Research Article

The impacts of aging, income and urbanization on health expenditures: A panel regression analysis for OECD countries

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Abstract

Objectives: The main purpose of this study is to investigate the factors affecting health expenditure levels through a panel data analysis. **Methods:** The study includes data from 35 OECD member countries between 2005 and 2015. We carried out panel regression analysis using STATA 13.0 econometric program. In the study, we used per capita health expenditure figures according to purchasing power parity as the dependent variable and we searched the impact of aging, urbanization and income on health expenditures with fixed effects panel regression model. **Findings:** The regression model indicates that aging, urbanization and income have positive effects on health expenditures per capita. For instance, a 1% increase in population ages 65+ causes an increase in health expenditures by $165 per capita. **Conclusion:** Although health expenditures are influenced by many factors, demographic structures and demographic changes, such as aging, urbanization and income, have a significant impact on health expenditures.

Keywords: Health expenditures, OECD, aging, panel data analysis

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Yaşlanma, gelir ve kentleşmenin sağlık harcamaları üzerindeki etkisi: OECD ülkeleri için bir panel regresyon analizi

Öz

Amaç: Bu çalışmanın amacı, sağlık harcamalarına etki eden faktörleri panel veri analizi ile incelemektir. **Yöntem:** Çalışma, 2005 ve 2015 yılları arasında 35 OECD ülkesinden elde edilen verileri içermektedir. Panel Regresyon analizi STATA bilgisayar programı kullanılarak yapılmıştır. Çalışmada satın alma gücü paritesine göre hesaplanmış kişi başına düşen sağlık harcaması bağımlı değişken, yaşlanma, kentleşme ve gelir bağımsız değişken olarak kullanılmıştır. Bu değişkenlerin sağlık harcamaları üzerindeki etkisi sabit etkiler panel regresyon modeli ile incelenmiştir. **Bulgular:** Regresyon modeli yaşlanma, kentleşme ve gelirin kişi başına düşen sağlık harcamaları üzerinde etkili olduğunu göstermektedir. Örneğin, 65 yaş üstü nüfusun %1'lik artışı sağlık harcamalarında kişi başına 165 dolarlık artışa neden olmaktadır. **Sonuç:** Sağlık harcamaları birçok faktörden etkilenmekle birlikte, yaşlanma, kentleşme ve gelir gibi ülkelerin demografik yapısı ve demografik değişimleri sağlık harcamalarının artmasında önemli rol oynamaktadır

Anahtar Kelimeler: Sağlık harcamaları, OECD, yaşlanma, panel veri analizi

Introduction

Attaining high levels of health status is seen as a priority area in the development and growth of countries along with education. Levels of health status depends on the health expenditures in the country, as well as many other factors. However, it is considered that countries with high health expenditures generally have a high level of health status, such as long-life expectancy at birth and low mortality. Health expenditures have been growing considerably for the last 35 years in the world.[1] More than 40 years ago, Newhouse asked: `What determines the quantity of resources a country devotes to medical care?' and this question is still discussed all around the world.[2] According to Whyness there are many factors that affect health expenditure quantity and structure, such as changes in population structure, increases in education and income levels, income distribution, technological developments, urbanization, improvements of social security systems for health services, facilitation of access to health, change of society's disease structure, increase of chronic diseases and aging. [3]

Globally, there are great variations on the amount countries spend on health. Per capita health expenditure is over 3000$ on average in high income countries, while in poor countries it is only 30$ per capita. Some countries spend more than 12% of gross domestic product (GDP) on health, for instance the United States spent more than 17% of its GDP on health in 2015.[4] In many countries, health is the first area to have the biggest share in GDP when compared with others such as security or justice.

Many socioeconomic factors, structures and characteristics of health systems affect the amount of health expenditures. Among the factors that determine the quantity of health expenditures,

aging is one of the most examined factor in recent years. So, health policy makers in many countries have expressed concern over the pressures that aging populations will exert on rising health care costs [5].

In the literature, population age structure and aging are often included as a covariate in health expenditure regressions. Commonly used indicators are the share of young (e.g., under 15 years) and old people (e.g., above 65 or 75 years) over the active or total population.[4] According to the report that has been published by the Organization of Economic Coorperation and Development (OECD), in developed countires, per capita health expenditure cost for population aged 65 and over have generally increased more rapidly than among those under age 65. [6] In this direction, the main purpose of this study is to examine the impact of aging, income and urbanization on health expenditures and discuss the effect of aging on expenditure using a panel data analysis for OECD countries between 2005-2015 years.

Material and method

The data and statistical analysis

The study includes yearly data from 35 OECD countries for the period of between 2005 and 2015 years. We included all 35 OECD member countries except Lithuania in this study. The per capita health expenditure, according to purchasing power parity (unit dollar), was used as the dependent variable in the study. As explanatory variables, we used the share of urban population in the total population for the effect of urbanization, Gross Domestic Product (GDP) per capita for the effects of income, the percentage of the population aged +65 years for the effects of aging in the study. Table 1 shows the variables used in the regression model.

Table 1. Defining variables

Variable	Definition	Source
hexp	The per capita health expenditure, purchasing power parity ($)	World Health Organization[7]
gdp	Groos Domestic Product per capita, purchasing power parity ($)	International Monetary Fund[8]
age	The percentage of the population aged +65 in total population	World Bank[9]
urban	The share of urban population in the total population	World Bank[9]

We have obtanied the data from the official page of International Monetary Fund, World Bank and World Health Organization. We utilizied the STATA 13.0 computer package program for panel data analysis.

The estimated regression model

The estimated models in this frame are as follows:

$hexp_{it} = \alpha + \beta_1\, gdp + \beta_2\, age + \beta_3\, urban + \varepsilon_{ij}$ *(Pooled Model)*

$hexp_{it} = \alpha_i + \beta_1\, gdp + \beta_2\, age + \beta_3\, urban + \varepsilon_{ij}$ *(Fixed Effects Model)*

$hexp_{it} = \alpha + \beta_1\, gdp + \beta_2\, age + \beta_3\, urban + (\mu_i + \varepsilon_{ij})$ *(Random Effects Model)*

hexp : *the per capita health expenditure, purchasing power parity US dolars unit*

gdp : *Gross Domestic Product per capita*

age : *the percentage of the population aged +65 years*

urban: *the share of urban population in the total population*

GDP per capita is considered to be an indicator of the welfare of individuals in a given population and is among the determinants of

health expenditures. As countries' production and income grows, individuals demand services that enable them to live more comfortably. Living more comfortably and longer depends on the person being healthy and educated before anything else. It is therefore expected that people will increase their healthcare needs for better living conditions when income increases. It is possible to find many studies which reveal the relationship between income level and health expenditures. For instance, Newhouse in 1997, Gerdthamand and Jonsson in 1992, Huang in 2004 and Çalışkan in 2009. They found that the income level is as one of the most important factor affecting health expenditure [10-11-12-13]. So, a strong and positive relationship is expected between health expenditures and income in the study results.

Some writers and researchers argue that aging is not a statistically significant determinant in the increase of health expenditures but these analyses have been carried out in developed countries, which generally have an older population[14]. Actually, the effect of aging on health expenditures varies according to the country and the period studied. Generally, the level of health expenditures for people aged 65 years and older is higher than the general population. It could thus be said that health expenditures increase as the population ages, because the elderly use health services more and require more complex services than young people. For instance, in the study conducted by Fujino in Japan, it was found that the elderly (+65 years of age) used health care services 3.2 times more than the average population, which naturally results in an increasing of health expenditures [12]. Similarly, Di Matteo stated that 31 per cent of the increase in future health expenditures will be related to population aging in Canada [13]. Many studies which examine the relationship between health expenditures and aging have found similiar results. That's why, we expect a positive relationship between health expenditures and aging in the study.

Urbanization is one of the other variables related to health expenditures. Urbanization is considered to cause an increase in health expenditures. It is not only about easier access to healthcare services but also that better quality healthcare is often available in urban settings. Moreover, urban populations are affected negatively by stress, air pollution, traffic problems, etc. Thus, the more healthcare services provided in urban centres, the more healthcare expenditures are expected to increase[13].

Many factors, such as the characteristic structure of the health system, education levels, changing in social value judgments, the share of public health expenditures, the developments and the level of health technology and the structure of diseases, can affect the level health expenditures as well[4]. In this study, we aimed to test the factors that impact the health expenditures using panel data analysis for the period of 2005-2015 for 35 OECD countries. Panel data is multi-dimensional data involving measurements over time. Panel data contains observations of multiple phenomena obtained over multiple time periods for the same firms, individuals or countries. Panel data consists of N number of units and T number of observations. T and N are bigger than one in panel data like in our data set. In the panel data method, different models can be used depending on the assumptions, fixed effects model, random effects model, classical model. First of all, we tested the existence of time and/or unit effect in our model with F and LM tests. The reason for this was to see if our model conplied with classic regression. In panel regression models, the existence of unit or time effects should be tested in the model. Under the presence of unit or time effects, the least squares estimator, which is the classical regression estimator, gives biased results. Therefore, the presence of these effects in our model was first tested by F and LM Breush Pagan tests. The null hypothesis of the F and LM tests is that there is no unit or time effect. The alternative hypothesis states that there is a unit or time effect. Secondly, the relationship

between these effects and independent variables should be focused. If the unit/time effect in the model is correlated with independent variables, the fixed effects model will be valid. In this case, it is suitable to use fixed effects model estimators. However, if the unit effects in the model are not correlated with independent variables, then it will be more accurate to use random effects model estimators instead of the fixed effects model. Under the unit/time effect existence, Hausman Test is used to test the relationship of these effects with independent variables. The test results showed that the fixed effects model is suitable for the data analyzed in the Table 2.

Results

Before estimation results, some basic descriptive statistics of the independent and dependent variables and F, LM and Hausman test results are given in Table 2.

The average GDP per capita was $ 36.101 in 35 OECD countries for the period 2005-2015. In the same period, the total health expenditure per capita for these countries was 3.126 dollars. The ratio of 65 years and over in total population was 15. 36% and the urbanization rate was 77. Moreover, according to the probability value of F, LM and Hausman test, the fixed effects model is valid to make estimations. Then, we estimated our model by using the fixed effects model within the group estimator method. After, we tested the basic assumptions. These are heteroscedasticity, autocorrelation and inter-unit correlation assumptions. We found that there are both inter-unit correlation, autocorrelation and heteroscedasticity. For this reason, the final estimation results of our study were obtained by using Driscoll and Kraay standard error correction estimator, which is one of the robust estimators in the presence of heteroscedasticity, autocorrelation and inter-unit correlation instead of direct fixed effects within group predictor method.

The results obtained using Driscoll and Kraay standard error correction estimator in the Table 3. According to the results of the table, the estimation results of the model are in accordance with the expected results and are reasonable. Statistically, the model is significant at the 1% level (F_{prob} = 0.0000).

In the table, x_1 symbolizes GDP per capita, x_2 symbolizes the ratio of +65 age in total population, x_3 symbolizes urbanization, y symbolizes the total health expenditure per capita. The findings of the model indicate that GDP per capita, population ages 65+ and urban population positively affect health expenditures per capita (t_{prob}=0.000 for each).

In the model, income variable is statistically significant at 1% level and has a positive value as expected. According to the analysis results, $1 increase in GDP per capita leads to rise in health expenditures per capita by $0.09 on average.

According to the model's estimation results, urbanization rate is another factor that has an effect on health expenditures. Urbanization rate in the model is statistically significant at 1% level and has a positive value as expected. According to the model results a 1% increase in urban population brings about an increase in health expenditures per capita by $46.55 on average.

Another factor that has an impact on health expenditures is aging. In the model, the ratio of total population of +65 age ratio population is statistically significant at 1% level and has a positive value as expected. According to model results a 1% increase in population ages 65+ causes the increase in health expenditures per capita by $165 on average.

According to the estimation results, aging is the most effective variable on health expenditures for OECD countires between 1995-2015 among other examined variables. Empirical results are evidence of the hypothesis that aging significantly impacts health expenditures.

Table 2. Descriptive statistics on variables

	gdp ($)	*hexp ($)*	*Age +65 (%)*	*Urban (%)*
Mean	*36.10*	*3.19*	*15.36*	*77.17*
Minimum	*13.36*	*586*	*5.34*	*49.65*
Maximum	*99.51*	*9.45*	*26.34*	*97.86*
Std. Deviation	*14.40*	*1.655*	*3.81*	*11.33*
Observation	*385*	*385*	*385*	*385*
Model		**F Test**	**LMTest**	**Hausman Test**
$hexp_{it} = \beta_0 + \beta_1 gdp_{ij} + \beta_2 age_{ij} + \beta_2 urban_{ij} + \varepsilon_{ij}$		F_{unit} =22.06 (0.000)* F_{time}=0.13 (0.56) $F_{unit\text{-}time}$=---	LM_{unit} =2015.00 (0.000)* LM_{time}=2.14 (0.053) $LM_{unit\text{-}time}$=1150.37 (0.000)*	H_{test} =22.29 (0.000)*

*values in parentheses indicate the probability value

Table 3. Regression models results

Regression with Driscoll-Kray standard Errors Method: Fixed-effects regression		Number of observations			385	
		Number of groups			35	
Group variable (i): id Maximum lag: 2		F (3.34)			113.58	
		Prob > F			0.0000	
		Within R- squared			***0.7387***	
y	Coefficient	Drisc/Kraay Std. Err.	t value	p>t	(95% conf. Interval)	
x₁	**.091642**	.0089532	10.24	**0.000**	.0734469	.1098371
x₂	**165.1104**	32.62445	5.06	**0.000**	98.0958	231.4113
x₃	**46.55023**	11.05004	4.21	**0.000**	24.09385	69.00661
constant	**-6241.741**	984.3554	-6.34	**0.000**	-8241.992	-4241.02

Discussion and conclusion

Health expenditures are influenced by many factors such as education, income, health insurance policy, urbanization, aging, health technology etc. Health expenditures are on the forefront of the issues discussed in countries' health policies. Especially since the 1960s, the health sector is constantly developing and, accordingly, health expenditures have been on the increase all around the world. According to the World Bank data, the per capita health expenditures in countries with high income groups increased from $ 2078 in 1994 to $ 5205 in 2014. In the same period, per capita health expenditures in the middle-income group went from $ 139 to $ 577, and in the upper middle-income group, increased from $ 196 to $ 928. As a result of these increases, many countries are now undergoing various reforms in their healthcare systems. In recent years, Estonia, Turkey, the United States, Iran, England are just a few of the countries implementing health system reform efforts in order to increase the quality of service delivery and to ensure the sustainability of health expenditures. So, the studies on factors determining health expenditures have gained importance in health economics literature for many years.

The main objective of this study was to identify the factors that have an impact on health expenditures and to examine empirically the relationship between increasing elderly population and health expenditures for OECD countries. According to the results of study, GDP per capita, the ratio +65 age in total population and urbanization variables have statistically significance (at 1% level) and a positive effect on health expenditures per capita. Among examined variables, the ratio +65 age in total population is the most effective factor on health expenditures for OECD counties between 1995 and 2015. The results show us that the general aging of the society increases the health expenditure in the country. In other words, aging has been found to be one of the main determinants of health expenditures for OECD countries in this period.

In recent years the quantity and quality of research both cross-country comparisons and studies on individuals on the relationship between demographic change or aging and health expenditure has increased substantially. As a result of the aging of the world population, old age and the interest in health problems encountered in old age are increasing. For example, with aging, chronic diseases that require long-term care increase in society. This situation affects health expenditures especially in the long term. In the studies conducted, it is found that the health expenditures due to chronic diseases are relatively higher than the health expenditures caused by other diseases. The most important reason for this is that these diseases require long-term care, high maintenance burden and labour, and technology-intensive care. For instance, Yang and colleagues examined the health care use of 25.994 elderly persons from the 1992–1998 Medicare Current Beneficiary Survey Cost and Use files. Their results confirmed strongly that monthly health care expenditures for elderly people do increase substantially with age [15]. In the study conducted by Xu and colleagues, the percentage of population over 60 years old has been found positively associated with government health expenditure in lower-middle income countries [4]. In other study conducted by Hitiris and Posnett, the coefficient of the population aged 65 years and over has been found to be statistically significant and positive relationship as in this study[16]. In another study carried out by Çalışkan, the relationship between the population of 65 years of age and over and the total, public and private health expenditure per capita was examined in OECD countries for the years 1984 to 2005, and positive and significant relationships were determined between the proportion of the population aged 65 years and over and all three health expenditure indicators [13]. We obtained similar results in our study. Aging was found to be the most important determinant of health expenditures relative to income and urbanization. There are many social, political, and economic effects of aging. Due to the aging

of the population in many countries, the development and implementation of education, social, and employment policies toward the elderly are very important. In this study, we examined only the economic effects of aging in an empirical manner and found that it has an impact on health expenditures.

The aging population is important not only in the current period but also in the creation of health policies due to the influence on future health expenditures. The development of social insurance schemes for the elderly, the opening of old age, care and research institutes in universities, the improvement of elderly home care services, the development of local governments in elderly care, the creation elderly living and social areas are policies that are discussed to ensure the sustainability of future health expenditures against aging. In addition to aging, the increasing urban population, compared with the past, is another area where the impact on health expenditures in the future is discussed, mainly due to access to healthy food and habitats, stress, more traffic accidents, and difficulty in providing public health services.

Ethical issues

Ethical Committee approval is not obtained since any data related to human subjects or living organisms and there is no conflict of interest.

Author contribution: The authors contributed equally to the preparation of the article.

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