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# THE EFFECTS OF ECONOMIC VARIABLES ON HEALTH EXPENDITURE PER CAPITA AND LIFE EXPECTANCY AT BIRTH: PANEL DATA ANALYSIS FOR MIDDLE TOP INCOME COUNTRIES

# EKONOMİK DEĞİŞKENLERİN KİŞİ BAŞI SAĞLIK HARCAMASI VE DOĞUŞTA YAŞAM BEKLENTİSİ ÜZERİNE ETKİLERİ: ORTA ÜST GELİR ÜLKELERİ İÇİN PANEL VERİ ANALİZİ

Osman ŞENOL[1], Durmuş GÖKKAYA[2], Ümit ÇIRAKLI[3]



1. Arş. Gör., Süleyman Demirel Üniversitesi, Sosyal Bilimler Enstitüsü, osmansenol@sdu.edu.tr, https://orcid.org/0000-0001-5626-2921
2. Arş. Gör. Dr., Yozgat Bozok Üniversitesi, İktisadi ve İdari Bilimler Fakültesi, Sağlık Yönetimi Bölümü, durmus.gokkaya@yobu.edu.tr, https://orcid.org/0000-0002-6713-1748
3. Doç. Dr., Yozgat Bozok Üniversitesi, İktisadi ve İdari Bilimler Fakültesi, Sağlık Yönetimi Bölümü, umit.cirakli@yobu.edu.tr, https://orcid.org/0000-0002-3134-8830

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## Abstract

Income inequality and income distribution issues are among the issues that are emphasized both in individual and national dimensions. With the increase in globalization, the interdependence of countries, income inequalities and their reasons and their reflections on different areas, especially health services, have been the subject of many studies. Literature shows that the relationship between health and income and the effect of income on basic health indicators are tested in line with income inequality and absolute income hypotheses. In this study, the effects of income inequalities and economic variables on life expectancy at birth and health expenditure per capita were analysed using panel data analysis method. This study, using 2000-2019 data, was conducted on middle-upper income and high income countries. As a result of the analysis, it was seen that public expenditure and increases in GDP level had a positive effect on primary health indicators. On the other hand, it was determined that the increase in unemployment rate and Gini index values had negative effects on health indicators. Last of all income factor both in individual and social dimensions have a significant effect on life expectancy at birth and health expenditure per capita.

***Keywords: Economy, Health Expenditure Per Capita, Life Cxpectancy at Birth, Panel Data Analysis***

## Öz

Hem bireysel boyutta hem ülkesel boyutta gelir eşitsizliği ve gelir dağılım konuları önemle üzerinde durulan konular arasındadır. Küreselleşmenin artması ile birlikte ülkelerin birbirlerine bağlılıklarının artması, gelir eşitsizlikleri ve nedenleri ve bunların başta sağlık hizmetleri olmak üzere farklı alanlara yansımaları birçok çalışmaya konu olmuştur. Literatür incelendiğinde sağlık ve gelir ilişkisi ve gelirin temel sağlık göstergeleri üzerinde etkisi gelir eşitsizliği ve mutlak gelir hipotezleri doğrultusunda test edildikleri görülmektedir. Bu çalışmada ise gelir eşitsizlikleri ve ekonomik değişkenlerin temel sağlık göstergelerinden olan doğumdan beklenen yaşam süresi ile kişi başı sağlık harcaması üzerinde etkileri panel veri analiz yöntemi ile incelenmiştir. 2000-2019 verilerinin kullanıldığı bu çalışma orta-üst gelir ve yüksek gelir grubunda yer alan ülkeler üzerinde yapılmıştır. Yapılan analiz sonucunda ise kamu harcaması ve GSYİH düzeyinde artışların temel sağlık göstergeleri üzerinde olumlu etkisi olduğu görülmüştür. Diğer taraftan işsizlik oranı ve Gini endeks değerlerindeki büyümenin sağlık göstergeleri üzerinde ise olumsuz etkilerinin olduğu tespit edilmiştir.

***Anahtar Kelimeler: Politik Ekonomi, Kişi Başı Sağlık Harcaması, Doğuşta Beklenen Yaşam Süresi, Panel Veri Analizi***

## GENİŞLETİLMİŞ ÖZET

### Çalışmanın Amacı

Bu araştırmanın temel amacı gelir eşitsizliklerinin kişi başı sağlık harcaması ile doğuşta beklenen yaşam süresini nasıl ve ne derece etkilediğini tespit etmektir. Bu doğrultuda gelir eşitsizlikleri ile ilgili temel değişkenleri kullanıp panel veri analiz yöntemi sayesinde sağlık göstergeleri üzerinde etkileri tespit edilmeye çalışılmaktadır.

### Araştırma Soruları

Gelir eşitsizliği ile ilgili değişkenler orta üst gelir grubu ülkelerde kişi başı sağlık harcamasını ve doğuşta etkilemekte midir? Etkiliyorsa nasıl ve ne derecede etkilemektedir?

### Literatür Araştırması

Sağlık ve gelir ilişkisini açıklamada öne çıkan iki temel hipotez bulunmaktadır. Bunlar mutlak gelir hipotezi ve gelir eşitsizliği hipotezidir. Mutlak gelir hipotezi, bireyin sağlığını bireyin gelir düzeyinin bir fonksiyonu olarak görmekte ve bireyin gelir düzeyi arttıkça sağlık durumunun iyileştiğini öne sürmektedir. Gelir eşitsizliği hipotezi ise, bireyin sağlığını bireyin gelir düzeyinin yanında toplumdaki gelir eşitsizliğinin bir fonksiyonu olarak görmekte olup mutlak gelir yanında bir ülkedeki gelir dağılımının da sağlık çıktıları üzerinde bağımsız bir etkisinin olduğunu iddia etmektedir. Gelir eşitsizliği hipotezi artan gelir eşitsizliğinin sağlık çıktılarını olumsuz etkilediğini öne sürmektedir (Çukur ve Bekmez, 2011: 22). Literatürdeki farklı örneklem, zaman boyutu ve değişkenlerle yapılan çalışmalar incelendiğinde ekonomik değişkenlerin temel sağlık göstergeleri üzerinde önemli bir etkisinin olduğu görülmektedir. Bazı ekonomik değişkenler temel sağlık göstergeleri ile pozitif yönde ilişkili iken, bazı değişkenler ise negatif yönde ilişkili oldukları görülmektedir. Bu çalışmada ise literatürdeki çalışmalardan farklı olarak orta üst gelir grubundaki ülkelere ait ekonomik değişkenlerin kişi başı sağlık harcaması ve doğumdan beklenen yaşam süresi üzerinde etkileri incelenmektedir.

### Yöntem

Bu çalışmada gelişmiş ve gelişmekte olan ülke gruplarına ekonomik değişkenlerin doğumdan beklenen yaşam süresi ile kişi başı sağlık harcama düzeyi üzerinde etkileri tespit etmek amaçlı gerçekleştirilmiştir. Ülke grupları seçilirken Dünya Bankası ülke sınıflandırması dikkate alınmıştır. Diğer taraftan kişi başı sağlık harcama düzeyi ile doğumdan beklenen yaşam süresini çalışmada yer alan değişkenlerden farklı başka faktörlerde etkilediği bilinmektedir. Ancak çalışmanın temel çıkış noktası ekonomik değişkenler ile belirtilen sağlık göstergeleri arasında ne tür bir ilişkiye sahip olduklarını tespit etmektir. Çalışmada panel veri modellermesi ile iki farklı model geliştirilecektir. Bu çalışmada ise dönem sayısının 20 olması sebebi ile mikro panel varsayımları altında testlerle ilerlenecektir. Sağlık göstergeleri bağımlı değişken olarak modele dâhil olurken diğer değişkenler ise bağımsız değişken olarak modele dâhil olacaklardır.

## Sonuç ve Değerlendirme

Modellerde yer alan değişkenler genel olarak yorumlandığında Gini endeks değeri hem toplum için hem ülke için önemli olmasına rağmen modellerde anlamsız çıkmıştır. İşsizlik oranı değişkeni her iki modelde de anlamlı çıkmış ve bağımlı değişkenlerle negatif bir ilişki içinde olduğu görülmektedir. İşsizlik düzeyindeki artış başta gelir azaltıcı bir etken olması sebebi ile insanların kendi sağlıkları için harcama yapabilecekleri miktar azalmaktadır. Diğer taraftan işsizlik düzeyindeki artış başta stres olmak üzere toplum üzerinde olumsuz etkilerinin olması sebebi ile ortalama yaşam sürecini olumsuz olarak etkilediği görülmektedir. GSYH değişkeni ise her iki modelde anlamlı çıkmış olup bağımlı değişkenler ile de pozitif bir ilişki içerisinde olduğu görülmektedir.

## 1. INTRODUCTION

Life expectancy at birth is one of the basic health indicators of a country or society. It is also a pioneering parameter used as health statistics to compare the development levels of countries. Life expectancy at birth is a criterion trying to predict the average number of years a person will live based on his date of birth. The longer a person's life expectancy, the more contribution he can make to society and the economy. For example; Considering the prolongation of working hours and retirement at a later age, a person can contribute to production by engaging in economic activity for a long time. In addition to economic development, life expectancy at birth is also regarded as an indicator of both human and social development. Countries take various measures in order to increase this average and for individuals to live healthier. In addition to combating tobacco, alcohol and addictive substances, serious policies are put forward to gain healthy living behaviours and improve living conditions. Since the health of citizens plays a human capital role in the development of countries, the value given to human life increases day by day and it is emphasized.

Another health indicator level is the health expenditure per capita criterion. It is a known fact that per capita income and per capita health expenditure in developed countries are higher than those in underdeveloped and developing countries. This is evident when looking at the Organization for Economic Co-operation and Development (OECD) statistics (www.oecd.org). Considering the development progress of countries, as the development levels increase, the share of national income for health increases. With the increase in spending in the health sector, economic development and growth also increase indirectly. Investments in the health sector can both extend the life expectancy of individuals with improved healthcare opportunities, and generate increases in welfare with economic development and growth. For this reason, governments may tend to increase the shares allocated to health more. However, due to limited budgets, especially underdeveloped and developing countries don't or cannot allocate enough shares for health. In this direction, payments made out of pocket come into play. The limited budget deficits and health expenditures are tried to be covered from these payments. However, out-of-pocket payments can pose a problem for most citizens due to inequality in income distribution. With the injustice in the distribution of income, most citizens cannot benefit from private health services because additional fees are required. Citizens with high income do not have a problem at the point of receiving service, as they can have private health or complementary insurance.

With the developing technology opportunities, the increase of the population, the increase in the elderly population due to the prolongation of life expectancy, the increase of epidemics and the increase of diseases, the expenditures made by people for health are increasing day by day, as countries cannot adequately finance their health expenditures. Again, the increase in drug prices and the fact that some drugs are not covered by insurance cause an increase in out-of-pocket expenditures. Especially in countries such as the USA, the lack of health insurance that covers everyone may result in catastrophic

health expenditures. However, injustices or inequalities in income distribution also have negative effects on many indicators, especially health. Inequality in income distribution can significantly affect individuals' access to health services and their health preferences. Individuals with low income may not have access to quality health services for various reasons (such as transportation fee, examination fee, analysis and examination costs). Individuals with low income can become more disadvantaged due to socio-economic factors and become more healthcare users. For example, lack of adequate living conditions and nutrition opportunities for individuals, poor working condition, and inability to reach clean water can cause deterioration of their health. As a result, it brings many problems such as the inability to meet the treatment fees in order to regain their deteriorated health. Therefore, it is possible to talk about a positive relationship between individuals' income distribution and health. Individuals with increased income may have less illness because they will continue their lives under more favourable conditions and pay more attention to their health. On the other hand, individuals with low income are more at risk of getting sick. In this context, this research tries to reveal the effects of economic indicators', especially income inequality, on per capita health expenditure and life expectancy at birth. While the index value of Gini was used to represent income inequality, other extra economic indicators were included in the study

## 2. LITERATURE REVIEW

This study uses the variables of life expectancy at birth, health expenditures per capita, unemployment rates, income per capita, public expenditures, gross domestic product rates and Gini index value used in income inequality to reveal relationships between economic indicators and health indicators. When the literature is examined, there are various studies conducted with such variables and other related variables. It is useful to mention these studies.

*"There are two main hypotheses that stand out in explaining the relationship between health and income. These are the absolute income hypothesis and the income inequality hypothesis. The absolute income hypothesis sees the health of the individual as a function of the income level of the individual and suggests that as the income level of the individual increases, individual's health status improves. The income inequality hypothesis sees the health of the individual as a function of income inequality in the society as well as the income level of the individual, and claims that in addition to absolute income, income distribution in a country also has an independent effect on health outcomes. The income inequality hypothesis suggests that increasing income inequality negatively affects health outcomes"* (Çukur and Bekmez, 2011). It is known that income and income inequality of countries have effects on health indicators or outcomes. While health outcomes are positively affected by the increase in income, health outcomes can be negatively affected by income inequality. This situation is clearly seen some studies (Easterly, 1999; Gray Molina and Purser, 2010; Kawachi and Kennedy, 1997; Lynch et al., 1998; Preston, 1975; Rodgers, 1979; Subramanian and Kawachi, 2004). There is a significant and

strong relationship between the increase in per capita income and life expectancy at birth. On the other hand, when income inequality increases, it is seen that health outcomes are negatively affected.

Easterly (1999) examined the effect of income on the quality of life in his study, which included a panel data set consisting of 81 indicators between 1960, 1970, 1980 and 1990, based on world bank data. It has been observed that it has a positive effect on 32 of the 81 indicators with the increase in income. There are health indicators among these indicators. In the study, it is stated that there are positive improvements in health indicators as income increases. It has been determined that there is a positive and significant relationship between infant deaths, deaths under the age of five and life expectancy at birth with increased income. On the other hand, Kawachi and Kennedy (1997), in a study where they tested the relationship between six different income inequality indicators and total mortality rates in 50 states of the USA, revealed that income inequality has a strong relationship between death rates and life expectancy.

Jaba et al. (2014) examined the relationship between per capita health expenditures, which is one of the input dynamics of the health system, and life expectancy at birth, which is one of the outputs of the healthcare system, using panel data analysis. Based on the data grouped according to geographical location and income level, it was concluded that there is a significant relationship between health expenditures and life expectancy in this study covering 175 world countries and 16 years (1995-2010). Cundiff and Campus (2010) examined life expectancy as a function of health expenditures, available health resources and lifestyle variables comparing 30 OECD member countries to the United States. As a result of this study, it was seen that although the USA health expenditures were high, it did not perform adequately in health indicators. In addition, the study found that there is a positive relationship between health expenditures and life expectancy.

In the study conducted by Kim and Lane (2013), the relationship between public health expenditures and national health outcomes among developed countries was analysed empirically. Data of 17 OECD countries between 1973-2000 were used in the study. The fixed impact model was used to analyse the panel data between countries. Infant mortality rate and life expectancy from birth were used as dependent variables in the study. Total public health expenditure, unemployment rate, population over 65, per capita income and Gini coefficient were used as independent variables. As a result of the study, a positive significant relationship was found between government health expenditures and life expectancy at birth and infant mortality rates. Another finding is that there is a positive and significant relationship between per capita income and life expectancy at birth, while income inequality has a negative correlated with life expectancy at birth.

Tüylüoğlu and Tekin (2009) conducted a study in order to determine how income level and health expenditures can affect life expectancy at birth and infant mortality rate. Accordingly, health indicators and the economic indicators of 176 countries for the year 2003 were examined by the multiple

regression analysis method in the study. As a result of the study, it has been observed that health expenditures are more effective than income level on life expectancy at birth and infant mortality rate. In other words, the result of this study shows that per capita health expenditures give meaningful results in explaining life expectancy at birth and infant mortality rate, whereas per capita income is less important in explaining life expectancy at birth and infant mortality rate.

Aydın (2020) conducted a study using panel data analysis method with the annual data of 7 OECD countries for the period 2000-2016. While the life expectancy was used as the dependent variable in the study, gross domestic product, health expenditure and unemployment rate were used as independent variables. As a result of this study, it is concluded that the most important factor affecting life expectancy in OECD countries is health expenditures. In addition, two-way causality relationship has been found between expected life span and unemployment rate, and per capita gross domestic product. In addition, the study revealed that there is a one-way causality relationship towards life expectancy from health expenditures. Yorulmaz (2016) conducted a study of panel data analysis in order to determine the factors affecting the life expectancy at birth including data from 107 countries for the period 1991-2013. As a result of the study, it has been revealed that per capita income, population growth and urban population ratio have a positive effect on life expectancy at birth. In addition, it has been determined that public and private health expenditures can have a positive or negative effect on life expectancy at birth.

Halisçelik, Acaravcı and Güzel (2019) investigated the effects of income distribution (Gini index) and health expenditure on life expectancy at birth in Turkey for the period 1987-2016 by using the autoregressive distributed lag (ARDL) bounds testing approach and found that the rising income inequality effected life expectancy negatively. Traş and Özbek (2020) examined the effects of per capita GDP, crude birth rate, urbanization rate and carbon dioxide emissions per capita on life expectancy at birth using dynamic panel econometric estimates in 28 OECD countries for the period 1980-2018 and found that a 1% increase in per capita income reduced life expectation at birth by about 0.007%.

Çıraklı (2019) examined the relationship between economic variables (using real GDP, unemployment, inflation and economic crises) and health expenditures and Ministry of Health budget in Turkey for the period of 1974-2015 by using ARDL (Autoregressive Distributed Lag) bounds testing approach . As a result of the study, it was found that the increase in Real GDP has an increasing effect on public health expenditures, while it has a decreasing effect on private health expenditures together with inflation. Again, in this study, it is concluded that the increase in the unemployment rate in the long run has a significant effect on only the share of the Ministry of Health budget in the general budget. In addition, the study states that while economic crises generally have a decreasing effect on private health expenditures, the results in terms of public health expenditures are mixed.

Although the studies in the literature have different samples, time dimensions and variables, their results show that economic variables have a significant effect on basic health indicators. While some economic variables are positively associated with basic health indicators, some variables are found to be negatively related. In this study, unlike the studies in the literature, the effects of economic variables belonging to middle-upper income countries on per capita health expenditure and life expectancy from birth are examined.

## 3. DATA AND METHODOLOGY

### 3.1. Purpose and Scope of the Research

The main purpose of this research is to determine the effects of economic variables on life expectancy at birth and per capita health expenditure level on developed and developing country groups. We take into account the World Bank's country classification when selecting country groups. On the other hand, it is known that per capita health expenditure level and life expectancy at birth are affected by other factors different from the variables in the study. However, the scope of this study is limited to variables that we used.

### 3.2. Model and Data

We used the method of panel data analysis in the study. World Bank's income classification of countries shows that there are 132 developed and developing countries. However, we included 49 countries with complete data in the study. In addition, data were gathered as annually for the 2000-2019 period.

**Table 1.** Variables of Study

| **Variables** | **Symbol** |
|---|---|
| Life Expectancy at Birth | lnlexatb |
| Gini Coeffient | dlngini |
| Income per Capita | dlnincpc |
| Health Expenditure per Capita | lnhexpc |
| Gross Domestic Product | Lngdp |
| Unemployment Rate | Lnunemp |
| Public Expenditure Level | Lnpexl |

The variables to be used in the model are specified in the table above. In order to reduce the numerical values of variables, variable, we applied the natural logarithm to the series of the LEXATB, the Gini index, income per capita, health expenditure per capita, Gross Domestic Product, unemployment, and public expenditure level. The LEXATB series is stationary at the level. The series of Gini index and income per capita became stationary after taking their first difference. Health expenditure per capita, unemployment and Gross Domestic Product are stationary in their natural logarithm. Public expenditure level is stationary at level.

We developed two different models for the study. While health indicators will be included in the model as dependent variable, other variables will be included in the model as independent variable. The mathematical representation of these models is as follows.

**Model 1.**

$$\Delta LLEXATB_{it} = c_0 + \sum_{j=1}^{pi} \lambda_{ij}\, \Delta LGINI_{i,t-j} + \sum_{j=0}^{qi} \delta_{ij}\, \Delta LINCPC_{i,t-j} + \sum_{j=0}^{qi} \varphi_{ij}\, \Delta LGDP_{i,t-j} + \sum_{j=0}^{qi} \Theta_{ij}\, \Delta LUNEMP_{i,t-j} + \sum_{j=0}^{qi} \ddot{\Theta}_{ij}\, \Delta LPEXL_{i,t-j} + \gamma_1 LGINI_{i,t-1} + \gamma_2 LINPC_{i,t-1} + \gamma_3 LGDP_{i,t-1} + \gamma_4 LUNEMP_{i,t-1} + \gamma_5 LPEXL_{i,t-1} + \varepsilon_{it}$$

**Model 2:**

$$\Delta LHEXPC_{it} = c_0 + \sum_{j=1}^{pi} \lambda_{ij}\, \Delta LGINI_{i,t-j} + \sum_{j=0}^{qi} \delta_{ij}\, \Delta LINCPC_{i,t-j} + \sum_{j=0}^{qi} \varphi_{ij}\, \Delta LGDP_{i,t-j} + \sum_{j=0}^{qi} \Theta_{ij}\, \Delta LUNEMP_{i,t-j} + \sum_{j=0}^{qi} \ddot{\Theta}_{ij}\, \Delta LPEXL_{i,t-j} + \gamma_1 LGINI_{i,t-1} + \gamma_2 LINPC_{i,t-1} + \gamma_3 LGDP_{i,t-1} + \gamma_4 LUNEMP_{i,t-1} + \gamma_5 LPEXL_{i,t-1} + \varepsilon_{it}$$

For both model 1 and model 2, the left side of the equation in the equation gives the dependent variable. In the above equations, "$C_0$" is the constant component of the model, "Δ" is the first difference operator, "L" is the logarithm of the series, "$\varepsilon_{it}$" is error term with zero mean and variance constant within each unit, "i" is the cross-section and finally "t" is the information about the period. Although different variables are used when estimating the dependent variable in panel data analysis models, there are variables that affect the dependent variable but cannot be measured or are not included in the model. The effects of variables that we cannot predict within the scope of the model or are not included in the model are summed up in the ε error term.

### 3.3. Determination of Panel Data Model Methods

Basically, three different approaches have been developed while modelling panel data. These approaches are pool model, random effects model and fixed effects model. Different tests have been developed to make a choice between models. On the other hand, panel data models are divided into two as micro and macro. Each group has its own tests of hypothesis. Baltagi (2013) classified panels up to 20 periods as micro panels and those longer than 20 periods as macro panels. On the other hand, he did not consider it compulsory to provide the stationary condition in series in micro panels, while he stated that it is necessary to provide the stationary condition in macro panels. In this study, since the number of periods is 20, we will proceed with tests under micro panel assumptions.

# 4. FINDINGS

In this part of the research, the testing of the panel data hypothesis tests and the findings of the models that have been created will be included.

## 4.1. Multiple Linear Connection Problem

Before modelling in a panel data analysis, it should be checked whether the specific assumptions of the panel data are met. First, variables with high correlation should not be used within the same model. Otherwise, as Gujarati (2004) stated, there may be multiple linear connection problems in the model. In panel data analysis, different methods have been developed to detect and solve the multiple linear connection problem in the model. One of these methods is VIF, which is named as Variance Inflation Factor or with a different expression. In the model to be established, firstly, the VIF values of the variables were examined for multi-linear connection problem detection. As O'brien (2007) stated, the formula to be used in calculating the VIF values of the variables is: 1 / (1-R2). The R2 value is the ratio used to represent the proportion of the variance for a dependent variable explained by an independent variable. It has been stated in the literature that the VIF threshold value can be accepted as 4 in some studies, 5 in some studies, or up to 10 in some studies (Acikgoz et al., 2015).

**Table 2.** VIF Values of Variables

| **Variable** | **$R^2$** | **VIF Value** |
|---|---|---|
| lnlexatb | 0.23 | 1.29 |
| dlngini | 0.14 | 1.16 |
| dlnincpc | 0.66 | 2.94 |
| lnhexpc | 0.63 | 2.70 |
| Lngdp | 0.59 | 2.43 |
| Lnunemp | 0.11 | 1.12 |
| Lnpexl | 0.15 | 1.17 |

As seen in Table 2, VIF values of the variables show that there is no variable can cause multiple linear connection problems in models. VIF values of all variables are lower than 4 which is the most critical value. In this direction, all the variables included in the model remained in the model and the analysis continued. On the other hand, tests for which approach to use in modelling are given below.

## 4.2. Panel Data Model Identification Tests

The F test was conducted to determine whether the models should be initially pooled or fixed effects. As a result of the F test, it is understood that the models should be estimated with the fixed effects model. In the next step, Hausman test was conducted to determine whether the models should be predicted with fixed or random effects. The probability values of Hausman test result shows that the

fixed effects estimator was valid while the random effects estimator was inconsistent. After deciding to use fixed effect estimator, we investigated whether the models had autocorrelation problems or not.

**Table 3.** Panel Data Model Identification Tests

| | **Model 1** | | **Model 2** | |
|---|---|---|---|---|
| | **Statistic** | **Prob.** | **Statistic** | **Prob.** |
| **F- Fixed Effects** | 5.7 | 0.000 | 242.05 | 0.000 |
| **Hausman Test** | 15.5 | 0.0084 | 57.33 | 0.000 |

### 4.3. Autocorrelation Test

Autocorrelation should not exist in models created in line with panel data studies. The existence of autocorrelation in a model means that the error terms of the variables are related to each other. In case of encountering an autocorrelation problem, the problem must be resolved in order to obtain more accurate results.

**Table 4.** Autocorrelation Test Results of Models

| **Test** | **Model 1** | | **Model 2** | |
|---|---|---|---|---|
| | **Statistic** | **Prob.** | **Statistic** | **Prob.** |
| **Wooldridge test** | 0.993 | 0.32 | 54.670 | 0.000 |

Wooldridge (2002) autocorrelation test results of model 1 and model 2 are given in Table 4. The H0 hypothesis of the Wooldridge autocorrelation test is established as autocorrelation at the primary level. While the H0 hypothesis cannot be rejected in Model 1, in other words, the H0 hypothesis is accepted and there is no autocorrelation. In Model 2, the H0 hypothesis is rejected, indicating the presence of autocorrelation. Another important assumption after clarifying the autocorrelation situation in the models is whether there is heteroscedasticity problem or not.

### 4.4. Heteroscedasticity Test

In panel data studies, all models must be built on homoscedasticity. Therefore, homogeneity of variance should be tested for models. Since fixed effects approach is adopted in the models, the Modified Wald Test, which gives the most accurate result in heteroscedasticity, was used in this approach. It was tested whether there is homoscedasticity in the models with the Modified Wald test. In both models, the H0 hypothesis is rejected and it is seen that there is a variance problem. The presence of varying variance in a model causes erroneous estimators to be obtained. Therefore, in order to get more accurate results in models 1 and 2 with varying variance, the problem must be eliminated. Robust correction tests have been developed to eliminate the effects of these problems. Driscoll and Kraay robust estimator were used in the models to obtain more accurate predictive coefficients.

**Table 5.** Heteroscedasticity Test

| | Model 1 | | Model 2 | |
|---|---|---|---|---|
| **Test** | **Chi²** | **p** | **Chi²** | **p** |
| **Modified Wald Test** | 14.07 | 0.000 | 22.05 | 0.000 |

### 4.5. Cross Section Dependency Test

In Table 6, cross section dependency tests were conducted for both model 1 and model 2. When the test results are examined, the H0 hypothesis, which is established as there is no cross-sectional dependency, is rejected, and it is seen that both models have cross-sectional dependencies. Cross section dependency in models will be taken into account when applying robust correction tests. Driscoll and Kraay estimator will be used to eliminate the problem. More linear results were obtained thanks to Robust resistive estimators.

**Table 6.** Cross Section Dependency Test

| | Model 1 | | Model 2 | |
|---|---|---|---|---|
| **Test** | **Statistic** | **Prob** | **Statistic** | **Prob** |
| **Breusch-Pagan LM** | 8284,475 | 0.000 | 7757,843 | 0.000 |
| **Pesaran Scaled LM** | 146,574 | 0.000 | 1357,153 | 0.000 |
| **Pesaran CD** | 59,169 | 0.000 | 5279,948 | 0.000 |

### 4.6. Panel Data Analysis Results

Within the scope of the research, 2 different dependent variables were used and a seperate model was produced for each dependent variable. Firstly, F test and Hausman tests were conducted to determine the most suitable panel data approach for each model. As a result of the tests, it was seen that both models should be estimated with fixed effects approach. It was checked whether each model met the basic assumptions for panel data analysis. When the basic assumptions of Model 1 are checked, it is seen that there is no autocorrelation problem, but there is a cross section and variance problem. When the status of meeting the basic assumptions of Model 2 is examined, it has been determined that there are problems of autocorrelation, changing variance and cross-section dependence. Certain problems are inevitable because panel data models have cross-section and time series data. However, different robust correction tests have been developed to solve each problem encountered. Among these robust tests, some tests are used only for heteroscedasticity conditions (Huber, Eicker and White Robust Estimator), while others are used in case of multiple problems. Driscoll and Kraay robust resistant estimator were used to solve the problems encountered in this study. Driscoll and Kraay estimator is a test used to obtain more consistent estimation values and solve these problems in case of encountering autocorrelation,

changing variance and cross-section dependence problems in the developed model (Tatoğlu, 2012: 266). The calculation of the said robust correction estimate is shown below:

$$V(\hat{\beta}) = (X'X)^{-1}\hat{S}_T(X'X)^{-1}$$

In the above equation, $\hat{S}_T$ is defined as the following equation:

$$\hat{S}_T = \hat{\Omega}_0 + \sum_{j=1}^{m(T)} w\,(j,m)\,[\hat{\Omega}_j + \hat{\Omega}'_j]$$

Where m(T) is the lag lentght for otocorrelation, w(j, m(T)) are Bartlett weights, which enable $\hat{S}_T$ to be positively defined and allow higher order lags to take lower weights in the sample autocovariation function.

LEXATB variable is used as dependent variable in Model 1. Independent variables are public expenditure level, unemployment rate, gross domestic product, Gini index value and per capita income level. It is understood that after the necessary preliminary tests are carried out for Model 1, this model must be estimated with the fixed effects model. It was checked whether the model provided the basic assumptions. While there is no autocorrelation problem in Model 1, the cross section dependency and heteroscedasticity problem have been encountered. For this reason, Driscoll and Kraay estimator were used. On the other hand, whether the model is meaningful as a whole is understood by looking at the F statistic value and the F probability value. The fact that the F probability value is 0.000 in Table 7 indicates that the model is integrally significant. The $R^2$ value in the model shows the power of independent variables to explain the dependent variable. The fact that the $R_2$ value is 81% indicates that the power of the independent variables to explain the dependent variable is sufficient.

From the findings of the variables in the model 1, we can see that all variables except the Gini index variable are significant. When the findings are evaluated, it is possible to say that if there is a one-unit increase in the public expenditure level, the LEXATB can increase by 0.07 units; in case of an increase of one unit in the level of unemployment, may cause a decrease of 0.05 in the LEXATB. On the other hand, an increase of 0.03 in the LEXATB can be achieved by a one-unit increase in the GDP of a country and. Finally, a one-unit increase in per capita income level can create an increase of 0.11 units in LEXATB.

**Table 7.** Panel Data Results of Driscoll and Kraay Standard Error for Model 1

| **Independent Variable:** LNLEXATB | **Method:** Panel EGLS | | **Period:** 2000-2019 | |
|---|---|---|---|---|
| **Total Observations:** 931 | | | **Cross-sections:** 49 | |
| **Variable** | **Coefficient** | **Robust Standard Error** | **t-statistic** | **Probability** |
| LNPEXL | 0.07512 | 0.00272 | 27.1050 | 0.000 |
| LNUNEMP | -0.05401 | 0.00152 | 3.52591 | 0.0004 |
| LNGDP | 0.02687 | 0.00046 | 58.4720 | 0.000 |
| DLNGINI | 0.00415 | 0.01219 | 0.34251 | 0.732 |
| DLNINCPC | 0.11622 | 0.02131 | 2.63482 | 0.0086 |
| C | 3.420.353 | 0.016455 | 207.8610 | 0.000 |
| $R^2$ : 0.81 | F-statistic: 816.7052 | | Prob (F-Statistic): 0.0000 | |

In Model 1, the gini index value variable, which was found to be insignificant, was removed and re-estimated. Before reaching the final estimation result, basic assumptions were checked and necessary correction tests were applied. As a result of the analysis, it was observed that there was an increase of approximately 0.08 in the predictor coefficient of the DLNINCPC variable, while there was no significant change in the predictor coefficients of the other variables.

In Model 2, the PEXL variable is the dependent variable, and independent variables are the same as the variables in model 1. Independent variables of Model 2: Public expenditure level, unemployment rate, gross domestic product, Gini index value and per capita income level. In Model 2, it was first checked whether the basic assumptions were met in the panel data analysis. Necessary tests have been made to determine the most suitable panel data approach for Model 2 and it has been seen that it has to be estimated with the fixed effects approach. In Model 2, autocorrelation problem, heteroscedasticity problem and cross section dependency problem were encountered. These problems need to be corrected. More robust predictors were obtained using the Driscoll and Kraay robust correction test. The F probability value of 0.000 indicates that the model is meaningful as a whole. The fact that the R2 value of the other model is 0.63 indicates that the independent variables have sufficient ability to explain the dependent variable.

The findings of the variables in the model 2 shows that the coefficients of DLNINCPC and DLNGINI variables are not significant. The results also show that a one-unit increase in the level of public expenditure can create an increase of 0.64 units in the level of HEXPC. Therefore, it is possible to say that these two variables are in a positive relationship parallel to each other. On the other hand, it is seen that an increase of one unit in the GDP variable can trigger an increase of 0.55 units in the

HEXPC. When the unemployment rate is analysed, it is seen that it has a negative relationship with the dependent variable. It is foreseen that on unit increase in unemployment level may cause a decrease of 0.22 units in HEXPC. On the other hand, it is seen that the constant term is significant in both models.

**Table 8.** Panel Data Results of Driscoll and Kraay Standard Error for Model 2

| **Independent Variable:** LNHEXPC | | **Method:** Panel EGLS | **Period:** 2000-2019 |
|---|---|---|---|
| **Total Observations:** 931 | | **Cross-sections:** 49 | |
| **Variable** | **Coefficient** | **Robust Standart Error** | **t-statistic** | **Probability** |
| DLNGINI | 0.2136299 | 0.408226 | 0.52 | 0.601 |
| DLNINCPC | -0.913737 | 0.747659 | -1.22 | 0.221 |
| LNPEXL | 0.648543 | 0.096673 | 17.05 | 0.000 |
| LNUNEMP | -0.212392 | 0.049543 | -4.29 | 0.000 |
| LNGDP | 0.5543885 | 0.012941 | 42.84 | 0.000 |
| C | -1.199.71 | 0.457415 | -26.23 | 0.000 |
| $R^2$: 0.63 | F-statistic: 480.69 | | Prob (F-Statistic): 0.000 | |

When the analysis results of Model 2 are examined, it is seen that DLNGINI and DLNINCPC variables are not significant. In order to get more accurate predictive values, variables that were found to be not significant were removed from the model and analyzed again. Necessary robust correction tests were applied to the basic assumption problems encountered before reaching the final estimation result. As a result of the analysis, it was observed that there was an increase of 0.34 units in the estimator coefficient of the LNGDP variable, while there was no significant change in the other variables.

## 5. CONCLUSION AND EVALUATION

Today, life span is one of the most important values of a society. Almost everyone wants to live a quality and long life. Life expectancy at birth is one of the most important indicators in cross-country comparisons. Accordingly, it is very important to determine the factors related to the average life span of a country. On the other hand, economic indicators are important among the indicators that determine a person's life process and quality of life. Per capita health expenditure level is also an important issue for the society. It is important to know how much of the income people have spent for health services and to determine the factors that determine this level of expenditure. There are many factors affecting both the life expectancy at birth and the level of health expenditure per capita. However, since the main purpose of the study was to determine how economic variables affect these two basic health indicators, other variables were ignored.

Although the Gini index value is important for both the societies and the countries, this study shows that it has no significant effect on life expectancy at birth and health expenditures per capita. The variables included in the model in a panel data analysis modelling present an integrity. In case an extra different variable is added to the model, the predictive values of all variables change. It should be kept in mind that the variable used to represent the Gini index value is not significant only at our models. The unemployment rate variable is found to be significant in both models and it is seen that it has a negative relationship with the dependent variables. Since the increase in the level of unemployment is primarily an income-reducing factor, the amount people can spend for their own health is decreasing. On the other hand, it is observed that the increase in the level of unemployment negatively affects the average life span due to its negative effects on the society, especially stress. The GDP variable is found to be significant in both models and it is seen that it is in a positive relationship with the dependent variables. The increase in the GDP of a country enables it to develop further economically, to spend more on society and to increase its per capita income. As a result of the increase in the income level of people, they are able to allocate more resources for their own health and they enter into the behaviour of meeting their deferred service needs. As a result, it can be understood from the models that income factor both in individual and social dimensions have a significant effect on life expectancy at birth and health expenditure per capita. Increasing the income, in other words wages, of workers will help to be able increase the life expectancy at birth of people. Programs to decrease to unemployment rates should be applied, since unemployment prevents people's spending on health.

Compliance with Ethical Standards

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