klarin, 2018; Kenny, 2018; Yıldırım and Yıldırım, 2020). Economic and social issues are mostly linked to human well-being that improvements in health will contribute economic and social dimensions positively and help achieve sustainable development (SDSN, 2014). Health is thought to be related with almost all 2030 SDGs. For example, poor health and poverty are so close together that infected person cannot work efficiently and his income decreases in the long term. The relationship between infectious diseases and poverty can be determined by income level. Higher income provides better treatment or decreases disease risks in poor countries (Guegan *et al.*, 2018). In addition, higher education and less gender inequalities contribute to life expectancy at birth positively and so it influences health indicators positively too (Erdogan *et al.*, 2012).

The study aims to investigate the role of health on economic growth in OECD countries. By cluster analysis, the study will explain how health indicators influence economic growth in countries with low health status and higher health status separately. Accordingly, the study will point out the contribution of health for economic growth in developing countries in the context of sustainable development.

Health and growth nexus

Health is thought to have its most important economic effects on human capital and on enterprise capital (Sachs, 2001). Mushkin (1962) said that the economic resources (labor and goods) allocated to health care represent an investment in health sector. On the other hand, health expenditures improve the labor product and continue to offer a return for years. The labor product created and the savings obtained from the health expenditures in the future emerge as "efficiency" with the decrease in the rates of disease. Barro (1996) stated that variables such as life expectancy at birth, which is one of the health indicators, will contribute more to economic growth because health status measured by life expectancy at birth or similar indicators will create a clearer framework and foresight about economic growth.

Understanding health indicators will help in determining health status of countries and also economic growth (Yumuşak and Yıldırım, 2009). Health indicators can be varied in the literature. In this study, life expectancy at birth series was chosen as a health indicator. There is a general consensus that life expectancy at birth is related to economic growth. However, this relationship may be positive or negative and may be statistically insignificant. While the positive relationship between life expectancy and growth is related to the number and quality of the workforce, the negative relationship is related to the decrease in mortality rates.

Savings are expected to be negative in old age and positive in youth. Improvement in health conditions will reduce death rates in youth period and old age period (Aisa and Pueyo, 2004). Life expectancy at birth also changes the lifelong benefit expectations and affects human capital investment decisions. The prolongation of life expectancy, in addition to reducing fertility, increases savings by reducing the amount of consumption in adulthood for both skilled and unskilled labor (Chen, 2010). Improvements in life expectancy, especially in low-income countries, and life expectancy at birth are based on great advances in health. Among the reasons for improvements in health, prevention or reduction of infectious diseases, decreasing the rates of various health programs and other diseases, increasing access to clean water, improving shelter and clothing facilities are considered. The impact of health improvement on economic growth is seen in two ways. The first is the increase in working hours due to the decrease in duration of disease and long life, and the second is the higher output production per hour of the healthy and fit labor force (Ram and Schultz, 1979). There are various empirical studies that guide this paper. Some of these studies can be summarized as follows:

Heshmati (2001) examined the relationship between the gross domestic product and the per capita health expenditure for OECD countries by causality approach. As a result of the causality tests, he concluded that increased health expenditures per capita had positive impacts on economic growth. Akram *et al.* (2009) investigated the effects of different health indicators on economic growth for the period of 1972–2006. They concluded that GDP per capita is positively affected by health indicators in the long term, but in the short term, health indicators do not have a significant impact on GDP per capita. Wang (2011) used the data of 31 countries from 1986 to 2007 to investigate the causality between the increase in health expenditures and economic growth. According to the results, the increase in health expenditures will encourage economic growth. Zaidi and Saidi (2018) investigated the relationship between health expenditures, environmental pollution and economic growth using data for the years 1990–2015 in Sub-Saharan Africa. According to the results of autoregressive distributed lag (ARDL) test, while economic growth had a positive effect on health expenditures, environmental pollution had negative effects on long-term health expenditures. Reinhart (1999) found that high life expectancy had a positive effect on economic growth, but this effect was not linear. Sachs and Warner (1997) showed a nonlinear relationship between economic growth and human capital. The variable they use to approach human capital was life expectancy at birth. Blackburn and Cipriani (2002) investigated a threshold effect between birth expectancy, fertility rate and mortality rates at birth and economic growth. Aisa and Pueyo (2006) showed that the impact of health expenditures on economic growth is positive in less developed countries and negative in developed countries. This result showed that the effect of health expenditures on economic growth depends on the level of development. The effectiveness of health services to increase life expectancy can be measured by considering nonlinear effects in the context of economic growth. Desbordes (2011) showed that developments in life expectancy had a nonlinear impact on per capita income in the 1940–1980 period. Life expectancy at birth in 1940 had a negative impact on per capita income in countries under the age of 43 and a positive effect on countries over the age of 53. Dang (2018) examined the causal relationship between education and health services in Vietnam's national survey data for 2010, 2012 and 2014. He found that education resulted in statistically significant effects on the use of health services. He also concluded that there was an important link between health insurance and income. Halici-Tuluce *et al.* (2016) studied the relationship between health expenditures and economic growth in low- and high-income countries with dynamic panel data in the period of 1995–2012 and period of 1997–2009. For 25 high-income and 19 low-income countries, the relationships between short- and long-term mutual causality have been investigated. In the high-income countries, in the short term bidirectional and in the long term one-way causality was found. In addition, they found that private health expenditures have a negative impact on economic growth. This situation has been explained by the fact that private health expenditures were low in low-income countries' GDP or they were caused by the negative effects of these expenditures on fixed capital investments. Kouassi *et al.* (2018) studied the relationship between the health expenditures and economic growth of the South African Development Community (SADC) member country with panel data methodology for 1995–2012 period. The findings showed that health expenditures and GDP had a cointegrated relationship and health services in the SADC region are a compulsory commodity. Most studies focusing on the relationship between health indicators and growth assume a linear relationship, but many studies show that macroeconomic relationships are not always linear Aisa and Pueyo (2004); Reinhart (1999); Sachs and Warner (1997). In this study, nonlinear characteristics were also considered in examining the relationships between the series.

Data and methodology

The study employed cluster analysis at first. Cluster analysis was a general method used for a wide variety of methods or applications that can be used to create a classification, and these methods generate empirically distinct clusters of similar individuals, objects, properties or variables. The main reason for using this method was to create similar (homogeneous) groups in the data set. Cluster analysis referred to a set of objective methods for quantifying the structural features of an observation cluster (Beckstead, 2002). The aim of cluster analysis is to maximize differences between clusters and intracluster similarities. With the help of cluster analysis, 21 OECD countries (Austria, Belgium, Canada, Czech Republic, Germany, Denmark, Spain, Estonia, Finland, France, Hungary, South Korea, Mexico, Norway, Poland, Portugal, Slovakia, Slovenia, Sweden and America) were classified with two homogeneous clusters through health indicators. To determine clusters' death rates, life expectancy at birth, health expenditures (ratio to national product), health expenditures per capita, government expenditures per capita, health expenditures incurred in advance, deaths due to cancer, drug expenditures per capita, number of doctors per capita, number of nurses per capita, number of beds per capita, annual potential mortality, health graduation rates, treatment care bed rates, psychiatric care bed rates, infant mortality rates and alcohol consumption rates were used as health indicators. Then, panel data methodology was used to determine significant relationships between variables.

Results

Table 1 shows country groups by clusters. The first cluster represents developed countries and the second cluster represents developing countries through health indicators. France, Germany, Finland, Slovenia, Belgium and Portugal were the first country group with high health status and Estonia, Czech Republic, Hungary, South Korea, Poland and Slovakia were the second country group with low health status.

First cluster	Distance	Second cluster	Distance
France	0.000	Estonia	0.000
Germany	0.340	Czech Republic	0.854
Finland	0.629	Hungary	0.545
Slovenia	0.691	South Korea	1,718
Belgium	0.710	Poland	0.318
Portugal	0.811	Slovakia	0.406

Table 1.
Cluster analysis

By panel data methodology, the study tried to eliminate the problems caused by the short time dimension. Growth rates, life expectancy at birth, export rates, population data, fixed capital investments, inflation and foreign direct investments were variables for panel data analysis. The life expectancy at birth and growth are control variables. Variables were obtained from the World Bank, World Health Organization and OECD websites.

In the study, the relationships between life expectancy at birth and economic growth were investigated in the period of 1999–2016 for 12 OECD countries. The data set discussed in the study has both a horizontal section and a time dimension. Therefore, panel data methodology was preferred to take advantage of its advantages and to eliminate the problems caused by the short time dimension. The variables used in the study are growth rates, life expectancy at birth, export rates, population data, fixed capital investments, inflation and foreign direct investments.

Variables other than the life expectancy at birth and growth are control variables. Variables were obtained from the World Bank, World Health Organization and OECD websites. The natural logarithm of investment, population, export and life expectancy at birth series were used.

Cross-sectional dependency

If there is a cross-sectional dependency, the results obtained from the panel data analysis can be biased and inconsistent. To test cross-sectional dependency here, Breusch-Pagan (1980) CDLM_1 test, Pesaran (2004) CDLM_2 test and Pesaran *et al.* (2008) bias-adjusted CD test were used. Hypotheses used in cross-sectional dependence can be shown as follows:

H_0. There is no cross-sectional dependency

H_1. There is a horizontal cross-sectional dependence

Breusch-Pagan (1980) CDLM1 test statistic:

$$\mathrm{CDLM}_1 = T \sum_{j=i+1}^{N-1} \widehat{\rho}ij \tag{1}$$

ρij shows the estimates of the cross-sectional correlations.

According to H_0 hypothesis, N is fixed and $T \to \infty$. Statistics are asymptotic distribution of Chi-square with $N(N\text{-}1)/2$ degrees of freedom. In addition, the CDLM1 test is used when time dimension (T) is greater than the cross dimension (N), ($T > N$); Pesaran (2004) presented an improved version of equation 1 for samples in which both the cross-section size and the time dimension were large:

$$\mathrm{CDLM}_2 = \sqrt{\frac{1}{N(N-1)}} \sum_{i=1}^{N-1} \sum_{j=i+1}^{N-1} \left(T \widehat{\rho}ij^2 - 1\right) \tag{2}$$

It was assumed that T and N would be used in cases where both observations were large. However, it is assumed that there is no cross-sectional dependence in case of T and $N \to \infty$. For this reason, the LM test is developed with the same method and given the correlation coefficients using $N > T$; it is assumed that T and N in equation 2 can be used where both are large. However, it is assumed that there is no cross-sectional dependence in case of T and $N \to \infty$. For this reason, the LM test was developed with the same method. For the cases where $N > T$ is used by the correlation coefficients, the statistics in equation 3 are given:

$$\mathrm{CDLM}_2 = \sqrt{\frac{2T}{N(N-1)}} \left(\sum_{i=1}^{N-1} \sum_{j=i+1}^{N-1} \widehat{\rho}ij^2 \right) \tag{3}$$

The last one is the LM test, which was developed byPeseran (2008). This test is based on the LM test, where T is fixed and N is large. In addition, while the other test that Pesaran (2004) suggests is inconsistent, this statistic provides more consistent results:

$$\mathrm{LM}_{\mathrm{adj}} = \sqrt{\frac{2}{N(N-1)}} \sum_{i=1}^{N-1} \sum_{j=i+1}^{N-1} T\,\widehat{\rho}\,ij\,(T-k)\frac{(T-k)\widehat{\rho}\,ij^2 - \mu Tij}{\sqrt{u^2_{Tij}}} \tag{4}$$

According to Table 2, the null hypotheses for growth rate, fixed capital formation, total population, export volume, Inflation, foreign direct investment and life expectancy at birth were all rejected. Therefore, it was determined that there was a cross-sectional dependency in the series. The unit root tests were performed considering the cross-sectional dependence. Panel unit root testing methods, also known as first generation tests, are the most preferred tests in empirical researches (Im *et al.*, 2003; Maddala and Wu, 1999; Levin *et al.*, 2002; Hadri, 2000; Choi, 2001).

Unit root tests, which take into account the cross-sectional dependence, are called the second-generation panel unit root tests. For the second-generation panel unit root tests, Pesaran (2007) developed the cross-sectionally augmented Dickey–Fuller test:

$$\Delta y_{it} = \alpha i + b_i y_{i,t-1} + \sum_{I=1}^{p_i} c_{ij}\,\Delta\bar{y}_{i,t-j} + d_{it} + h_i\bar{y}_{t-1} + \sum_{I=0}^{p_i} \eta\,\ddot{\mathrm{u}}\,\Delta Y_{i,t-j} + \varepsilon_{it} \tag{5}$$

Test hypotheses as follows:

H_O. $b_i = 0$, series is stationary

H_1. $b_i < 0$, series is nonstationary

As seen in Table 3, it was found that the variable of growth rate was stationary for the first cluster. Total population was found to be stationary in the intercept model, fixed capital formation and life expectancy at birth were stationary in the intercept and trend model. On the other hand, export volume and inflation were found to be nonstationary and null hypothesis is rejected. It is seen that the first differences of the series are stationary. For the

	First cluster		Second cluster	
Variables	Stat.	Prob.	Stat.	Prob.
Growth	13.22	0.000***	7.83	0.000***
Lfcfgdp	4.20	0.000***	8.33	0.000***
Lpop	4.50	0.000***	−2.08	0.038**
Lexp	9.08	0.000***	13.70	0.000***
Inf	10.83	0.000***	9.45	0.000***
Fdigdp	2.52	0.012***	4.44	0.000***
Lleb	16.13	0.000***	16.15	0.000***

Note(s): ** represents statistical signigance level for 5% and *** represents statistical signifance level for 1%
Abbreviations, Variables: growth – Growth rate; lfcfgdp – Fixed capital formation (investments); Lpop – Total population; Lexp – Export volume; Inf – Inflation; fdigdp – Foreign direct investment; Lleb – Life expectancy at birth

Table 2.
Cross-sectional dependency results

		First cluster		Second cluster	
		t-stat	Prob.	*t*-stat	Prob.
Intercept	Growth	−2.901	0.003***	−2.281	0.095*
	Lexp	−1.008	0.957	−1.555	0.661
	Lfcfgdp	1.391	0.918	−1.753	0.040**
	Lpop	−2.854	0.002***	3.305	1.000
	Inf	−0.365	0.358	−1.956	0.025**
	fdigdp	−1.743	0.041**	1.721	0.957
	lleb	−1.788	0.445	−2.295	0.090*
Intercept and Trend	growth	−3.154	0.017**	−2.740	0.688
	lexp	−1.115	0.998	−1.774	0.890
	lfcfgdp	−1.792	0.037**	−0.460	0.323
	lpop	2.342	0.990	1.114	0.867
	inf	−0.076	0.470	−0.718	0.236
	fdigdp	−0.842	0.200	−1.965	0.025**
	lleb	−2.979	0.045**	−2.802	0.103

Note(s): * represents statistical signifance level for 10%; ** represents statistical signigance level for 5% and *** represents statistical signifance level for 1%

Table 3.
Pesaran CADF test results

second cluster, it was concluded that variables such as growth rate, fixed capital formation, inflation, foreign direct investment and life expectancy at birth were stationary. Export volume and total population were found to be nonstationary.

Threshold model

In panel data methodology, determining threshold effect is an important approach (Hansen, 1999). The hypothesis that there is no threshold effect can be represented by linear restraint.

$H_O.\ \beta_1 = \beta_2$

Under the null hypothesis, *threshold y* is not defined, so conventional tests have nonstandard distributions. If there is no threshold effect for the null hypothesis, the model should be:

$$y_{it} = \mu_i + \beta_1' x_{it} + e_{it} \tag{6}$$

When converted to fixed effects model, the model:

$$y_{it}^* = \beta_1' x_{it}^* + e_{it}^* \tag{7}$$

In Equation 6, the β_1 regression parameter is estimated by the least squares method. Single-regime model equation:

$$y_{it} = \mu + X_{it}(q_{it} < \gamma)\beta_1 + X_{it}(q_{it} \geq \gamma)\beta_2 + u_i + e_{it} \tag{8}$$

The q_{it} is the threshold variable, and γ is the threshold parameter. In addition, these coefficients are divided into two regimes: β_1 and β_2. On the other hand, u_i is the individual

	Critical values			
F-Stat	%10	%5	%1	Prob.
6.31	7.3004	9.3759	13.0377	0.126

Table 4.
Threshold effect for the first cluster

effect of the parameters, e_{it} is the error term. In this study, the threshold variable is determined as life expectancy at birth and dependent variable is growth rate.

In Table 4, it was seen that there was no threshold effect for the first cluster. In other words, there is no nonlinear relationship between health and growth for the country group with relatively high health indicators. Therefore, the relationships between health indicators and growth for the first cluster were investigated with the help of linear models.

There was an individual effect according to F test results by rejecting the null hypothesis. In case of individual effect, Hausman's test is applied to determine whether the fixed effect or random effect model estimator is effective. The Hausman test result is 26.83 (Prob. 0.0002). According to the test result, the random effect estimator is inconsistent and the fixed effect estimator parameter is determined to be effective. It should be investigated whether the model is one way or two ways. Because of panel data analysis, time effects may be present besides individual effects. The time effect represents effects over time and does not change according to the individual. The time effect must be added as an argument to the model. In this study, when the presence of time effect was analyzed, it was seen that there were also time effects besides individual effects. The fixed effects model was extended to include time effect. The results obtained from the panel regression analysis were investigated with the diagnostics tests (Table A1). According to the test results, there is no problem of cross-sectional dependence in the model where there are problems of heteroskedasticity and autocorrelation. Arellano, Foot and Rogers' estimator was used to overcome heteroskedasticity and autocorrelation problems. Variance estimator of parameters:

$$\mathrm{Var}\left(\widehat{\beta}\right) = \frac{N-1}{N-K}\,\frac{M}{M-1}(X'X)^{-1}\left(\sum_{i=1}^{N} X'{}_{i}\widehat{u}_i \;\; \widehat{u}_i X_i\right)(X'X)^{-1} \tag{9}$$

Where M is the number of clusters; N, the number of units in the clusters; and $\widehat{u}_i$ is the i. residuals in the j. clusters.

The results obtained from the estimation can be seen in Table A2. According to the results obtained from Table A2, health indicators for the first cluster have no effect on growth. Table 5 shows the result of the threshold impact analysis for the second cluster. It was seen that there was threshold effect for the second cluster. In other words, there was a nonlinear relationship between health and growth for the country group with relatively low health indicators.

Regimes-dependent panel regression test results are shown in Table 6.

It was found that the threshold effect was statistically significant at 10% significance level according to panel threshold model results for the second cluster consisting of Estonia, Czechia, Hungary, South Korea, Poland and Slovakia countries. The threshold value at the 95% confidence interval was found to be 4.2862 between the lower value of 4.2851 and the upper value of 4.2879. In addition, the first regime β_1 and second regime β_2 coefficients of 9.68 and 9.66 were statistically significant. As a result, an increase in health indicators in the first regime increases growth further.

Conclusion

The future will rise through sustainable economies in the context of sustainable development. Accordingly, countries should take care of the balance between economic, social and environmental issues. MDGs guided countries how they could transform into

Table 5. Threshold effect for second cluster

	Critical values			
F-Stat	%10	%5	%1	Prob.
40.31	38.674	44.894	63.148	0.093

Table 6.
Panel threshold model results

Threshold effects	
Threshold variables: lleb	4.2879***
%95 Confidence interval	[4.2862, 4.2891]
Regimes	
β_1	9.68*** (0.000)
β_2	9.66*** (0.000)
Control variables	
Lexp	4.98*** (0.000)
Inf	−1.33 (0.186)
Fdigdp	2.50** (0.014)
Lfcfgdp	2.35** (0.021)
Dlpop	1.43 (0.156)
$\delta 1$	−0.41 (0.683)

Note(s): ** represents statistical signigance level for 5% and *** represents statistical signifance level for 1%

sustainable economy until 2015 and then 2030 SDGs began to guide countries to achieve sustainable development goals until 2030 (Yıldırım and Yıldırım, 2020). Both MDGs and 2030 SDGs include health issue as an important target to achieve sustainable development. Health development can influence other issues or goals to achieve sustainable development in the long term that countries should improve their health policies as much as their economic or environmental policies (WHO, 2002; Suhrcke *et al.*, 2005; Furie and Balbus, 2012; Seke *et al.*, 2013; Buse and Hawkes, 2015; Tangcharoensathien *et al.*, 2015). Especially, the health sector is mostly important for developing countries to achieve sustainable development. As proved by prior studies, it is known that improvements in health sector influence economic development positively in lower-income countries or developing countries. In this context, this study found that there was no relationship between health and economic growth for OECD countries with higher health status. In other words, life expectancy at birth was not a significant determinant for economic growth in countries with higher health status. This situation may be caused by the decrease in the mortality rates in developed countries and the decrease in savings due to prolonged life. On the other hand, it was found that there was a nonlinear relationship for OECD countries with lower health status. An increase in health indicators has a higher positive effect on economic growth in the regime in which health indicators are low. However, the difference is too small to be ignored. Therefore, when the threshold effect is ignored, the increase in life expectancy for the countries with lower health status has a positive effect on economic growth.

This study provided same findings as prior literature (Blackbrun and Cipriani, 2002;Asia and Pueyo, 2006;Desborders, 2011; Halici-Tuluce *et al.*, 2016; Kouassi *et al.*, 2018). In the countries with relatively young populations, the decrease in the mortality rate of the youth and the change in the expectations of lifelong benefit positively affect the investment decisions of the human capital, and thus, a positive effect on growth occurs. Decreasing disease times, prolonged working hours due to prolonged life and high productivity of population with high human capital provide positive impacts on economic growth. Improvements in economic and social life will bring sustainable developments in the long term. To achieve sustainable development, health improvements are so important tool for developing countries rather than developed countries. Most of problems such as hunger or poverty are based on poor health that higher health conditions will provide human well-being in the context of economic and social life.

This study proved that health improvements had a positive effect on economic development for OECD countries (Estonia, Czech Republic, Hungary, South Korea, Poland, Slovakia) with low health status. Based on empirical findings, the study suggests that developing countries should improve health sector to achieve economic and social development at the same time based on SDGs.

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Appendix

Heteroskedasticity
Modified Wald test for groupwise heteroskedasticity in fixed effect regression model
H_0: sigma(i)^2 = sigma^2 for all i
chi2 (6) = 646.64
Prob > chi2 = 0.0000
Cross-sectional dependency
Pesaran's test of cross-sectional independence = −2.897, Pr = 1.9962
Friedman's test of cross-sectional independence = 3.111, Pr = 0.6829
Frees' test of cross-sectional independence = 0.600
LR test for autocorrelation
Modified Bhargava *et al.* Durbin–Watson = 1.2539819
Baltagi–Wu LBI = 1.3675553

Table A1. Diagnostics tests

R-sq: Obs per group				
within = 0.80				
between = 0.16				
overall = 0.013				

Variables	Coef.	Std. err.	*t*	*P*
Dependent variable: growth				
Dexp	0.0638	0.103	0.61	0.566
Dinf	0.0002	0.001	0.17	0.871
Fdigdp	−0.0053	0.011	−0.46	0.662
Dlleb	−0.1373	0.529	−0.26	0.806
Lfcfgdp	0.0588	0.015	3.89	0.012
Lpop	−0.3594	0.083	−4.33	0.008
Cons	5.7413	1.355	4.24	0.008

Table A2.
Panel OLS test results for first cluster

Corresponding author
Durmus Cagri Yildirim can be contacted at: cyildirim81@gmail.com