Ekonomi, Politika & Finans Araştırmaları Dergisi, 2024, 9(2): 346-366
Journal of Research in Economics, Politics & Finance, 2024, 9(2): 346-366
Araştırma Makalesi / Research Article, https://doi.org/10.30784/epfad.1455475

# THE IMPACT OF ECONOMIC FACTORS ON PUBLIC HEALTH EXPENDITURE IN TÜRKİYE: PRINCIPAL COMPONENT ANALYSIS EVALUATION FOR THE PERIOD 2002-2022

## Türkiye'de Ekonomik Faktörlerin Kamu Sağlık Harcamaları Üzerine Etkileri: 2002-2022 Yılları Arası Dönemin Temel Bileşenler Analizi ile Değerlendirilmesi

**Zeynep ÖZMEN***

**Keywords:**
Principal Component Analysis,
Health Expenditure,
Economic Factors

**JEL Codes:**
H51, I15, C32

**Abstract**

This study analyzes the economic factors affecting public health expenditure in Türkiye from 2002 to 2022. The main objective is to identify the economic reasons for the decreasing share of public health expenditure in Gross Domestic Product (GDP). It examines macroeconomic variables such as GDP per capita, unemployment rate, labor force participation rate, consumer price index, tax revenue, and exchange rate using principal component analysis (PCA). The results show that GDP per capita, exchange rate, and tax revenue significantly impact public health expenditure, indicating a direct relationship between economic growth and health spending. The unemployment rate does not directly affect public health expenditure, while an increase in labor force participation rate can reduce it. This study underscores the importance of macroeconomic stability and effective economic policies for sustainable health financing in Türkiye. By using long-term data, it provides a comprehensive analysis of how economic factors impact health expenditure, distinguishing it from other studies in the literature. The findings emphasize that a healthy economy leads to increased public investment in health services.

**Anahtar Kelimeler:**
Temel Bileşenler Analizi,
Sağlık Harcamaları,
Ekonomik Faktörler

**JEL Kodları:**
H51, I15, C32

**Öz**

Bu çalışma, 2002-2022 yılları arasında Türkiye'de kamu sağlık harcamalarını etkileyen ekonomik faktörleri analiz etmektedir. Temel amaç, kamu sağlık harcamalarının Gayri Safi Yurt İçi Hasıla (GSYİH) içindeki payının azalmasının ekonomik nedenlerini belirlemektir. Temel bileşenler analizi (PCA) kullanılarak kişi başına GSYİH, işsizlik oranı, işgücüne katılım oranı, tüketici fiyat endeksi, vergi geliri ve döviz kuru gibi makroekonomik değişkenler incelenmiştir. Sonuçlar kişi başına düşen GSYİH, döviz kuru ve vergi gelirinin kamu sağlık harcamalarını önemli ölçüde etkilediğini ve ekonomik büyüme ile sağlık harcamaları arasında doğrudan bir ilişki olduğunu göstermektedir. İşsizlik oranı kamu sağlık harcamalarını doğrudan etkilemezken, işgücüne katılım oranındaki artış harcamaları azaltabilmektedir. Bu çalışma, Türkiye'de sürdürülebilir sağlık finansmanı için makroekonomik istikrarın ve etkili ekonomi politikalarının önemini vurgulamaktadır. Uzun vadeli verileri kullanarak, ekonomik faktörlerin sağlık harcamalarını nasıl etkilediğine dair kapsamlı bir analiz sunmakta ve literatürdeki diğer çalışmalardan ayrılmaktadır. Bulgular, sağlıklı bir ekonominin sağlık hizmetlerine yapılan kamu yatırımlarının artmasına yol açtığını vurgulamaktadır.

* Assist. Prof. Dr., Düzce University, Gümüşova Vocational College, Department of Health and Safety, Türkiye, zeynepozmen34266@gmail.com

*Received Date (Makale Geliş Tarihi): 19.03.2024* *Accepted Date (Makale Kabul Tarihi): 29.06.2024*

## 1. Introduction

In recent years, understanding the dynamics of public health expenditure and the factors that influence it has become increasingly important for both policymakers and researchers. These expenditures are recognized as an indicator of how much governments invest in health services and directly impact overall public health, accessibility, and quality of health services (Yetim et al., 2021). Particularly in developing countries such as Türkiye, understanding the impact of economic factors on public health expenditure is crucial for developing and implementing effective health policies (Esen and Çelik Keçili, 2022).

Healthcare expenditure represents a large proportion of GDP in all Organisation for Economic Co-operation and Development (OECD) countries and has increased significantly in recent decades (OECD, 2024). For example, median health expenditure in the OECD increased from 3.8% in 1960 to 7.9% in 1990 (Anderson et al., 2000). OECD health data for the period 1975-2004 also show that growth in health expenditure per capita has consistently exceeded growth in GDP per capita (Nghiem and Connelly, 2017). Moreover, the growth in health expenditure is faster in wealthier countries, and the health sector accounts for a larger share of GDP in these countries. For example, in the United States, the richest country in the OECD, health expenditure as a proportion of GDP was 5.2% in 1960, 14.0% in 1998, and 17.3% in 2022 (Vankar, 2024).

Looking at current health indicators in Türkiye, the ratio of health expenditure to GDP increased from 4.6% in 2000 to 5.5% in 2009. After the 2008 social security reform, health expenditure started to decline steadily, finally falling below 5% in 2011 and reaching 4% in 2022, about half of the OECD average of 8.8% (TURKSTAT, 2023). The same pattern can be observed for out-of-pocket spending by households in Türkiye; while it was 28.6% in 2000, it started to decline rapidly after 2008, falling to 14.51% in 2009 (World Bank Open Data, 2023). In 2020 it was 16.43% and in 2022 18.5% (TURKSTAT, 2023). Although this situation points to the positive effects of universal health coverage, the share of out-of-pocket health expenditure by households in total expenditure on health services raises questions about the sustainability of financing (Sülkü and Caner, 2011; Kara, 2013; Yavuz et al., 2013; Aboubacar and Xu, 2017; Focacci, 2023). In Türkiye, which has the lowest ratio of health expenditure to national income among OECD countries (8.8 %), out of every 100 liras of general health expenditure, 78 liras are covered by the public sector and the remaining 22 liras by individuals (Euronews, 2022).

The reasons for the increase in health expenditure are complex and multidimensional in the literature. Studies on the factors influencing public health expenditure show that, contrary to common perception, the direct impact of population aging on health expenditure is rather limited (Bieszk-Stolorz and Dmytrów, 2023), while macroeconomic indicators such as GDP at (Peker Say and Yücel, 2006; Topcu and Atasayar, 2020; Boyacioğlu and Terzioğlu, 2022; Söyük, 2023), consumer price index (Erdogan and Erdogan, 2023), exchange rate (Esen and Çelik Keçili, 2022) and labour force participation rate (Coşkun Yılmaz, 2023) play an important role (Kurt, 2015; Atilgan et al., 2017; Piabuo and Tieguhong, 2017; Liu et al., 2019). However, in the existing literature, the effects of these factors are usually analyzed in isolation, and their complex interactions are not sufficiently addressed. This paper aims to fill this gap by comprehensively analyzing how these economic factors together affect public health expenditure in Türkiye.

To effectively analyze the multifaceted nature of health expenditures, PCA is widely used in the literature. PCA helps in reducing the dimensionality of complex data sets and identifying the main components that influence health expenditures. For example, Munsur et al. (2009) used PCA to analyze household out-of-pocket health expenditures in Bangladesh and found that drug expenditures constitute a larger component compared to other health expenditures. Chao and Wu (2017) utilized PCA loadings to weight variables from the Medical Expenditure Panel Survey data and created data-driven indices. Similarly, Guo et al. (2008) applied PCA to analyze drug expenditure and utilization trends in the US Medicaid programs, identifying expenditure and utilization patterns. Wanzala et al. (2019) assessed the performance of health systems in Kakamega County, Kenya, using PCA, and identified components that significantly impact health service delivery. Additionally, Getzen and Poullier (1992) demonstrated that the increase in health expenditures in OECD countries is largely related to policy and expenditure management rather than demographic factors, associating it with medical advancements. Reimers and Powell (2001) analyzed the relationship between health expenditures and GDP in OECD countries, showing that health expenditures are determined by income and medical progress. Zhang and Wan (2023) used grey correlation and PCA methods to analyze the factors affecting health expenditures in China and predict future trends. These studies show that PCA is a powerful tool in analyzing health expenditures and services, providing significant insights into the impacts of economic, social, and demographic factors.

By employing PCA in this study, I aim to provide a comprehensive understanding of how various economic factors collectively influence public health expenditure in Türkiye. This approach allows us to identify the primary components that significantly impact health expenditure and to analyze their interactions in a multidimensional framework. PCA helps address the complexity and multidimensionality of the factors influencing health expenditures, providing a more holistic view compared to traditional single-factor analyses.

The study is structured as follows. The second section consolidates the theoretical underpinnings of the study through a comprehensive review of the literature behind the study. Section 3 describes the data used, the data sources, the research questions, and the methodology. The empirical analysis is presented in the fourth section. This study uses PCA followed by regression analysis to understand the impact of economic factors on public health expenditure (PHE). PCA was chosen to reduce the original dataset's multidimensionality and address multicollinearity issues. This method simplifies the strong correlations between the variables in the dataset, creating a smaller number of independent components. These components are then used as independent variables in the regression analysis. Newey-West standard errors were used in the regression model because the assumptions of freedom from error (autocorrelation) and homoscedasticity (constant variance) were not fully met in the initial analyses. The Newey-West method provides robust standard errors against both autocorrelation and heteroskedasticity, making the model estimates more reliable. The fifth section summarizes the main findings and draws conclusions on the impact of economic factors on public health expenditure. In the last section, the limitations of the study and suggestions for future research are presented.

Considering the unique conditions of Türkiye and the impact of public investment in health services, this study provides an in-depth understanding of the relationship between health

expenditure and economic factors and helps policy makers to develop strategic recommendations for the sustainability of public health expenditure.

## 2. Background

The trends and determinants of health expenditure in OECD countries have been analysed extensively and the main determinants of health expenditure growth have been found to be: income growth (Panopoulou and Pantelidis, 2011; Wang, 2015), education (Yetim et al., 2021), population ageing (Pekkurnaz, 2015; Jakovljevic et al., 2020), technological progress (Nghiem and Connelly, 2017) and health insurance penetration (Lorenzoni et al., 2014).

This may indicate the positive impact of universal health coverage (Dorlach and Yeğen, 2023). A similar trend can be observed for voluntary health payment schemes in Türkiye, which fell from 0.4% of GDP in 2000 to 0.3% in 2009 and 0.2% between 2011 and 2019 (Ministry of Family, Labor and Social Services, 2020).

These percentages may not necessarily mean that individuals are paying more for healthcare. On the contrary, due to the 2008 Social Security reform and the expansion of universal health coverage, more people are gaining access to healthcare services, and out-of-pocket expenses for individuals are decreasing. The reduction in the ratio of health expenditure to GDP may indicate that the government is able to deliver healthcare services more efficiently, thereby reducing the financial burden on citizens. For low-income households, this can reduce health inequalities and improve overall health conditions. The increase in out-of-pocket health expenditures from 16.43% in 2020 to 18.5% in 2022 may indicate increased demand for and utilization of healthcare services due to the pandemic. Additionally, this increase might signal the need for more accessible and effectively managed health expenditures overall. The decrease in health expenditures as a percentage of GDP may be associated with the more efficient and preventive delivery of healthcare services, which is a positive development that enhances overall quality of life.

It is well known that Türkiye has a national health system; therefore, health expenditure is a significant part of the composition of government expenditure. Although researchers and health professionals occasionally question the efficiency of the health system and health spending, especially during periods of high workload such as epidemics and pandemics (Erdogan and Erdogan, 2023), there are very few studies that examine the impact of economic factors on health spending.

The literature indicates that the increase in real per capita income, technological innovations, the widespread use of insurance for medical treatment and the ageing of the population play an important role in the increase in health expenditure (Sülkü and Caner, 2011; Kara, 2013; Yavuz et al., 2013; Focacci, 2023). Şenol's (2021) study begins by highlighting that the economic crises of 1994, 2001 and 2009 significantly negatively impacted public health expenditures and health indicators. The economic difficulties experienced during these crises led to a decrease in public funding for health services, leading to decreased access to health services and general health indicators. The study shows that these negative effects were caused not only by economic conditions but also by the political preferences of the time.

Another important study by Atılgan et al. (2017) analyses the impact of health spending on economic growth in Türkiye. The results, which support the health-led growth hypothesis, show a positive relationship between health expenditures and economic growth. This suggests that investment in health services has a positive impact not only on human capital, but also on overall economic performance.

Sparkes et al. (2019) discussed how health financing reforms are a political process and how these reforms trigger political challenges by affecting the distribution of interest groups. In their study, they highlighted the importance of political economy analysis in addressing the political challenges encountered during the reform process. Specifically, the reforms in Türkiye have led to significant improvements in the financing of and access to health services, but have also created a number of political challenges. Similar findings have been observed in studies conducted in both Türkiye and other countries.

For instance, Akdağ (2011) examined the impact of the Health Transformation Program on the Turkish health system and noted that while the reforms improved access to health services, they also posed challenges for financing sustainability. Sayan and Yıldırım (2012) analyzed the distribution of health expenditures in Türkiye and assessed the social justice implications of the reforms. Another study by Erus and Hatipoğlu (2017) explored the political dimensions of health reforms in Türkiye, detailing the political and economic impacts of the reforms and discussing measures to address inequalities in access to health services.

Additionally, Wendt et al. (2010) examined the political effects of health system reforms in European countries, highlighting the role of interest groups. Yip and Hsiao (2008) discussed the health reforms in China, detailing the political and economic obstacles encountered during implementation. Roberts et al. (2008) emphasized the necessity of strong political support and stakeholder involvement for the successful implementation of health reforms.

Taking these studies together, the independent variables affecting public health expenditures have been analyzed taking into account Türkiye's economic structure. It has been frequently emphasized in the literature that macroeconomic variables such as GDP per capita, unemployment rate, labor force participation rate, consumer price index, tax revenue and exchange rate have significant effects on health expenditures (Esen and Çelik Keçili, 2022; Coşkun Yılmaz, 2023; Atılgan et al., 2017; Erdogan and Erdogan, 2023). In addition, GDP per capita is an important indicator for evaluating the impact of economic growth and welfare level on health expenditures in PCA analyses. This variable was used as income or GDP in the studies by Chao and Wu (2017), Getzen and Poullier (1992), Reimers and Powell (2001) and Zhang and Wan (2023). Tax revenues, which have a direct impact on health expenditures, have also been analysed in the context of health expenditure financing and budget in studies by Getzen and Poullier (1992) and Aboubacar and Xu (2017).

However, unlike the studies in the literature, this study allows policymakers and researchers to approach the issue from a more holistic perspective by evaluating the impact of multiple economic factors on health expenditures simultaneously. In this way, more informed decisions can be made in the development of health policies and management of public health expenditures.

## 3. Data and Methodology

### 3.1. Data and Data Sources

In this study, the effect of economic factors on public health expenditure in Türkiye in the period 2002-2022 is analyzed by performing PCA using STATA 18 program. The analysis was performed using annual data. The abbreviations, explanations and sources of the variables used in the study are shown in Table 1.

**Table 1**. **Study Variables**

| Variables | Unit | Description | Source |
|---|---|---|---|
| **Dependent Variable** | | | |
| PHE | TL | Public health expenditures | Turkstat |
| **Independent Variables** | | | |
| GDP per capita | TL | GDP per capita | Turkstat |
| LFPR | % | Labor force participation rate | Turkstat |
| CPI | % | Consumer price index | Turkstat |
| FER | $ | Foreign exchange rate | Turkstat |
| UNR | % | Unemployment rate | Turkstat |
| TAX | TL | Tax revenues | Ministry of Finance |

### 3.2. Methodology

There are several reasons for using PCA as a method. The first is to reduce multicollinearity. Economic indicators are often highly correlated with each other. For example, GDP per capita and public health expenditure may have a linear relationship. PCA reduces this multicollinearity by allowing each principal component to carry independent information. PCA also helps identify the data set's main trends and patterns (Alan, 2021). It is important to see more clearly the impact of economic indicators on public health expenditure. The third reason is that PCA reduces the independent variables to a smaller number of principal components, making it easier to interpret which factors are more dominant and their potential impact on public health expenditure.

According to the analyses carried out in the paper, the formula of PCA can be explained as follows:

(i) For each economic indicator (e.g. GDP per capita, CPI, TAX), the values are averaged and divided by the standard deviation. This process eliminates scale differences between variables.

$$x_{ij}^{*} = \frac{x_{ij} - \bar{x}_j}{S_j} \tag{1}$$

where $x_{ij}$ is the original value, $\bar{x}_j$ is the mean of the jth variable, $s_j$ is the standard deviation of the jth variable and $x_{ij}^{*}$ sis the standardized value.

(ii) The covariance matrix of the standardized data is calculated. This matrix contains variances and covariances between variables.

$$C = \frac{1}{n-1} X^T X \tag{2}$$

(iii) The eigenvalues and eigenvectors of the covariance matrix are calculated. Large eigenvalues represent the main sources of variance in the data set.

(iv) Principal components that explain a certain percentage of the total variance are selected. These components are a compressed form of the information in the original data set.

### 3.3. Research Hypotheses

The hypotheses that define the scope of the study and will help to understand in depth the relationship between public health expenditure and economic factors are as follows:

$H_1$: Between 2002 and 2022, certain economic factors significantly influence public health expenditure in Türkiye.

$H_2$: Macroeconomic variables such as GDP per capita, unemployment rate, labor force participation rate, consumer price index, tax revenue, and exchange rate have a significant impact on public health expenditure in Türkiye.

$H_3$: The unemployment and labor force participation rates directly and indirectly significantly affect public health expenditure in Türkiye.

$H_4$: Türkiye's public health expenditure is resilient to economic fluctuations, implying health financing sustainability.

## 4. Results

### 4.1. Descriptive Statistics

Before starting the analysis, descriptive statistics (such as mean, median, standard deviation, minimum, and maximum) were obtained for each variable to understand the general structure of the dataset (Table 2).

**Table 2. Descriptive Statistics**

| | PHE | GDP per capita | LFPR | CPI | FER | UNR | TAX |
|---|---|---|---|---|---|---|---|
| Mean | 9.73e+07 | 33998.05 | 48.81952 | 14.99095 | 3.878571 | 11.01429 | 5.21e+11 |
| Std. dev. | 1.07e+08 | 38537.99 | 3.103637 | 13.70628 | 4.414437 | 1.234215 | 6.06e+11 |
| Minimum | 1.33e+07 | 5486 | 43.5 | 6.16 | 1.16 | 9.2 | 5.96e+10 |
| Maximum | 4.64e+08 | 176651 | 53.2 | 64.27 | 18.7 | 14 | 2.71e+12 |
| Variance | 1.14e+16 | 1.49e+09 | 9.632565 | 187.862 | 19.48725 | 1.523286 | 3.67e+23 |
| Skewness | 2.241414 | 2.64008 | -0.0215083 | 2.546138 | 2.323885 | 1.199488 | 2.470779 |
| Kurtosis | 7.820355 | 10.11822 | 1.76071 | 9.187042 | 7.695656 | 3.806551 | 9.238639 |

From the observed values, the variables PHE, GDP per capita, and TAX especially have rather high maximum values and large variances, suggesting that these variables may have heavy tails and potentially high skewness (Table 2). This could mean that the assumption of normal distribution is violated and should be considered in the analysis. Given the statistical characteristics of the data, histograms were plotted for each variable to understand the variables'

distribution better. These graphs show the shape of the distributions of the variables and possible outliers. The relationships between the variables were then analyzed using the correlation matrix.

The histogram of public health expenditure shows large values with very low frequencies, and most of the distribution is concentrated in low values. This indicates that in some periods (e.g., COVID-19), health expenditure can be exceptionally high (Figure 1).

The CPI histogram shows mostly low values, with the distribution narrowing at the other extreme for higher values. This suggests that low levels of inflation are more common overall but that there are also occasional periods of high inflation (Figure 2).

An analysis of the unemployment rate histogram shows that it is mainly concentrated between 10 and 11. This indicates that the share of the unemployed in the labour force is generally concentrated in a narrow range. This reflects the dynamics of the labor market, which may be influenced by macroeconomic stability or specific policy interventions (Figure 3).

The activity rate histogram shows that it is concentrated around a certain value (around 48) and that other values are less frequent. The participation rate can be assumed to be more homogeneously distributed in the data set, and the labor market has a relatively stable structure (Figure 4).

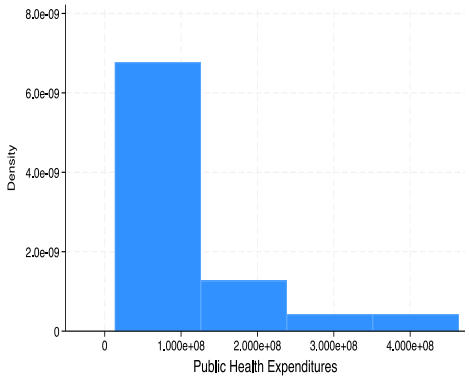


**Figure 1. Public Health Expenditures**

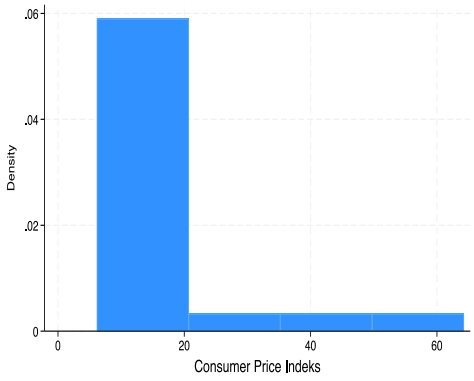


**Figure 2. Consumer Price Index**

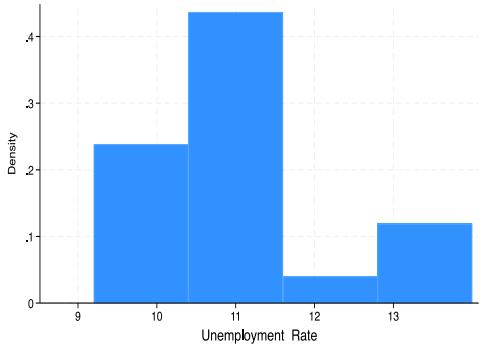


**Figure 3. Unemployment Rate**

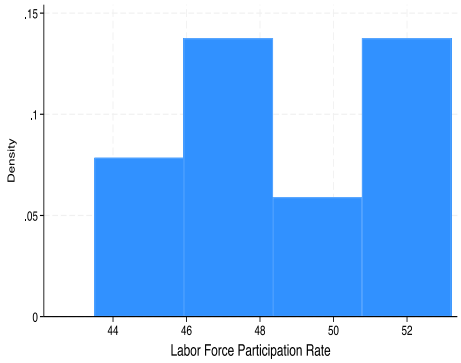


**Figure 4. Labor Force Participation Rate**

The exchange rate histogram shows that it has very low values at a low frequency, and a large part of the distribution is at higher values. This suggests that it tends to cluster around a particular value and may be a more volatile variable (Figure 5).

The histogram of tax revenue shows that there is a single class (the leftmost class) with a large value, and then the distribution drops rapidly. This shows that most tax revenues are low, but the distribution is characterized by a small number of high tax revenues (Figure 6).

The histogram of GDP per capita shows high values with a low frequency, which is usually characteristic of large economies. It also shows a higher frequency at lower values, indicating that the number of people with lower income levels is greater. This indicates a wide range of levels of economic activity and inequalities in income distribution (Figure 7).

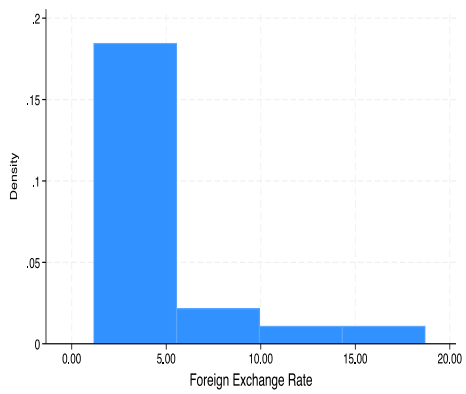


**Figure 5. Foreign Exchange Rate**

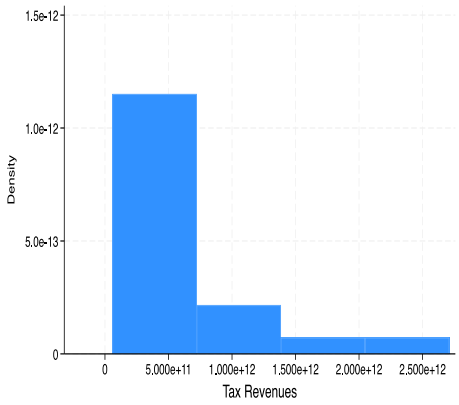


**Figure 6. Tax Revenues**

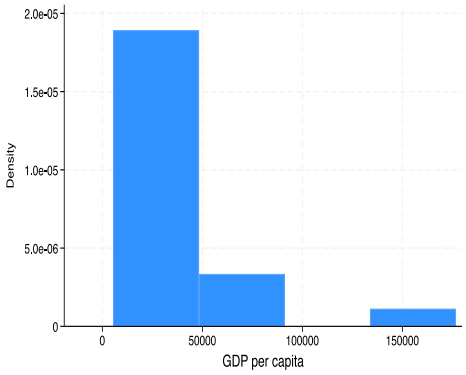


**Figure 7. GDP per capita**

### 4.2. Correlation

The pairwise correlations of the variables were calculated to understand the strength and direction of the relationship between each pair of variables. The correlation matrix calculates the Pearson correlation coefficients between each variable and presents them in a matrix format. Correlation coefficients take values between -1 and +1, where +1 indicates a fully positive

linear relationship, -1 indicates a fully negative linear relationship, and 0 indicates no relationship. High positive or negative values in the correlation matrix indicate a strong relationship between the relevant variables. If such a relationship is found, it is important to consider how to combine these variables in the PCA. Also, very high correlations (e.g. 0.8 or higher) may indicate multicollinearity problems, in which case PCA may be useful to address these problems.

**Table 3. Pearson's Correlation Coefficients**

| Variables | PHE | GDP per capita | LFPR | CPI | FER | TAX | UNR |
|---|---|---|---|---|---|---|---|
| PHE | 1.0000 | | | | | | |
| GDP per capita | 0.9926 | 1.0000 | | | | | |
| LFPR | 0.6041 | 0.5988 | 1.0000 | | | | |
| CPI | 0.8256 | 0.8463 | 0.4723 | 1.0000 | | | |
| FER | 0.9903 | 0.9795 | 0.5911 | 0.8722 | 1.0000 | | |
| TAX | 0.9959 | 0.9992 | 0.6149 | 0.8378 | 0.9826 | 1.0000 | |
| UNR | 0.1587 | 0.1005 | 0.1362 | -0.0908 | 0.1330 | 0.1126 | 1.0000 |

This correlation matrix shows the strength of the relationships between the variables in the dataset (Table 3). A very high correlation (0.9926) was found between PHE and GDP. This shows that health expenditure is generally closely related to the size of a country's economy. It suggests that, in general, the larger a country's economy, the more resources it can allocate to health services.

There is also a very high correlation (0.9903) between PHE and FER. This shows that changes in exchange rates can have a large impact on health expenditure. The high correlation may be because many medical supplies and pharmaceuticals are imported, and fluctuations in exchange rates directly affect the cost of these imports. As a result, when the local currency depreciates, the cost of imported medical goods increases, leading to higher public health expenditure.

The correlation between PHE and TAX is also very high (0.9959). This indicates that health expenditure is closely related to tax revenue, showing that health expenditure receives significant financing from the government budget when tax revenue increases. This relationship can be attributed to the structure of the government's budget allocation process, where increased tax revenue allows for more funds to be directed towards public services, including health. When the economy performs well, and tax revenues are high, the government has more financial resources to allocate to the health sector, enhancing the overall quality and accessibility of healthcare services.

The correlation between CPI and GDP per capita is also high (0.8463), indicating that there is a significant relationship between the size of the economy and consumer prices. On the other hand, the correlations between UNR and other variables are relatively low. This suggests that the unemployment rate may tend to move independently of other economic indicators, that unemployment may not be influenced by certain aspects of economic conditions, or that other factors may play a role in unemployment.

Given the high correlations in the data set, PCA was used to reduce its size and overcome the problems of multicollinearity. PCA simplifies the relationships between variables in the dataset by extracting independent principal components from highly correlated variables.

### 4.3. Principal Component Analysis

The first three principal components in the PCA analysis explain 96.95% of the total variance (Tables 4, 5, and 6). This is quite high and is generally considered sufficient for analysis. This means that they reflect most of the information in the data set. The first component alone explains 73.59% of the variance, indicating that it is a very strong component.

**Table 4**. **Summary of Principal Components Analysis**

| **Principal Components/Correlation** | | Number of obs | 21 |
|---|---|---|---|
| | | Number of comp. | 7 |
| | | Trace | 7 |
| Rotation: | (unrotated = principal) | Rho | 1.0000 |

The eigenvectors (weights of the principal components) show the relationship of each principal component to the original variables. For Comp1, PHE, GDP, FER, and TAX have high positive weights, indicating that these four variables largely explain this component. This could represent the economic size and financial position. Comp2 is particularly dominated by the variable UNR. This suggests that the unemployment rate may move independently of the other variables and that this component may capture the impact of unemployment on economic factors. Comp3 is dominated by LFPR and is a component that captures labor market dynamics.

To calculate the scores of the components in the analysis, principal component scores are generated for each observation, and then regression analyses are performed using these scores. This analysis is important for understanding which economic factors influence public health expenditure. In this way, 'pc1', 'pc2', and 'pc3' variables were created. This means that most of the variance between the variables in the dataset is explained by the first four principal components.

**Table 5**. **Eigenvalue and Cumulative Variance Table**

| **Component** | **Eigenvalue** | **Difference** | **Proportion** | **Cumulative** |
|---|---|---|---|---|
| Comp1 | 5.15117 | 4.10204 | 0.7359 | 0.7359 |
| Comp2 | 1.04914 | 0.462684 | 0.1499 | 0.8858 |
| Comp3 | 0.586452 | 0.394502 | 0.0838 | 0.9695 |
| Comp4 | 0.191949 | 0.17173 | 0.0274 | 0.9970 |
| Comp5 | 0.0202194 | 0.0192176 | 0.0029 | 0.9998 |
| Comp6 | 0.00100179 | 0.000931681 | 0.0001 | 1.0000 |
| Comp7 | 0.0000701121 | | 0.0000 | 1.0000 |

When the loadings (eigenvectors) of the principal components are analyzed, the effects of each variable on the first four principal components are observed. For example, the variables 'PHE,' 'GDP,' 'FER', and 'TAX' have very high loadings on the first principal component (Comp1). This indicates that the first component is largely explained by these variables and that these variables represent economic size or financial condition.

**Table 6. Load Vectors of Principal Components**

| Variable | Comp1 | Comp2 | Comp3 | Comp4 | Comp5 | Comp6 | Comp7 |
|---|---|---|---|---|---|---|---|
| PHE | 0.4350 | 0.0343 | -0.1179 | -0.2766 | -0.1785 | -0.7784 | -0.2853 |
| GDP per capita | 0.4350 | -0.0248 | -0.1100 | -0.2522 | 0.5064 | 0.4304 | -0.5411 |
| LFPR | 0.2984 | 0.1614 | 0.9339 | 0.1110 | -0.0098 | 0.0016 | -0.0171 |
| CPI | 0.3874 | -0.2555 | -0.1792 | 0.8517 | 0.1298 | -0.1013 | 0.0035 |
| FER | 0.4352 | -0.0023 | -0.1398 | -0.0584 | -0.7665 | 0.4453 | 0.0425 |
| TAX | 0.4359 | -0.0092 | -0.0874 | -0.2730 | 0.3223 | -0.0099 | 0.7897 |
| UNR | 0.0542 | 0.9523 | -0.2062 | 0.2103 | 0.0574 | 0.0128 | 0.0077 |

In the next step, a regression model was constructed to understand the impact of economic factors on public health expenditure using these principal component values.

$$PHE = \beta_0 + \beta_1 PC1 + \beta_2 PC2 + \beta_3 PC3 + \in \quad (3)$$

Here $PHE$ is public health expenditure. $PC1, PC2, PC3$ are the principal components obtained by PCA. $\beta_0, \beta_1, \beta_2, \beta_3$ are regression coefficients, and $\in$ is the error term.

**Table 7. Principal Components Regression Analysis Results**

| Source | SS | df | MS | Number of obs | 21 | |
|---|---|---|---|---|---|---|
| | | | | F(3, 17) | 349.82 | |
| Model | 2.2480e+17 | 3 | 7.4935e+16 | Prob > F | 0.0000 | |
| Residual | 3.6416e+15 | 17 | 2.1421e+14 | R-squared | 0.9841 | |
| | | | | Adj R-squared | 0.9812 | |
| Total | 2.2845e+17 | 20 | 1.1422e+16 | Root MSE | 1.5e+07 | |
| **PHE** | **Coefficient** | **Std. Err.** | **t** | **P>\|t\|** | **[95% conf. interval]** | |
| pc1 | 4.65e+07 | 1441963 | 32.24 | 0.000 | 4.34e+0 | 4.95e+07 |
| pc2 | 3669434 | 3195150 | 1.15 | 0.267 | -3071744 | 1.04e+07 |
| pc3 | -1.26e+07 | 4273572 | -2.95 | 0.009 | -2.16e+07 | -3582652 |
| cons | 9.73e+07 | 3193835 | 30.47 | 0.000 | 9.06e+07 | 1.04e+08 |

**Note:** The p-values indicate statistical significance: $p < 0.05$

According to the results of the regression analysis carried out in the study (Table 7), The model explains 98.41% of the observed variance (R-squared = 0.9841), which is very high and indicates that the model represents the data well. The F-test (Prob > F = 0.0000) indicates that the model is statistically significant, which means that at least one of the independent variables in the model has a significant effect on PHE. The coefficient of 'pc1' is approximately 46.5 million, indicating that the first principal component positively and strongly affects PHE. The p-value of this component is 0.000, which is highly statistically significant. The first principal component (PC1) obtained from the analysis is identified as the main factor influencing a large proportion of health expenditure. High positive loadings indicate that the variables PHE, GDP

per capita, FER and TAX strongly relate to this component. In other words, the larger and healthier the economy, the higher the public expenditure on health. The coefficient of 'pc2' is about 3.67 million, but the p-value of this component is 0.267, which is not statistically significant. UNR has a high weight on this component. This suggests that this factor does not have a direct effect on health expenditure or that its effect is masked by other factors. The coefficient of 'pc3' is about -12.6 million and the p-value is 0.009, which means that this component has a negative and statistically significant effect on the GHE. The LFPR has a significant impact on this component and tends to reduce public health expenditure. The fact that the LFPR has a high impact on this component indicates that the participation of people of working age in the labor force can have a significant impact on economic activity.

### 4.4. Diagnostic Tests

A homoscedasticity test was performed to test the assumptions of the regression model. The Breusch-Pagan/Cook-Weisberg test is used to test for heteroskedasticity (non-constant variance) (Table 8).

**Table 8. Breusch–Pagan/Cook–Weisberg Test for Heteroskedasticity**

| | |
|---|---|
| Assumption | Normal error terms |
| Variable | Fitted values of PHE |
| H0 | Constant variance |
| chi2(1) | 0.62 |
| Prob > chi2 | 0.4314 |

According to the results of the test, since the P-value is 0.4314, we do not have sufficient evidence to reject the null hypothesis. In this case, the data are considered to have a constant variance (homoscedasticity). This means that the errors of the regression model have a constant variance and there is no problem of heteroskedasticity. This result indicates that the model accurately reflects the characteristics and relationships and that the standard error estimates are reliable. This means that the model successfully satisfies one of the econometric assumptions and increases the robustness of the analysis.

Looking at the distribution of the points in the graph, the errors are mostly randomly distributed along a horizontal line (Figure 8). However, a slight upward trend, especially towards larger predicted values, indicates homoscedastic errors. The p-value (0.4314) obtained earlier with the Breusch-Pagan test provides strong evidence that the errors of the model have a constant variance and that there is no problem of heteroskedasticity. This graph also supports this conclusion, as it shows no evidence of an increase or decrease in the variance of the errors. However, before commenting on any irregularities or significant deviations in the graph, the Durbin-Watson test was performed to further examine the actual values of these points and their relationship with other variables in the model.

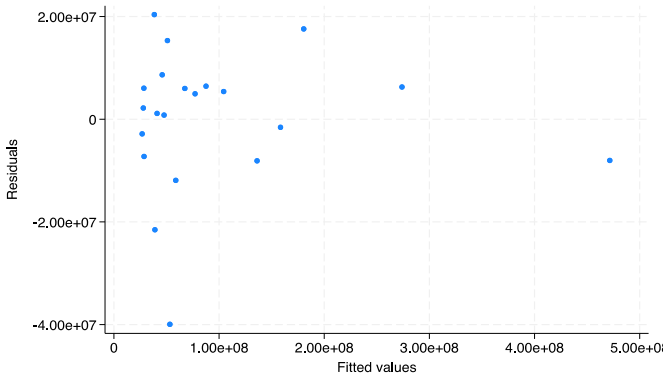


**Figure 8. Distribution of Residuals**

The Durbin-Watson (DW) d-statistic tests regression analysis's independence of error terms (residuals). This statistic is used to detect serial correlation (autocorrelation) between errors. The Durbin-Watson statistic usually takes a value between 0 and 4. If DW ≈ 2, it is assumed that there is no serial correlation between the errors (i.e. the errors are independent). If DW < 2, there may be a positive serial correlation. If DW > 2, there may be a negative serial correlation.

The result of the Durbin-Watson statistic is 0.6037619. This result is significantly less than 2. This may indicate positive serial correlation, i.e. one error term is positively correlated with the previous error term. Serial correlation is a common problem with time series data, and it is necessary to assess whether time is a factor in the data. If there is a positive serial correlation, it should be recognized that the standard errors of the regression model may be underestimated, making some variables appear statistically significant. This can affect the reliability of the model estimates and the accuracy of the interpretations.

The Breusch-Godfrey LM test was used to determine whether autocorrelation exists in the error terms (Table 9). If the test's p-value is below the significance level (usually 0.05 or 0.01), this is taken as evidence of autocorrelation in the model. The Breusch-Godfrey LM test results show that the chi-squared value for one lag is approximately 5.387, which is associated with 1 degree of freedom. As the p-value of this test is 0.0203, it indicates that there is a serial correlation (autocorrelation) between the errors at the 5% significance level. This indicates that there is first-order autocorrelation in the error terms in the regression model. Robust regression was performed using Newey-West standard errors to correct for autocorrelation in the model. This accounts for autocorrelation and heteroskedasticity and provides more reliable standard errors and test statistics.

**Table 9**. **Breusch–Godfrey LM Test for Autocorrelation**

| **lags(p)** | **chi2** | **df** | **Prob > chi2** |
|---|---|---|---|
| 1 | 5.387 | 1 | 0.0203 |

**Note:** $H_0$: No serial correlation

According to the regression results with Newey-West standard errors (Table 10), The main component pc1 has a positive and statistically significant effect on public health

expenditure (PHE). The coefficient is about 46.5 million, and its standard error is 1,016,406. The t-statistic is 45.74, and the p-value is 0.000, indicating that pc1 has a strong and significant effect on PHE. The effect of component pc2 on PHE is not statistically significant ($p > 0.05$). The coefficient is approximately 3.669.434, and its standard error is 3.573.710. The t-statistic is 1.03, and the p-value is 0.319, so we cannot say anything definite about the effect of pc2 on PHE. The main component, pc3, has a negative and statistically significant effect on PHE. The coefficient is about -12.6 million, and its standard error is 3.261.126. The t-statistic is -3.86, and the p-value is 0.001, indicating that pc3 has a significant and negative effect on PHE. The constant term represents the expected value of PHE when all other independent variables are zero and is estimated to be around 97.3 million. Its standard error is 3,872,670, and the t-statistic is 25.13, indicating that the constant is statistically significant.

**Table 10. Regression with Newey–West Standard Errors**

| | | | | Number of obs | | 21 |
|---|---|---|---|---|---|---|
| | | | | Maximum lag | | 1 |
| | | | | | F( 3, 17) | 994.83 |
| | | | | | Prob > F | 0.0000 |
| **PHE** | **Coefficient** | **Std. Err.** | **t** | **P>\|t\|** | **[95% conf.** | **interval]** |
| pc1 | 4.65e+07 | 1016406 | 45.74 | 0.000 | 4.43e+07 | 4.86e+07 |
| pc2 | 3669434 | 3573710 | 1.03 | 0.319 | -3870435 | 1.12e+07 |
| pc3 | -1.26e+07 | 3261126 | -3.86 | 0.001 | -1.95e+07 | -5718727 |
| cons | 9.73e+07 | 3872670 | 25.13 | 0.000 | 8.92e+07 | 1.05e+08 |

As a result, pc1 and pc3 have significant effects on PHE in the model, while the effect of pc2 is not significant. According to the results of the diagnostic tests for the regression model, we can say that the model is generally in good condition. In addition, the results obtained without logarithmic transformation of the variables seem to have successfully revealed an important part in explaining the effect of economic indicators on health expenditure.

## 5. Conclusion

This study aims to analyze the economic factors affecting public health expenditures in Türkiye from 2002 to 2022. In the context of Türkiye, key determinants of public health expenditures are GDP per capita, tax revenues, and exchange rates. According to the PCA, the first principal component shows that GDP per capita, exchange rate, and tax revenues positively and strongly impact public health expenditures. This component generally represents the country's economic size and financial condition. As economic development increases, public health expenditures also rise. This means that the state can allocate more resources, and economic growth positively reflects on health expenditures (Ataklı-Yavuz and Yılmaztürk, 2023). A healthy economy facilitates more investment in public health services (Esen and Çelik Keçili, 2022). However, during economic downturns, health expenditures are constrained. Income levels determine individuals' access to health services and their spending on these services. Higher-income levels lead to higher health expenditures, while lower income levels restrict access to health services (Boyacıoğlu and Terzioğlu, 2022; Gerdtham and Jönsson, 2000).

Fiscal policies also play a critical role in determining health expenditures. Government funding for health expenditures largely depends on tax revenues; increases in tax revenues boost the budget allocated to health expenditures while decreases constrain them (Okunade and Suraratdecha, 2000). Increased tax revenues enable the government to invest more in health services. Sayan and Yıldırım's (2012) study also highlights the critical importance of tax policy for financing health services.

Another significant factor is exchange rates. An increase in exchange rates raises the cost of imported medical supplies and drugs, thus increasing public health expenditures. Since Türkiye's health sector heavily relies on imports, fluctuations in exchange rates directly affect health expenditures (Esen and Çelik Keçili, 2022).

According to the PCA, the unemployment rate dominates the second principal component. This component indicates that the unemployment rate moves independently of other economic variables and does not directly impact public health expenditures. This finding shows that the indirect effects of unemployment on health expenditures are limited (Coşkun Yılmaz, 2023).

Finally, the labor force participation rate dominates the third principal component. This component represents labor market dynamics. An increase in the labor force participation rate suggests more individuals are employed and tends to reduce public health expenditures. As the labor force participation rate increases, access to employer-provided health insurance improves, reducing the demand for public health services. Yetim et al. (2021) found similar results in their study on OECD countries. They showed that individuals actively participating in the workforce have fewer health problems compared to the unemployed, thus reducing public health expenditures. Atılgan et al. (2017) also highlight the reducing effect of the labor force participation rate on health expenditures.

Health expenditures cannot be easily reduced like other budget items. Firstly, health is considered a fundamental human right, and states must provide health services to their citizens (WHO, 2024). Restricting access to health services results in significant individual and societal costs. Untreated illnesses, early deaths, and productivity losses lead to negative outcomes that affect the entire society. Therefore, cuts or inadequacies in health expenditures result in irreparable damage (Human Rights Watch, 2023).

Secondly, health expenditures significantly involve externalities. One person's health directly affects the health and well-being of others. Control of infectious diseases and vaccination are good examples of this. Hence, investments in health benefit the entire society and have positive externalities (Özen and Köse, 2022).

Thirdly, health expenditures arise largely from mandatory and urgent needs. Unlike other goods and services, health is often non-deferrable or indispensable. Ensuring the continuity of financing models is essential rather than cutting expenditures (Topcu and Atasayar, 2020).

Fourthly, health forms the basis of human capital, and healthy individuals drive economic and social development. Good health increases productivity, enhances educational success, and reduces poverty. Thus, health expenditures are also an investment in the future, determining the country's development potential. Short-term savings at the expense of health expenditures can lead to heavy costs in the long term.

For these reasons, sustainable models for financing health expenditures are critical. Flexible financing methods that balance public resources, social health insurance, and personal contributions according to needs must be implemented. Ensuring fair, accessible, and quality health services is a fundamental duty of the state (Altınöz and Aslan, 2019).

In conclusion, this article highlights the multidimensional nature of economic factors affecting public health expenditures in Türkiye. Therefore, policymakers must consider the factors influencing health expenditures and establish well-designed financing mechanisms to create a resilient and inclusive health service network.

## 6. Limitations and Future Research

Although this study provides a comprehensive analysis of the economic factors affecting public health expenditure in Türkiye, there are some shortcomings and potential areas for future research. One of these is the limited time frame. Although the period 2002-2022 covers significant economic changes, the analysis of trends and cyclical effects over a longer period could contribute to a deeper understanding of the relationship between economic factors and health expenditure. In addition, the inclusion of different macroeconomic variables and social factors (e.g. education level, lifestyle, health awareness) could provide a more comprehensive understanding. As a suggestion for future research, Türkiye's economic and health expenditure data were not compared with those of other countries with similar economic structures or different health systems. Such comparisons would allow Türkiye's situation to be assessed from a broader perspective.

**Declaration of Research and Publication Ethics**
This study which does not require ethics committee approval and/or legal/specific permission complies with the research and publication ethics.

**Researcher's Contribution Rate Statement)**
I am a single author of this paper. My contribution is 100%.

**Declaration of Researcher's Conflict of Interest)**
There are no potential conflicts of interest in this study.

## References

Aboubacar, B. and Xu, D. (2017). The impact of health expenditure on the economic growth in sub-Saharan Africa. *Theoretical Economics Letters,* 7(3), 615–622. https://doi.org/10.4236/tel.2017.73046

Akdağ, R. (2011). *Sağlıkta dönüşüm programı değerlendirme raporu (2003-2010).* Ankara: TC Sağlık Bakanlığı Yayınları.

Altınöz, B. and Aslan, A. (2019). Eğitim ve sağlık faktörleri bağlamında beşeri sermayenin ekonomik büyümeye katkısı: N-11 ülkeleri için bir uygulama. In A. Umut (Ed.), *3. International economic research and financial markets congress proceeding book* (pp. 183-194). Paper presented at the International Economics Research and Financial Markets Congress, Gaziantep, Türkiye.

Anderson, G.F., Hurst, J., Hussey, P.S. and Jee-Hughes, M. (2000). Health spending and outcomes: Trends in OECD Countries, 1960–1998. *Health Affairs,* 19(3), 150–157. https://doi.org/10.1377/hlthaff.19.3.150

Ataklı-Yavuz, R. and Yılmaztürk, R. G. (2023). Sağlık harcamalarının ekonomik etkileri: Türkiye örneği. *Yönetim ve Ekonomi Araştırmaları Dergisi,* 21(3), 163-175. https://doi.org/10.11611/yead.1344037

Atilgan, E., Kiliç, D. and Ertuğrul, H. M. (2017). The dynamic relationship between health expenditure and economic growth: Is the health-led growth hypothesis valid for Türkiye? *The European Journal of Health Economics,* 18(5), 567–574. https://doi.org/10.1007/s10198-016-0810-5

Bieszk-Stolorz, B. and Dmytrów, K. (2023). The well-being-related living conditions of elderly people in the European Union - Selected aspects. *Sustainability,* 15(24), 16823. https://doi.org/10.3390/su152416823

Boyacioğlu, E.Z. and Terzioğlu, M.K. (2022). Do health spending and economic growth matter in development? Evidence from Türkiye. *Ekonomi Politika ve Finans Araştırmaları Dergisi,* 7(Özel Sayı), 19-32. https://doi.org/10.30784/epfad.1147618

Chao, Y. and Wu, C.-J. (2017). Principal component-based weighted indices and a framework to evaluate indices: Results from the Medical Expenditure Panel Survey 1996 to 2011. *PLoS ONE,* 12(8), e0183997. https://doi.org/ 10.1371/journal.pone.0183997

Coşkun Yılmaz, S. (2023). The effect of health and education expenditures on the employment: Empirical evidence from Türkiye. *Journal of Economics and Research,* 4(2). https://doi.org/10.53280/jer.1357586

Dorlach, T. and Yeğen, O. (2023). Universal health coverage with private options: The politics of Türkiye's 2008 health reform. *Studies in Comparative International Development,* 58(3), 430–456. https://doi.org/10.1007/s12116-023-09402-2

Erdogan, S. and Erdogan, E.S. (2023). Analyzing the asymmetric effect of disaggregated health expenditures on economic growth. *Quality & Quantity,* 57(3), 2673–2686. https://doi.org/10.1007/s11135-022-01487-6

Erus, B. and Hatipoğlu, O. (2017). Health policy and redistribution: Türkiye's health transformation program in perspective. *Health Policy and Planning,* 32(8), 1120-1127. https://doi.org/10.1093/heapol/czx062

Esen, E. and Çelik Keçili, M. (2022). Economic growth and health expenditure analysis for Türkiye: Evidence from time series. *Journal of the Knowledge Economy,* 13, 1786–1800. https://doi.org/10.1007/s13132-021-00789-8.

Euronews. (2022). *Sağlık harcamalarının milli gelire oranı.* Retrieved from https://tr.euronews.com/saglik/2022/04/05/sagl-k-harcamalar-n-n-milli-gelire-oran-oecd-ve-ab-de-sagl-ga-en-az-pay-ay-ran-ulke-turkiy /(18/3/2024)

Focacci, C.N. (2023). Old versus young: How much do countries spend on social benefits? Deterministic modeling for government expenditure. *Quality & Quantity*, 57, 363-377. https://doi.org/10.1007/s11135-022-01371-3

Gerdtham, U.G. and Jönsson, B. (2000). International comparisons of health expenditure: Theory, data and econometric analysis. In A.J. Culyer and J.P. Newhouse (Eds.), *Handbook of health economics* (pp. 11-53), https://doi.org/10.1016/S1574-0064(00)80160-2

Gerdtham, U.-G., Søgaard, J., Andersson, F. and Jönsson, B. (1992). An econometric analysis of health care expenditure: A cross-section study of the OECD countries. *Journal of Health Economics*, 11(1), 63–84. https://doi.org/10.1016/0167-6296(92)90025-V

Getzen, T.E. and Poullier, J.P. (1992). International health spending forecasts: Concepts and evaluation. *Social Science & Medicine*, 34(9), 1057-1068. https://doi.org/10.1016/0277-9536(92)90106-M

Guo, J., Jing, Y., Nguyen, K., Fan, H., Li, X. and Kelton, C. (2008). Principal components analysis of drug expenditure and utilisation trends for major therapeutic classes in US Medicaid programmes. *Journal of Medical Economics*, 11(4), 671-694. https://doi.org/10.3111/13696990802596095

Human Rights Watch. (2023). Governments should step up public health care spending. Retrieved from https://www.hrw.org/news/2023/09/21/governments-should-step-public-health-care-spending

Jakovljevic, M., Sugahara, T., Timofeyev, Y. and Rancic, N. (2020). Predictors of (in)efficiencies of healthcare expenditure among the leading Asian economies – Comparison of OECD and non-OECD nations. *Risk Management and Healthcare Policy*, 13, 2261–2280. https://doi.org/10.2147/RMHP.S266386

Kara, A. (2013). A low quality–high cost–low satisfaction trap in public health care: A model and an efficiency-quality-welfare improving stochastic resolution. *Quality & Quantity*, 47(4), 2081–2093. https://doi.org/10.1007/s11135-011-9643-6

Kurt, S. (2015). Government health expenditures and economic growth: A Feder-Ram approach for the case of Türkiye. *International Journal of Economics and Financial Issues*, 5(2), 441–447. Retrieved from https://dergipark.org.tr/en/pub/ijefi/

Liu, Y.-H., Chang, W.-S. and Chen, W.-Y. (2019). Health progress and economic growth in the United States: The mixed frequency VAR analyses. *Quality & Quantity*, 53, 1895-1911. https://doi.org/10.1007/s11135-019-00847-z

Lorenzoni, L., Belloni, A. and Sassi, F. (2014). Health-care expenditure and health policy in the USA versus other high-spending OECD countries. *The Lancet*, 384(9937), 83–92. https://doi.org/10.1016/S0140-6736(14)60571-7

Ministry of Family, Labor and Social Services. (2020). *OECD ve AB ülkelerinde sağlık ve geri ödeme sistemleri*. Ankara: Sosyal Güvenlik Kurumu.

Munsur, A.M., Atia, A., Koffi, A.K. and Kawahara, K. (2009). Household out-of-pocket expenditures on health care in Bangladesh according to principal component analysis (PCA). *Bioscience Trends*, 3(1), 25-31. https://doi.org/10.5582/bst.3.25

Nghiem, S.H. and Connelly, L.B. (2017). Convergence and determinants of health expenditures in OECD countries. *Health Economics Review*, 7(1), 29. https://doi.org/10.1186/s13561-017-0164-4

OECD. (2024). *Health expenditure and financing* [Dataset]. Retrieved from https://stats.oecd.org/index.aspx?DataSetCode=SHA

Okunade, A.A. and Suraratdecha, C. (2000). Health care expenditure inertia in the OECD countries: A heterogeneous analysis. *Health Care Management Science*, 3(1), 31–42. https://doi.org/10.1023/a:1019020802989

Özen, A. and Köse, C.B. (2022). Türkiye'de kamu harcaması bileşenlerinin ekonomik büyümeye etkisi. *Ekonomi Politika ve Finans Araştırmaları Dergisi,* 7(1), 32-52. https://doi.org/10.30784/epfad.1006124

Panopoulou, E. and Pantelidis, T. (2011). Convergence in per capita health expenditures and health outcomes in the OECD countries. *Applied Economics*, 44(30), 3909–3920. https://doi.org/10.1080/00036846.2011.583222

Peker Say, N. and Yücel, M. (2006). Energy consumption and CO2 emissions in Türkiye: Empirical analysis and future projection based on an economic growth. *Energy Policy*, 34(18), 3870–3876. https://doi.org/10.1016/j.enpol.2005.08.024

Pekkurnaz, D. (2015). Convergence of health expenditure in OECD countries: Evidence from a nonlinear asymmetric heterogeneous panel unit root test. *Journal of Reviews on Global Economics*, 4, 76–86. https://doi.org/10.6000/1929-7092.2015.04.07

Piabuo, S.M. and Tieguhong, J.C. (2017). Health expenditure and economic growth - A review of the literature and an analysis between the economic community for central African states (CEMAC) and selected African countries. *Health Economics Review*, 7(1), 23. https://doi.org/10.1186/s13561-017-0159-1

Reimers, C.W. and Powell, L.M. (2001). Health care spending in OECD countries: A convergence analysis. *Journal of Health Economics*, 20(6), 1271-1282. https://doi.org/10.1016/S0167-6296(01)00110-2

Roberts, M.J., Hsiao, W., Berman, P. and Reich, M.R. (2008). *Getting health reform right: A guide to improving performance and equity*. Oxford: Oxford University Press.

Sayan, S. and Yıldırım, J. (2012). Inequities in health care financing in Türkiye: Redistributive effect of health care payments by households. *The European Journal of Health Economics*, 13(3), 351-364. https://doi.org/10.1007/s10198-011-0306-2

Söyük, S. (2023). The impact of public health expenditure and gross domestic product per capita on the risk of catastrophic health expenditures for OECD countries. *Frontiers in Public Health*, 11, 1122424. https://doi.org/10.3389/fpubh.2023.1122424

Sparkes, S.P., Bump, J.B., Özçelik, E.A., Kutzin, J. and Reich, M.R. (2019). Political economy analysis for health financing reform. *Health Systems and Reform*, 5(3), 183–194. https://doi.org/10.1080/23288604.2019.1633874

Sülkü, S.N. and Caner, A. (2011). Health care expenditures and gross domestic product: The Turkish case. *The European Journal of Health Economics*, 12(1), 29–38. https://doi.org/10.1007/s10198-010-0221-y

Şenol, O., Gökkaya, D. and Çirakli, Ü. (2021). The effects of economic variables on health expenditure per capita and life expectancy at birth: Panel data analysis for middle top income countries. *Mehmet Akif Ersoy Üniversitesi İktisadi ve İdari Bilimler Fakültesi Dergisi,* 8(3), 1499–1515. https://doi.org/10.30798/makuiibf.909994

Topcu, E. and Atasayar, Y. (2020). Sağlık harcamaları, sermaye birikimi ve ekonomik büyüme arasındaki nedensel ilişki: Gelişmiş ve gelişmekte olan ülkeler üzerine bir inceleme. *Ekonomi Politika ve Finans Araştırmaları Dergisi,* 5(2), 276-291. https://doi.org/10.30784/epfad.734004

TURKSTAT. (2023). Public health expenditures. Retrieved from https://data.tuik.gov.tr/Bulten/Index?p=49676&dil=2#

Vankar, P. (2024). *U.S. national health expenditure as percent of GDP from 1960 to 2022* [Dataset]. Retrieved from https://www.statista.com/statistics/184968/us-health-expenditure-as-percent-of-gdp-since-1960/#:~:text=In%202022%2C%20U.S.%20national%20health,GDP%20share%20among%20developed%20countries

Wang, F. (2015). More health expenditure, better economic performance? Empirical evidence from OECD countries. *INQUIRY: The Journal of Health Care Organization, Provision, and Financing*, 52, 0046958015602666. https://doi.org/10.1177/0046958015602666

Wanzala, M., Were, V., Oloo, J. and Nguka, G. (2019). Assessing capacity and performance of health systems using principal component analysis: Results from cross sectional survey in Kakamega County, Western Kenya. *Journal of Health, Medicine and Nursing*, 59, 33-40. https://doi.org/10.7176/JHMN/59-05

Wendt, C., Frisina, L. and Rothgang, H. (2010). Healthcare system types: A conceptual framework for comparison. *Social Policy & Administration*, 43(1), 70-90. https://doi.org/10.1111/j.1467-9515.2008.00647.x

WHO (1946). Constitution of the World Health Organization (WHO). Retrieved from https://www.globalhealthrights.org/instrument/constitution-of-the-world-health-organization-who/

World Bank Open Data. (2023). *Open data* [Dataset]. Retrieved from https://data.worldbank.org/indicator/SH.XPD.OOPC.CH.ZS?locations=TR

Yavuz, N.C., Yilanci, V. and Ozturk, Z.A. (2013). Is health care a luxury or a necessity or both? Evidence from Türkiye. *The European Journal of Health Economics*, 14(1), 5–10. https://doi.org/10.1007/s10198-011-0339-6

Yetim, B., İlgün, G., Çilhoroz, Y., Demirci, Ş. and Konca, M. (2021). The socioeconomic determinants of health expenditure in OECD: An examination on panel data. *International Journal of Healthcare Management*, 14(4), 1265–1269. https://doi.org/10.1080/20479700.2020.1756112

Yip, W. and Hsiao, W. (2008). The Chinese health system at a crossroads. *Health Affairs*, 27(2), 460-468. https://doi.org/10.1377/hlthaff.27.2.460

Zhang, X. and Wan, X. (2023). Research and prediction of health expenditure factors in China based on machine learning methods. In K. Li, Q. Li, P. Fournier-Viger., W-Ch. Hong., X. Liang., L. Wang and X. Xu (Eds.), *Atlantis highlights in computer sciences* (pp. 737-744). https://doi.org/10.2991/978-94-6463-040-4_112