Research Article

# The Analysis of Health Expenditure as a Determinant of Economic Growth in 37 High Income Countries

**Özlem Özsoy[1]\* and Metin Gürler[2]**

*[1]Ekol Hospital İzmir, Turkey*

*[2]Uluslararası Rekabet Araştırmaları Kurumu (URAK), Istanbul, Turkey*

**\*Corresponding Author:** Özlem Özsoy, Ekol Hospital İzmir, Turkey.

## Abstract

**Background:** Labour force, which is one of the main factors of production function with capital input in traditional economic growth theory, has got an important effect on a country's economic growth. So a productive labour force is crucial for an economy. An increase in health expenditure improves good health care to the citizens. Since people who were provided by good health care feel themselves more productive, the increasing productivity in labour force and working hours cause an economic growth hence enhancement in income (Gross Domestic Product, GDP) and income per capita (IPC) in a country incessantly. Also higher IPC means better access to the health services which were supplied by public and private sectors in a country. This study aims to investigate the relationship between the share of health expenditure in GDP (HEXP) and IPC data and vice versa for 37 High Income Countries (HIC).

**Methods:** Cross-section data (CSD) analysis and panel data (PD) analysis consisting of random and fixed effects estimations were used in the study to investigate the relationship between HEXP and IPC for selected country group.

**Results:** According to the random effects model (RAM) and fixed effects model (FEM) with PD analysis and CSD analysis in the study, HEXP is found as one of the determinants of IPC and IPC as a main determinant of HEXP in 37 HIC. Granger causality test is also applied to test the direction of causality between HEXP and IPC for HIC and Turkey. It is obviously seen that IPC Granger causes HEXP increase whereas we can't reject HEXP doesn't cause IPC hypothesis according to Granger test statistics for PD. There is also no proven correlation between two variables for CSD analysis.

**Conclusion:** In the study after the analysis of 37 HIC together it is found that IPC promotes HEXP not at once but in a time period. In the manuscript our results show that economic growth Granger causes HEXP increase and HEXP does not Granger cause IPC for PD. For CSD there is no relationship between HEXP and IPC. The case of IPC not increasing to a high income level from middle income stuck on a threshold is called in literature as "Middle Income Trap (MIT)". So guiding how HIC jumped from middle class to high income class is important for the emerging countries (EC) to avoid the "MIT". EC should increase HEXP to improve labour force productivity, which will cause a rapid economic growth as developed countries have done in past.

**Keywords:** High Income Countries (HIC); Cross-section Data (CSD); Economic Growth

Since the capital and technology are scarce, limited labour force is the main and key determinant of growth at the initial level of development for the DC at the first stages of industrialization. Primary industries use mostly natural resources and labour intensively in DC. So that an improvement in health status of labour force will increase the productivity and result with an economic growth enhancing IPC in a country. Economic growth not only increases IPC but also promotes health in two ways; first of all it causes a rise

in technological investments in healthcare system and then the governments and citizens increase health expenditures by income enhancement.

The improvements in healthcare system with the developments in innovation will decrease diseases and promote well-being for the citizens. The increase in HEXP allows the development of preventive and therapeutic methods against diseases which will ensure the productivity of labour force providing a healthy life in a country [1]. Healthy labour force will produce more and national income will increase enhancing IPC. Income increase will also effect health care expenditures positively. This positive feedback will last with the income increasing.

The relationship between HEXP and ICP of 37 HIC (Table 2) was tested within the study empirically. In the study, a literature review of the subject was also conducted. In the following chapter the effect of HEXP on ICP was analysed by Cross-section Data Model (CSDM) and Panel Data Model (PDM). The data was gathered from the World Bank [2,3].

It is clear that productivity should be increased by giving priority to the healthcare of the citizens hence making labour force feeling well-being.

International Monetary Fund (IMF) classifies the countries as 39 advanced (developed) economies at one side and 155 emerging markets (economies) and developing economies at the other side in its publication World Economic Outlook published twice a year [4]. IMF simply defines the countries as EC which are still developing countries (DC) but on the way to be developed sooner. On the other side the World Bank classifies countries as high income, upper middle income, lower middle income and lower income according to their IPC [5].

In this study, totally 37 HIC those might be taken as an example of economic development success have been investigated by CSM and PDM analyses. The relationship of HEXP with IPC for 37 HIC have been tested with both CSM for the year 2014 and PDM for twenty periods starting from 1995 ending 2014. Granger causality test is also applied to test the direction of causality between HEXP and IPC.

The Human Development Report which is regularly published annually by the United Nations Development Programme (UNDP),

seems to have put people at the centre of the development. In The Human Development Indices and Indicators Report [6], countries were divided into four groups as the Very High Human Development (59 countries according to the report), the High Human Development (53 countries according to the report), the Medium Human Development (39 countries according to the report) and the Low Human Development (38 countries according to the report). In the Human Development Report 2016 [7] the number of the countries which have got Very High Human Development were 51 whereas it was 49 in the Human Development Report 2015 [8]. According to the UNDP Human Development Reports it seems there is an improvement in human development with the increasing HEXP. Increasing HEXP will also promote an innovative healthcare system and will decrease mortality rates in a country and promote to reach a healthy labour force enhancing productivity and economic growth in a country not in short term but in a time period [1].

Romer [9] described labour services (L) as skills such as eye-hand coordination that are available from a healthy physical body and are measured by counts of people in his study about endogenous technological change in economic growth.

In the book edited by López-Casasnovas, Rivera and Currais [10] the impact of health on long-run development, economic growth, and poverty reduction was examined by many authors.

In his article, Kurt [11] gathered the literature in the relationship between health expenditures and economic growth study in a table.

In the table 1 selected studies analysing the relationship between health expenditure and economic growth which is an extended version of Kurt's literature table there are some basic studies investigating and analysing the relationship between health expenditures and economic growth.

## Methods
### Analysis of the relationship between HEXP and IPC
### Country and data selection

In the study PD observation of 37 HIC with time period 1995 - 2014 and CSD observation of same country group with for the year 2014 were applied. The countries which were observed are all members of the World Bank high income grouping countries.

| Authors | Name of the study | Year of the study | Countries observed in the study | The study's time period | Method | Empirical results |
|---|---|---|---|---|---|---|
| Heshmati A [12] | On the causality between GDP and health care expenditure in augmented Solow growth model | 2001 | The Organisation for Economic Co-operation and Development (OECD) countries | 19701992 | Solow growth model | Positive |
| Kar M and Taban, S [13] | The impacts of the disaggregated public expenditure on economic growth | 2003 | Turkey | 19712000 | Cointegration | Negative |
| OECD and The World Bank [14] | OECD Reviews of Health System: Turkey 2008 | 2009 | OECD countries and Turkey | 1980-2006 | Ordinary Least Squares (OLS) | Positive |
| Chakroun M [15] | Health care expenditure and GDP: an international panel smooth transition approach | 2009 | OECD countries | 19752003 | Multivariate nonlinear | Positive |
| Yumusak, I.G. and Yildirim, D.C. [16] | An econometric examination over the relation between health expenditure and economic growth | 2009 | Turkey | 19802005 | Cointegration | Negative |
| Arısoy, I., Unlukaplan, I. and Ergen, Z. [17] | The relationship between social expenditures and economic growth: a dynamic analysis intended for 1960-2005 period of the Turkish economy | 2010 | Turkey | 19602005 | Cointegration | Positive |
| Cetin M and Ecevit E [18] | The effect of health expenditures on economic growth: a panel regression analysis on OECD countries | 2010 | OECD countries | 19902006 | Pooled OLS | No relationships |
| Ak R [19] | The Relationship between Health Expenditures and Economic Growth: Turkish Case | 2012 | Turkey | Time series data | Johansen Co-integration (Causality) Test | There is not a short-term relationship between the series although there is a long-term relationship between health expenditures and economic growth |

| Eryiğit SB, Eryiğit KY and Selen U [20] | The long-run linkages between education, health and defence expenditures and economic growth: evidence from Turkey | 2012 | Turkey | 19502005 | Cointe-gration | Positive |
|---|---|---|---|---|---|---|
| Yardımcıoğlu F [21] | An Econometric Analysis of the Relationship between Health and Economic Growth in OECD Countries | 2012 | 25 OECD countries | 1975-2008 | Pedroni panel cointe-gration, Pedroni Full Modified Ordinary Least Square (FMOLS) and Canning-Pedroni causality methods | Positive |
| Tıraşoğlu M and Yıldırım B [22] | Health Expenditure and Economic Growth Relationship in the Case of Structural Break: A Case Study for Turkey | 2012 | Turkey | 2006 Jan.-2012 March | Lee and Strazicich unit root test (2004) | Long-term relationship between health and economic growth in the presence of one structural break |
| Deloitte and Yased [23] | Turkey Life Science and Healthcare Report | 2012 | Turkey | 2002-2015 (2011-2015 period is forecasted) | Per Capita GDP and Health-care Spending Relation-ship in Turkey by Graph | Positive (As Turkey's ICP has grown, the healthcare per capita has also increased 16,86% CAGR during 2002-2010). |
| Lago-Penas S., Cantarero-Prieto D and Fernandez BC [24] | On the relationship between GDP and health care expenditure: a new look | 2013 | 31 OECD countries | 19702009 | Fixed effects model (FEM) | The adjustment to income changes in those countries with a higher share of private health expendi-ture over total expenditure is faster. |

| | | | | | |
|---|---|---|---|---|---|
| Akar S [25] | An Investigation of The Relationship among Health Expenditures, Relative Price of Health Expenditures and Economic Growth in Turkey | 2014 | Turkey | 2004 January-2013 March | Cointegration analysis and Vector Error Correction Model (VECM). | Positive in long run, no relationship in short run. |
| Kurt S [11] | Government Health Expenditures and Economic Growth: A Feder–Ram Approach for the Case of Turkey | 2015 | Turkey | 2006 Jan.-2013 Oct. seasonally adjusted monthly data | Feder-Ram Model | Positive and significant |
| Aydemir C and Baylan S [26] | Health Expenditure and Economic Growth: A Case Study for Turkey | 2015 | Turkey | 1998-2012 | Granger Causality Test | Linear causality |
| Hayaloglu P and Bal HC [27] | The Relationship Between Health Expenditures and Economic Growth in Upper-Middle Income Countries | 2015 | 54 Upper-Middle Income countries | 2000-2013 | PD analysis | Positive (the increase in total health expenditures, public and private sector health expenditures are affected economic growth positively in the upper middle -income countries) |
| Bedir S [28] | Healthcare Expenditure and Economic Growth in Developing Countries | 2016 | DC | 1995-2013 | Causality test of Toda and Yamamoto (1995) and Dolado and Lütkepohl (1996) | Increases in income level stimulate healthcare expenditures for some of the emerging market economies |

| Basar S, Kunu S and Bozma G [29] | Impacts of Education and Health Expenditures on Economic Growth: An Application on Turkey | 2016 | Turkey | 1998 Jan-2016 Jan | Augmented Dickey-Fuller (ADF), Zivot-Andrews Unit Root Test | Positive |
|---|---|---|---|---|---|---|

**Table 1:** Selected studies analysing the relationship between health expenditure and economic growth.

OECD: The Organisation for Economic Co-operation and Development; DC: Developing Countries; FEM: Fixed Affects Model; OLS: Ordinary Least Squares; ADF: Augmented Dickey-Fuller; FMOLS: Full Modified Ordinary Least Square; VECM: Vector Error Correction Model; CAGR: Compound Annual Growth Rate.

**Source:** [11] and the authors.

The countries are not only having high income per capita but more than one million population as well. For the period 1995 - 2014 the data was collected from the World Bank [2,3].

At the initial level of development for EC basic inputs such as labour and capital are key determinants of economic growth. During the first stages of industrialization, labour moves from urban areas to the cities to work at factories and the saving of residents and foreign direct investments reveals as capital accumulation.

An improvement in health status of labour force increases the productivity resulting with an economic growth and enhancing IPC in a country. Higher IPC means better access to health services those are provided by public or private sectors. Good health service which prevents from disease and treats the illness supports a resilient labour force.

Following the existing literature for the relationship between IPC and HEXP the estimated model in the study can be described as follow:

$\ln(Y_{it}) = f(X_{it})$, ln: natural logarithm, $Y_{it}$: IPC, $X_{it}$: HEXP

$\ln(Y_{it}) = f(X_{it})$, ln: natural logarithm, $Y_{it}$: HEXP, $X_{it}$: IPC

$\ln(Y_{it}) = \alpha + \beta \times X_{it} + \upsilon_t$, i= 1,2,3 ... 37 (countries), t = 2014 for CSD, $Y_{it}$: IPC or HEXP, $X_{it}$: HEXP or IPC

$\ln(Y_{it}) = \alpha + \beta \times X_{it} + \upsilon_t$, i= 1,2,3 ... 37 (countries), t = 1995-2014 (20 periods) for PD, $Y_{it}$: IPC or HEXP, $X_{it}$: HEXP or IPC.

IPC as an indicator of economic growth and HEXP as an indicator of healthcare expenditure were used in the study. For IPC variables natural logarithms of the values are used. For PD analysis 20 periods starting from 1994 and ending 2014 and for CSD analysis the 2014 year were studied for 37 HIC.

$\alpha$ is the constant coefficient (intercept) and $\beta$ is the regression coefficient (independent variable coefficient/ slope). $\upsilon_t$ is the disturbance (error) term that represents the changes in IPC or HEXP (increase/decrease) is not defined by HEXP or IPC at time *t*. $\upsilon_t$ is a random variable with well-defined probability properties and is $\upsilon_t$ ~Normally and Independently Distributed (NID) (0, $\sigma^2$) where $\upsilon_t$ has zero (0) mean and common variance ($\sigma^2$) for all countries according to the Classical Normal Linear Regression and is normally and independently distributed according to time and countries [30].

## Results

### The development of IPC during the period 1995 - 2014

Considering IPC (natural logarithm) development during the period 1995-2014 in the study, Norway is the country which has got the highest IPC among 37 HIC whereas Switzerland, Australia, Denmark and Sweden are the followers of Norway. On the other hand Poland, Hungary and Croatia seem as the countries who have lowest income per capita (Figure 1). Turkey who is not a member of HIC but a member of Upper Middle Income Countries according to the World Bank classification [5] and EC according to IMF country classification [4] has got approximately 10,304 USD IPC that is an

amount of 3,000 USD below Croatia which has got the lowest rank among HIC. In the figure the upward line passing from the origin (y = x) tells that IPC doesn't change from 1995 to 2014 and the countries below the line mean that the countries has got a progress in IPC where the countries upper the line mean a recession in IPC. It seems Norway has got the best performance in increasing the income per capita during the period 1995 - 2014 where Japan has got the worst performance with a decrease in income per capita.



**Figure 1:** The development of IPC (1995-2014). Source: [3].

### The development of HEXP during the period 1995 - 2014

For the period 1995 - 2014 considering the HEXP for Turkey as a sample of EC and 37 HIC it can be obviously said that Turkey has a leading positive change rate. Turkey has got a change rate as 116% for the period 1995 - 2014 and the Korea Republic has followed Turkey with a 100.8% change rate in the HEXP. For the same period, Uruguay has got the lowest change rate in the HEXP with a 32.1% decline. The world average rate is 16.8% and HIC average is 33% in the same period. Turkey has got a tremendous increasing HEXP after 1995 but got into stuck at 5 - 6% range for a decade (Table 2).

Considering HEXP development during the period 1995-2014 United States of America (USA) is the country which has got the highest HEXP among 37 HIC in 2014 (Figure 2). Sweden, Switzerland, France and Germany are the followers of USA mean while Latvia, Singapore and Saudi Arabia are the countries who have lowest HEXP. Turkey has got a 5.42% share ratio that is an amount of the half of the world average rate and 44% of HIC average rate. In the figure the upward line tells that HEXP doesn't change from 1994 to 2014 and the countries below the line mean that the countries has got a progress in HEXP where the countries upper the line mean a recession in HEXP. It seems Korea Republic (South Korea) has got

| Country Name | 1995 | 2000 | 2005 | 2010 | 2011 | 2012 | 2013 | 2014 | Change (1995-2014) |
|---|---|---|---|---|---|---|---|---|---|
| Turkey | 2,51 | 4,95 | 5,45 | 5,61 | 5,29 | 5,24 | 5,38 | 5,42 | 116,0% |
| Korea, Rep. | 3,67 | 4,23 | 5,33 | 6,79 | 6,83 | 7,01 | 7,20 | 7,37 | 100,8% |
| Singapore | 2,94 | 2,71 | 3,74 | 3,96 | 3,93 | 4,22 | 4,53 | 4,92 | 67,7% |
| Saudi Arabia | 2,93 | 4,24 | 3,42 | 3,49 | 3,57 | 3,86 | 4,25 | 4,68 | 59,7% |
| New Zealand | 6,95 | 7,47 | 8,25 | 11,20 | 11,24 | 11,53 | 11,17 | 11,03 | 58,7% |
| Cyprus | 4,74 | 5,77 | 6,37 | 7,20 | 7,50 | 7,40 | 7,41 | 7,37 | 55,6% |
| Japan | 6,62 | 7,53 | 8,18 | 9,58 | 10,07 | 10,17 | 10,25 | 10,23 | 54,5% |
| Sweden | 7,96 | 8,18 | 9,06 | 9,47 | 11,70 | 11,80 | 11,97 | 11,93 | 49,8% |
| Netherlands | 7,44 | 7,42 | 9,60 | 10,48 | 10,53 | 11,01 | 11,04 | 10,90 | 46,4% |
| Belgium | 7,61 | 8,12 | 9,24 | 10,17 | 10,42 | 10,54 | 10,57 | 10,59 | 39,2% |
| United Kingdom | 6,62 | 6,94 | 8,24 | 9,51 | 9,34 | 9,41 | 9,34 | 9,12 | 37,8% |
| Denmark | 8,13 | 8,70 | 9,77 | 11,08 | 10,87 | 10,98 | 11,25 | 10,81 | 33,0% |
| Slovak Republic | 6,06 | 5,50 | 7,04 | 8,51 | 7,96 | 8,15 | 8,00 | 8,05 | 32,8% |
| United States | 13,09 | 13,07 | 15,15 | 17,02 | 17,06 | 17,02 | 16,90 | 17,14 | 31,0% |

| Italy | 7,10 | 7,91 | 8,71 | 9,42 | 9,27 | 9,28 | 9,22 | 9,25 | 30,3% |
|---|---|---|---|---|---|---|---|---|---|
| Australia | 7,26 | 8,08 | 8,45 | 9,02 | 9,20 | 9,36 | 9,36 | 9,42 | 29,8% |
| Portugal | 7,42 | 9,14 | 9,98 | 10,44 | 10,07 | 9,74 | 9,55 | 9,50 | 28,1% |
| Norway | 7,72 | 8,27 | 8,89 | 9,25 | 9,14 | 9,16 | 9,39 | 9,72 | 26,0% |
| Switzerland | 9,33 | 9,91 | 10,86 | 10,96 | 11,11 | 11,48 | 11,59 | 11,66 | 24,9% |
| Slovenia | 7,46 | 8,26 | 8,50 | 9,07 | 9,08 | 9,37 | 9,29 | 9,23 | 23,9% |
| Finland | 7,85 | 7,22 | 8,43 | 9,05 | 9,01 | 9,30 | 9,55 | 9,68 | 23,3% |
| Lithuania | 5,37 | 6,46 | 5,83 | 6,97 | 6,64 | 6,43 | 6,40 | 6,55 | 21,9% |
| Spain | 7,44 | 7,21 | 8,12 | 9,56 | 9,48 | 9,39 | 9,10 | 9,03 | 21,3% |
| Ireland | 6,44 | 6,03 | 7,27 | 8,76 | 8,15 | 8,32 | 8,01 | 7,78 | 20,9% |
| Chile | 6,49 | 7,92 | 6,69 | 6,97 | 7,00 | 7,24 | 7,53 | 7,79 | 19,9% |
| Germany | 9,43 | 10,10 | 10,52 | 11,25 | 10,93 | 10,99 | 11,16 | 11,30 | 19,8% |
| Poland | 5,36 | 5,50 | 6,20 | 6,85 | 6,67 | 6,58 | 6,40 | 6,35 | 18,5% |
| Canada | 8,86 | 8,67 | 9,57 | 11,20 | 10,82 | 10,78 | 10,67 | 10,45 | 17,9% |
| Austria | 9,55 | 10,06 | 10,53 | 11,17 | 10,94 | 11,17 | 11,14 | 11,21 | 17,4% |
| Croatia | 6,74 | 7,66 | 6,89 | 8,25 | 7,80 | 7,80 | 7,83 | 7,80 | 15,7% |
| France | 10,11 | 9,77 | 10,60 | 11,20 | 11,19 | 11,31 | 11,41 | 11,54 | 14,1% |
| Czech Republic | 6,69 | 6,31 | 6,93 | 7,43 | 7,50 | 7,55 | 7,49 | 7,41 | 10,7% |
| Israel | 7,15 | 6,97 | 7,29 | 7,28 | 7,32 | 7,73 | 7,89 | 7,81 | 9,2% |
| Hungary | 7,22 | 7,06 | 8,28 | 7,85 | 7,84 | 7,74 | 7,53 | 7,40 | 2,4% |
| Estonia | 6,32 | 5,26 | 5,00 | 6,19 | 5,75 | 6,36 | 6,48 | 6,38 | 1,0% |
| Greece | 8,27 | 7,60 | 9,36 | 9,18 | 9,76 | 9,23 | 9,19 | 8,08 | -2,2% |
| Latvia | 5,76 | 6,00 | 6,37 | 6,40 | 5,95 | 5,75 | 5,67 | 5,58 | -3,2% |
| Uruguay | 12,63 | 7,82 | 11,15 | 8,63 | 8,55 | 8,74 | 8,68 | 8,58 | -32,1% |
| Memorandum (averages) | | | | | | | | | |
| European Union (EU) | 8,29 | 8,39 | 9,23 | 10,05 | 9,99 | 10,05 | 10,07 | 10,04 | 21,1% |
| OECD members | 9,22 | 9,82 | 10,98 | 12,12 | 12,07 | 12,20 | 12,22 | 12,35 | 34,0% |
| HIC | 9,23 | 9,86 | 10,98 | 12,07 | 11,98 | 12,10 | 12,13 | 12,27 | 33,0% |
| World | 8,51 | 9,02 | 9,79 | 10,03 | 9,83 | 9,85 | 9,84 | 9,94 | 16,8% |

**Table 2:** HEXP by the years.

Source: [2].

the best performance in increasing the HEXP during the period 1995-2014 where Uruguay has got the worst performance with a decrease in HEXP.

**The productivity**

Porter [31] stated that the only understandable concept of competitiveness at the national level is productivity. In order to offer a high and rising standard of living to the citizens, it is necessary to use the labour force and the capital efficiently in the country. The author defines productivity as total production amount per unit labour or per capita in the country.

The productivity ratio which has got a positive increasing trend faces with two sharp decreases in 2001 and 2009 financial crises. After the world financial crisis in 2009 it seems Turkey has got a

rithm of IPC and HEXP for the year 2014. The positive relationship can be seen obviously between two variables with the line equation. The countries on the equation line indicates the countries where the natural logarithm of IPC and HEXP are equal. The equation tells us one unit increase in HEXP causes approximately 0.17 (17%) increase in natural logarithm of IPC which means approximately 5,265 USD increase in IPC in 37 HIC' average.
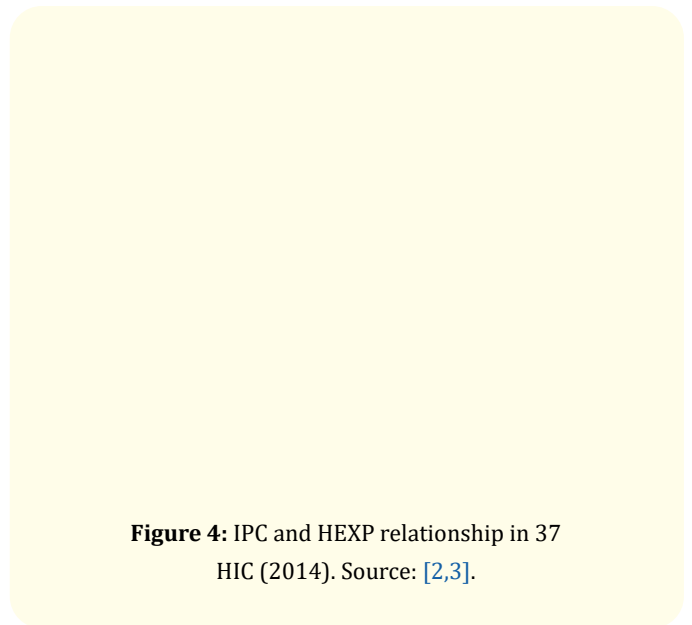
**Figure 2:** The Development of the HEXP (1995-2014). Source: [2].

recovery in productivity so that the ratio started to increase. After reaching its highest level in 2008 as 37.5% the ratio has started to fluctuate in 32-36 % range (Figure 3).
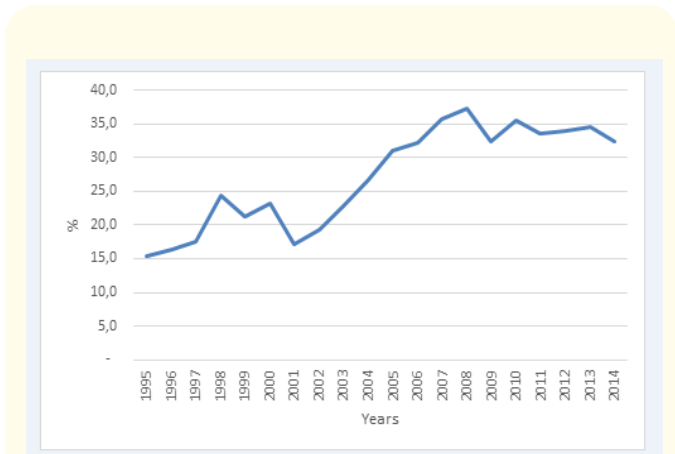


**Figure 3:** The Ratio of Productivity of Turkey to the HIC Average Value (1995-2014). Source: [32].

**Figure 4:** IPC and HEXP relationship in 37 HIC (2014). Source: [2,3].

In 2014, USA is the leader country where Sweden is second and Switzerland is the third countries in HEXP where Saudi Arabia is ranked as the country which has the lowest HEXP. Norway is the leader in the IPC, Switzerland as the second and Australia is the third country where Croatia seems as the country which has the lowest IPC among 37 HIC in 2014.

If the relationship between natural logarithm of IPC and HEXP in figure 4 is wanted be expressed as a regression for 37 HIC, the following equation is obtained. The relationship between the natural logarithm values of HEXP and IPC is estimated with CSD by the EViews 9 software (QMS, Emeryville, California, United States) (Table 3). The equation tells us one percent increase in HEXP causes approximately 0.14 (14%) increase in natural logarithm of IPC which means nearly 4,080 USD increase in IPC for 37 HIC in average.

### The relationship between GDP per capita and health expenditure share in GDP with CSD method

The figure 4 which was estimated by SPSS (IBM, Armonk, NY, USA) software below shows the relationship between natural loga-

$\ln (IPC_{2014}) = 9.16 + 0.14 * HEXP_{2014}$ ln: natural logarithm.

| Dependent Variable: LN_IPC; Method: Least Squares | | | | |
|---|---|---|---|---|
| Date: 02/14/17 Time: 12:21 Sample: 1 37 | | | | |
| Included observations: 37 | | | | |
| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
| C | 9.159040 | 0.298740 | 30.65892 | 0.0000 |
| HEXP | 0.138310 | 0.032069 | 4.312854 | 0.0001 |
| R-squared | 0.347024 | Mean dependent var | | 10.40622 |
| Adjusted R-squared | 0.328367 | S.D. dependent var | | 0.556507 |
| S.E. of regression | 0.456075 | Akaike info criterion | | 1.320220 |
| Sum squared resid | 7.280159 | Schwarz criterion | | 1.407297 |
| Log likelihood | -22.42407 | Hannan-Quinn criter. | | 1.350919 |
| F-statistic | 18.60071 | Durbin-Watson stat | | 1.828607 |
| Prob(F-statistic) | 0.000125 | | | |

**Table 3:** The Relationship Between HEXP and IPC with CSDM (2014).

C: Constant; LN_IPC: Natural Logarithm of IPC; HEXP: Health Expenditure Share in GDP (%), IPC: Economic Growth; S.E.: Standard Error; S.D.: Standard Deviation; R-squared: statistical measure that represents the proportion of the variance for a dependent variable that's explained by an independent variable; F-statistic: the test statistic for testing the statistical significance of the model.

In the equation nearly 35% of the changes in IPC are expressed by HEXP. The statistical values of the coefficients of the regression are statistically significant ($p < 0.05$ and the absolute values of the coefficients t are outside the threshold values of the t distribution).

**Detecting autocorrelation in the regression**

To detect the presence of autocorrelation in the residuals of the regression above the Durbin-Watson d statistic is applied.

$H_0$: There is no sequential relationship between error terms (neither the same nor opposite direction).

$H_1$: There is a sequential relationship between error terms.

The d-value ($d_L$) at the lower limit is taken as 1.419 and the d-value at the upper limit ($d_U$) is taken as 1.530 with 1 explanatory variable (health expenditure share in GDP) at level 5% and 37 observations (country) [30]. $H_0$ can't be rejected if $d_U < 4 - d_U$. As the d (1.8286) value obtained in the regression is $1.530 < 1.8286 < 2.47$, the null hypothesis ($H_0$) can't be rejected and it can be said that there is neither the same direction nor the opposite direction sequential relationship between the error terms.

**The relationship between IPC and HEXP with random effects model (REM, 1995 - 2014)**

The following estimated equation tells the relationship between natural logarithm of IPC and HEXP was expressed by REM regression by PD during the period 1995 - 2014.

$\ln (IPC)_{1995-2014} = 8.07 + 0.23*HEXP_{1995-2014}.$

One unit increase in the HEXP causes approximately 0.23 units increase in the natural logarithm value of IPC of the 37 HIC which means nearly 7,190 USD increase in IPC during 20 years period average. If the regression is wanted to be obtained by pooled ordinary least squares method it would be as:

$\ln (IPC)_{1995-2014} = 8.47 + 0.18*HEXP_{1995-2014}.$

The regression of the relationship between natural logarithm values of IPC and HEXP for the 37 HIC obtained by the REM with PD covering the twenty years using the EViews 9 software can be seen as below (Table 4).

The regression above shows that about 30% of the changes in the IPC of the 37 HIC is expressed by the HEXP values of the coun-

| Dependent Variable: LN_IPC | | | | |
|---|---|---|---|---|
| Method: Panel EGLS (Cross-section random effects) | | | | |
| Date: 02/14/17 Time: 09:54 Sample: 1995 2014 | | | | |
| Periods included: 20 Cross-sections included: 37 | | | | |
| Total panel (balanced) observations: 740 | | | | |
| Swamy and Arora estimator of component variances | | | | |
| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
| C | 8.070526 | 0.143154 | 56.37646 | 0.0000 |
| HEXP | 0.232417 | 0.013186 | 17.62605 | 0.0000 |
| | Effects Specification | | | |
| | | | S.D. | Rho |
| Cross-section random | | | 0.571793 | 0.7391 |
| Idiosyncratic random | | | 0.339743 | 0.2609 |
| | Weighted Statistics | | | |
| R-squared | 0.296011 | Mean dependent var | | 1.311869 |
| Adjusted R-squared | 0.295057 | S.D. dependent var | | 0.404883 |
| S.E. of regression | 0.339943 | Sum squared resid | | 85.28438 |
| F-statistic | 310.3121 | Durbin-Watson stat | | 0.202386 |
| Prob(F-statistic) | 0.000000 | | | |
| | Unweighted Statistics | | | |
| R-squared | 0.262837 | Mean dependent var | | 9.960770 |
| Sum squared resid | 325.3703 | Durbin-Watson stat | | 0.053048 |

**Table 4:** The Relationship Between HEXP and IPC with REM.

C: Constant; EGLS: Estimated Generalized Least Squares; LN_IPC: Natural Logarithm of IPC; HEXP: Health Expenditure Share in GDP (%); IPC: Economic Growth; S.E.: Standard Error; S.D.: Standard Deviation; R-squared: statistical measure that represents the proportion of the variance for a dependent variable that's explained by an independent variable; F-statistic: the test statistic for testing the statistical significance of the model.

tries. When the statistical values of the coefficients of the regression are examined; HEXP coefficient (slope) and the constant coefficient are statistically significant ($p < 0.05$ and the absolute values of the coefficients' t values are outside the threshold values of the t distribution). Considering the relationship between the IPC values of the 37 HIC and HEXP according to the regression results obtained by using the CSM is also confirmed by the regression results obtained using the PDM.

To test the validity of the REM which shows the relationship between HEXP and natural logarithm values of IPC obtained with the EViews 9 software above, with the Hausman Test:

- $H_0$: REM can be applied,
- $H_1$: FEM can be applied.

The following Hausman test (Table 5) also shows that null hypothesis indicating REM can be applied can't be rejected, since with 1 df (degree of freedom) and $X^2$ (chi-square) value is not statistically significant.

If the null hypothesis is rejected, the alternative one which tells FEM can be applied for the relationship should be accepted and the regression estimated by FEM will be as below:

| Correlated Random Effects - Hausman Test Equation: Untitled | | | |
|---|---|---|---|
| Test cross-section random effects | | | |
| Test Summary | Chi-Sq. Statistic | Chi-Sq. d.f. | Prob. |
| Cross-section random | 1.869716 | 1 | 0.1715 |
| Cross-section random effects test comparisons: | | | |
| Variable | Fixed | Random | Var (Diff.) | Prob. |
| HEXP | 0.237807 | 0.232417 | 0.000016 | 0.1715 |
| Cross-section random effects test equation: Dependent Variable: LN_IPC | | | |
| Method: Panel Least Squares Date: 02/14/17 Time: 09:56 | | | |
| Sample: 1995 2014 Periods included: 20 | | | |
| Cross-sections included: 37 Total panel (balanced) observations: 740 | | | |
| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
| C | 8.026691 | 0.112625 | 71.26907 | 0.0000 |
| HEXP | 0.237807 | 0.013763 | 17.27928 | 0.0000 |
| | Effects Specification | | |
| Cross-section fixed (dummy variables) | | | |
| R-squared | 0.816420 | Mean dependent var | 9.960770 |
| Adjusted R-squared | 0.806745 | S.D. dependent var | 0.772832 |
| S.E. of regression | 0.339743 | Akaike info criterion | 0.728733 |
| Sum squared resid | 81.02867 | Schwarz criterion | 0.965290 |
| Log likelihood | -231.6311 | Hannan-Quinn criter. | 0.819941 |
| F-statistic | 84.37719 | Durbin-Watson stat | 0.217705 |
| Prob(F-statistic) | 0.000000 | | |

**Table 5:** Hausman Test for REM to Test the Relationship Between HEXP and IPC.

C: Constant; EGLS: Estimated Generalized Least Squares; LN_IPC: Natural Logarithm of IPC; HEXP: Health Expenditure Share in GDP (%); IPC: Economic Growth; S.E.: Standard Error; S.D.: Standard Deviation; R-squared: Statistical measure that represents the proportion of the variance for a dependent variable that's explained by an independent variable, F-statistic: The test statistic for testing the statistical significance of the model.

$$\ln (IPC)_{1995-2014} = 8.03 + 0.24*HEXP_{1995-2014}$$

It simply means that one unit increase in HEXP for 37 HIC in average causes nearly 24% increase in IPC in average. The regression above shows that about 91.6% of the changes in the IPC is expressed by the HEXP values of the 37 HIC.

### Granger causality tests

The Granger Causality tests may be approved for both panel and CSD sets to show the direction of the causality between HEXP and IPC.

### To test HEXP causes IPC?

$$\ln (IPC)_{it} = \alpha_l + \beta_l \times \ln(HEXP)_{it} + \upsilon_{it}$$

**Citation:** Özlem Özsoy and Metin Gürler. "The Analysis of Health Expenditure as a Determinant of Economic Growth in 37 High Income Countries". *Acta Scientific Nutritional Health* 4.9 (2020): 19-33.

- H$_0$: HEXP does not Granger cause IPC
- H$_1$: HEXP Granger causes IPC

**To test IPC causes HEXP?**

ln (HEXP)$_{it}$ = α$_i$+ β$_l$ ×ln(IPC)$_{it}$ +ω$_{it}$

- H$_0$: IPC does not Granger cause HEXP
- H$_1$: IPC Granger causes HEXP
- i= 1, 2, 3... 37; t=1995-2014 (20 periods) for PD and t= 2014 for CSD and the disturbances υ$_{it}$ and ω$_{it}$ are uncorrelated.

According to the table 6 results computed, F value exceeds the critical F value and p<0.05 level of significance, so we reject null hypotheses and accept that IPC Granger causes HEXP for PDM.

| Pairwise Granger Causality Tests Date: 10/02/17 Time: 16:00 Sample: 1995 2014 Lags: 2 | | | |
|---|---|---|---|
| Null Hypothesis: | Obs | F-Statistic | Prob. |
| HEXP does not Granger Cause LN_IPC | 666 | 0.70091 | 0.4965 |
| LN_IPC does not Granger Cause HEXP | | 15.3497 | 3.E-07 |

**Table 6:** Pairwise Granger Causality Tests with PD.
LN_IPC: Natural Logarithm of IPC; IPC: Economic Growth; HEXP: Health Expenditure Share in GDP.

According to the table 7 results computed F values do not exceed the critical F value and p>0.05 level of significance so we are not able to reject both null hypotheses which imply that HEXP Granger does not cause economic IPC and vice versa for CSM.

| Pairwise Granger Causality Tests Date: 10/02/17 Time: 16:11 Sample: 1 37 Lags: 2 | | | |
|---|---|---|---|
| Null Hypothesis: | Obs | F-Statistic | Prob. |
| HEXP does not Granger Cause LN_IPC | 35 | 0.02681 | 0.9736 |
| LN_IPC does not Granger Cause HEXP | | 2.15758 | 0.1332 |

**Table 7:** Pairwise Granger Causality Tests with CSD.
LN_IPC: Natural Logarithm of IPC; IPC: Economic Growth, HEXP: Health Expenditure Share in GDP.

## Discussion and Conclusion

Turkey has got progressive increasing health expenditures and HEXP during the period 1995-2014 as an upper middle-income country and EC. But it seems that HEXP is still well below HIC, EU, OECD and even world averages. Comparing with advanced countries Turkey should increase health expenditures and HEXP to reach an economic growth improving productivity with achieving healthy labour force.

Analysis of the results of CSM estimation shows that the equation ln(IPC$_{2014}$) = 9.16+0.14*HEXP$_{2014}$ ln: natural logarithm, tells that one percent increase in HEXP causes approximately 0.14 (14%) increase in natural logarithm of IPC which means nearly 4,080 USD increase in income per capita for 37 HIC in average. In the equation about 35% of the changes in IPC are expressed by HEXP.

As the Hausman test also shows that null hypothesis indicating REM can be applied can't be rejected, the relationship between income per capita (natural logarithm) and health expenditure share in national income may be expressed by REM regression and the equation ln (IPC)$_{1995-2014}$ = 8.07 + 0.23*HEXP$_{1995- 2014}$ is estimated. If the regression is wanted to be obtained by pooled OLS method it would be as; ln (IPC)$_{1995-2014}$ = 8.47 + 0.18*HEXP$_{1995- 2014.}$

One unit increases in the HEXP value causes an increase of about 0.23 units in the natural logarithm value of IPC of the 37 High HIC which means nearly 7,190 USD increase in IPC for 37 HIC in 20 years period average.

The regression of the relationship between natural logarithm vales of IPC and HEXP for the 37 HIC obtained by the REM for PD covering the twenty years obtained using the EViews 9 software (QMS, Emeryville, California, United States) shows that about 30% of the changes in the IPC of the 37 HIC is expressed by the HEXP values of the countries.

It is also found that IPC promotes HEXP not at once but in a time period. After testing the direction of causality between HEXP and IPC of the countries in the study by the Granger causality test, in the manuscript our results show that economic growth Granger causes HEXP increase and HEXP doesn't Granger cause IPC for PD. For CSD there is no relationship between HEXP and IPC.

The results reveal that an increase in IPC enhances HEXP whereas HEXP has no significantly positive effect on IPC of a country

hence economic growth. UNDP'S Human Development Index UN also puts the healthy life in the centre of the human development with the GDP [6-8].

Heshmati [12], OECD and the World Bank [14], Chakroun [15], Yumuşak and Yıldırım [16], Eriğit., *et al*. [20], Yardımcıoğlu [21], Deloitte and Yased [23], Lago-Penas., *et al*. [24], Kurt [11], Aydemir and Baylan [26], Hayaloğlu and Bal [27], Bedir [28], Başar., *et al*. [29] have found positive relationship between HEXP and economic growth.

Kar and Taban [13], Yumuşak and Yıldırım [16] have found negative relationship between HEXP and economic growth.

On the other hand, Çetin and Ecevit [18] have found no relationship whereas Ak [19], Tıraşoğlu and Yıldırım [22] and Akar [25] have found positive relationship in the long run between HEXP and economic growth.

The increase in HEXP will cause innovative improvements in healthcare system and it will prevent from disease, treat the illness and support a resilient labour force. And healthy labor force will enhance productivity and economic growth in a country. This development occurs not at once but in time period. In the study the results show that economic growth Granger causes HEXP increase only for panel data not for cross-section data and HEXP doesn't Granger cause IPC both for PD and CSD.

## Funding

None.

## Authors' Contributions

All authors analysed and interpreted the data and wrote the manuscript together. All authors read and approved the final manuscript.

## Conflict of Interests

The authors declare that they have no competing interests.

## Bibliography

1. Gürler M and Özsoy Ö. "Exploring the relationship between life expectancy at birth and economic growth in 56 developing countries". *Journal of Global Health Reports* 2 (2019): e2019001.

2. The World Bank Health Expenditure, Total (% of GDP) data (2017).

3. The World Bank GDP per capita (current US$) data (2019).

4. IMF. World Economic Outlook (WEO). "Growth Slowdown, Precarious Recovery". (2019): 133-134.

5. The World Bank Country Classification (2016).

6. United Nations Development Programme (UNDP). The Human Development Indices and Indicators Report: 2018 Statistical Update (2018).

7. UNDP. Human Development Report: Human Development for Everyone (2016).

8. UNDP. Human Development Report: Work for Human Development (2015).

9. Romer PM. "Endogenous Technological Change". *Journal of Political Economy* 98.5 (1990): 71-102.

10. López-Casasnovas G., et al. "Health and Economic Growth: Findings and Policy Implications". Cambridge: MIT Press (2005).

11. Kurt S. "Government Health Expenditures and Economic Growth: A Feder–Ram Approach for the Case of Turkey". *International Journal of Economics and Financial Issues* 5.2 (2015): 441-447.

12. Heshmati A. "On the causality between GDP and health care expenditure in augmented Solow growth model". Department of Economic Statistics, Stockholm School of Economics, Working Paper Series in Economics and Finance 423 (2001): 1-19.

13. Kar M and Taban S. "The impacts of the disaggregated public expenditure on economic growth". *Journal of Ankara University Faculty of Political Science* 53.3 (2003): 145-169.

14. OECD. The World Bank. OECD Reviews of Health Systems: Turkey 2008. OECD Publishing, Paris (2009).

15. Chakroun M. "Health Care Expenditure and GDP: An international panel smooth transition approach". *International Journal of Economics* 4.1 (2010): 189-200.

16. Yumuşak IG and Yıldırım DC. "An econometric examination over the relation between health expenditure and economic growth". *The Journal of Knowledge Economy and Knowledge Management* 4.81 (2009): 57-70.

17. Arısoy I., *et al.* "The relationship between social expenditures and economic growth: a dynamic analysis intended for 1960-2005 period of the Turkish economy". *Maliye Dergisi* 158 (2010): 398-421.

18. Cetin M and Ecevit E. "The effect of health expenditures on economic growth: a panel regression analysis on OECD countries". *Doğuş Üniversitesi Dergisi* 11.2 (2010): 166-182.

19. Ak R. "The Relationship between Health Expenditures and Economic Growth: Turkish Case". *International Journal of Business and Economics Research (IJBMER)* 3.1 (2012): 404-409.

20. Eryigit SB., *et al.* "The long-run linkages between education, health and defence expenditures and economic growth: evidence from Turkey". *Defence and Peace Economics* 23.6 (2012): 559-574.

21. Yardimcioglu F. "An Econometric Analysis of the Relationship between Health and Economic Growth in OECD Countries". *Eskişehir Osmangazi University Sosyal Bilimler Dergisi* 13.2 (2012): 27-47.

22. Tıraşoğlu M and Yıldırım B. "Health Expenditure and Economic Growth Relationship in the Case of Structural Break: A Case Study for Turkey". *Electronic Journal of Vocational Colleges (EJOVOC)* 2.2 (2012): 111-117.

23. Deloitte and Yased. "Turkey Life Science and Healthcare Report" (2012).

24. Lago-Penas S., *et al.* "On the relationship between GDP and health care expenditure: a new look". *Economic Modelling* 32 (2013): 124-129.

25. Akar S. "An Investigation of the Relationship among Health Expenditures, Relative Price of Health Expenditures and Economic Growth in Turkey". *Management and Economics* 21.1 (2014): 311-322.

26. Aydemir C and Baylan S. "Health Expenditure and Economic Growth: A Case Study for Turkey". *Sosyal Bilimler Enstitusu Dergisi (DUSBED)* 7.13 (2015): 417-435.

27. Hayaloğlu P and Bal HC. "The Relationship between Health Expenditures and Economic Growth in Upper Middle-Income Countries". *İşletme ve İktisat Calışmaları Dergisi* 3.2 (2015): 35-44.

28. Bedir S. "Healthcare Expenditure and Economic Growth in Developing Countries". *Advances in Economics and Business* 4.2 (2016): 76-86.

29. Başar S., *et al.* "Impacts of Education and Health Expenditures on Economic Growth: An Application on Turkey". *Journal of Social Science*, Iğdır University. 2.10 (2016): 189-204.

30. Gujarati DN and Porter DC. Basic Econometrics. 5th edition. New York: McGraw-Hill/Irwin (2009).

31. Porter ME. "Competitive Advantage of Nations. Harvard Business Review". *Harvard Business Review* (1990): 73-91.

32. The World Bank World Development Indicators dataset.