An Investigation of the Relationship between Health Care Expenditures and Economic Growth

Author

Murat BİNAY[1*]

Affiliations

[1]Doctoral Program in Financial Economics, Yeditepe University Graduate School of Social Sciences, Istanbul, 34755, Turkey.

*To whom correspondence should be addressed; E-mail: murat.binay@std.yeditepe.edu.tr

Abstract

In the 1960s, endogenous growth theories revealed that human capital accumulation is at least as important as physical capital accumulation on economic growth. Then, it was focused on how to increase the accumulation of human capital, and it was determined that the two main components were primarily education and then health.

There are many studies in the literature on the relationship between economic growth and health expenditures. In the studies on the relationship between health expenditures and economic growth, although it has been observed that health expenditures generally increase economic growth, there are also studies that do not affect economic growth or decrease economic growth.

In this study, the relationship between health expenditures and economic growth has been examined for OECD countries with five different methods: panel data analysis, structural break panel data analysis, panel causality test, dynamic panel data analysis and non-linear panel data analysis. In these methods, firstly, the relationship between economic growth and health expenditures was examined. Then, the other generally accepted components of economic growth in the literature, such as capital accumulation, total factor productivity and the democracy index, whose effects on economic growth are discussed, were included in the model and the effect of health expenditures on economic growth was determined.

Keywords: Economic Growth; Health Expenditures; Non-Linear Panel Data Analysis

INTRODUCTION

In this study the relation between health expenditures and economic growth has been examined for OECD countries, including Türkiye, with five different methods: panel data analysis, structural break panel data analysis, panel causality test, dynamic panel data analysis and non-linear panel data analysis. In these methods, firstly, the relation between health expenditures and economic growth is examined, then the other components of economic growth that are generally accepted in the literature, such as total factor productivity, capital accumulation and the democracy index, whose effects on economic growth are discussed, are included in the model to determine the effect of health expenditures on economic growth. has been studied.

In addition, although there are studies on the optimal level of public expenditures in the literature, it has been observed that there is no study on the optimal level of health expenditures in OECD countries, and it has been tried to calculate at which health expenditure level the economic growth will be maximum. In addition, while it is almost agreed in the literature that physical capital accumulation, total factor productivity positively affects economic growth.

It is thought that democracy's effect and health expenditures increase growth by increasing human capital accumulation and reducing income inequality, as well as increasing the ratio of public consumption expenditures to GDP and preventing physical capital accumulation and reducing growth.

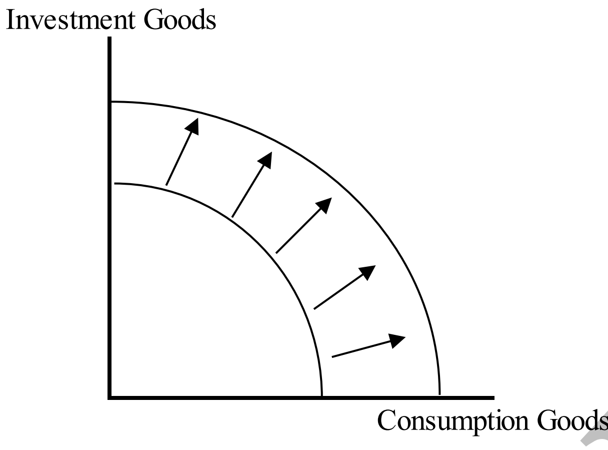
Therefore, in this study, although their effect on economic growth is controversial in the literature, these two variables, which are thought to increase economic growth by increasing human capital, will be added to the model and how much they contribute to economic growth besides total factor productivity and accumulation of physical capital which are agreed as the main elements of economic growth, are analyzed.

1. Economic Growth Concept

According to another definition, economic growth is defined as the increase in real output per capita (Economic, 2005: 55, Karluk, 2005: 55), as the economy grows and the production capacity of the economy increases, more goods and services are produced.

Economic growth can be explained as the expansion of goods and services production capacity. In other words, if the production possibilities of the country are shifted to the right in a production possibility frontier, it can be said in economic growth, as seen in Figure 1.

Figure 1. *Production Opportunities Curve*



Economic growth is measured as an increase in real per capita income. These increases arise only in the long run due to the fact that potential of the country or the production scale is widening or more productive. Therefore, the concept of economic growth is often thought as a long-term problem and is determined more in the macroeconomic sense than supply. In other words, the factors that cause an economy's production opportunity curve to slide outward or to the right of the long-run aggregate supply curve are theories of economic growth theory. Behind these shifts, it is pointed out that governments are three important sources of economic growth that can be measured in terms of real GDP and percentage of increase in real GDP, as well as the effects of infrastructure investments that increase technology policies and education and physical capital stock to increase the production factors' productivity (Parasız, 1997: 5; Kibritçioğlu, 1998: 207, 208).

2. Health Expenditures and Economic Growth Relation

Most of the economists have a common view that the high level of health of countries affects the development of the country positively (Karagul, 2002: 72). There is a direct impact of health, income and prosperity of the countries, labor productivity, demographic and human capital factors (Taban, 2006: 33).

Developed countries can allocate more from the Gross Domestic Product (GDP) for the protection, development and treatment of human health that is the main element of economic growth. In a sense, health investments are considered as "productive investment" (Tokgöz, 1981: 503).

Developments in health and education services affect the production function and raise the level of labor services. When the workforce is healthy, less time is wasted and more effective efforts are made. It is also a fact that healthy labor power will make a significant contribution to a rapid economic growth (Talas, 1972: 80).

It should not be forgotten, however, that the level of health is also important for the person to be able to receive education and economic activities. In this direction, health and education should be evaluated together in the human capital stock (Karagül, 2002: 70)

Theoretical discussions on economic growth literature focus on the role of human capital in the economic growth process (Çetin and Ecevit, 2010: 166). Because human capital is a source of economic growth and health is the most important economic component of human capital, a cause of health and economic growth is also considered as a reason for health (European Commission, 2005: 20).

In the literature, causality relation between health expenditures and GDP is explained by four different hypotheses. Among these are the hypothesis that health spending positively affects GDP (Mushkin, 1962: 129, Hansen and King 1996: 135, Bloom and Canning 2000: 1209, Groosman 1972: 223, Newhouse 1977: 5, Foo Tang 2011: 199). In this hypothesis, there is a one-way causality from health expenditures to GDP. The second is the hypothesis that health spending affects not only the positive growth of growth but also the growth of the health sector (Elmi and Sadeghi, 2012: 88, Mehrara and Musai, 2011: 103). Here, two-way causality from health expenditure to GDP and from GDP to health spending is discussed. The third hypothesis is that health expenditures do not affect GDP. In other words, there is no causal relationship between two variables in this hypothesis. The last hypothesis assumes that health expenditures negatively affect GDP (Akar, S., 2014: 312).

There is a causal relationship between health and income. Rural health expenditures of the countries, health expenditure of the society and health of the society can affect the productivity of the country. This relationship can be bi-directional as well as health-conscious or health-conscious. Although these divergent forms differ between countries, the causality relation can be observed in both countries in different income groups (Erdil and Yetkiner, 2004: 702).

The province of these studies, Groosman (1972) did not work is done. According to this study, the health service expressed as fixed capital stock positively affects output growth. Spending on the health sector encourages economic growth as a type of investment. Newhouse (1977) suggests that GDP at national level is a positive influence on medical care.

Mushkin (1962) pioneered the study of health as an important catalyst for economic growth and economic growth, followed by a number of studies investigating the relationship between health spending and income in the literature. A large part of these studies (Newhouse (1977), Parkin et al. (1987), Wang and Rettenmaier (2007) and Hartwig (2008) show that both variables have a positive correlation (Tang and Ch'ng, 2011: 6814).

Jones (1990) dealt with public expenditure in the United States between 1964 and 1984 by means of a model of imbalance between public expenditure and economic growth variables. Other expenditures, which health and transfer spending reduce by economic growth, have reached the result, in particular expenditures incurred by local governments, to encourage growth.

Kelly (1997) reached the conclusion that between 1970 and 1980, 73 countries' health spending did not make a meaningful contribution to economic growth.

Base and Snow (2003), from 1971 to 2000 for the period between annual data using in Türkiye in the distribution of public spending (education, health, social security and infrastructure spending) was investigated using the co-integration approach, the effects of economic growth. Econometric results of the analyzes showed that the effect of infrastructural expenditures is statistically insignificant and the effect of growth of health expenditures is negative, while the effect of education and social security expenditures on economic growth is positive.

Tan et al. (2010) representing a correct relationship Keynes public expenditure to national income from their work in order to test the hypothesis for Türkiye's economy in 1969-2003 period; has identified the existence of a causality relationship from infrastructure spending to gross domestic product.

Nelson and Phelps (1966) and Romer (1990) defined the interdependence between per capita income and health expenditure in models of internal growth. Health spending contributes to economic growth by developing human capital, and at the same time, the growth of economic growth can be led to human capital investments to achieve a chain growth.

Ak's (2012) study that was done with health expenditure in Türkiye showed there was not a short-term relationship between economic growth, but has determined that a relationship in the long term.

Atılgan et al., (2016) Türkiye is a person 0,434'lük% the head of the 1% increase in health spending per person by using the ARDL model to determine the relationship between private in 1975-2013 in a study conducted for the period of health care spending to economic growth identified is the cause of national income growth they have.

Uçan and Atay (2016), the study covers the period 2006Q1-2014Q4 they analyze the relationship between the growth of health expenditures in Türkiye and have determined that the run relationship between variables.

Kıymaz et al. (2006), the relationship between health spending and economic growth in Türkiye 1984-1998 period for their study addressed using the Johansen cointegration analysis, private health spending and Gross National Product (GNP) to include that of a cointegration relationship and per capita GDP than medical expenses one-sided relationship.

The impact of health expenditure on economic growth, which is one of the important indicators of health, is multifaceted and long-lasting (Taban, 2006: 35). Recent studies have also proved that the positive impact of investments on health in the economic development process. The macroeconomic and health commission (2001) and the comprehensive report published by the European Commission (2005), set up by the World Health Organization, point out that for both developed and developing countries, health spending is an incentive for GDP growth and that health spending should be done (Karabulut, 2010: 139).

Sorkin (1977) has concluded that in developed countries, the society has made little positive contribution to economic growth despite improvements in health conditions.

Strauss and Thomas (1998) have shown an empirical study of the relationship between health and productivity. According to the study result, there is a relationship between some health indicators (disease types and nutrition habits) and physical efficiency.

Reinhart (1999) deals with the effects of government spending on economic growth with a life expectancy at birth. In Bloom et al. (2001) empirical analyzes, they used the human capital Solow model.

For most of the empirical studies on the effect of health on economic growth, the main problem is that as a health indicator it is often necessary to take life expectancy at birth. For example, Bloom and Canning (2000) found that birth expectancy had a positive and significant effect on the economic growth process. In this study, health was measured as a life expectancy at birth; other dimensions of health did not join the account.

Erdil and Yetkiner (2004) assessed a causality relationship was found that worked towards economic growth from health in low- and middle-income countries and health expenditure in high-income countries.

When human capital on economic growth in the private economy of Türkiye is examined as a factor in human capital is seen that most of the studies used in training again. However, the health issue, which is basic component of human capital, has attracted the attention of researchers and they have started to take a lead in this field. Examples of studies done in this area are Kar and Ağır (2003), Taban (2005), Temiz and Korkmaz (2007).

Taban (2005), the relationship between health and economic growth in Türkiye is another study evaluating in terms of causality. Here, GDP, total health spending and birth expectancy data for 1980-2000 period are used. According to the results of the analysis, there was a two-way causality relationship between birth expectancy and economic growth, whereas no causality relationship was found between total health expenditure and economic growth.

Temiz and Korkmaz (2007), the relationship between health and economic growth in Türkiye, using the Johansen cointegration test and error correction model have been discussed in terms of causality. For this, GNP for 1965-2005 period benefited from birth expectancy and infant mortality rate data. According to empirical results; a positive and bi-directional causality relationship between birth expectancy and economic growth was observed, but a negative and one-way causality relationship was found from infant mortality to economic growth.

According to the Gyimah and Wilson (2004), an increase of 22% and 30% in per capita income in Africa and OECD countries contributed to improvements in health spending.

The role of health spending on economic growth is often encouraging (Mushkin, 1962: 129). This positive effect of health expenditures in the literature is explained by the "health-based growth hypothesis". According to the health-based growth hypothesis, health spending is the productive capital. In other words, investments in the health sector contribute to total economic growth. In addition, the presence of a poor healthcare sector in countries affects the efficiency of the capital in the negative direction. This effect helps explain the failure of the health sector in underdeveloped countries (Foon Tang, 2011: 201).

On the other hand, according to Bloom and Canning (2000), health spending has positive effects on economic prosperity and growth. The reasons for this positive effect are summarized as follows; Healthy individuals (employees) are more efficient and healthy individuals have a positive effect on human capital. The fact that the average life span is too high encourages an increase in physical investments. However, increased health spending supports the longer average life span and, in this case, increases long term growth.

In studies dealing with countries of the Organization for Economic Co-operation and Development (OECD), a positive relationship was found between health spending and economic growth. Hansen and King (1996) conducted a unit root analysis of health spending and GDP variables in OECD countries and found that these series are not static. Nevertheless, it emphasized the importance of GDP in determining the level of total health expenditure.

Beraldo, Montolio and Turati (2009) assesed 1 percent increase in total health spending increases the per capita GDP by between 0,06 and 0,10 percent. The increase of 0.04 percent to 0.07 percent is due to public expenditures.

McCoskey and Selden (1998) used panel data differently from Hansen and King (1996) when examining GDP and per capita health expenditure in OECD countries, and this panel provided a unit root test. According to this study, the series contain unit root and the null hypothesis is rejected. However, the results of the study show that national health expenditures reduce the likelihood of misdetection in panel data analysis and misleading health policies.

Baltagi and Moscone (2010) examined the long-term relationship between health spending and economic growth in OECD countries in the period 1971-2004. According to the study results, since the elasticity of health expenditures is less than 1, these expenditures are expressed as mandatory goods from luxury goods. In addition, long term health spending and economic growth are related to each other.

The results of the study, Baltagi and Moscone (2010), Beraldo et al. (2009), there is no statistically significant relationship between economic growth and health spending.

In addition to OECD countries, there are studies in different countries that test the causality relationship between health spending and growth and achieve different outcomes. For example, Foo Tang (2011) found that there was a two-way causality between long-term health spending and growth in Malaysia in the period of 1970-2009.

Kuhn and Prettner (2012) found that employment in the healthcare sector in the United States (USA) increased growth by about 2 percent in the 2008-2012 period. However, the study suggests that countries with health expenditures of 6-7 percent of GDP have higher growth rates.

According to Dormont et al. (2008), the potential impacts of public health spending in the US, Europe, and Japan are positively affecting potential growth and productivity. The reasons for this are shown in the developed economies to meet the health services from the public budget. The study also found that health expenditures tend to increase in the same direction as per capita income (unit income elasticity).

Akram (2009) investigated the impact of health indicators on economic growth in Pakistan between 1972-2006. The study shows that per capita GDP is positively affected by long-term health indicators. However, short-term health indicators do not have a significant impact on GDP per capita.

Mehrara and Musai (2011) examined the causality between health spending and economic growth in oil-exporting countries. According to this study, economic growth and health expenditures are related in both ways.

Wang (2011) assesed; growth in low- and high-income countries is due to the different characteristics of health spending, as it occurs at different levels. Nevertheless, in countries with similar economic conditions and moderate economic development, economic growth is positively affected, although the level of health expenditure varies.

Elmi and Sadeghi (2012), unlike Wang (2011), analyzed co-integrated relationship and causality between economic growth and health expenditures in developing countries between 1990 and 2009. According to the study, there is a two-way causality between long term GDP and health expenditure variables. For this reason, it is suggested that the hypothesis of growth based on health is valid in developing countries.

Gerdtham and Jönsson (1991) in their study of twenty-two OECD countries; Contrary to Groosman (1972) and Newhouse (1977) studies, the relative price of health spending is not related to national income. The supply of health expenditures is increasing due to the national gender. Moreover, the relative price of health spending close to price elasticity -1 creates a rationing effect 1 in the amount of health spending. Hence, the level of health expenditure is not large in countries with higher price levels. However, the difference in the amount of health spending and the amount of health expenditures among countries also changes the definition of health expenditures from country to country. Gerdtham and Jönsson (2000) analyzed the relationship between international health spending and GDP for twenty-one OECD countries during the period 1960-1997. The results of this study show that, unlike the results of Gerdtham and Jönsson (1991), both variables are not static and that health expenditures and GDP are cointegrated.

Hitiris and Posnett (1992) found that health expenditures, which are close to 1 in income and price elasticities, are an important determinant of GDP.

Okunade and Karakus (2001) investigated whether health spending, the relative price of health spending and the GDP variables for the OECD countries during the period 1960-1997 were cointegrated. Study; In the UK, Ireland and Greece, health spending has been claimed to be regarded as luxury goods in the long run, since the price and income elasticity of the health expenditure is greater than 1. However, health spending, the relative price of health spending and the GDP variables coexist. For this reason, implementation of national health spending policies in OECD countries can be beneficial for growth.

According to Milne and Molana (1991), neglecting the relative price of health spending leads to income elasticity greater than 1. The fact that a relative unit of increase in income does not increase real health spending due to the compensatory role of relative price.

According to the study results, the relative price of health expenditures and the GDP tend to increase together. Besides this increase tendency, health spending also increases in the same direction.

The analysis of health expenditure and GDP in Türkiye generally have focused on the analysis of cointegration between public spending and GDP. For this reason, studies addressing health expenditures in public spending are relatively few. Studies that analyze the causality between health expenditures and GDP have different results using different samples.

Kar and Ağır (2002), in Türkiye for the period 1926-1994, implies that there is unidirectional causality from health spending to economic growth. The reason for this is that the share allocated for health expenditures in the budget is small.

Taban (2004), with health indicators in the 1968-2003 year in Türkiye, has analyzed the causal relationship between economic growth. Health indicators in work; the birth expectancy at birth, the number of beds of health institutions, the number of health institutions and the number of persons per health personnel. The results of the study show that there is no causality relationship between the number of health institutions and GDP. However, there is a two-way causality relationship between other health indicators and GDP. Looking at these results, it is stated that GDP will be positively affected if health expenditures are given importance.

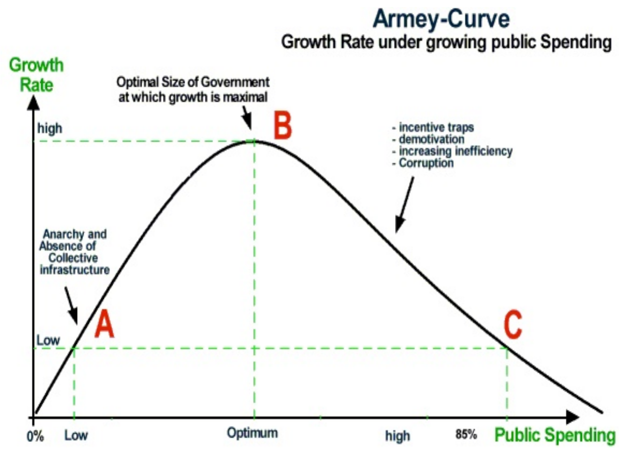
Öksüzler and Turhan (2005), have identified the period 1960-2000 unidirectional causality relationship from GDP per capita health spending per capita in Türkiye.

Eryiğit et al. (2012), the 1950 to 2005 period, positive impact on economic growth suggests that health spending in Türkiye found.

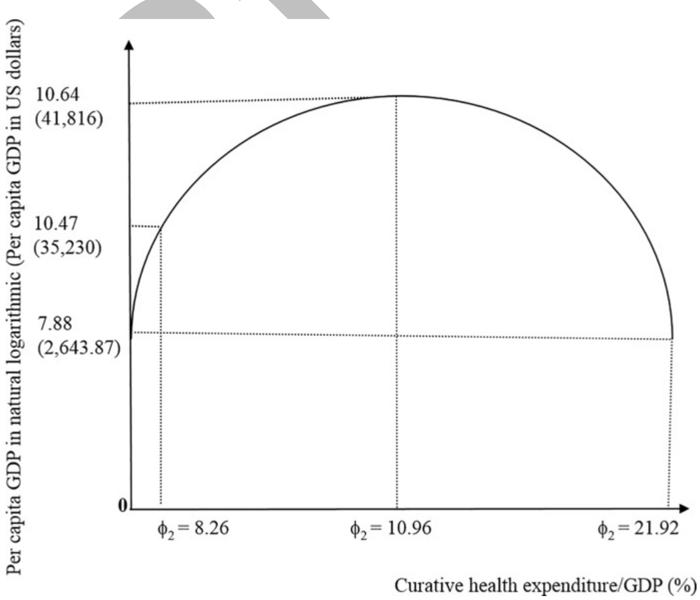
3. Armey Curve Analysis

The Armey curve shows the relationship between the public sector size in the economy (public expenditure / GDP ratio) and real GDP (or real GDP growth rate). In the absence of the public sector, very low output is produced (G0). This output level may be theoretically zero. There are a number of studies that test the truth of the Armey curriculum. Pevcin (2004, pp. 10-11) tested the Armey curriculum for 12 European Union (EU) countries from 1950 to 1996 and concluded that there was a similar relationship to the inverse u-curve.

De Witte and Moesen (2010) supported the Armey curve, arguing that there was an optimal public volume in their work for 23 OECD countries. Facchini and Melki (2011) similarly reached the findings supporting the Armey curve in their studies for France with the data of 1871-2008 period.(Akbulut, 2015: 43).



In 2016, Wang's study titled ” Health expenditures spent for prevention, economic performance and social welfare ”examined the effect of the ratio of preventive health expenditures to GDP on economic growth and social welfare, and it is assessed that the preventive health expenditure at the ratio %1,19 increased the economic growth 4 percent and this relationship is shown in the graph on the right (Wang, Wang ve Huang, 2016: 6).



In this study; effects of health expenditures per capita on national income per capita 21 OECD countries (Australia, Austria, Belgium, Canada, Denmark, Finland, Germany, Iceland, Ireland, Israel, Japan, Korea, Netherlands, New Zealand, Norway, Portugal, Spain, Switzerland, UK, US and Turkey) were examined using annual data for the 1975-2012 period. In this study, real GDP per capita (GDPPC), which is regulated by purchasing power parity as dependent variable, and real health expenditure per capita, which is regulated by purchasing power parity (HEXPC), is used as independent variable. The data is taken from the OECD.Stat website in US dollars.

In this study, the Armey Curve approach is adapted to the relationship between health expenditures and national income and the following model is formed.

- $GDPPC_{it} = \beta_{0i} + \beta_{1i} HEXPC_{it} + \beta_{2i} HEXPC_{it}^2 + \varepsilon_{it}$

3.1. Cross Section Dependence

In the study, the existence of horizontal cross-sectional dependence among the countries forming the panel was investigated with Breusch and Pagan (1980) Lagrange Multiplier (LM) test, Pesaran (2004) scale (LM) test, Pesaran (2004) horizontal cross-sectional dependence (Cross) -section Dependency (CD) test and Baltagi, Feng and Kao (2012) bias-corrected scaled (LMBC) test.

In panel data analysis, it is important to determine whether there is a cross-sectional dependence between the countries that make up the panel and if such dependency exists, to use the methods that take this situation into account. If there is a cross-sectional dependence between the countries that make up the panel, tests and coefficient estimations without considering this situation may produce misleading or even inconsistent parameters (Chudik ve Pesaran, 2015:402).

H_0: There is no horizontal cross-section dependence between countries

H_1: There is horizontal cross-section dependence between countries

cross-sectionality was evaluated by several different methods to eliminate the problem of size distortion and to eliminate the pseudo-correlation problem. In

Table 1, the H0 hypothesis was rejected because the probability value was less than 0.05 in the series and tests performed for the model.

Table 1: Cross Section Dependency Test Results

	LM Test Statistics	***LM_S Test Statistics***	***CD Test Statistics***	***LM_{BC} Test Statistics***
GDPPC	8289.75 (0.00)	373.90 (0.00)	90.85 (0.00)	373.62 (0.00)
HEXPC	8200.65 (0.00)	369.75 (0.00)	90.34 (0.00)	369.47 (0.00)
Model	1746.19 (0.00)	69.46 (0.00)	10.16 (0.00)	-

3.2.Panel Root Test with Structural Break

In econometric analysis, it is necessary to determine the degree of status of the series before proceeding to regression analysis. Because the test methods to be used in the later stages of the analysis are determined according to the stationary degrees of the series. If the series is not stationary in the level values, false regression problem may be encountered in the analysis of the level values of these series. (Engle ve Granger, 1987 : 258).

Since the cross-sectional dependence among the countries was determined in the study, the second generation unit root test should be used. For this purpose, Taylor and Sarno (1998) MADF, Breuer, Mcknown and Wallace (2002) SURADF, Bai and Ng (2004) and Pesaran, (2006) can be used in one of the CADF tests. However, these tests take into account the horizontal cross-sectional dependence between the countries that make up the panel, but do not take into account the structural breaks in the series. However, when there is a structural break in the series, the tests performed without considering this situation may give a deviated result.(Charemza ve Deadman, 1997).

Therefore, the stability of the series in Carrion-i-Silvestre et al. (2005) developed by PANKPSS test. In addition to taking into account the horizontal cross-section dependence between the countries that make up the panel, this test allows up to five structural breaks in the series of each of the horizontal sections forming the panel and can determine the dates of the structural breaks separately for each country and test the stability of the series under the presence of these structural breaks. (Gocer and Akin, 2016). Carrion-i-Silvestre et al. (2005) developed by PANKPSS test is based on the following model:

- $y_{i,t} = \alpha_{i,t} + \beta_{it}t + \varepsilon_{i,t}$

- $\alpha_{i,t} = \sum_{k=1}^{m} \theta_{i,k} D(T_{b,k}^{i})_t + \sum_{k=1}^{m} \gamma_{i,k} DU_{i,k,t} + \alpha_{i,t-1} + v_{i,t}$

$v_{i,t}$; error term series with zero mean and constant variance,

α constant terms, *t;* time trend $i = 1, \ldots, N$ and $t = 1, \ldots, T$. $D(T_{b,k}^{i})_t$ and $DU_{i,k,t}$ dummy variables,

Carrion-i-Silvestre, vd. (2005) hypothesis tests

- H_0: *The series is stable under structural breaks*
- H_1: *The series is not stable under structural breaks*

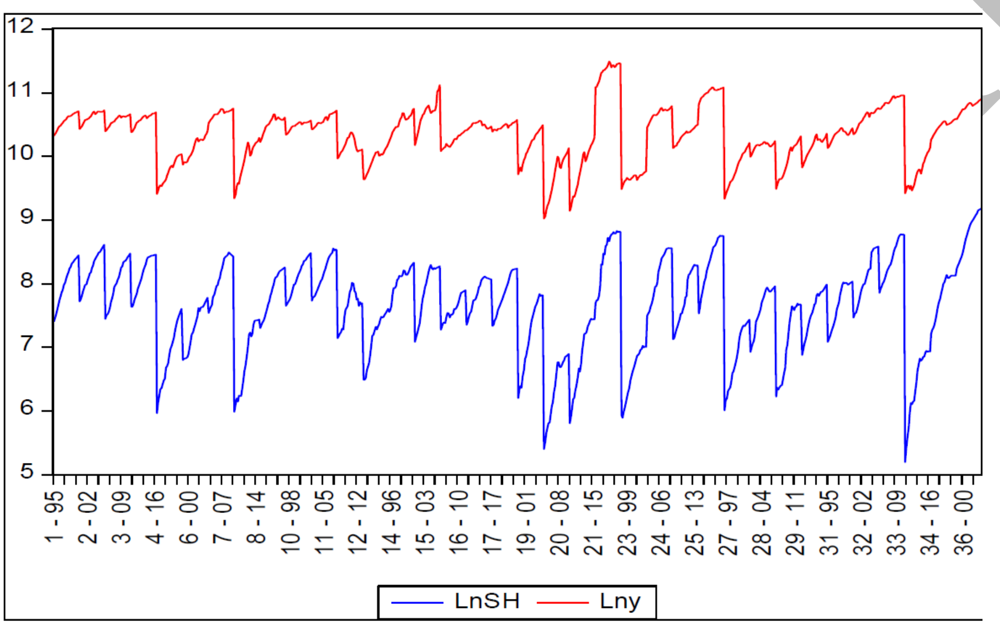
In this study, the stationarity of the series was tested with PANKPSS multiple structural fracture panel unit root test and obtained test statistics and critical values are presented in Table 2.

Panel Data Analysis

Three basic conditions must be met in order to ensure efficiency in GMM estimation, the first of these conditions is that it does not matter whether there is first-order autocorrelation in the model, but there is no second-order autocorrelation. The desired situation is that the basic hypothesis for 1st order autocorrelation (AR (1)) cannot be rejected, regardless of whether the basic hypothesis is rejected for 2nd order autocorrelation (AR (2)). The second condition is that the basic hypothesis of the sargan test, which is established as "over-identification restrictions are valid", cannot be rejected and the probe value should not be below 1.000 and below 0.25. The third and last condition is that the number of instrument variables used in the model must be equal to N or smaller than N (Yerdelen Tatoğlu, F., 2018: 80-109).

In this part the effects of health expenditure on economic growth in 36 OECD countries are examined by dynamic panel data analysis for the period 1990-2019 and the relation can be followed in Chart 1.

Chart 1. *The Relationship Between Health Expenditure per Capita and National Income Per Capita in OECD Countries*



Source: Worldbank 2020

$$Y=AK^{\alpha}L^{\beta} \quad (1)$$

$$LogY=LogA+LogK\alpha+LogL\beta \quad (2)$$

$$LogY=LogA+\alpha LogK+\beta LogL \quad (3)$$

In Cobb Douglas function Y; total production, A; technology level, K; capital stock, L; the amount of labor, α and β indicate the shares of capital and labor in production.

$$dY/dt=dA/dt+dK/dt+Dl/dt \quad (4)$$

β=1 $-\alpha$ (5)

Y=$AK\alpha L$1$-\alpha$ (6)

Y/L= ($AK\alpha L$1$-\alpha$)/ L (7)

y=$Ak\propto$ (8)

y is production per labor force, k shows the capital stock per labor force. A is the (external) technology parameter that cannot be explained by the model, and it is also called Solow Residue in the literature (Aslan and Yılmaz, 2015: 18).

In the Endogenous Growth Theory developed by Romer (1986) and Lucas (1988), technological progress;

It has been included in the model as a result of human capital and human capital has been accepted as the most important determinant of economic growth.

In this case, the equation was rearranged to include human capital (H) and the following model was obtained:

y=$Hk^{\propto}$ (9)

In this study, human capital; In this study, human capital; represented by per capita health expenditures (SH) and included in the analysis.

y=$(SH)^{\gamma}k^{\propto}$ (10)

Lny=$Ln(SH)^{\gamma}$+$Lnk^{\propto}$ (11)

Lny=$\gamma LnSH$+$\propto Lnk$ (12)

so, the model is;

$Lnyt$=β_0+$\beta_1 LnSHt$+$\beta_2 Lnkt$+et (13)

Here y; real national income per capita, SH; real health expenditure per capita calculated according to purchasing power parity, k; shows the real stock of fixed capital per labor force.

β_1; β_2; show the effect of the 1% change in the fixed capital stock per capita on the per capita national income. Our expectation as a result of the analysis; The positive results of β_1 and β_2, that is, increases in per capita health expenditures and per capita fixed capital stock will positively affect per capita national income and economic growth of countries.

4. Econometric Method

At first using Im, Pesaran, Shin (2003) and Breitung (2000) panel unit root tests the stationarity of the series studied; then by using Pedroni panel cointegration test the existence of cointegration was examined. Long and short term analyzes between series; Panel Dynamic Ordinary Least Squares (PDOLS) method was used. Causality relationships between series; Dumitrescu and Hurlin (2012) were analyzed with the panel causality test.

5. Panel Unit Root Test

Econometric analyzes are sensitive to the stationarity of the series. Because spurious regression problem may be encountered in analyzes to be made with non-stationary series (Engle & Granger, 1987). For this reason, unit root test should be applied to the series' first in the analysis. In this study, the stationarity of the series was investigated by Im, Pesaran and Shin, and Breitung panel unit root tests. These tests are based on a model such as:

$$\Delta Yi,\, t=\delta iYi,\, t-1+\Sigma_{j=1}{}^{pi}\beta ij\Delta Yi,\, t-j+Xi,\, t'\theta+\varepsilon i,\, t \quad (14)$$

Here p; optimum delay length, Xi, t';

$H0$: $|\delta i=\delta|=1$ The series is not stationary for all countries that make up the panel $H1$: $|\delta i=\delta|<1$ The series is stationary for all countries that form the panel format. It has been accepted that the unit root parameter δi may differ between the countries that make up the panel. The hypotheses of this test are: $H0$: $|\delta i|=1$ For some countries that make up the panel, the series is not stationary $H1$: $|\delta i|<1$ Series is stationary for some countries making up the panel format. In the study, Pesaran and Shin, Breitung and Im panel unit root tests were performed and the results are presented in Table 1.

Table 1. *Panel Data Unit Root Results*

Variable	Breitung Test		Im, Pesaran ve Shin Test	
	Test Stat.	Probability Value	Test Stat.	Probability Value
$\boldsymbol{Lny}$	-1,02	0,15	0,44	0,69
$\boldsymbol{Ln}$HE	1,14	0,87	-1,63*	0,05
$\boldsymbol{Lnk}$	-0,72	0,22	-0,97	0,19
$\Delta\boldsymbol{Lny}$	-11,35***	0,00	-11,57***	0,00
$\Delta\boldsymbol{Ln}$HE	-4,22***	0,00	-4,59***	0,00
$\Delta\boldsymbol{Lnk}$	-6,09***	0,00	-13,55***	0,00

Note: *** and * are stationary at 1% and 10%, respectively, Δ; indicates that the first difference of the relevant variable is taken. The optimum lag length was determined according to the Akaike information criterion.

According to Engle and Granger (1987), since the series are not stationary in their level values, spurious regression problem may be encountered in the analyzes to be made with the level values of these series.

Therefore, the existence of a cointegration relationship between the series should be tested.

6. Panel Cointegration Test

In this study, the existence of cointegration between the series was examined with the Perdroni (2004) test. Pedroni (2004) panel unit root test is based on the following equation:

$$yit=\alpha i+\delta it+\beta 1ix1i,\ t+\beta 2ix2i,\ t+\cdots+\beta Mi^{x}Mi,\ t+\varepsilon i,\ t \quad (15)$$

Here t=1,…,; i=1,…,N; m=1,…,M.

In this test, y and x should not be stationary in level, but should be series that become stationary when their difference of the same degree is taken.

When the error term series is stationary, it is decided that the series are cointegrated.

For this, when the series of error terms are opened and written in accordance with the AR (1) process;

$$\varepsilon_{it}=\rho_i\varepsilon_{i,t-1}+u_{i,t} \quad (16)$$

Against the autocorrelation problem, when the lagged values of the difference of the dependent variable are added as explanatory variable;

$$\varepsilon_{it}=\rho_i\varepsilon_{i,t-1}+\sum_{j=1}^{p_i}\psi_{ij}\Delta\varepsilon_{i,t-j}+v_{i,t} \quad (17)$$

obtained.

Hypotheses of the Pedroni panel cointegration test:

H_0: $|\rho_i|=1$ No cointegration between series

H_1: $|\rho_i|<1$ There is cointegration between the series format.

Table 2. *Panel Cointegration Test Results*

			Weighted	
	Test Stat.	**Prob. Value**	**Test Stat.**	**Prob. Value**
Panel v statistics	5,35***	0,00	0,31	0,36
Panel ρ statistics	-0,27	0,37	1,21	0,82
Panel PP statistics	-4,30***	0,00	-2,17**	0,01
Panel ADF statistics	-3,53***	0,00	-3,95***	0,00
Group ρ statistics	3,24	0,94	-	-
Group PP statistics	-1,96**	0,01	-	-
Group ADF statistics	-4,36***	0,00	-	-

Note: *** and **; indicates the existence of a cointegration relationship at the 1% and 5% significance level, respectively.

According to the results in Table 2; There is a cointegration relationship between health expenditures, fixed capital investments and economic growth Since the cointegration relationship between the series was determined, it was decided that long and short term analyzes could be started.

7. Long Term Analysis

In the study, long-term analysis was carried out using the level values of the series, within the framework of Equation (16), with the PDOLS method. While estimating the cointegration coefficient, this method includes the lag and antecedents of the independent variable in the model, thus avoiding the problems of internality, autocorrelation and varying variance

Table 3. *Long Term Analysis Results*

Variable	Coefficient	t- statistics	Prob. Value	R^2	Adj. $\bar{R}^2$
$\boldsymbol{Ln}$**HE**	0,27***	22,81	0,00	0,99	0,98
$\boldsymbol{\Delta Lnk}$	0,32***	14,14	0,00		

Note: *** means statistically significant at the 1% level.

According to the findings in Table 3; GDP per capita in OECD countries for the period 1990-2019; 1% increase in health expenditures per capita increased 0.27%, 1% increase in fixed capital stock per labor force increased 0.32%.

The obtained findings are in line with theoretical expectations. It has been found that the effects of the increases in the fixed capital stock per labor force on the national income are more than the health expenditures.

8. Short Term Analysis

In the study, the short-term analysis was carried out by with the PDOLS method.

$$\Delta Lnyt=\alpha 0+\alpha 1\Delta Ln\text{HE}t+\alpha 2\Delta Lnkt+\alpha 3ECTt-1+vt \qquad (18)$$

There is a long-term causality relationship from the independent variables to the dependent variable (Binh, 2013: 58-59). In the study, the short-term analysis was carried out with the PDOLS method and the results are presented in Table 4.

Table 4. *Short Term Analysis*

Variable	*Coefficient*	*t- statistics*	*Probability Value*	R^2	Adj. $\bar{R}^2$
$\boldsymbol{\Delta Ln}$**HE**	0,22***	22,81	0,00	0,55	0,55
$\boldsymbol{\Delta Lnk}$	0,26***	14,14	0,00		

$\boldsymbol{ECTt-1}$	-0,04**	-2,26	0,02		

Note: *** and **; means statistically significant at the 1% and 5% level respectively.

According to the findings in Table 4; in the short run, increases in per capita health expenditures and per capita fixed capital stock increase per capita national income, again the effect of per capita fixed capital stock is greater. The coefficient of error correction term was found to be statistically significant. In this case, the error correction mechanism of the model works. In other words, the deviations occurring in the short run disappear and the series maintain their stable relations in the long run. The fact that the coefficient of error correction term is statistically significant also reveals the existence of a long-term causality relationship from health expenditures and fixed capital stock to economic growth. Panel Causality Test The causality relationships between the series included in the analysis can be tested with different methods such as Granger (1969) and Dumitrescu and Hurlin (2012) causality tests. Among these methods, the Granger (1969) test tests the existence of a causal relationship between the variables in all countries that make up the panel, while the Dumitrescu and Hurlin (2012) causality test is a stronger test that can reveal the causal relationships valid for certain countries (Gülmez, 2015: 27). For this reason, the existence of causal relationships between the series was examined with the help of Dumitrescu and Hurlin (2012) causality test.

Dumitrescu and Hurlin (2012) causality test hypotheses;

H_0: $\beta i(k)$=0 There is no causality at all the countries from X to Y

H_1: {$\beta(k)$=0, i=1, 2,…,N1 There is causality at some countries from X to Y

$\beta(k)\neq0$, i=N1+1, N1+2,…,N there is causality is in the form.

In the study, Dumitrescu and Hurlin (2012) panel causality tests were performed and the results are presented in Table 4.

Table 5. *Dumitrescu ve Hurlin (2012) Panel Causality Test Results*

$\boldsymbol{H_0}$ **Hypothesis**	**W − statistics**	$\boldsymbol{\bar{Z}}$ **− statistics**	**Prob. Value**
$\boldsymbol{Ln}$**HE**$\nrightarrow\boldsymbol{Lny}$	3,04*	1,73*	0,06
$\boldsymbol{Lny}\nrightarrow\boldsymbol{LnH}$E	7,33***	11,57***	0,00

$Lnk \nrightarrow Lny$	3,42***	2,76***	0,00
$Lny \nrightarrow Lnk$	6,84***	10,34***	0,00
$Lnk \nrightarrow Ln$HE	5,81***	7,92***	0,00
LnHE $\nrightarrow Lnk$	4,37***	4,63***	0,00

Note: *** and * indicate the existence of a causal relationship from the first variable to the second variable at the significance level of 1% and 10%, respectively.

As a result, there are two-way and very strong causal relationships between health expenditures and economic growth, between fixed capital stock and economic growth, and between health expenditures and fixed capital stock in OECD countries. Here, the causality relationship between health expenditures and economic growth; It is suggested that increasing health expenditures accelerate economic growth by increasing human capital, while increasing economic growth enables individuals and countries to allocate more resources to health services.

Causality relations between fixed capital stock and economic growth; This suggests that the increased amount of capital (machinery-equipment, factory building, etc.) increases the production and income in the economy, while the increased income allows more fixed capital investments to be made in the countries.

The mutual causality relationship between health expenditures and fixed capital stock is; building, road, etc. in the field of health. It implies that the expenditures of medical machinery and equipment purchased for use in this field positively affect the fixed capital stock of the countries, while the increasing fixed capital stock increases the national income and expenditures for the health sector in the countries.

9. Dynamic Panel Data Analysis

In the study, the effect of health expenditures on economic growth was investigated with balanced panel analysis, using data from 22 OECD countries for the period 1990-2017.

Dynamic panel data analysis method is used in the study. Dynamic panel data analysis has advantages such as a greater number of observations and more homogeneous structure, increasing the degree of freedom and reducing the problem of connection between explanatory variables.

In addition, dynamic panel data analysis can give more effective results in cases such as autocorrelation, changing variance, and internality problems. Two-stage system generalized moments (two-step System-GMM) method also gives stronger results in dynamic panel data analysis. (Hayaloğlu and Topal, 2017: 199). Because the lagged value of the dependent variable is included in the model as an independent variable, and the internality problem that may occur can be eliminated from the beginning.

In the differential GMM developed by Arellano and Bond (1991), the problems that may occur in the dynamic panel estimation can be eliminated by using the previous period values of the dependent variable as the instrument variable and by taking the first-order differences of the variables and including them in the model. System GMM panel data analysis is used when the time dimension (T) is smaller than the unit size (N), and the efficiency of the model is increased by including more instrumental variables in the model (Hayaloğlu and Topal, 2017: 199).

9.1. Model and Dataset

Below is the econometric model created to analyze the relationship between health expenditures and economic growth and other components of economic growth with dynamic panel data:

$$GSHit = \alpha + \beta_1 \, GSHit\text{-}1 + \beta_2 HEit + \beta_3 DEMit + \beta_4 TFVit + \beta_5 FSit + uit \quad (19)$$

In the model, time t is country i; α constant term; β's are slope coefficients; μ is the unit effect and u are the error term. GSH, which shows the economic growth rate, is the dependent variable. SH is the main independent variable and expresses the ratio of health expenditures to national income, while other variables are control variables that have an effect on economic growth. TVF Total Factor Productivity is the ratio of FS physical capital stock to national income. In Equation the growth rate of national income per capita, the ratio of health expenditures to national income and the ratio of physical capital stock to national income, which are the main components of economic growth, are modeled over total factor productivity and democracy index. In this study, the relationship between health expenditures and economic growth (the rate of increase in national income) was determined by 22 OECD countries (Canada, England, Australia, Belgium, New Zealand, Austria, Denmark, Finland, Ireland, Greece, Germany, Hungary, Iceland, Japan, Korea, Netherlands, Switzerland, Norway, Italy, Spain, Sweden and the USA) were analyzed using annual data for the period 1990-2019. The data are taken from Penn World Table 9.1, OECD Stat and Polity IV, the series expressed in million USD based on 2011. Data analyzes were carried out using Stata 15 and Gauss 20 computer programs. In order to provide balanced panel analysis, the condition of having an equal number of data from 23 countries was taken into account, and 690 observation values were obtained from 23 countries with 30 years of data for the period 1990-2019.

9.2 Data Sources and Descriptive Statistics

Table 6. *Data Sources*

Variable	Explanation	Data source
GSH	Real gross domestic product per capita, adjusted for purchasing power parity	Penn World Table 9,1
HE	Real health expenditure per capita adjusted for purchasing power parity	OECD Stat
FS	Physical Capital Stock	Penn World Table 9,1
FV	Total Factor Efficiency	Penn World Table 9,1
DEM	Democracy Index	Polity IV

Table 7. *Descriptive Statistics*

Variables	Average	Stand. Dev.	Min.	Max.
GSH	2.135	2.847	-9.135	11.114
FS	22.305	3.573	11.543	35.675
TFV	0.9881076	0.0656486	0.7329	1.2125
DEM	9.905842	0.3663462	8	10

Variables	**Average**	**Stand. Dev.**	**Min.**	**Max.**
HE	8.693	2.023	3.994	16.517

Table 8. *Dynamic Panel Data Analysis Results*

Variables	**Pooled LSM**	**Fixed Effect LSM**	**Differnece-2 GMM**	**System-2 GMM**
Gsh(-1)	0.233* (12.62) [0.000]	0.285* (8.09) [0.000]	0.243* (11.13) [0.000]	0.204* (5.53) [0.000]
HE	0.226* (5.14) [0.895]	0.186* (7.96) [0.993]	0.201* (7.98) [0.547]	0.203* (9.22) [0.001]
TVF	0.362* (5.77) [0.691]	0.326* (10.02) [0.271]	0.354* (5.32) [0.267]	0.298* (4.17) [0.046]
DEM	0.164* (7.39) [0.889]	0.088*** (1.72) [0.857]	0.189* (3.46) [0.542]	0.148** (2.15) [0.427]
Constant	14.436* (6.03)	12.536* (2.65)	11.365* (3.17)	14.305* (3.73)
Wald (χ2)	3688.92 [0.000]	8098.02 [0.000]	3992.27 [0.000]	1376.45 [0.000]
Sargan (χ2)	19.795 [0.833]	18.003 [0.905]	20.917 [0.794]	19.564 [0.848]
AR (1)	-3.339 [0.000]	-3.199 [0.001]	-3.305 [0.001]	-3.285 [0.001]
AR (2)	1.622 [0.102]	1.513 [0.125]	1.647 [0.100]	1.572 [0.115]
Hansen Test			9.12 [0.764]	6.18 [0.905]

Fark Hansen			0.19 [0.996]	1.35 [0.241]
R^2	0.94	0.98		
Country Number	23	23	23	23
Observation Number	690	690	690	690
Instrumental variable number			16	15

Two-stage GMM models are preferred to correct the heteroscedasticity and autocorrelation problems of single-stage GMM estimators (Tatoğlu, 2018: 134). The difference GMM estimation results are shown in column 3 of the table. The autoregressive coefficient, which was not within the lower and upper limits shown in the 1st and 2nd columns, was found to be statistically significant at the 1% level. Other variables were not found to be statistically significant. In the 4th column, two-stage system GMM results are seen and the validity and significance of the Wald test statistic and the system GMM method were questioned. Sargan and Hansen test statistics are whether the instrument variables are valid; With AR (1) and AR (2) tests, it was questioned whether there was a first and second order autocorrelation in the model. The model was found to be statistically significant at the 1% level according to the Wald test statistic. There is no first-order or second-order autocorrelation problem in the model. It has been determined that the instrumental variables used in the Sargan and Hansen test are also valid. The difference Hansen test also showed that there was no internality problem. Therefore, the necessary assumptions are provided to use the system GMM. When the coefficients estimated using the system GMM are examined, it is seen that the most important factor of economic growth is total factor productivity. When the ratio of health expenditures to national income increases by 1%, the economic growth rate increases by 0.203. This is in line with the Keynesian view in the literature and the endogenous economic growth model based on human capital. The effect of democracy index on economic growth remained as the lowest factor with 0.149.

RESULTS

According to convergence hypothesis approach, undeveloped countries will have a higher growth rate, while developed countries will have a lower growth rate.

This part follows papers mainly Ulusoy (2001) and Ulusoy and Yalçın (2011).

Ulusoy and Yalçın (2011), states "If the speed of convergence parameter is positive, one can predict the sign of the coefficients in formula, The first coefficient (1_e-βt)α(1_θ)>0 indicates that the more a country saves, the more rapidly it grows, The second (1_e-βt)β1>0 , indicates that the scale of the labor force is a contributing factor to the per worker output, The third coefficient (1_e-βt) shows the effect of economic freedom on the production of a country and it is expected to be positive, Finally, the last term e-βt indicates that countries grow faster if they are initially below their balanced growth path".

By using Cobb Douglas function, it is derived:

$$Ait / A_{it} = Yit^{\beta 1} HER^{\o}_{wit} A_{it}^{\o -1} - y \tag{20}$$

then;

$$Lny_{it} = (1 - e^{-\beta t})\ \alpha\ (1 - \theta)\ Lns_{it} + (1 - e^{-\beta t})\ \beta 1\ LnL_{it} + (1 - e^{-\beta t})\ \emptyset\ Ln\mathrm{HE}_{it} + (1 - e^{-\beta t})\ Ln\ (\gamma + (1 - \alpha)\ \beta 1 n_{it}) + (1 - e^{-\beta t})\ \alpha\ (1 - \theta)\ Ln\ [\delta + (1 - \alpha)\ (1 - \theta)\ nit + e^{-\beta t} Lny_{t-1} + \mu_{it} \tag{21}$$

This is the reverse of the neoclassical approach, that is, output per worker is now proportional to Health Expenditure Labor Level and savings rate.

The higher the productivity of labor in economically free countries, the greater the positive effect of income savings per worker around balanced growth path values.

The results of the Pearson correlation matrix between the variables used in the analysis are below.

Table 9. *Pearson Correlation Matrix*

	HER	s	n

L	0.506	-0.121	-0.088
HER		-0.090	-0.262
s			0.082

When the correlation coefficients were examined, there was a positive and moderate (r=-0.121) negative and low-level, negative and low-level (r=-0.088) negative-oriented low-level relationship between the L variable and the HC, s and n variables, respectively. In addition, it is seen that there is a negative and low-level relationship (r=-0.090), (r=-0.262) between the HC variable and the s and n variables, respectively. Another finding is that there is a positive low-level relationship between the s variable and the n variable (r=0.082).

In general, no high level of negative or positive correlation was found. The nonlinear least squares estimation results of the dynamic econometric model are below.

Table 10. *Nonlinear Least Squares Estimation Results*

Parameter	Beta	SD	t	p
β	0.206	0.024	8.440***	**<0.001**
α	-11.336	13.290	-0.850	0.394
θ	1.033	0.030	34.030***	**<0.001**
β1	-0.045	0.028	-1.600	0.110
Ø	1.449	0.171	8.480***	**<0.001**

The coefficient of the θ parameter was found to be positive and statistically significant ($p<0.05$). In the light of this finding, when the productivity of the new technology stock increases by 1%, the per capita income increases by 1.033%.

The ratio (Ø) coefficient of per capita health expenditures to national income is positive and statistically significant ($p<0.05$). According to this finding, when the ratio of health expenditures per capita to national income increases by 1%, per capita income increases by 1.449%.

DISCUSSION

The labor ($\beta 1$) coefficient was negative and not statistically significant ($p>0.05$). For the coefficient of convergence (β), the model converged at the point where the β coefficient was the smallest as a result of 5000 iterations with the NLS technique.

The coefficient of convergence is the initial value of the capital stock, which decreases exponentially at the rate $\beta >0$, with the weight of the capital value per worker and the weighted average of the initial and balanced growth path values. This ratio indicates that it converges to the balanced growth of physical productivity. It is seen that these coefficient results are statistically significant and the coefficient is low (0.206 per year, $p<0.05$). In light of this finding, GDP per capita growth for 23 countries is slow and will be effective in the long run. Life on a logarithmic scale of output per half worker is approximately;

$\ln(2)/0.206 = 3.365$ years

In other words, it takes 3,365 years to close half of the gap between countries' per capita income.

CONCLUSION

Based on the findings of the study; it can be said that countries that want to increase their per capita national income should increase their per capita health spending while doing so by calculating the optimum amount of health spending.

By dynamic panel data analysis, the relationship between health expenditures and democracy index and economic growth in the 1990-2017 period in 22 OECD countries was investigated with the system GMM technique, which has an important place in dynamic panel data methodology.

The results of the study determined the existence of a positive relationship between health expenditures, physical capital stock, total factor productivity and democracy index and GSH.

According to the panel Granger causality results, health expenditures, capital stock and total factor productivity are the Granger causes of GSH. No causality could be detected from democracy to GDP.

These results prove that health expenditures and democracy index are among the determinants of GDP in OECD countries in the long run.

In addition, the factors affecting economic growth have been sorted for OECD countries in a sense and it has been determined that total factor productivity, physical capital stock, health expenditures and democracy index increase the economic growth rate, respectively.

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