*Bingöl Üniversitesi*
*İktisadi ve İdari Bilimler Fakültesi Dergisi*
*Bingol University*
*Journal of Economics and Administrative Sciences*
Cilt/Volume: 8, Sayı/Issue: 1
Yıl/Year: 2024, s. 145-160
DOI: 10.33399/biibfad.1412196
ISSN: 2651-3234/E-ISSN: 2651-3307
Bingöl/Türkiye
**Makale Bilgisi /Article Info**
**Geliş/Received:** 30/12/2023 **Kabul/ Accepted:** 12/05/2024

# Do Changes in Demographic Factors Affect Public Health Expenditures? The Case of Turkiye

## *Demografik Faktörlerdeki Değişiklikler Kamu Sağlık Harcamalarını Etkiliyor Mu? Türkiye Örneği*

**Sacit SARI***

**Abstract**

The main objective of this study is to analyze the effect of demographic factors on public health expenditures in the Turkish economy for the period between 1980 and 2021. Time series methods are employed in this analysis. The stationarity of the variables is tested with the conventional unit root test, while Zivot-Andrews unit root test is employed to identify potential structural breaks in the data. The existence of long-run relationships between non-stationary variables is investigated using the ARDL bounds test method. According to the analysis results, a persistent and statistically significant association exists between public health expenditures and GDP, contingent upon variables such as the old dependent population ratio, urbanization, and population. While increases in national product decrease public health expenditures, increases in demographic variables cause an overall rise in total public health expenditures. Increasing life expectancy, changing demographic structure, urbanization, and advances in medical technology have significantly increased health expenditures. Policymakers must establish strategies to boost the representation of the private sector in the health market if public health spending is to be sustainable and efficient.

***Keywords:*** Public health expenditure, demographic trends, ARDL bounds test

***JEL Codes:*** C22; H51; J11

**Öz**

Bu çalışmanın temel amacı, 1980-2021 dönemi arası kamu sağlık harcamalarının belirleyicilerini yıllık verilerle demografik faktörler özelinde Türkiye ekonomisi için analiz etmektir. Bu kapsamda zaman serisi yöntemleri kullanılmıştır. Değişkenlerin durağanlığı geleneksel birim kök testleriyle ve serilerde yapısal kırılmayı içselleştiren birim kök testiyle sınanmıştır. Düzeyde durağan olmayan değişkenler arasındaki uzun dönemli ilişkilerin varlığı ARDL sınır testi yöntemiyle araştırılmıştır. Analiz sonucuna göre, kamu sağlık harcamaları ile GSYH, yaşlı bağımlı nüfus oranı, şehirleşme ve nüfus değişkenleri arasında uzun dönemli bir ilişki bulunmaktadır. GSYH düzeyindeki artışlar kamu sağlık harcamalarını azaltırken, demografik değişkenlerdeki artışlar kamu sağlık harcamalarını artırmaktadır. Beklenen yaşam süresinin artması, değişen demografik yapı, kentleşme ve tıbbi teknolojideki ilerlemeler sağlık harcamalarını önemli ölçüde artırmıştır. Sürdürülebilir ve verimli bir kamu sağlık harcaması için politika yapıcıların özel sektörün sağlık piyasasındaki payını artıracak politikalar geliştirmesi gerekmektedir.

***Anahtar Kelimeler:*** Kamu sağlık harcamaları, demografik eğilimler, ARDL sınır testi

***JEL Kodları:*** C22; H51; J11

* Dr. Arş. Gör., Munzur Üniversitesi, İ.İ.B.F. Uluslararası Ticaret ve İşletmecilik Bölümü, sacitsari@munzur.edu.tr, ORCID: https://orcid.org/0000-0002-1305-5727

## 1. INTRODUCTION

Economics places significant emphasis on the health factor, as it serves as a primary influencer of human and social well-being, providing valuable insights into a country's economic condition, development level, and overall prosperity. Thus, within the scope of health economics, it investigates health expenditures (hereafter referred to as HE) in terms of cost-benefit analysis, financing methods, and determinants of HE. Indeed, as mentioned by Tiras and Turkmen (2020), resources allocated to HE increase in countries with higher levels of economic development. According to the World Bank (2023), the proportion of HE to GDP in Ghana, Turkiye and the United Kingdom in 2019 was 3.42%, 4.34% and 10.15%, respectively. HE in these countries, which are classified differently in terms of income and development level, shows the relationship between HE and economic development. Individuals and societies with increasing income levels are expected to rise their HE. Higher GDP per capita is associated with increased life expectancy at birth due to enhanced economic growth and development within a nation, thereby resulting in extended longevity (Miladinov, 2020 :18). Table-1 shows the data on GDP per capita, some of the main health indicators and personal HE in Ghana, Turkiye, and the United Kingdom in 2019. Health metrics, such as access to treatment, life expectancy, newborn and maternal mortality rates, provide critical information on countries' medical infrastructure, level of medical technology and, eventually, their level of development. Indeed, in the United Kingdom, a developed country, life expectancy, the number of doctors and HE are higher than in other countries. In Turkiye, which is the subject of the study, the indicators are better than in Ghana, which is a less developed country, as expected. These facts demonstrate the importance of health services infrastructure and expenditures in a country's economy.

**Table 1:** Main Health Indicators

| Countries/2019 | GDP per capita in 2019(constant 2015 US dollar) | Average Life Expectancy at Birth | Rate of newborn mortality (per 1000 live births) | Number of medical doctors per 10,000 people | Individual HE per capita (Out-Of-pocket) U.S. dollar |
|---|---|---|---|---|---|
| Ghana | 1981.61 | 64,74 | 34,51 | 1,03 | 26,31 |
| Turkiye | 12073.87 | 77,832 | 8,63 | 19,26 | 67,75 |
| United Kingdom | 47240.6 | 81,204 | 3,76 | 29,42 | 698,9 |

**Source:** World Bank and World Health Organization (WHO, 2023)

As the most crucial factor that individuals and society can possess, WHO defines health as a state of complete physical, mental, and social well-being, as well as the absence of any disease or disability (WHO, 2023). Health is also defined as the ideal level that individuals aspire to achieve (Yap and Selvaratnam, 2018). As stated by Khan, Razali and Shafie (2016), better health conditions are important factors that increase economic growth and productivity, in addition to being the most important element for the life of individuals and societies. Health, in conjunction with education, stands as one of the most crucial elements influencing the quality of human capital. Human capital, in turn, serves as a cornerstone for both economic growth and development (Imoughele and Ismaila, 2013). Human capital, regarded a factor of production alongside labor and capital in today's knowledge economies, plays a critical role in the formation and expansion of national economies. In Human Capital theory, education and health play foundational roles in shaping individual productivity and economic outcomes. Education is regarded as a primary form of human capital investment, as it equips individuals with knowledge, skills, and abilities essential for employment and economic participation (Becker, 2009). Higher levels of education are associated with increased

productivity, earning potential, and socioeconomic mobility (Card, 1999). Similarly, health is considered a vital component of human capital, as it influences individuals' ability to work, learn, and contribute to society (Grossman, 1972). Good health enhances productivity, reduces absenteeism, and improves overall well-being, thereby positively impacting economic growth and development (Bloom, Canning and Sevilla, 2004). By expanding HE and education expenditures, policymakers seek to increase the proportion of healthy and educated individuals in society, thereby enhancing overall development. As as Esener and Karadag (2020) emphasize, in public finance, education expenditures and HE are characterized as quasi-public goods with positive externalities. In this respect, health plays an essential role in the quality of human capital (Raghupathi and Raghupathi, 2020). Being aware of this fact, national economies are trying to accelerate their economic performance and development processes by improving the efficiency of their human capital through increased investments and expenditures in health.

The ultimate use of healthcare products and services, including both individual healthcare and collective services, is what the OECD refers to as HE. Public funding, required health insurance, optional health insurance, and private resources, including individual out-of-pocket costs, contributions from non-governmental organizations (NGOs), and corporate sector investments are only a few of the ways that HE is financed (OECD, 2024).

Demographic and socio-cultural developments have also boosted the demand for and expenditures on health. Increasing education level, women's participation in the labor force, urbanization, longer life expectancy, and advances in medical and pharmaceutical technology have increased the demand for health services (Christiansen et al. 2006; Ecevit, Cetin and Yucel, 2018). Indeed, this is illustrated in Table 2, which presents socio-economic variables such as population, urban population, dependent population (the proportion of people aged 0 to 14 and over 65 to the overall population), life expectancy, number of hospital beds and the ratio of HE to GDP in the Turkish economy. During the respective periods in Turkiye, the population has increased considerably, life expectancy has risen and urbanization has increased. In addition the demand for health care has risen over the years in line with expectations.

**Table 2:** Selected Demographic and Health Indicators in the Turkish Economy

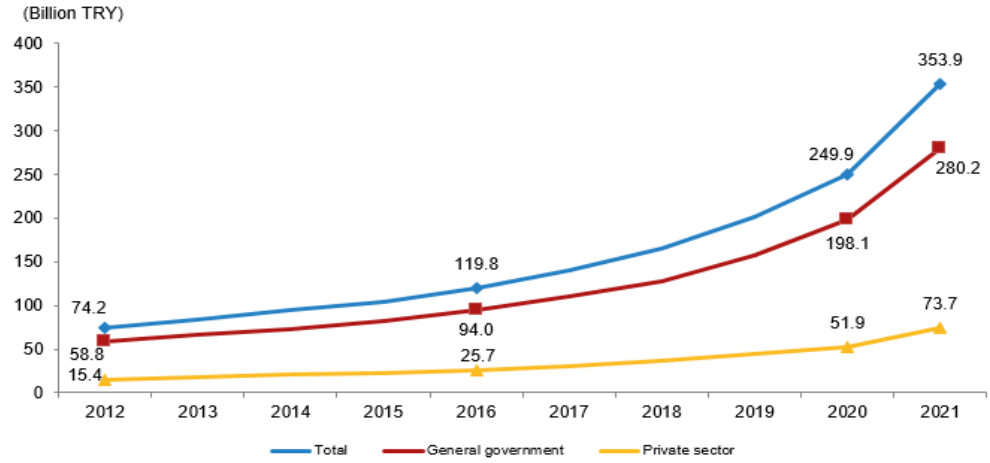
| Indicator | 1980 | 1990 | 2000 | 2010 | 2020 |
|---|---|---|---|---|---|
| **Population** | 44,089,069 | 54,324,142 | 64,113,547 | 73,195,345 | 84,135,428 |
| **Average Life Expectancy at Birth** | 62.5 | 67.70 | 71.80 | 75.069 | 75.85 |
| **Ratio of Urban Population to Total Population** | 43.78 | 59.203 | 64.741 | 70.825 | 76.105 |
| **Dependent Population Rate** | 81.304 | 67.948 | 57.457 | 49.44533 | 46.828 |
| **Number of patient beds per 1000 population** | 2.2 | 2.4 | 2.1 | 2.74 | 2.80 (2018) |
| **Ratio of HE to GDP** | 2.498 | 2.448 | 4.167 | 4.762 | 4.723 |

**Source:** World Bank (2023)

Although HE vary from country to country, they are generally financed by the public sector. In this context, accurately determining the factors influencing total HE, public HE (herafter denoted by PHE) and private HE accurately is essential for the efficiency and sustainability of HE. Although health services in Turkiye, which is the subject of this study, are generally under the guidance of the public sector, the share of private health services in total HE has increased in recent years, and the health system in Turkiye has become a structure of private-public sector. According to TURKSTAT data, the proportion of public sector HE to total HE was 79.2%, while private sector HE accounted for 20%. Total HE amounted to 353

billion 941 million TL in 2021, of which 280 billion 220 million TL was spent by the public sector (TurkStat, 2022).

**Figure 1:** Trends in HE




**Source:** Turkstat (2022).

The trend of public, private, and total HE in the Turkish economy between 2012 and 2021 is presented in Figure 1. Total, public and private HE are on a steady upward trend. Although a major percentage of HE is made by the public sector, it is seen that private sector HE has increased substantially in recent years. In addition, since the 2020 Covid-19 pandemic period, HE has increased at a very high rate.

The impact of demographic variables on PHE in the Turkish economy will be examined using annual data from 1980 to 2021. While there are studies analyzing the determinants of HE in the Turkish economy, there is a scarcity of research investigating the determinants of PHE within the framework of demographic factors, considering the evolving social and demographic structure. In this context, this study is expected to contribute to the literature. This study will begin with an introductory section. The results of the primary research investigations evaluating the determinants of HE will be discussed in the literature review section. The variables utilized in the study and the theory of the econometric methods will be introduced in the methodology section. The following section will present the results of the analysis. The study will conclude with a section on policy recommendations.

## 2. LITERATURE REVIEW

Numerous studies have been conducted out since Newhouse's (1977) research to investigate the determinants of HE. The impact of income, socio-demographic characteristics, technology, and medical developments (number of doctors, medical equipment infrastructure) on HE were explored in these research. Some studies in the literature, which will be analyzed in detail below, have investigated the determinants of HE by distinguishing between public and private expenditures. Studies analyzing total HE and private HE are summarized as follows.

In a study conducted by Hitiris and Posnett in 1992, an examination was undertaken to assess the factors influencing the aggregate health spending in a dataset comprising twenty

OECD countries over the period from 1960 to 1987. Authors concluded that GDP and population over 65 have positive effect on HE.

Christiansen et al. (2006) examined the relationship between HE and income, age, unemployment and life expectancy variables for the economies of 25 EU member states and Turkiye between 1980 and 2003 (1990 to 2003 for 11 countries). While all the countries studied showed a positive connection between aging and per capita HE, a negative relationship was found for the 0-5 age group and the 75 and over age group.

Di Matteo (2005) examined the relationship between real per capita HE, level of income, and population age range in the United States (1980-1998) and Canada (1975-2000). The results revealed that both variables positively affect HE.

Shiu and Chiu (2008) examined the relationship between HE and income, elderly dependent population, expected life and number of physicians in Taiwanese economy for the period between 1960 and 2006. According to the authors, there is a long-run association between the relevant variables and HE and the variables other than life expectancy positively affect HE.

Khan et al. (2016) investigated the drivers of HE in the Malaysian economy between 1981 and 2014 using the ARDL bounds testing approach. Stating that HE is associated with explanatory variables in the long-run, the authors concluded that real GDP per person and life expectancy variables affect HE positively, while population growth and dependent population affect negatively.

Ecevit et al. (2018) investigated the determinants of per capita HE in Turkic republics for the period between 1995-2015 using panel data methods. The authors stated that per capita HE and explanatory variables such as per capita income, population over 65 and urbanization, are cointegrated and all variables have a positive effect on HE.

Tıras and Turkmen (2020) analyzed the factors determining HE in 19 EU countries and Turkiye between 1995 and 2018 using panel data method. The authors stated that the variables are cointegrated in the long run. Per capita income has statistically significant positive effects on HE, population over 65, carbon dioxide emission and life expectancy at birth variables do not have significant effects.

In their study Yetim et al. (2020) evaluated the indicators of HE in 36 OECD countries for the period between 2000 and 2017 using Panel OLS method. While education level and income level positively affected HE, inflation rate negatively affected HE. It was found that the dependency ratio and unemployment variables did not have statistically significant effects on HE.

Several other studies analyzed the determinants of PHE, which is also the subject of this study. The general findings of these studies indicate that income, dependent population, education level and urbanization have effects on PHE.

Di Matteo and Di Matteo (1998) analyzed the determinants of real per capita PHE in the Canadian economy. The results indicated that real income, the percentage of the dependent population aged 65 and up, and real federal government transfer expenditures per capita have a positive and significant effect on PHE.

Rahman (2008) examined the variables determining PHE in Indian states from 1971 to 1991. It is concluded that per capita income and literacy rate affect PHE, the population's age

structure and demand-related variables are statistically insignificant, and increases in real per capita income reduce PHE.

Baltagi and Moscone (2010) studied the relationship between HE and income, PHE and young and old dependent population for 20 OECD member countries for the period covering 1971-2004. The authors state that HE are compulsory expenditures (elasticity less than 1) and that only income and young dependent population have significant effects on HE.

Using the Johansen cointegration method, Abbas and Hiemenz (2011) investigated impact of economic, demographic and socio-political variables on PHE in the Pakistani economy during the years from 1972 to 2006. According to the study, a long-run relationship exists between the variables and that income has a positive effect on PHE, while urbanization and unemployment have a negative effect.

Dhoro et al. (2011) examined the relationship between the selected variables and PHE for the Zimbabwean economy between 1975 and 2005. The authors stated that the series are cointegrated, real per capita income, literacy rate and foreign HE assistance have a positive effect on PHE, while inflation has a negative effect.

Ke, Saksena and Holly (2011) in their study covering 143 countries investigated HE and related factors determining PHE with panel data methods for the period between 1995-2008. The analysis results indicated that income increases all types of expenditures, while demographic variables do not have a significant effect. The authors stated that HE is considered as 'luxury' goods.

For the the Nigerian economy, Imoughele and Ismaila (2013) analyzed the main variables of PHE for over the period from 1986 to 2010. The authors found that the series were cointegrated in the long-run, and although the GDP, unemployment rate and inflation variables have positive effects on PHE, the coefficients are insignificant.

Boachie et al. (2014) used annual data from 1970 to 2008 to study key factors influencing PHE in the Ghanaian economy. The findings of the analysis show that cointegration relationship exists between PHE, crude birth rate, carbon dioxide absorption, real GDP, life expectancy, urbanization, inflation and rural population. Except for the urbanization rate, all other variables affect public expenditures of health positively.

Using the ARDL bounds test approach, Abdullah, Azam and Zakariya (2016) investigated the effects of socioeconomic and environmental factors on PHE in the Malaysian economy from 1970 to 2014. The authors concluded that the variables are cointegrated and that increases in national product, carbon dioxide absorption, mortality rate and birth rate increase PHE.

Byaro et al. (2018) studied the factors determining the growth of PHE in the Tanzanian economy from 1995 to 2014. While real GDP per capita and population over 65 years affect public expenditures of health positively, life expectancy affects it negatively.

Tosun (2018) used VAR method to understand the determinants of per capita public health expenses. The author finds that increases in income, population over 65 and fertility rate will increase PHE.

Yap and Selvaratnam (2018) examined the drivers of public health expenses in Malaysia for the period between 1970 and 2017 using ARDL bounds approach. The bounds test results pointed out series are cointegrated. Income per capita and elderly population above 65 years

of age affect PHE positively, while infant mortality rate (number of live babies per 1000 births) affects PHE negatively.

Esener and Karadag (2020) used panel data methods to investigate the variables determining PHE in 47 developing countries, including Turkiye, between the years 2000-2017. According to the results, economic growth, inflation and openness to international trade have a negative affect PHE, while fixed capital formation and urbanization have positive affect PHE.

Yun (2021) analyzed the relationship between demographic structure and PHE in Malaysia from 1971 to 2019 using ARDL bounds approach. The author stated that public education expenditures (+), dependent population between 0-14 (-), elderly dependent population over 65 (+) and economic growth (+) variables have significant long-term effects on PHE.

Summarising the results of the studies on PHE, it is concluded that there is no consensus in the literature. The analysis results seem to vary depending on the econometric method used, the country group, or the level of development of the country. In some studies, increases in national product increase PHE (Di Matteo and Di Matteo, 1998; Abbas and Hiemenz, 2011), while in some studies (Rahman, 2008; Esener and Karadag, 2020) increases in national product decrease PHE. In the studies, other variables affecting PHE are generally identified as dependent ratio, urbanisation and main health and environmental indicators. There is a relatively small number of studies directly analysing PHE in the Turkish economy. In this context, this study is expected to contribute to the literature as it is the first to analyze PHE in the context of demographic variables in the Turkish economy.

## 3. METHODS

The methodology part of this study will utilize the use of time series approaches. The main requirement of time series analysis is the stationarity of the variables in the model. The stationarity condition is a prerequisite for the robustness of the analysis. As there is little information about past periods in such series, the effect of shocks to the series will be temporary and the corresponding data series will move around the mean (Goktaş, Pekmezci and Bozkurt, 2019: 1). Otherwise, analyses involving non-stationary series may result in spurious regression, where a significant relationship between variables appears despite its absence in reality. This occurrence undermines the reliability of conventional hypothesis tests, confidence intervals, and forecasts (Stock and Watson, 2020: 582).

A $y_t$ series;

$$\mathrm{E}(y_t) = \mu \quad (1)$$

$$Var(y_t) = \sigma^2 \quad (2)$$

$$Cov(y_t, y_{t-k}) = \rho_k \quad (3)$$

Equations 1, 2 and 3 state that $y_t$ is stationary if its mean and variance are constant and the covariance of the series with its lags is time independent and varies with the lag length (Mert ve Cağlar, 2019).

Models estimated using past data in the analyses conducted with stationary series can be used for forecasting and prediction purposes (Stock and Watson, 2020). In this context, the

stationarity of the series will be tested with the Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) unit root tests (URT), which are frequently used in the literature.

Factors such as comprehensive policy changes in a country's economy, any kind of crises, and natural disasters could cause structural breaks in macroeconomic series. These shocks may change the mean, trend, or both of the series. Failure to model structural breaks in the series will diminish the reliability and predictive power of the results. Thus, the series will also be tested with the Zivot-Andrews (1992) URT with breaks. Under this test, the date of structural breaks need not be known in advance; breaks are determined endogenously within the scope of the test. In the Zivot-Andrews (1992) URT, models are based on the assumption that the breaks are at the level (Model A), in the trend (Model B) or both at the level and in the trend (Model C). Within the scope of this study, Model A, which assumes that structural break in the level and Model C, which assumes that structural breaks are both in the trend and in the level, are applied.

Model A: $y_t = \mu + \beta_t + \varphi DU_t(T_b) + \alpha y_{t-1} + \Sigma_{i=1}^{k} c_i \Delta y_{t-i} + \varepsilon_t$ (4)

Model C: $y_t = \mu + \beta_t + \varphi DU_t(T_b) + \lambda DT_t(T_b) + \alpha y_{t-1} + \Sigma_{i=1}^{k} c_i \Delta y_{t-i} + \varepsilon_t$ (5)

In Equations 4 and 5, $DU_t$ denotes a break in level and $DT_t$ denotes a break in trend.

$DU_t(T_b)$=1 if t > $[TT_b]$, 0 otherwise and $DT_t(T_b)$=t-$[TT_b]$ if t > $[TT_b]$, 0 otherwise (Zivot and Andrews, 1992: 8).

Series with unit roots lose information when differenced to make the series stationary. Since the effect of past shocks in the in the series is neutralized, long-run relationships disappear (Goktaş et al., 2019: 37). Long-run relationships between non-stationary series are tested using cointegration tests. Granger (1986) originally proposed the idea of cointegration, which Engle and Granger (1987) explicitly refined (Pesaran, 2015). Cointegration is basically defined as the linear combination of two or more series that are non-stationary at level will have a common stochastic trend (Stock and Watson, 2020). In cointegration tests, the stationarity of the series should be I(1). Due to their nature, some series are stationary at level while others become stationary when first differences are taken. To solve this issue and examine the long-term relationship between series with I(0), I(1), or both degrees of stationarity, Pesaran, Shin and Smith (2001) developed a cointegration test. ARDL bounds test is based on the OLS method and is frequently used in the literature since it offers advantages over other cointegration tests. These advantages can be stated as follows. First of all, in cases where the stationarity of the series is not conclusive, ARDL bounds method can be applied as long as the series are not I(2) (Pesaran et al., 2001: 290). Moreover, if there is ambiguity in the degree of integration due to structural breaks in the series, ARDL method provides more robust results than other cointegration tests (Goktaş et al., 2019). ARDL bounds testing approach estimates the short-long run coefficients and the error correction term (ECT) of the model using a single reduced form equation (Lawal et al., 2016). As stated by Pesaran (2015), ARDL bounds test gives better results in Monte Carlo simulations with small samples. Due to all these advantages, this study will analyze the existence of cointegration between the series using ARDL bounds test.

The following model is established to analyze the determinants of public HE.

$lnPHE_t = \beta_0 + \beta_1 lnGDP_t + \beta_2 lnOLDDEP_t + \beta_3 lnURB_t + \beta_4 lnPOP_t + \varepsilon_t$ (6)

Descriptive statistics are shown in Table-3. Among the corresponding series, PHE represents the total public health expenditure, GDP denotes the national product of the

Turkish economy at constant 2015 prices, and OLDDEP indicates the ratio of the population over 65 to the total population. The URB variable indicates the proportion of urban population to total population, and POP indicates Turkish total population. Finally, in represents the natural logarithm of the variables.

**Table 3:** Descriptive Statistics

| Variable | Definition | Mean | Min. | Max. | Standart D. | J-B Prob | Data Source |
|---|---|---|---|---|---|---|---|
| **PHE** | Total PHE at constant prices in 2015 (Turkish Lira) | 41109.84 | 1485.884 | 122271.7 | 33060.10 | 0.2088 | OECD |
| **GDP** | National product of the Turkish economy at constant prices in 2015 | 8.90E+11 | 3.08E+11 | 2.01E+12 | 4.84E+11 | 0.0983 | World Bank |
| **OLDDEP** | Ratio of 65+ population to total population | 9.0300 | 7.9300 | 12.2962 | 1.2015 | 0.0041 | World Bank |
| **URB** | Ratio of urban population to total population | 64.060 | 43.780 | 76.569 | 8.948 | 0.2338 | World Bank |
| **POP** | Population | 64305325 | 44089069 | 84147318 | 11890212 | 0.3158 | World Bank |

The following equation is established to determine the cointegration relationship and long-run coefficients in the ARDL cointegration test;

$$\Delta lnPHE_t = \beta_0 + \sum_{i=0}^{p} \psi_1 \Delta lnPHE_{t-i} + \sum_{i=0}^{q_1} \psi_2 \Delta lnGDP_{t-i} + \sum_{i=0}^{q_2} \psi_3 \Delta lnOLDDEP_{t-i} + \sum_{i=0}^{q_3} \psi_4 \Delta lnURB_{t-i} + \sum_{i=0}^{q_4} \psi_5 \Delta lnPOP_{t-i} + \delta_1 lnPHE_{t-i} + \delta_2 lnGDP_{t-1} + \delta_3 lnOLDDEP_{t-1} + \delta_4 lnURB_{t-1} + \delta_5 lnPOP_{t-1} + \varepsilon_t \quad (7)$$

In this equation, $\delta$ denotes the long-run coefficients. In this context, the hypotheses in the ARDL bounds test are formulated as follows. The null hypothesis $H_0$ states that there is no cointegration relationship between the series, while the alternative hypothesis $H_1$ states that the series are related in the long run.

$$H_0 = \delta_1 = \delta_2 = \delta_3 = \delta_4 = \delta_5 = 0$$

$$H_1 = \delta_1 \neq \delta_2 \neq \delta_3 \neq \delta_4 \neq \delta_5 \neq 0$$

The F statistic obtained from this equation is compared with the critical values. If the F statistic is higher than the I(1) critical value, the null hypothesis $H_0$ is rejected and it is concluded that series move together in the long run (cointegration exist). If the F statistic is less than the I(0) critical value, the null hypothesis $H_0$ cannot be rejected, indicating no relationship between the series. Finally, if the F statistic is between the lower and upper critical values, the test results will be inconclusive.

In the ARDL bounds test, the equation with short-run coefficients and error correction term is stated as follows.

$$\Delta lnPHE_t = \theta_0 + \sum_{i=0}^{p} \lambda_1 \Delta lnPHE_{t-i} + \sum_{i=0}^{q_1} \lambda_2 \Delta lnGDP_{t-i} + \sum_{i=0}^{q_2} \lambda_3 \Delta lnOLDDEP_{t-i} + \sum_{i=0}^{q_3} \lambda_4 \Delta lnURB_{t-i} + \sum_{i=0}^{q_4} \lambda_5 \Delta lnPOP_{t-i} + \varphi ECT_{t-1} + \varepsilon_t \quad (8)$$

The ECT, denoted by $\varphi$, should be statistically significant and between 0 and -1. This coefficient indicates the proportion of deviations from equilibrium that will be corrected in each period. Finally, as stated by Lawal et al. (2016), a number of tests should be applied to test the robustness of the model. In this context, autocorrelation, functional form, normality and heteroskedasticity are examined. Additionally, the CUSUMQ and CUSUM tests recommended by Pesaran et al. (2001) are used to test the stability of the model's coefficients.

## 5. RESULTS

This section will report the results of the analysis. Accordingly, the URT results of the series are presented in Table-4. According to both test results, it is concluded that the PHE and GDP variables are stationary at first differences, while URB and POP variables are stationary at level. The OLDDEP variable was stationary only in the PP URT in the model with constant term and trend.

In ADF and PP tests, which are traditional URTs, structural breaks are not considered. Failure to endogenize possible breaks within the model throughout the analysis period may undermine the robustness of the URT results. In this regard, since the period between 1980 and 2021, which is the study period in the Turkiye economy, is a period of economic, social and political crises and natural disasters, the stationarity of the series is also analyzed with the Zivot-Andrews (1992) URT with one structural break. The results are given in Table-5.

**Table 4:** URT Results

| Series | ADF URT | | PP URT | |
|---|---|---|---|---|
| | Constant | Cons. and Trend | Constant | Cons. and Trend |
| **lnPHE** | -0.9977 | -2.1389 | -1.1753 | -2.1449 |
| **D(lnPHE)** | -11.7491*** | -12.8607*** | -11.2851*** | -31.8933*** |
| **lnGDP** | 0.0367 | -2.6779 | 0.2472 | -2.6779 |
| **D(lnGDP)** | -6.6036*** | -6.5145*** | -6.9689*** | -6.8624*** |
| **lnOLDDEP** | 2.6155 | 3.5309 | 4.7285 | -0.6051 |
| **D(lnOLDDEP)** | 0.0973 | -1.8643 | -1.3915 | -3.5401** |
| **lnURB** | -4.3188*** | -2.7614 | -6.7863*** | -6.8604*** |
| **lnPOP** | -3.4393** | -3.0027* | -9.5833*** | -3.7454 |

**Note:** *,** and *** indicate 10%, 5% and 1% level.

**Table 5:** Zivot-Andrews (1992) URT Results

| Series | Model A Test Stat. | Break Date | Model C Test Stat. | Break Date |
|---|---|---|---|---|
| **lnPHE** | -4.2854 | 2010 | -4.6176 | 2002 |
| **D(lnPHE)** | -4.1823 | 1992 | -12.4577 | 1993 |
| **lnGDP** | -4.0878 | 1999 | -4.4518 | 1999 |
| **D(lnGDP)** | -6.9620 | 2003 | -6.8913 | 2003 |
| **lnOLDDEP** | -2.0951 | 2015 | -3.3224 | 2014 |
| **D(lnOLDDEP)** | -5.4757 | 2004 | -5.7107 | 2009 |
| **lnURB** | -5.9960 | 1991 | -8.4597 | 2012 |
| **lnPOP** | -3.0710 | 2002 | -3.1423 | 2015 |
| **D(lnPOP)** | -5.6758 | 2009 | -5.5486 | 2009 |

**Note:** Model A %5 critical value, -4.93; Model C %5 critical value, -5.08.

The results are generally consistent with the ADF and PP URT results. The Zivot-Andrews (1992) URT Model A captures a structural break in the constant term, while Model C captures a structural break in both the constant term and the trend. The GDP, OLDDEP and POP variables are stationary when differenced in both models. The PHE variable is stationary when differenced only in the context of Model C. The URB variable is stationary at its level

value, just as in ADF and PP URT. The break dates in the series were chosen as the years of economic crises and following periods (1993, 2002, 2009), 1999, the year of natural disasters, and 2003, the year the AK Party government came to power.

The cointegration test results, short and long run coefficients, ECM term, and diagnostic tests for the ARDL bounds test are presented in Table 6. First of all, according to the cointegration test result, the F test statistic (14.1288) is greater than the critical values at all significance levels, which leads to the rejection of the null hypothesis. This indicates that the series are cointegrated in the long run. It is concluded that there is a long-run relationship between PHE and the explanatory variables over the period 1980-2021 in the Turkish economy. This result is consistent with Abdullah et al. (2016) and Yap and Selvaratnam (2018), which are among the studies examining the determinants of PHE with the ARDL bounds test approach.

**Table 6**: ARDL Bounds Test Results

| **ARDL Bounds test results**<br>**Model 5: Unrest. Constant and Unrest. Trend (4,0,2,5,5)** | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **A) Cointegration Test Result** | **F statistic** | | **Critical values** | | | | | |
| | | | %10 | | %5 | | %1 | |
| | 14.12882 | I(0) | 3.032 | I(0) | 3.577 | I(0) | 4.885 | |
| | | I(1) | 4.213 | I(1) | 4.923 | I(1) | 6.550 | |
| **B) Long run coefficients** | **Variables** | **Coefficients** | **Standard E.** | | **t statistic** | | **Prob.** | |
| | lnGDP | -0.4037 | 0.1765 | | -2.2866 | | 0.0383 | |
| | lnOLDDEP | 1.3241 | 0.8031 | | 1.6487 | | 0.1215 | |
| | lnURB | 6.3834 | 1.8673 | | 3.4183 | | 0.0042 | |
| | lnPOP | 13.0289 | 2.5726 | | 5.0644 | | 0.0002 | |
| **C) Short Run Coefficients and Error Correction Term** | **Variables** | **Coefficients** | **Standard E.** | | **t statistic** | | **Prob.** | |
| | C | -328.3172 | 34.5224 | | -9.5102 | | 0.0000 | |
| | Trend | -0.2293 | 0.0227 | | -10.0983 | | 0.0000 | |
| | D(lnPHE(-1)) | 0.5238 | 0.0976 | | 5.3650 | | 0.0001 | |
| | D(lnPHE(-2)) | 0.2546 | 0.0876 | | 2.9039 | | 0.0116 | |
| | D(lnPHE(-3)) | -0.1079 | 0.0645 | | -1.6742 | | 0.1163 | |
| | D(lnOLDDEP) | -1.5533 | 1.4230 | | -1.0915 | | 0.2934 | |
| | D(lnOLDDEP(-1)) | -2.2188 | 1.6646 | | -1.3329 | | 0.2038 | |
| | D(lnURB) | -3.0817 | 4.7019 | | -0.6554 | | 0.5228 | |
| | D(lnURB(-1)) | 8.1914 | 6.0813 | | 1.3469 | | 0.1994 | |
| | D(lnURB(-2)) | -4.1020 | 5.7007 | | -0.7195 | | 0.4836 | |
| | D(lnURB(-3)) | 29.5159 | 5.1466 | | 5.7349 | | 0.0001 | |
| | D(lnURB(-4)) | -7.8849 | 2.8068 | | -2.8091 | | 0.0139 | |
| | D(lnPOP) | -1.9890 | 4.8463 | | -0.4104 | | 0.6877 | |
| | D(lnPOP(-1)) | -22.2258 | 5.2224 | | -4.2558 | | 0.0008 | |
| | D(lnPOP(-2)) | -18.4821 | 5.2168 | | -3.5427 | | 0.0032 | |
| | D(lnPOP(-3)) | -3.0459 | 5.7187 | | -0.5326 | | 0.6026 | |
| | D(lnPOP(-4)) | -26.2659 | 5.9980 | | -4.3791 | | 0.0006 | |
| | DUMMY | -0.0868 | 0.0329 | | -2.6337 | | 0.0196 | |
| | **ECT** | -0.3261 | 0.0773 | | -4.2151 | | 0.0005 | |
| **D) Diagnostic Tests** | **Statistical Test** | | | **Prob.** | | | | |
| | Jarque-Bera Normality Test | | | 0.4731 | | | | |
| | Breusch-Godfrey Autocorrelation Test | | | 0.4000 | | | | |
| | Breusch-Pagan-Godfrey Heteroscedasticity Test | | | 0.9190 | | | | |
| | Ramsey RESET test | | | 0.4107 | | | | |

**Note:** Critical values are taken from Narayan (2005).

Panel B of the table shows the long-run coefficients. While increases in GDP decrease PHE, increases in all other variables increase PHE. Since the variables are expressed in

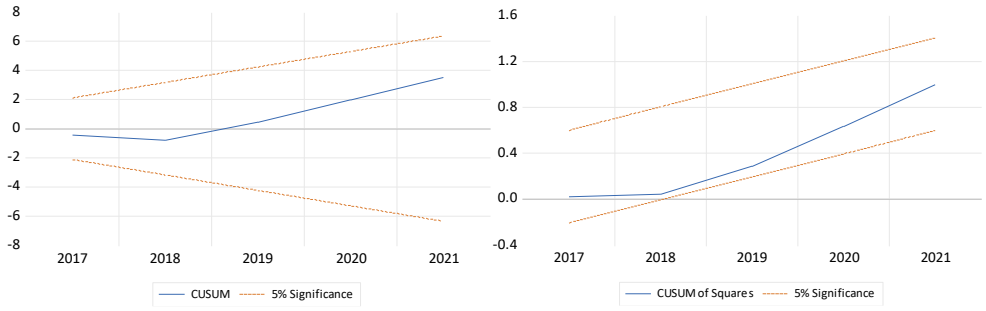
logarithmic terms, the coefficients directly represent the elasticity values. A 1% increase in national product decreases total PHE by approximately 0.40%. Although a 1% increase in the OLDDEP variable increases PHE by approximately 1.32%, the coefficient is statistically insignificant. A 1% increase in urban population also increases PHE by 6.38%, whereas a 1% increase in population increases PHE by approximately 13%. The decrease in PHE associated with increases in the GDP variable can be explained as follows. As the income level increases, individuals' demand for private health insurance and private health services (out-of-pocket health expenditure) increases, which may cause the coefficient to be negative. This implies a decrease in public sector health expenditures and an increase in the share of the private sector. This outcome aligns with the findings of Rahman (2008) and Esener and Karadağ (2020), which examine public health expenditures (PHE) across 47 countries, inclusive of the Turkish economy. However, it diverges from the conclusions drawn by Ke et al. (2011) and Abdullah et al. (2016).

The increase in the proportion of individuals over 65 years of age in the population also leads to an increase in PHE. PHE rises due to the fact that age-related diseases of individuals in this age group increase and the majority of these individuals are covered by social insurances. However, as mentioned earlier, the coefficient is statistically insignificant. The urbanisation rate also causes an upward trend in PHE. Since the urban population has more access to health services than the rural population, PHE increases as the urban population grows. Finally, the rise in the country's population causes an upward trend in PHE. Since the demand for health services will also increase as the population increases, an increment is observed in the PHE variable. The analysis findings emphasize a significant association between demographic factors and PHE. Given the predominant role of the public sector in the health realm, an expansion in the nation's population precipitates heightened demand for healthcare services, consequently driving an increase in PHE. Moreover, it is observed that the increase in urban population, (facilitating enhanced healthcare accessibility), along with the growth in the elderly population, contributes to the rise in PHE. These findings are consistent with the prevailing body of literature (Hitiris and Posnett, 1992; Di Matteo and Di Matteo, 1998; Boachie et al., 2014; and Byaro et al., 2018).

Panel C of the table shows the short-run coefficients and error correction term. Firstly, in the short-run, PHE is positively affected by its lagged values. Past period public health expenditures positively affect the current period PHE. On the other hand, OLDDEP, URB, and POP variables do not have a significant effect on PHE in the short run. It is concluded that the effects of demographic variables on PHE generally emerge in the long run. The DUMMY variable, which is included in the model to represent the breaks in the series, affects PHE negatively in the short run. The ECT is statistically significant. In the short run, approximately 32% of the deviations from equilibrium are adjusted to equilibrium.

Diagnostic test results are presented in panel D of the table. The results show that the series are normally distributed, free from autocorrelation and heteroscedasticity problem and no model specification error. Lastly, Cusum and Cusum of Squares results for the stability of the coefficients are presented in Figure-2. The coefficients are within the corresponding confidence intervals, demonstrating that the model can be used for forecasting and predictive purposes.

**Figure 2:** Cusum and Cusum of Squares Results




## 6. CONCLUSION AND POLICY RECOMMENDATIONS

Health is a fundamental phenomenon that determines the quality of life and level of development of individuals, societies, and countries. In addition to being the most significant asset that individuals possess, health is one of the main indicators, along with education, that determines the quality and quantity of human capital as a necessary factor for development in national economies. Changes in production-consumption patterns, technological advancements, and demographic and social developments have led to an increase in health-related demand and expenditures. Although the health market of varies across countries due to factors such as the development level, insurance-pension systems, and social state policy, it is generally a predominantly public sector market structure. PHE has increased along with the increase in average life expectancy, the development of medical technology and the growth in the population of countries. This has caused significant burdens on the budgets of national economies. At that point, it has become necessary for policymakers to make a careful planning to ensure that the financing of HE is efficient and sustainable. In this regard, determining the factors of PHE properly would lead to effective, sustainable, and efficient financing of expenditures of health. Therefore, it is necessary to analyze the impact of demographic factors on PHE. In this framework, this study analyzes the impact of demographic factors on PHE in the Turkish economy from 1980 to 2021 using the ARDL bounds test. It is concluded that the non-stationary series are cointegrated in the long run and there is a long-run relationship between PHE, GDP, old dependent population ratio, urbanization, and population in the Turkish economy. The result of the analysis is consistent with Abdullah et al. (2016) and Yap and Selvaratnam (2018). While increases in national product decrease PHE, increases in demographic variables cause an overall rise in total PHE. Only the coefficient of the old dependent population ratio series is statistically insignificant. The negative effect of the GDP series on PHE is consistent with the results of Rahman (2008) and Esener and Karadag (2020). As expected a priori demographic variables have a positive impact on PHE. In the ARDL bounds test, the error correction term (ECT) is statistically significant. Approximately 32% of the deviations from equilibrium in the short run are restored to equilibrium after one period.

HE has increased considerably as a result of longer life expectancy, higher educational attainment, urbanization, and advances in medical technology. The Turkish health system is generally a market structure with a high public sector involvement. Consequently, the demand for health care services from a growing and aging population is projected to increase. Based on the study's findings and the evolving demographics of the Turkish population, it is advisable to meticulously plan PHE to ensure the provision of essential and adequate public health services. Policymakers should implement policies that include incentives and support for the private sector to participate more in the health market. Indeed, individuals whose economic welfare rises as a result of increases in economic growth will demand more

utilization of private health services. It is crucial for the sustainability of PHE that the public sector steers the growing, aging, more educated, and more urbanized population towards state-subsidized private health insurances. For the efficiency and sustainability of PHE, it is recommended that the public sector be involved in providing basic health services, reduce its share in the health market and engage more in regulatory and supervisory activities.

**Reference**

Abbas, F., & Hiemenz, U. (2011). Determinants of public health expenditures in Pakistan. *ZEF-Discussion Papers on Development Policy*, (158).

Abdullah, H., Azam, M., & Zakariya, S. K. (2016). The impact of environmental quality on public health expenditure in Malaysia. *Asia Pacific Journal of Advanced Business and Social Studies (APJABSS)*, *2*(2), 365-379.

Baltagi, B. H., & Moscone, F. (2010). Health care expenditure and income in the OECD reconsidered: Evidence from panel data. *Economic modelling*, *27*(4), 804-811.

Becker, G. S. (2009). *Human capital: A theoretical and empirical analysis, with special reference to education*. University of Chicago press.

Bloom, D. E., Canning, D., & Sevilla, J. (2004). The effect of health on economic growth: a production function approach. *World development*, 32(1), 1-13.

Boachie, M. K., Mensah, I. O., Sobiesuo, P., Immurana, M., Iddrisu, A. A., & Kyei-Brobbey, I. (2014). Determinants of public health expenditure in Ghana: a cointegration analysis. *Journal of Behavioural Economics, Finance, Entrepreneurship, Accounting and Transport*, *2*(2), 35-40.

Byaro, M., Kinyondo, A., Michello, C., & Musonda, P. (2018). Determinants of public health expenditure growth in Tanzania: An application of Bayesian model. *African Journal of Economic Review*, *6*(1), 1-13.

Card, D. (1999). *The causal effect of education on earnings*. Handbook of labor economics, 3, 1801-1863.

Christiansen, T., Bech, M., Lauridsen, J., & Nielsen, P. (2006). Demographic Changes and Aggregate Health-Care Expenditure in Europe. ENEPRI Research Reports No. 32, 22.

Dhoro, N. L., Chidoko, C., Sakuhuni, R. C., & Gwaindepi, C. (2011). Economic determinants of public health care expenditure in Zimbabwe. *International Journal of Economics and Research*, *2*(6), 13-25.

Di Matteo, L. (2005). The macro determinants of health expenditure in the United States and Canada: assessing the impact of income, age distribution and time. *Health policy*, *71*(1), 23-42.

Di Matteo, L., & Di Matteo, R. (1998). Evidence on the determinants of Canadian provincial government health expenditures: 1965–1991. *Journal of health economics*, *17*(2), 211-228.

Ecevit, E., Cetin, M., & Yucel, A. G. (2018). Turki cumhuriyetlerinde saglik harcamalarinin belirleyicileri: Bir panel veri analizi. *Akademik Araştırmalar ve Çalışmalar Dergisi (AKAD)*, *10*(19), 318-334.

Esener, S.C. & Karadag, Y.(2020). Kamu maliyesi gozunden gelişmekte olan ulkelerde kamu sağlık harcamalarının belirleyicileri uzerine bir ampirik bir analiz. *Selcuk Zirvesi, 2.Uluslararası Sosyal Bilimler Kongresi Türkiye.*

Goktaş, P., Pekmezci, A., &Bozkurt, K.(2019). Ekonometrik Serilerde Uzun Dönem Esbutunlesme ve Kısa Donem Nedensellik. Gazi Kitabevi: Ankara.

Grossman, M. (1972). On the concept of health capital and the demand for health. In Determinants of health: an economic perspective (pp. 6-41). Columbia University Press.

Hitiris, T., & Posnett, J. (1992). The determinants and effects of health expenditure in developed countries. *Journal of health economics*, *11*(2), 173-181.

Imoughele, L. E. and Ismaila, M. (2013). Effect of public education expenditure on economic growth in Nigeria (1980-2010): *Interdisciplinary journal of contemporary research in business,* 4(11).

Ke, X. U., Saksena, P., & Holly, A. (2011). The determinants of health expenditure: a country-level panel data analysis. *Geneva: World Health Organization*, *26*(1-28).

Khan, H. N., Razali, R. B., & Shafie, A. B. (2016). Modeling determinants of health expenditures in Malaysia: evidence from time series analysis. *Frontiers in pharmacology*, *7*, 69.

Lawal, A. I., Nwanji, T. I., Asaleye, A., & Ahmed, V. (2016). Economic growth, financial development and trade openness in Nigeria: An application of the ARDL bound testing approach. *Cogent Economics & Finance*, *4*(1), 1258810.

Mert, M., & Cağlar, A. E. (2019). Eviews ve Gauss Uygulamalı Zaman Serileri Analizi. Detay Yayıncılık: Ankara.

Miladinov, G. (2020). Socioeconomic development and life expectancy relationship: evidence from the EU accession candidate countries. *Genus,* 76(1), 2.

Narayan, P. K. (2005). The saving and investment nexus for China: evidence from cointegration tests. *Applied economics*, *37*(17), 1979-1990.

Newhouse, J. P. (1977). Medical care expenditure: A cross national. *Journal of Human Resources*, 12, 115-125.

OECD (2024), Health spending (indicator). doi: 10.1787/8643de7e-en (Accessed on 15 March 2024).

Pesaran, M. H. (2015). *Time series and panel data econometrics*. Oxford University Press.

Pesaran, M. H., Shin, Y., & Smith, R. J. (2001). Bounds testing approaches to the analysis of level relationships. *Journal of applied econometrics*, *16* (3), 289-326.

Raghupathi, V., & Raghupathi, W. (2020). Healthcare expenditure and economic performance: insights from the United States data. *Frontiers in public health*, *8*, 156.

Rahman, T. (2008). Determinants of public health expenditure: some evidence from Indian states. *Applied Economics Letters*, *15*(11), 853-857.

Shiu, Y. M., & Chiu, M. C. (2008). Re-estimating the demographic impact on health care expenditure: evidence from Taiwan. *The Geneva Papers on Risk and Insurance-Issues and Practice*, *33*, 728-743.

Stock, J. H., & Watson, M. W. (2020). Introduction to econometrics 4th ed. Pearson.

Tıras, H. H. & Turkmen, S. (2020). Sağlık Harcamalarının Belirleyicilerine Yonelik Bir Araştırma; AB ve Turkiye Ornegi. *Bingol Universitesi Iktisadi ve Idari Bilimler Fakultesi Dergisi*, 4 (1), 107-139.

Tosun, C. (2018). *Turkiye'de sağlık harcamalarının belirleyicileri.* (Unpuplished doctoral dissertation). Hacettepe University.

Turkiye Statistical Institute (2022). Health Expenditure Statistics 2021. Retrieved February 10, 2023, from https://data.tuik.gov.tr/Bulten/Index?p=Health-Expenditure-Statistics-2021-45728&dil=2

World Bank (2023). World development indicators 2023. The World Bank. Retrieved March 08, 2023, from https://datacatalog.worldbank.org

Yap, K., & Selvaratnam, D. (2018). Empirical analysis of factors influencing the public health expenditure in Malaysia. *Journal Of Emerging Economies And Islamic Research, 6*(3), 1-14.

Yetim, B., Ilgun, G., Cilhoroz, Y., Demirci, S., & Konca, M. (2020). The socioeconomic determinants of health expenditure in OECD: An examination on panel data. *International Journal of Healthcare Management*, *14*(4), 1265-1269.

Yun, W. S. (2021). Impact of Demographical Structural Change on Public Health Care Expenditure in Malaysia. *Applied Economics*, *28*(2), 21-42.

Zivot, E., & Andrews, D. W. K. (1992). Further evidence on the great crash, the oil-price shock, and the unit-root hypothesis. *Journal of business & economic statistics*, *10*(3), 251-270.

***Ethics Statement*:** The author declare that ethical rules are followed in all processes of this study. In case of detection of a contrary situation, BİİBFAD Journal does not have any responsibility and all responsibility belongs to the authors of the study.
***Author Contributions:*** Sarı contributed to the identification of the topic, literature, data collection, data analysis and reporting sections of the study. The contribution rate of the 1st author is 100%.
***Conflict of Interest:*** There is no conflict of interest between the author's.
***Acknowledgement:*** We would like to thank the Editorial Board of BİİBFAD Journal for their intense interest and efforts and the referees for their contribution.