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An Analysis of Relationship between Health Expenditures and Life Expectancy: The Case of Turkey and Turkic Republics*

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Abstract
As one of the fundamental health outputs in the health economics literature, the improvement of life expectancy is one of the variables that positively affect economic growth. Many papers, investigating the relationship between health expenditure and life expectancy indicated that life expectancy has a positive effect on health expenditures. This study aims to investigate the relationship between life expectancy and health expenditures for the period of 2000-2015 in Turkey, Azerbaijan, Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan and Uzbekistan. Panel data approach was used for the study. The results of panel cointegration analysis indicate that there is a significant bidirectional long-term relationship between the two variables.

Keywords
Health expenditure, Panel data analysis, Life expectancy, Turkey, Turkic Republics.

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Introduction

Health expenditures contribute to economic growth and economic development both directly and indirectly. Health expenditures increase output by improving the productivity of labor and expanding the working life period of individuals. Thus, all countries implement supporting strategies of the investments of the private sector in health sector in addition to increase the share of health in public budget. However, it should be noted that, it is not adequate to increase the health expenditures of both public and private sectors in quantity. The enhancement of health expenditures qualitatively is the main target of effective health policies.

The qualitative and quantitative improvements in health expenditures positively affect health outputs. The decline in maternal and infant mortality rates and the increase in life expectancy are basic indicators of positive health outputs. Besides, any improvement in life expectancy leads to an increase in economic growth.

The relationship between health expenditures, life expectancy and economic growth has been discussed on the theoretical level by the economists who have contributed to the endogenous growth theory. Human capital models, one of the sub-branches of the endogenous growth theory, emphasize the significance of human capital in the economic growth process. According to these models, human capital is the most significant resource of productivity and technological progress. This viewpoint which argues that human capital is the most important source of productivity and technological progress implies a rejection of the view of the diminishing returns of capital that was put forward by Neoclassical growth theories. The endogenous growth theories accept the view of increasing returns of the capital, including human capital (Kar and Taban 2003:147-54).

Including human capital in the model is a significant theoretical innovation in terms of defining the source of growth. It is a fact that the increase in national output cannot be solely explained by an increase in working hours and physical capital or land. The difference between the increase in production inputs and output increase can be explained by human capital investments (Schultz 1961).

The basic components of human capital are education and health. Mushkin

(1962) and Schultz (1961) emphasized the importance of health for human capital. The quantitative and qualitative developments in health expenditures positively contribute to the increase in economic growth. As life expectancy is one of the variables that health expenditures affect, the relationship between health expenditures and economic growth can also be defined as the effects of life expectancy on economic growth.

The degree of effectiveness of life expectancy on economic growth varies from one country to another. As the life expectancy of individuals prolongs, the effects of average life expectancy on economic growth increase. There are many studies that present the positive relationship between life expectancy and economic growth. For instance, Bloom, Canning and Sevilla (2004) find that an annual improvement in life expectancy of the population leads to an increase by 4% in the output. The positive effects of the increase in life expectancy in terms of economic growth emerge through the following channels (Bloom and Canning 2003: 53):

• *Education Channel:* Increasing life expectancy makes it possible to benefit from the advantages of investments on education for a longer period of time. An increase in education investments, owing to a longer lifespan, means an improvement in the human capital.

• *Labor Market Channel:* Having healthier employees paves the way for a higher level of physical and mental efficiency and productivity in the labor market. Healthier employees contribute to shorter absenteeism due to illness or disability. Besides, the improvement in public health and a longer life expectancy enable lower fertility rates, which prevent having a high number of children. Thus, female labor force participation rate increases.

• *Saving Channel:* Longevity of lifespan affects the duration of both working period and retirement period. A longer period of retirement period incentivizes individual savings. Therefore, it can be argued that the positive effects of the increase in life expectancy on economic growth have encouraged researches on the determinants of life expectancy.

The positive effect of increase in life expectancy on economic growth performance increases the importance of the studies investigating thr variables affecting life expectancy. There are many variables affecting life expectancy: Fertility rate, nutrition, access to clean water, containment of illnesses, per capita income, literacy rate, urbanization, environmental conditions and health expenditures are basic variables that determine life expectancy (Barlow and Vissandjee 1999: 11-14). Investigating the impact of each of these variables on life expectancy will contribute to the literature of health economics. This study will focus only on the effects of health expenditures on the life expectancy.

Researches on the relationship between life expectancy and health expenditures are a significant source of data for policy makers in determining health policies. Life expectancy-health expenditures nexus can be analyzed using the data of a single country, as well as using a group of countries. In the literature, there are many studies that examine the relationship between life expectancy and health expenditures using the data of either a sample country or country groups. Furthermore, as the aim of policy makers is to implement effective policies, the findings of the studies investigating the relationship between health expenditures and life expectancy are employed as data source in determining health policies to have a higher economic growth.

The aim of this study is to examine the relationship between life expectancy and health expenditures. This paper contributes to the literature as being the first study analyzing the relationship between life expectancy and health expenditures on the selected countries, using the panel data analysis method. Besides, as far as we reviewed in the literature, this research is the first paper analyzing that country group in terms of life expectancy-economic growth nexus.

This study analyzes the relationship between health expenditures and life expectancy in Turkey and the Turkic Republics (Azerbaijan, Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan and Uzbekistan). In spite of having rich natural resources, the Turkic Republics confronted with serious economic and social problems in the early years of their independence.

For a sustainable economic growth, structural reforms have been initiated in these countries. For a stable economic growth, it is not enough to have rich natural resources. These countries also need to have a strong human capital.

Improvement in the average lifespan is an important indicator for qualified human capital. Many studies prove that any increase in health expenditures and improvement in health quality affect the average life expectancy positively. The findings of the studies that examine the relationship between health expenditures and life expectancy are data sources for health policies to improve the strength of human capital.

The basic motivation of this study is to provide reliable data and policy suggestions for the policymakers to initiate health policies in the selected countries by analyzing the relationship between average life expectancy and economic growth that is a critical indicator of quality of human capital. It is extremely important to put forward the long-term relationship between life expectancy and health expenditures. It is also critical to investigate both the effects of health expenditures on life expectancy and the effects of life expectancy on health expenditures to initiate convenient and suitable policies. It was concluded that the higher the effects of life expectancy on health expenditures, the higher the health expenditures on ineffective investments.

This study, in which panel data analysis was used, analyzes the relationship between health expenditures and life expectancy using the data period of 2000-2015. The reason for choosing this period is that it is the longest common period that could be reached for the variables of the countries included in the analysis. The results of the panel cointegration test indicate that there is a significant long-term bidirectional relationship between the two variables.

Compared to our study, in other studies which investigated the relationship between health expenditures and life expectancy, it was mostly found that there is a unidirectional relationship between the two variables. Another difference of our study is the way of obtaining results that show the presence of a bidirectional relationship between health expenditure and economic growth. The long-term coefficients for each country were calculated and the effects of both life expectancy on health expenditures and health expenditures on life expectancy were presented.

Besides, in the literature, while investigating the relationship between health expenditures and life expectancy, some of the studies have examined the effects of income level differences between countries and some of them have tested the effects of public and private health expenditures. However, in this study, the relationship between total health expenditures and life expectancy was investigated by considering data availability and the reliability of data.

The study is composed of two parts. The first part focuses on the literature review, the second part consists of the empirical analysis.

Literature Review

Jaba, Balan and Robu (2014) investigated the relationship between life expectancy at birth and health expenditures per capita to determine to what extent the level of development of countries is effective. The data of 175 countries were used for the period of 1995-2010. According to the results, the lifespan in the developed countries gets longer, as health expenditures per capita increases. Rana, Alam and Gow (2018) investigated how the relationship between health expenditures and health outputs changed by considering income level differences between countries. In the study, the data of 161 countries were tested for the period of 1995-2014. One of the four variables used as a health output is life expectancy at birth. Empirical results showed that the relationship between health expenditures and health outputs is relatively stronger in the low-income countries.

Linden and Ray (2017) examined the relationship between life expectancy at birth and the public and private health expenditures for 34 OECD countries based on the period of 1970-2012. The study concluded that the relationship between health expenditures and life expectancy depends on the share of public health expenditures in GDP. Empirical evidences showed that in the country group where the public share is high, both public and private health expenditures have positive effects on life expectancy. Furthermore, there is bilateral relationship between life expectancy and health expenditures in this group. Similarly, Aı´sa, Clemente and Pueyo (2014) investigated the contribution of health expenditures to the increase in life expectancy in 29 OECD countries for the period of 1960-2000 by differentiating the effects of health expenditures from those of private expenditures. They pointed out to the importance of public health expenditures in terms of life expectancy. However, they also found that public health expenditures are effective in prolongation of lifespan up to a certain threshold value. According to the empirical findings, the effect of total health expenditures on the average life expectancy is not certain. When the share of public health expenditures reached up to 8% in GDP, the effects of these expenditures on life expectancy began to decrease.

Shahbaz et al. (2016) tested the data of the 1972-2012 period to examine the determinants of life expectancy in Pakistan. They found that public health expenditures affect life expectancy positively. According to the results of the causality analysis, there is a feedback effect between public health expenditures and life expectancy. Likewise, Ilori, Sunday and Adeleye (2016) examined the effect of public health expenditures on life expectancy in Nigeria, using the data of the 1981-2014 period. The empirical results showed that there is a long-term relation between life expectancy and public health expenditures.

Arthur and Oaikhenan (2017) investigated 40 Sub-Saharan African countries and found that private health expenditures are more effective than public health expenditures in terms of life expectancy at birth. They also found that the decrease in death rates was affected by a significant amount of public health expenditures, and life expectancy at birth was affected by a significant amount of private health expenditures. Novignon, Olakojo and Nonvignon (2012) investigated 44 Sub-Saharan African countries and found that the effects of public health expenditures are higher on life expectancy at birth than private health expenditures.

Crémieux, Ouellette, Pilon (1999) studied 15 years of data of ten Canadian provinces and found that low health expenditures lead to a decrease in life expectancy. Therefore, it can be said that low health expenditures have a negative effect on life expectancy.

In the literature, there are some studies suggesting that there is a weak relationship between health expenditures and life expectancy. Based on the availability of international cross-sectional data of 77 countries for 1990, Barlow and Vissandjée (1999) showed that health expenditures per capita have a weak effect on life expectancy by applying multivariate analysis. Nixon and Ulmann (2006) who tested the data of 15 European Union member states in the period of 1980-1995, proved that health expenditures have only marginal contribution to the improvement of life expectancy.

Sede and Ohemeng (2015) investigated the socio-economic determinants of life expectancy using Nigeria's data for the period from 1980 to 2011. They found evidence indicating the impact of public health spending on determining life expectancy is not significant. Bidzha, Greyling and Mahabir (2017) analyzed the effect of public health expenditures on the improvement of health outputs, using the data of nine Nigerian provinces for the period of 2005-2014. The study showed that there is no significant statistical relationship between public health expenditures and life expectancy at birth.

Data and Model

This study analyzes the relations between life expectancy (LLE) and health expenditures (LHE) in 2000-2015 in Azerbaijan (AZE), Kazakhstan (KAZ), Kyrgyzstan (KGZ), Tajikistan (TJK), Turkmenistan (TKM), Uzbekistan (UZB) and Turkey (TUR), which are called as the Turkic Republics. The data of the variables were taken from the World Bank database (The World Bank, 2019). In addition, the logarithmic transformations of the variables were used in the analyses. The graphics of the relevant variables of the countries were shown in Figure 1.

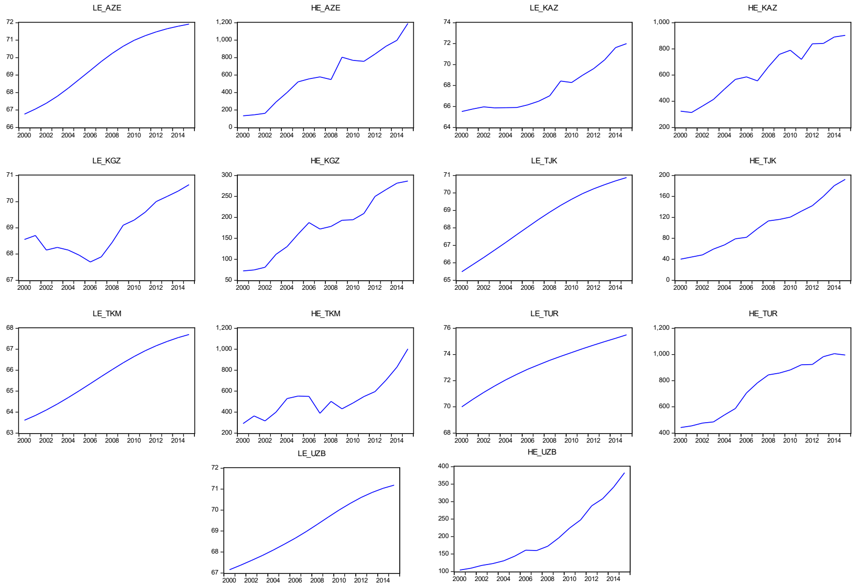

Figure 1. *The Graphics of the Original Level of the Variables*

Examining the graphics of the variables in Figure 1, it is evident that all of the LLE variables of the countries discussed in this study show a positive trend. When the graphics of the LHE variable is examined, it can be seen that there are some breaking points in certain periods. However, it can be said that the LHE variable shows a positive trend, as well.

In this study, the relations between the variables were modeled as shown below;

$$LLE_{n,t} = \beta_0 + \beta_1 LHE_{n,t} + u_t \qquad (1)$$

and

$$LHE_{n,t} = \alpha_0 + \alpha_1 LLE_{n,t} + e_t \qquad (2)$$

In the model No.1, LLE is the dependent variable, while LHE is the independent variable. The coefficient β_0 in the model is the constant term of the model, while the coefficient β_1 is the slope coefficient; it shows how 1% of change in LHE affects LLE. u_t is the error term of the model. In the model No.2, LHE is the dependent variable, while LLE is the independent variable. The coefficient α_0 in the model is the constant term of the model, while the coefficient α_1 is the slope coefficient; it shows how 1% of change in LLE affects LHE. e_t is the error term of the model. i and t indices in both of the models indicate that the variables are a panel data. n indicates the cross-section dimension of the data (the countries mentioned above), while t indicates the time dimension, and they are annual data of the years between 2000-2015.

Method and Findings

This study examines the relationship between the variables in five stages. The first stage examines the existence of the cross-sectional dependence in the variables and models. The second stage determines the levels of stationarity of the variables. The third stage designates whether the models are homogeneous or heterogeneous. The fourth stage presents whether there is a cointegration relation in the models. The last stage estimates the cointegration coefficients. In this part of the study, first, the methods used in the making of the stages mentioned were introduced and the results were provided.

Cross-sectional dependence tests

It is required to test the cross-sectional dependence in the pre-conditions of many analyses done in the dynamic panel data analyses. This is because the analyses to be used are susceptible to the cross-sectional dependence in the variables and model. Specifically, before using the panel unit root and panel cointegration methods, the cross-sectional dependence test should be done. If there is no cross-sectional dependence in the variables/model and if there is a first generation, a second-generation unit root or cointegration tests should be used. Cross-sectional dependence, as Yerdelen Tatoğlu (2013:9) also states, shows the significant correlation relation between the error terms derived for the panel data model. This means that a shock or a change in one of the examined countries affects other countries, as well.

There are many cross-sectional dependence tests developed, susceptible to the time dimension (T) and to the cross-section dimension (N) of the panel data. The first one is the LM test, developed by Breusch and Pagan (1980). This test gives more reliable results especially in the cases when N is small and T is big. Later on, CD_{LM} test was developed by Pesaran (2004). This test, differing from the LM test, is taken into account when T and N are big. The CD test, developed by Pesaran (2004), as well, gives valid results when N is big and T is small. The last one is the Bias-corrected scaled LM test, developed by Pesaran, Ullah and Yamagata (2008), making some additions to the other tests. The hypotheses of the tests are as follows;

H_0: There is no cross-sectional dependence.

H_1: There is cross-sectional dependence.

If the statistics calculated are higher than the critical values or if the probability values of the statistics are lower than the significance levels of the probability values, H_0 is rejected. It means that there is a cross-sectional dependence in the variable or in the model. In the reverse case, H_0 cannot be rejected; meaning that there is no cross-sectional dependence. In Table 1, the results of the cross-sectional dependence test of the variables and models used in the analyses were shown. It can be seen that there is a cross-sectional dependence in the variables and models used in this study, based on all of the results of the cross-sectional dependence test. H_0 is rejected in all of the cross-sectional dependence tests. The fact that there is a cross-sectional dependence in the variables and models requires second generation unit root tests and cointegration tests to be used in the study.

Table 1. *Results of the Cross-Sectional Dependence Test*

Variable	**LLE**		**LHE**	
Test	Test Statistic	Probability	Test Statistic	Probability
Breusch-Pagan LM	286.95*	0.0001	287.29*	0.0001
Pesaran scaled LM	39.95*	0.0001	40.01*	0.0001
Bias-corrected scaled LM	39.72*	0.0001	39.77*	0.0001
Pesaran CD	16.85*	0.0001	16.90*	0.0001
Model	**Model 1**		**Model 2**	
Breusch-Pagan LM	226.84*	0.0001	156.95*	0.0001
Pesaran scaled LM	30.68*	0.0001	19.89*	0.0001
Bias-corrected scaled LM	30.44*	0.0001	19.66*	0.0001
Pesaran CD	14.24*	0.0001	11.64*	0.0001

*It shows the cross-sectional dependence based on the 5% statistical significance level.

Smith et al. (2004) panel unit root test

Based on the results of the cross-sectional dependence test above, it was found that there is a cross-sectional dependence in all of the variables. This result requires the use of second generation unit root tests in examining the stationarity levels of the variables. Various second generation panel unit root tests have been developed. One of these is the unit root test developed by Smith, Leybourne, Kim and Newbold (2004). Smith et al. (2004) has strengthened the unit root tests using bootstrap. In the test, stationarity levels of the variables are examined using the IPS (t), Max, LM, Min. LM and WS statistics. With these test statistics, derived using bootstrap, potential problems in other methods, such as changing variance and autocorrelation are resolved. By means of this test, the constant model and constant-trend models in variables can be examined by taking the stationarity levels into account. The hypotheses of these five statistics derived are as follows;

H_0: *There is unit root, but no stationarity.*

H_1: *There is no unit root, but there is stationarity.*

The decision-making criterion for the hypotheses has two different ways. In the first one, the calculated test statistics can be compared to the bootstrap critical values or a decision can be made about the hypotheses, by checking the probability values of the test statistics. If the calculated test statistic is higher than the bootstrap critical values or the probability value is lower than the significance levels of 10%, 5% and 1%, H_0 is rejected. Thus, it is decided that the variable is stationary. If it is the reverse case, H_0 cannot be rejected, meaning that the variables are not stationary. As is the case with the time series analysis, a unit test can be done once again, by taking the difference of the non-stationary series. For example, if the series is stationary in its 1st difference, it means that that series is I (1).

The results of Smith et al. (2004) bootstrap unit root test of the LLE and LHE variables were shown in Table 2. As a result of the analyses, when the constant model is taken into account, it can be seen that the LLE variable is I (0), based on the IPS and Min. LM statistics, but is I (1) in the other three tests. When the constant-trend model is taken into account, it is I (1) based on all the tests, except for the IPS statistic. It is possible to accept the LLE variable as I (1). As for the LHE variable, it can be seen that it is I (1), based on the entire test statistics for both the constant model and the constant-trend model. The decisions have been made about the hypotheses by checking the probability values of the test statistics.

Table 2. *Bootstrap Panel Unit Root Test of the Variables*

LLE				
	Constant Model		**Constant-Trend Model**	
Test Name	**Level**	**First Difference**	**Level**	**First Difference**
IPS Statistic (Probability)	-2.58 (0.005)*	-2.85 (0.018)*	-2.94 (0.045)*	-4.02 (0.003)*
Max Statistic (Probability)	1.83 (0.997)	-2.09 (0.013)*	-0.64 (0.528)	-3.25 (0.004)*
LM Statistic (Probability)	5.41 (0.120)	6.78 (0.015)*	6.85 (0.147)	8.37 (0.012)*
Min. LM Statistic (Probability)	4.52 (0.037)*	4.84 (0.045)*	1.44 (0.984)	7.68 (0.002)*
WS Statistic (Probability)	-0.12 (0.952)	-1.70 (0.030)*	-0.09 (0.937)	-3.17 (0.001)*

LHE				
	Constant Model		**Constant-Trend Model**	
Test Name	Level	First Difference	Level	First Difference
IPS Statistic (Probability)	-1.21 (0.589)	-3.26 (0.001)*	-1.54 (0.859)	-3.75 (0.001)*
Max Statistic (Probability)	1.92 (0.999)	-3.15 (0.001)*	-0.92 (0.932)	-3.51 (0.001)*
LM Statistic (Probability)	4.27 (0.162)	7.24 (0.001)*	3.67 (0.842)	8.66 (0.001)*
Min. LM Statistic (Probability)	2.79 (0.179)	6.99 (0.001)*	1.51 (0.983)	8.19 (0.001)*
WS Statistic (Probability)	0.52 (0.999)	-3.52 (0.001)*	-1.38 (0.991)	-4.11 (0.001)*

*It indicates stationarity, based on 5% significance. The number of Bootstrap loops has been taken as 5000.

Homogeneity test

The fact that both variables are I (1) together, in other words, they are stationary on the same range/level. This implies that there might be a cointegration relation between the variables. As Engle and Granger (1987) state, even if the level values of the two variables are not stationary, the error terms derived from the model, set up with these two variables, might be stationary. This condition shows the cointegration relationship between the variables. Therefore, it is important to research the long-term relations between the LLE and the LHE variables. However, it is required to research the homogeneity of the country coefficients of the models, whose cointegration relation is researched, before doing a cointegration analysis in the panel data analyses.

Homogeneity is a very important term in the panel data analyses, especially regarding the cointegration tests and the estimate of the cointegration coefficients. The analyses to be used depend on whether there is homogeneity or not. Homogeneity indicates that for the units such as countries/regions/cities and so on, which are the subject of the analysis, slope coefficients, i.e.; for Model 1, β_1s equal to a single β coefficient; for Model 2, α_1s equal to a single α coefficient. However, if these coefficients differentiate for each country/region/city or differentiate for at least one country, it is found that the models have a heterogeneous structure. In the panel data analyses, whether the models have a homogeneous structure is generally determined by means of the homogeneity test, developed by Pesaran and Yamagata (2008). Pesaran and Yamagata (2008) determined whether the models have homogeneity or not, by means of two test statistics of $\tilde{\Delta}$ and $\tilde{\Delta}_{adj}$. These tests are based on the Random Coefficent Regression Model, which was developed by Swamy (1970). In case of homogeneity, cointegration tests and cointegration coefficient estimators that take homogeneity into account should be used. Besides, in case of heterogeneity, cointegration tests and cointegration coefficient estimators that take heterogeneity into account should be used. The hypotheses of the $\tilde{\Delta}$ and $\tilde{\Delta}_{adj}$ tests are as follows;

> *H_0: There is homogeneity in the model; all the βs equal to a single β coefficient.*
>
> *H_1: There is homogeneity in the model; at least one β is different.*

The decisions about hypotheses can be made by checking the probability values of the test statistics. If the probability value of the test statistics calculated are higher than the significance levels, such as 10%, 5% and 1% (in this study, 5% is considered), H_0 is not rejected, and it is decided that the model is homogeneous. In the reverse case, it is decided that the model is heterogeneous.

The results of the homogeneity tests of both Model 1 and Model 2 were shown in Table 3. Accordingly, both Model 1 and Model 2 are heterogeneous based on both of the test statistics. It means that the coefficients of the countries included in the study are not equal to one another, on the contrary, they differentiate. It is required to use cointegration tests and cointegration coefficient estimators that take this case into account.

Table 3. *The Results of Homogeneity Tests*

Model 1		
Test	**Test Stat.**	**Prob.**
$\tilde{\Delta}$	8.39*	0.001
$\tilde{\Delta}_{adj}$	9.25*	0.001
Model 2		
Test	**Test Stat.**	**Prob.**
$\tilde{\Delta}$	10.59*	0.001
$\tilde{\Delta}_{adj}$	11.67*	0.001

*It shows heterogeneity based on the 5% statistical significance level.

Westerlund and Edgerton (2007) cointegration test

Cointegration indicates long-term relations between the variables. As in the time series, cointegration analyses can also be done in the panel data of which T dimension is long. As a matter of fact, various substructures of the panel data econometrics are based on the time series econometrics. It is a precondition to test cross-sectional dependence and homogeneity to do a cointegration test in the panel data analyses. As stated above, cointegration analyses to be used vary, depending on whether there is cross-sectional dependence and homogeneity or not. This study investigates the long-term relations between the LLE and the LHE variables using a second generation cointegration test, developed by Westerlund and Edgerton (2007), that takes cross-sectional dependence into account and operates with a heterogeneity hypothesis.

The cointegration test, developed by Westerlund and Edgerton (2007:185), is based on the Lagrange multiplier (LM) test, developed by McCoskey and Kao (1998). The H_0 of this test is different from many panel cointegration tests. Here, H_0 indicates the existence of cointegration. The LM statistic used in the test is calculated as follows (Westerlund and Edgerton 2007:186);

$$LM_N^{+} = \frac{1}{NT^2}\sum_{i=1}^{N}\sum_{t=1}^{T}\hat{\omega}_i^{-2}S_{it}^2 \qquad (3)$$

$\hat{\omega}_i^{-2}$ in the equation No.3 indicates the long-term variances, while S_{it}^2

indicates the partial sum of the remainder terms. The values of these terms are derived using the fully modified least squares estimator for each unit (Westerlund and Edgerton 2007:187). After calculating the LM test statistic, the most important problem is how to derive the critical values. Westerlund and Edgerton (2007:187) suggest that the bootstrap critical values can be used in case of cross-sectional dependence in the examined model. They state that by using bootstrap, many statistical problems likely to occur will be removed. However, they suggest that asymptotic critical values can be used if there is no cross-sectional dependence. As stated above, the hypotheses of the test are as follows;

H_0: *There is cointegration.*

H_1: *There is no cointegration.*

These hypotheses can be tested for both the constant model and the constant -trend model. If the probability values of the calculated LM statistic value is higher than the significance value, H_0 cannot be rejected, meaning that there is a cointegration between the variables and that the independent variables affect the dependent variable in the long-term. In the reverse case, H_0 is rejected, meaning that there is no cointegration.

The results of the cointegration test of Model 1 were shown in Table 4. As there is a cross-sectional dependence in the variables and in the model, a decision was made about the hypotheses, by taking the bootstrap probability value into account. First of all, checking the results of the stationary model, H_0 cannot be rejected, based on both the results of the LM test of the Ordinary Least Squares (OLS) estimator and the results of the Yule-Walker estimator, which means that LHE has a significant effect on LLE in the long-term. Certainly, this effect might differentiate depending on the country. Checking the results of the constant-trend model, H_0 is not rejected based on the OLS estimator. As for the results of the Yule-Walker estimator, H_0 is rejected; meaning that there is no cointegration. When solely the constant model is taken into account here, it is possible to conclude that there is a cointegration for Model 1.

Table 4. *Model 1 Results of the Cointegration Test*

Constant Term Structure Model -OLS Estimator Results		
LM Statistical Value	*Bootstrap Probability Value*	*Probability Value*
1.409	0.934*	0.079*
Constant Term Structure Model -Yule Walker Estimator Results		
LM Statistical Value	*Bootstrap Probability Value*	*Probability Value*
1.409	0.798*	0.079*
Constant-Trend Term Structure Model -OLS Estimator Results		
LM Statistical Value	*Bootstrap Probability Value*	*Probability Value*
2.790	0.766*	0.003
Constant-Trend Term Structure Model -Yule Walker Estimator Results		
LM Statistical Value	*Bootstrap Probability Value*	*Probability Value*
2.790	0.008	0.003

*It shows the significant cointegration relation. The number of the Bootstrap cycle is taken as 5000.

The results of the cointegration test of Model 2 were shown in Table 5. It can be seen that the bootstrap probability values of the LM statistic values, which are calculated taking only the constant models into account, are above the statistical significance levels. In this case, the H_0 of the test cannot be rejected, which means that there is a significant cointegration relation in Model 2 for the constant model based on both the OLS and Yule-Walker estimators. In other words, LLE has a significant effect on LHE in the long run. It should be remembered that the derived long-term relations may differentiate depending on the country, since this test, developed by Westerlund and Edgerton (2007), takes heterogeneity into account. Whether there is a significant relation in any country or not, it is of importance to estimate the cointegration parameters to determine on what level the independent variables affect the dependent variables in Model 1 and Model 2 in the countries with significant relations.

Table 5. *Model 2 Results of the Cointegration Test*

Constant Term Structure Model -OLS Estimator Results		
LM Statistical Value	*Bootstrap Probability Value*	*Probability Value*
0.646	0.181*	0.259*
Constant Term Structure Model -Yule Walker Estimator Results		
LM Statistical Value	*Bootstrap Probability Value*	*Probability Value*
0.646	0.639*	0.259*
Constant-Trend Term Structure Model -OLS Estimator Results		
LM Statistical Value	*Bootstrap Probability Value*	*Probability Value*
2.284	0.001	0.011
Constant-Trend Term Structure Model -Yule Walker Estimator Results		
LM Statistical Value	*Bootstrap Probability Value*	*Probability Value*
2.284	0.017	0.011

* It shows the significant cointegration relation. The number of the Bootstrap cycle is taken as 5000.

Cointegration parameter estimates

As stated in the previous section, the estimates of the significant cointegration parameters are of importance. By estimating these, the whole panel; the common slope coefficients of the countries in Model and Model 2 are estimated. In addition, the slope coefficients of the countries differentiating since the heterogeneous structures of the models are calculated. In this study, the estimates of the cointegration parameters of Model 1 and Model 2 were calculated using the mean group estimator (MG), developed by Pesaran and Smith (1995), that operates under the heterogeneity hypothesis. The results of the MG estimate, taking the constant model into account for Model 1 and Model 2 were shown in Table 6.

Table 6. *Cointegration Parameter Estimates*

Model 1				Model 2			
Coefficient Estimates for the Whole Panel							
Variable	Coefficient	z statistic	Prob.	Variable	Coefficient	z statistic	Prob.
LHE	0.050*	6.75	0.001	LLE	17.453*	8.00	0.001
constant	3.933*	74.41	0.001	constant	-68.165*	-7.24	0.001
Wald Chi2=45.53* Prob> chi2=0.0001				Wald Chi2=64.05* Prob> chi2=0.0001			
Coefficient Estimates for Azerbaijan							
Variable	Coefficient	z statistic	Prob.	Variable	Coefficient	z statistic	Prob.
LHE	0.035*	12.23	0.001	LLE	25.700*	12.23	0.001
constant	4.022*	221.26	0.001	constant	-102.85*	8.91	0.001
Coefficient Estimates for Kazakhstan							
Variable	Coefficient	z statistic	Prob.	Variable	Coefficient	z statistic	Prob.
LHE	0.075*	6.04	0.001	LLE	9.514*	6.04	0.001
constant	3.730*	46.39	0.001	constant	-33.722*	-5.08	0.001
Coefficient Estimates for Kyrgyzstan							
Variable	Coefficient	z statistic	Prob.	Variable	Coefficient	z statistic	Prob.
LHE	0.019*	3.15	0.002	LLE	21.024*	3.15	0.002
constant	4.132*	129.02	0.001	constant	-83.908*	-2.97	0.003
Coefficient Estimates for Tajikistan							
Variable	Coefficient	z statistic	Prob.	Variable	Coefficient	z statistic	Prob.
LHE	0.052*	36.80	0.001	LLE	18.895*	36.80	0.001
constant	3.988*	613.38	0.001	constant	-75.315*	-34.71	0.001
Coefficient Estimates for Turkmenistan							
Variable	Coefficient	z statistic	Prob.	Variable	Coefficient	z statistic	Prob.
LHE	0.052*	5.50	0.001	LLE	13.017*	5.50	0.001
constant	3.859*	64.88	0.001	constant	-48.271	-4.87	0.001
Coefficient Estimates for Turkey							
Variable	Coefficient	z statistic	Prob.	Variable	Coefficient	z statistic	Prob.
LHE	0.074*	17.30	0.001	LLE	12.899*	17.30	0.001
constant	3.805*	135.20	0.001	constant	-48.798*	-15.25	0.001
Coefficient Estimates for Uzbekistan							
Variable	Coefficient	z statistic	Prob.	Variable	Coefficient	z statistic	Prob.
LHE	0.046*	25.39	0.001	LLE	21.125*	25.39	0.001
constant	3.995*	418.56	0.001	constant	-84.289*	-23.91	0.001

*It shows significance based on the 5% statistical significance level.

First of all, when the results of the cointegration parameter estimate of Model 1 are checked, it can be seen that for the whole panel, an increase by 1% in the LHE variable increases the LLE variable by 0.05%. This ratio is significant in statistical terms, as well. Furthermore, the coefficients of the LHE variable in all the countries are positive and significant in statistical terms. However, the effect of the LHE variable on the LLE variable differentiates depending on the country. The increase by 1% in the LHE variable affects Kazakhstan the most by 0.075%. Kazakhstan is followed by Turkey by 0.074%. In Uzbekistan, Turkmenistan and Tajikistan, the coefficient of the LHE variable is around 0.05%. While the coefficient of the LHE variable in Azerbaijan is 0.035%, it is 0.019% in Kyrgyzstan. In other words, Kyrgyzstan is the country where LHE affects LLE the least.

Finally, when the results of the cointegration parameter estimate of Model 2 are checked, it can be seen that for the whole panel, an increase by 1% in the LLE variable increases the LHE variable by 17.45 %, and it is significant in statistical terms. A change in LLE affects LHE in Azerbaijan the most, by 25.70%. Azerbaijan is followed by Uzbekistan by 21.125%; Kyrgyzstan by 21.024%; Tajikistan by 18.895%, Turkmenistan by 13.017%; Turkey by 12.899%; and last of all, Kazakhstan by 9.514%. For all the countries, these coefficients are significant in statistical terms. Both models are significant as a whole, based on the Wald Chi2 statistics that show the significance of models as a whole.

Conclusion

This study aims to investigate the relationship between the life expectancy (LLE) variable and health expenditures (LHE) variable in 2000-2015 in Azerbaijan, Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, Uzbekistan and Turkey, which are called as the Turkic Republics.

According to the result of the cointegration parameter estimates, an increase by 1% in health expenditures increases life expectancy by 0.05% in all the Turkic Republics. An increase by 1% in life expectancy, on the other hand, increases health expenditures by 17.45%. The results of the panel cointegration test indicate that there is a significant long-term bidirectional relationship between the two variables. This result is similar to the findings of Shahbaz et al. (2016). In most of the studies investigating the relationship between health expenditures and life expectancy, it was found that there was a unidirectional relationship between the two variables. The results, showing the bidirectional relationship between the two variables for the countries included in the study, can be evaluated as another uniqueness of this study. Therefore, it can be concluded that an increase in life expectancy has an important effect on health expenditures. These findings suggest that the relationship between health expenditures and life expectancy are really strong. This relationship differentiates for the sample countries in the panel. The effect of health expenditures on life expectancy in descending order is as follows: Kazakhstan (0.075%), Turkey (0.074%), Tajikistan (0.052%), Turkmenistan (0.052%), Uzbekistan (0.046%), Azerbaijan (0.035%), and last of all, Kyrgyzstan (0.019%). The effect of life expectancy on health expenditures in descending order is as follows: Azerbaijan (25.70%), Uzbekistan (21.12%), Kyrgyzstan (21.02%), Tajikistan (18.89%), Turkmenistan (13.01%), Turkey (12.89%), and last of all, Kazakhstan (9.51%).

The effect of life expectancy on health expenditures is relatively higher. Health expenses increase due to chronic diseases resulting from prolonged life expectancy. As countries determine their health policies to improve the power of human capital, they should take precautions to prevent health expenditures from increasing inefficiently. Some of the prominent precautions were stated below:

- Activities for health awareness should be supported.

- Preventive health services should be extended. Along with health awareness, an increase in preventive health services lowers the probability to contract a disease and contributes to a longer life expectancy. On the other hand, as the diagnosis and treatment expenses decrease, the resources that are not wasted can be transferred to investments that improve public health. Awareness and preventive health services decrease the risks of contracting chronic diseases and reduce the necessity to stay out of work life due to long-term treatments. Individuals with a long lifespan will be more productive and will contribute positively to the economic growth, as long as they are in production and work life. On the other hand, individuals with a long lifespan, who spend most of their lives in health institutions, will cause health expenditures to increase in an ineffective manner.

- The increase in life expectancy cannot be explained only by the quantitative increase in health expenditures. An increase of quality in health services, developments in the new treatment methods, and an increase in the access opportunities to health services are the developments that improve the efficiency of health policies.

Not only health policies, but also production strategies should be taken into consideration in the Turkic Republics. The economies of the countries such as Kazakhstan, Azerbaijan and Turkmenistan, mostly depend on natural resources; thus, the existence of natural resources brings both economic and political power to these countries. However, it is also required to invest in education, research and development, and technological innovations to get a sustainable economic growth performance (Şanlısoy 2019: 1584). Unless necessary policies are put into practice for developing new technologies, the dependency on the developed countries will persist. Finally, empowering the human capital that will produce and develop technology should be supported by qualitative and quantitative improvements, not only in the health sector but also in education.

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Sağlık Harcamaları ve Yaşam Beklentisi İlişkisi Üzerine Bir İnceleme: Türkiye ve Türki Cumhuriyetler Örneği*

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Öz

Sağlık ekonomisi literatüründe temel sağlık çıktılarından birisi olarak kabul edilen yaşam beklentisinin iyileşmesi, iktisadi büyüme performansını pozitif yönde etkileyen değişkenlerden birisidir. Dolayısıyla, hayat beklentisini belirleyen faktörlerin araştırılması ilgili literatürdeki birçok araştırmanın konusu olmuştur. Bu araştırmaların bir bölümünde yaşam beklentisinin sağlık harcamalarını pozitif yönde etkilendiğine dair bulgular elde edilmiştir. Söz konusu bulgular, sağlık politikalarının belirlenmesinde veri olarak kullanılmaktadır. Bu çalışmanın amacı, 2000-2015 dönemine ait veriler kullanılarak, Türkiye, Azerbaycan, Kazakistan, Kırgızistan, Tacikistan Türkmenistan ve Özbekistan'da sağlık harcamaları ile yaşam beklentisi arasındaki ilişkiyi analiz etmektir. Çalışmada panel veri analizi yöntemi tercih edilmiştir. Panel eş bütünleşme testi sonuçları, iki değişken arasında anlamla çift yönlü uzun dönemli ilişkilerin varlığını göstermektedir.

Anahtar Kelimeler

Sağlık harcaması, panel veri analizi, Yaşam beklentisi, Türkiye, Türki Cumhuriyetler.

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Анализ взаимосвязи между расходами на здравоохранение и продолжительностью жизни: пример Турции и тюркских республик*

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Аннотация

Как один из фундаментальных результатов в области здравоохранения в литературе по экономике здравоохранения, повышение ожидаемой продолжительности жизни является одной из переменных, которые положительно влияют на экономический рост. Во многих работах, посвященных исследованию взаимосвязи между расходами на здравоохранение и ожидаемой продолжительностью жизни, указывалось, что ожидаемая продолжительность жизни оказывает положительное влияние на расходы на здравоохранение. Данное исследование направлено на изучение взаимосвязи между ожидаемой продолжительностью жизни и расходами на здравоохранение на период 2000-2015 гг. в Турции, Азербайджане, Казахстане, Кыргызстане, Таджикистане, Туркменистане и Узбекистане. Для исследования использовался метод панельных данных. Результаты группового анализа коинтеграции показывают, что между этими двумя переменными существует значительная двусторонняя долгосрочная связь.

Ключевые слова

расходы на здравоохранение, групповой анализ данных, ожидаемая продолжительность жизни, Турция, тюркские республики

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