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THE RELATIONSHIP BETWEEN ECONOMIC GROWTH AND HEALTH, R&D EXPENDITURES AND UNEMPLOYMENT IN TURKEY

Neslihan ŞENOL[1] **Sema ONARAN**[2]

Abstract

Human capital, being one of the important factors affecting economic growth, has gained more importance especially since the beginning of the 1990s and the interest in this field has increased in economic growth studies. The increase in human capital accumulation contributes to the economic growth. Today, technological developments and R&D activities play an effective role in ensuring sustainable economic growth. Although the existence of a negative relationship between economic growth and unemployment is generally accepted in the economic theory, it is still a controversial issue because unemployment is a multidimensional problem. In this study, the relationship between economic growth and health expenditures, R&D expenditures, and unemployment in Turkey was investigated by using time series analysis for the period of 1990-2020. Johansen co-integration analysis results revealed that there is a long-run relationship between economic growth and health expenditures, R&D expenditures and unemployment in Turkey. The results of the study reveal that a positive change in the levels of health and R&D expenditures in Turkey has a positive contribution to economic growth, while there is a negative relationship between the level of unemployment and economic growth.

Key Words: *Economic Growth, Health Expenditures, R&D Expenditures, Unemployment*

TÜRKİYE'DE EKONOMİK BÜYÜME İLE SAĞLIK, AR-GE HARCAMALARI VE İŞSİZLİK İLİŞKİSİ

Öz

Ekonomik büyümeyi etkileyen önemli faktörlerden biri olan beşeri sermaye, özellikle 1990'lı yılların başından itibaren daha fazla önem kazanmış ve ekonomik büyüme çalışmalarında bu alana ilgi artmıştır. Beşeri sermaye birikimindeki artış ekonomik büyümeye katkı sağlamaktadır. Günümüzde teknolojik gelişmeler ve Ar-Ge faaliyetleri sürdürülebilir ekonomik büyümenin sağlanmasında etkin rol oynamaktadır. İktisat teorisinde ekonomik büyüme ile işsizlik arasında negatif bir ilişkinin varlığı genel olarak kabul edilse de işsizliğin çok boyutlu bir sorun olması nedeniyle hala tartışmalı bir konudur. Bu çalışmada, Türkiye'de ekonomik büyüme ile sağlık harcamaları, Ar-Ge harcamaları ve işsizlik arasındaki ilişki 1990-2020 periyodunda zaman serisi analizi kullanılarak araştırılmıştır. Johansen eşbütünleşme analizi sonuçları, Türkiye'de ekonomik büyüme ile sağlık harcamaları, Ar-Ge harcamaları ve işsizlik arasında uzun dönemli bir ilişki olduğunu ortaya koymuştur. Çalışmanın sonuçları, Türkiye'de sağlık ve Ar-Ge harcamaları düzeyindeki olumlu bir değişimin ekonomik büyümeye olumlu katkı sağladığını, işsizlik düzeyiyle ekonomik büyüme arasında ise negatif bir ilişki olduğunu ortaya koymaktadır.

Anahtar Kelimeler: *Ekonomik Büyüme, Sağlık Harcamaları, Ar-Ge Harcamaları, İşsizlik*

[1] *PhD, Kocaeli University, Social Sciences Institute, Economics Department, neslihansenol01@gmail.com, orcid.org/0000-0001-7586-4610*

[2] *PhD Student, Marmara University, Social Sciences Institute, Business Administration, Management and Organization Department, semaonaran@marun.edu.tr, orcid.org/0000-0002-3249-0660*

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1. Introduction

Economic growth affects people's living standards and welfare and it is one of the most fundamental issues of macroeconomics. There is an increasing interest in examining the relationship between income and health expenditures. Health expenditures have a very important and fundamental place for the general well-being of the society as well as the productivity of individuals. Therefore, health has a direct impact on economic development and growth. For this reason, governments around the world allocate a significant share of their budgets to this area in order to provide better health services. Although the economic structures and health expenditures of the countries differ from each other, there is an increasing trend in the health expenditures of the countries according to their gross domestic product per capita. Since the early 1990s, more emphasis has been placed on the role of human capital as the determinant of productivity and growth, and the importance of health and education in economic growth has received great attention. Today, a strong consensus has emerged that human capital accumulation is an important determinant of the economic growth. It can be said that there is a close relationship between the health levels of individuals, as one of the main sources of human capital, and economic development. The concept of human capital includes knowledge, skills, abilities, health status, and education level. The concept is not only associated with education and training, but also with any activity that increases the productivity and quality of the workforce (Woodhall, 1987: 21). Lucas (1988) argues that the increase in the human capital contributes to the productivity of the individual and also to other production factors, and states that there is a need for governments to develop education and technological infrastructure for accumulation of human capital which contribute to economic growth. A healthy society is a source of qualified people; therefore, it is of great importance for development. As a matter of fact, health refers not only to the absence of illness and disability, but also to the capacity of individuals to develop their own potential throughout their entire life. According to Barro's (1999) assessments, health is the engine of the economy and an asset that generates capital. Based on this statement, it can be considered that health is a determinant of human capital.

One of the most important factors that plays a role in the growth and development of national economies is the inventions and innovations developed in the fields of products, processes and technologies within the framework of research and development (R&D) activities. R&D investments are considered as one of the key criteria in evaluating a country's competitiveness and economic development. R&D investments affect economic growth through various channels such as innovation, capital accumulation, and development in human capital (Bor, et al., 2010). R&D is the key determinant of prosperity and productivity in the long run (Jones and Williams, 2000). R&D activities and innovation have been a driving force in ensuring sustainable growth over the years. Innovation has become as important for economic policies as it is for science and technology policies. The economic growth literature was dominated by the Solow (1956) model until the 1980s. In this model, the main actor of economic growth is technological developments that are determined externally. Technological innovation has

attracted more attention in the studies since the end of the 1980s in parallel with the developments in the world. In this context, R&D activities as the main factor of growth, are internally included in the model established by Romer (1990). The economic growth model based on R&D was first put forward by Romer (1990). Later, this approach was developed by other authors (Grossman and Helpman, 1991; Rivera-Betiz and Romer, 1991; Aghion and Howitt, 1992). These models are also known as first-generation internal growth models. In these growth models, it is predicted that the increase in R&D expenditures will increase long-term growth and therefore a higher growth is observed in large-scale economies. However, Jones (1995a, 1995b) was unable to determine the existence of the scale effect predicted by the first generation internal growth models. As a result, the second generation of internal growth models has been developed. These models predict that R&D expenditures will have an impact on the level of GDP per capita instead of the long-term economic growth rate.

In economic theory, it is generally accepted that economic growth in a country will increase employment (Kreishan, 2011: 228). There is a widespread consensus in economics literature regarding the existence of a positive relationship between economic growth and employment. According to the economic expectation, it is assumed that as long as economic growth provides an increase in employment, it will bring a solution to the employment problem in societies with rapidly increasing incomes. Although it is expected that there should be no unemployment problem in high-growth countries, it should be considered that the unemployment problem has a multidimensional and complex structure. Employment is one of the factors affecting economic growth. An increase in employment contributes to economic growth. Regarding to the relationship between economic growth and employment, the factor that provides the opportunity for economic growth to positively affect employment is the increase in investments. On the other hand, considering the impact of employment on the economic growth, the human capital factor comes to the forefront. Therefore, health levels of the individuals in societies are among the critical factors of human capital accumulation, and economic growth accordingly. In addition, human capital is the basis for increase in production and technological development. Human capital is at least as important on growth as physical capital. Moreover, the global and economic environment, natural resources, the level of science and technology, financial resources and education have an impact on economic growth (Altuntepe and Güner, 2013: 74).

In the literature, there is no consensus in the results of studies examining the long-term relationships between economic growth and health expenditures, and unemployment. In addition to studies concluding that health expenditures positively affect economic growth, there are also studies that did not find a relationship. Although there are many studies that found a negative relationship between unemployment and economic growth, there are also studies that have reached different results. This is because of the differences in the methods, time intervals and countries used by the researchers in the studies. In this study, the relationship between economic growth, health expenditures, R&D expenditures and unemployment for the period 1990-2020 in Turkey was empirically

investigated using time series technique with Johansen co-integration analysis. Moreover, the theoretical framework related to economic growth, health and R&D expenditures, and unemployment, and the literature on empirical studies examining the relationship between these variables were reviewed.

2. Literature Review

Since health is one of the basic components of human capital, the increase in health expenditures and developments in this field increase the quality of human capital. Thus, health expenditures appear as an important input in economic growth and development. The impact of health expenditures on economic growth is multidirectional and long-run. The positive effect of health expenditures is explained by the health-based growth hypothesis in the literature. In accordance with this hypothesis, health expenditures are productive capital (Akar, 2014: 312). Health expenditures for the realization of health services protect the current health of individuals and prevent future diseases that will arise in the following years and save future health expenditures (Mushkin, 1962: 136-7). Therefore, health services and health investments that increase the health capital stock play an important role in the development of the country's economy by ensuring the improvement of human capital day by day. In recent years, there have been many empirical studies on the relationship between human capital and economic growth. Some of these studies found a positive relationship between health expenditures and economic growth, while some did not find any relationship or found a negative relationship between them.

The relationship between health expenditures and economic growth in Turkey was examined in various studies. In a study covering the period of 1926-1994, it was found that there is a positive long-term relationship between human capital indicators and income in Turkey (Kar and Ağır, 2006: 62-64). In another study including the period of 1968-2003, no causal relationship between the number of health institutions and real GDP was found in Turkey, but it was concluded that a bidirectional causality relationship exists between other health indicators (life expectancy at birth, the number of beds in health institutions, the number of people per health personnel) and real GDP (Taban, 2006: 39). Examining the health expenditures and growth relationship, a long-term relationship was found for Turkey in a study for the period of 1984-1998 (Kıymaz et al., 2006: 288-9) and for the period of 2006:01-2012:03 (Tıraşoğlu and Yıldırım, 2012: 111). Akar (2014) examined the relationship between health expenditures, the relative price of health expenditures and economic growth in Turkey for the period of January 2004-March 2013 and found a significant long-term relationship between health expenditures and economic growth (Akar, 2014: 320). In another study, it was determined that there is a long term co-integration and bidirectional causality between health expenditures and economic growth in Turkey for the period of 2006Q1 to 2016Q2 (Akıncı and Tuncer, 2016). Atılgan, Kılıç and Ertuğrul (2017) studied Turkey case for 1975-2013 period and concluded that any increase in the level of health expenditures have a positive effect on the economic growth. Şen and Bingöl (2018) conducted a causality analysis for Turkey covering 2006-2017 period and their findings revealed a bidirectional causality between health expenditures and economic growth.

There are a number of panel data studies examining the relationship between health expenditures and growth. Baltagi and Moscone (2010) concluded that per capita health expenditures and GDP of 20 OECD countries in the 1971-2004 period are related to each other in the long run (Baltagi and Moscone (2010: 11). Çetin and Ecevit (2010) found a weak positive relationship between health expenditures and economic growth in 15 OECD countries during the 1990-2006 period (Çetin and Ecevit, 2010: 180). Pradhan (2011) concluded that there is a long-run relationship between health expenditures and economic growth in 11 OECD countries selected for the 1961-2007 period (Pradhan, 2011: 68-83). Tatoğlu (2011) found that there is a long-term relationship between per capita GDP and health expenditures of 20 OECD countries covering the period of 1975-2005. Elmi and Sadeghi (2012) concluded that there is a long-term reciprocal causality relationship between economic growth and health expenditures in developing countries in the 1990-2009 period (Elmi and Sadeghi (2012: 88-9). According to another study conducted for 27 EU member states and Turkey for 2001-2011 period, there is a short and long-term positive relationship between health expenditures per capita and economic growth (Selim et al., 2014: 20). It was concluded in a study including 34 OECD countries for the years of 2000-2013 that there is a long-term relationship between GDP per capita and health expenditures (Sayın, 2015: 304). Çelik (2020) found a unidirectional causality between health expenditures and economic growth from economic growth to health expenditures using panel data of G20 countries.

There are many studies investigating the relationship between R&D investments and economic growth. In a study using panel data technique for 20 OECD countries and 10 non-OECD countries for the 1981-1997 period, a strong positive correlation between innovation and GDP per capita was found (Ülkü, 2004: 27). Samimi and Alerasoul (2009) used panel data of 30 developing countries for the 2000-2006 period and found the impact of R&D on economic growth to be negligible due to low R&D expenditures. Sadraoui and Zina (2009) found a positive and significant relationship between R&D and economic growth using panel data of 23 countries. Akıncı and Sevinç (2013) found a causality between R&D expenditures and economic growth in Turkey during the 1990-2011 period. İğdeli (2019), examining the effect of R&D expenditures on growth in Turkey between 1990 and 2016, found a long-term significant positive relationship between R&D expenditures and economic growth. Genç and Tandoğan (2020) revealed the existence of a bidirectional causality relationship between R&D expenditures and growth in Turkey during the 1990-2017 period.

Since growth occurs as a result of increases in investment and production, it is expected that as a production factor labor is used in production and therefore employment will increase (Al-Habees and Rumman, 2012: 673-74). The view that economic growth increases employment was first put forward by Arthur M. Okun in 1962. Okun (1962), in his study on the American economy, stated that there is a negative relationship between real growth and unemployment rate, and this view was called Okun's Law in the literature. There are various studies examining the relationship between economic growth and unemployment and they do not have unique results. Harris and Silverstone (2000) found that real GDP and

unemployment have unidirectional causality. Muscatelli and Tirelli (2001) found a negative relationship between unemployment and growth in selected OECD countries covering the 1955-1990 period. Christopoulos (2003) concluded that there is a long-run relationship between unemployment and regional growth in all regions of Greece for the period of 1971-1993. Zagler (2003) analyzed Okun's law with data from Germany, Italy, England and France and concluded that in the long run, economic growth and unemployment are co-integrated and the relationship is positive. Holmes and Silverstone (2006) did not find a symmetrical relationship between growth and unemployment for the US economy. Villaverde and Maza (2007) concluded that the increase in unemployment slowed the growth in the Spanish economy. Sodipe and Ogunrinola (2011) found that economic growth positively affects employment in Nigeria. In a study by Kreishan (2011) covering the period 1970-2008, Okun's law was found to be invalid in Jordan. Considering the studies examining the relationship between economic growth and unemployment in Turkey; a unidirectional causality was found in some studies (Yılmaz, 2005; Kızılgöl, 2006; Göçer, 2015), and bidirectional causality in another study (Takım, 2010). Ceylan and Şahin (2010), found that real output had a reducing effect on unemployment in the 1950-2007 period during the growth period, and an increasing effect on unemployment in the contraction period. Based on this, they concluded that there is an asymmetrical relationship between unemployment and real GDP. Bölükbaş (2018) concluded that during the 2010-2017 period in Turkey, economic growth was affected by youth unemployment. On the other hand, in some other studies, no causal relationship was found between growth and unemployment for Turkey (Muratoğlu, 2011; Yıldırım et al., 2013; Timur and Doğan, 2015).

3. Data and Methodology

In this study, time series techniques were used to investigate the relationship between the economic growth and health expenditures, R&D expenditures and unemployment in Turkey. Time series analysis is a very important technique to evaluate the development of the data set for the observed time period (Brockwell and Davis, 2006: 8). The data set used in this empirical study includes annual data for the period of 1990-2020 using 31 observations. The dependent variable is Gross Domestic Product per capita (GDPPC), and the independent variables are health expenditures/GDP ratio, R&D expenditures/GDP ratio, and unemployment rate. The data used in the study was drawn from World Bank, OECD and Turkish Statistical Institute (TURKSTAT) databases. The regression model used in the study is shown in equation (1).

$$GDPPC = \beta_0 + \beta_1 HEALTH + \beta_2 RD + \beta_3 UNEMP + u \quad (1)$$

where β_0 is the constant, GDDPC denotes Gross domestic product per capita (USD), HEALTH denotes health expenditures as a ratio of GDP (%), RD denotes R&D expenditures as a ratio of GDP (%), UNEMP is unemployment rate (%), and u is the error term. The expected signs of the coefficients are as follows, $\beta_1>0$, $\beta_2>0$, and $\beta_3<0$. Augmented Dickey Fuller (ADF) unit root test was used to

determine the series have a unit root or not. Johansen co-integration analysis was conducted in order to examine the relationship between economic growth and health expenditures, R&D expenditures, and unemployment. For the purpose of stabilizing the variance of series in the analysis, logarithms of GDPPC variable was calculated and written by L preceding its name. Descriptive statistics of the variables are in Table 1.

Table 1: Descriptive Statistics of the Variables

Variables	Number of Observations	Mean	Maximum	Minimum	Standard Deviation
LGDPPC	31	8.7	9.44	7.73	0.59
HEALTH	31	4.15	5.5	2.4	0.97
RD	31	0.62	1.09	0.24	0.26
UNEMP	31	9.37	13.66	0.26	1.83

The most common problem in time series analysis is whether the series are stationary or not. When the series are not stationary, spurious regression problem is likely to exist. When the variables are non-stationary, high R^2 (goodness of fit) can be reached for a regression equation with statistically significant coefficients, while the series are unrelated (Granger and Newbold, 1974: 111). Therefore, whether all variables used in the model, and if they are stationary at what level they are stationary are determined by conducting with the ADF unit root test developed by Dickey-Fuller (1979, 1981). For the ADF test, the null hypotheses are that all variables have a unit root and accordingly series is non-stationary, and correspondingly, the alternative hypotheses are that none of them has a unit root. When the absolute value of the obtained t statistic value is greater than the absolute values of the MacKinnon critical values found according to various significance levels, it is decided that the series is stationary, and when it is small, the series is not stationary (Tarı, 2005:395). According to the results of the ADF test, null hypothesis was not rejected at 5% significance level since it is within the acceptance interval (5% critical value: -2.963972) for all the variables, therefore the series are found to have a unit root and considered as non-stationary. In order to eradicate the unit root, the first difference or if needed greater differencing should be taken. The first differences of the variables are represented as D preceding the names of variables. According to the results of ADF test in Table 2, the null hypotheses that variables have a unit root rejected for all the series (5% critical value: -2.967767); thus the variables became stationary at their first differences.

Table 2: ADF Unit Root Test Results for Variables at Levels and at First Differences

Variables	Level		First Differences	
	ADF Test Statistics	p-value for t-statistics	ADF Test Statistics	p-value for t-statistics
LGDPPC	-1.20972	0.6569	-5.61507*	0.0001
HEALTH	-1.64455	0.4482	-3.48054**	0.0160
RD	1.08883	0.9964	-3.39261**	0.0211
UNEMP	-1.24921	0.6395	-4.76503*	0.0007

Note: *, ** indicates 1% and 5% significance level, respectively.

Co-integration refers that time series variables have a long-run relationship and do not have trend of moving far away from each other (Johansen, 1988: 235; Dickey et al., 1991: 58). Johansen co-integration test was conducted for the variables whether they are co-integrated or not. Before applying Johansen co-integration test, it is necessary to determine the optimal lag length. According to various criteria in Table 3, the optimal lag length was determined as 4.

Table 3: Optimal Lag Length Selection Criteria

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-74.80867	NA	0.004031	5.837679	6.029655	5.894764
1	26.93512	165.8047*	7.15e-06	-0.513713	0.446166*	-0.228290
2	45.87665	25.25537	6.29e-06	-0.731604	0.996179	-0.217843
3	57.79459	12.35935	1.08e-05	-0.429229	2.066457	0.312869
4	88.93060	23.06371	6.07e-06*	-1.550414*	1.713175	-0.579978*

Note: * indicates lag order selected by the criterion. LR: sequential modified LR test statistic (each test at 5% level), FPE: Final prediction error, AIC: Akaike information criterion, SC: Schwarz information criterion, HQ: Hannan-Quinn information criterion

According to the results of the Johansen co-integration test in Table 4, both the trace statistics and the maximum eigenvalue statistics were found to be greater than the 5% critical value for rank zero ($p<0,05$). This means both values showed that there is co-integration at 5% level, thus the null hypothesis that there is no co-integration was rejected. Accordingly, the findings demonstrated a long run relationship among these four variables.

Table 4: Johansen Co-Integration Test Results for the Variables

Hypothesized Number of CE(s)	Trace Statistics	5% Critical Value	Prob*	Max Eigenvalue Statistics	5% Critical Value	Prob*
None(r=0)	108.4955	55.24578	0.0000	47.68434	30.81507	0.0002
At most 1(r≤1)	60.81120	35.01090	0.0000	31.13986	24.25202	0.0053
At most 2(r≤2)	29.67133	18.39771	0.0009	28.71474	17.14769	0.0007
At most 3(r≤3)	0.956592	3.841466	0.3280	0.956592	3.841466	0.3280

Note: *MacKinnon-Haug-Michelis (1999) p-values

From the Johansen co-integration analysis, it was concluded that short-term fluctuations of time series of GPDPC and other variables lead a long-run relationship. Once co-integration relationship was found, Vector Error Correction Mechanism (VECM) was used for the purpose of differentiating the dynamics of the equilibrium in short and long run. It is expected that the error correction coefficient will be statistically significant and negative. According to the results of the error correction model, the error correction coefficient was found to be -0.24 which means that about 24% of the one-unit deviation in the long term is corrected in the short term. Based on VECM results, the long run equation between GDPPC and the other variables is in equation (2).

$$GDPPC = 8.7226 + 0.0815*HEALTH + 2.032*RD - 0.1702*UNEMP + u \quad (2)$$

The findings show that a long-run relationship exist between economic growth and health expenditures, R&D expenditures, and unemployment. Health and R&D expenditures contribute to the economic growth while unemployment has a negative effect on the economic growth. According to this, 1% increase in health expenditures results 0.08% increase in economic growth, and 1% increase in R&D expenditures results 2.03% increase in economic growth. On the other hand, 1% increase in unemployment results 0.17% decrease in economic growth. After finding the long-run relationship between the variables, Granger causality test was conducted to observe the causality of each variable with GDPPC, and the results are shown in Table 5. The null hypothesis is that there is no Granger causality between the variables, and accordingly the alternative hypothesis is that there is Granger causality between them.

Table 5: Granger Causality Results

Variables	Direction of Causality	F-Statistic	Prob
HEALTH-GDPPC GDPPC-HEALTH	→ -	4.23609** 0.14957	0.0493 0.7020
RD-GDPPC GDPPC-RD	- →	0.02268 4.74554**	0.8814 0.0383
UNEMP-GDPPC GDPPC-UNEMP	- -	1.20681 1.88463	0.2817 0.1811

Note: ** indicates 5% significance level.

Granger causality test stated that H_0 hypotheses were rejected for the HEALTH and GDPPC relationship in the direction from HEALTH to GDPPC (F-statistic 4.23609, $p<0.05$), and also for the RD and GDPPC relationship in the direction from GDPPC to RD (F-statistic 4.74554, $p<0.05$). The results showed no causality between UNEMP and GDPPC. In conclusion, Granger causality tests revealed that there is one-way causality from health expenditures and economic growth, and also one-way causality economic growth to R&D expenditures.

4. Conclusion

Human capital, considered as one of the crucial factors of production and productivity affecting the economic growth, has attracted more interest in the economics literature especially in the last thirty years. In societies with a certain level of economic development, the increase in resources allocated to health increases labor productivity and this accelerates economic growth of countries. As another important factor affecting economic growth, R&D investments are important element in obtaining international competitive advantage and ensuring the continuity of economic growth. The driving force of long-term growth is technological innovations and R&D. As countries allocate more resources to the R&D field, their economic growth seems to increase. Economic growth is affected by many macroeconomic factors; it is a generally accepted view in economic theory that there is an inverse relationship between growth and unemployment.

In this study, the relationship between economic growth and health expenditures, R&D expenditures and unemployment in Turkey for the period of 1990-2020 was investigated using time series analysis. According to the findings of the study, Johansen co-integration analysis results revealed that there is a long-run relationship between economic growth and health expenditures, R&D expenditures, and unemployment and the effects were found to be significant. Health and R&D expenditures have a positive contribution to the economic growth in Turkey, while there is a negative relationship between economic growth and unemployment. Granger causality test stated that there is unidirectional causality from health expenditures to economic growth and from economic growth to R&D expenditures. The results of the study are found to be generally compatible with both theoretical and empirical literature. The findings of the study imply that health and R&D expenditures play important role in the growth of Turkish economy. Considering the negative relationship between economic growth and unemployment rate found in the study, it is necessary to focus on employment policies as well as human capital investments in order to increase economic growth.

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