İKTİSADİ İDARİ VE SİYASAL ARAŞTIRMALAR DERGİSİ
JOURNAL OF ECONOMICS BUSINESS AND POLITICAL RESEARCHES

E-ISSN: 2564-7466	https://dergipark.org.tr/tr/pub/iktisad
Cilt:7, Sayı:19, Ekim 2022	Vol:7, No:19, October 2022

The Impact of Health Expenditures on Medical Product Exports: A Case of E7 Countries

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Sağlık Harcamalarının Medikal Ürün İhracatı Üzerindeki Etkisi: E7 Ülkeleri Örneği

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DOI: https://doi.org/10.25204/iktisad.1144254

Makale Bilgileri
Makale Türü: Araştırma Makalesi

Geliş Tarihi: 15.07.2022

Kabul Tarihi: 18.08.2022

Abstract

It was aimed to analyze the impact of health expenditures on medical product exports in E7 countries (Turkey, China, India, Russia, Indonesia, Brazil and Mexico) in the developing countries group in the paper. In this context, it was first performed the MADF unit root test to test the stationarity of the series in the study covering the period 2000-2017. Then it was performed the Swamy S test to determine the homogeneity and heterogeneity of the series. Finally, it was applied the Dumitrescu-Hurlin Panel causality test to determine the causality relationship between the series. As a result of the findings, it was determined that the series were stationary and heterogeneous in the first difference and that there was a bidirectional causality relationship between the two variables. In other words, both health expenditures affected medical product exports and medical product exports affected health expenditures. In this perspective, when countries' health expenditures increase, medical product exports also increase, and when medical product exports increase, health expenditures also increase.

Keywords: health expenditures, medical product export, panel causality, E7 countries.

Article Info
Paper Type: Research Paper

Received: 15.07.2022

Accepted: 18.08.2022

Öz

Bu çalışmada gelişmekte olan ülkeler grubunda yer alan E7 ülkelerinde (Türkiye, Çin, Hindistan, Rusya, Endonezya, Brezilya ve Meksika) sağlık harcamalarının medikal ürün ihracatı üzerindeki etkisinin analiz edilmesi amaçlanmıştır. Bu bağlamda, 2000-2017 dönemini kapsayan çalışmada öncelikle serilerin durağanlığını sınamak için MADF birim kök testi, serilerin homojenliğini-heterojenliğini belirlemek amacıyla Swamy S testi ve son olarak, nedensellik ilişkini belirleyebilmek için Dumitrescu-Hurlin Panel nedensellik testi uygulanmıştır. Bulgular sonucunda, serilerin birinci farkta durağan ve heterojen olduğu ve iki değişken arasında çift yönlü nedensellik ilişkisi olduğu saptanmıştır. Hem sağlık harcamaları medikal ürün ihracatını hem de medikal ürün ihracatı sağlık harcamalarını etkilemiştir. Böylece, ülkelerin sağlık harcamaları arttığında medikal ürün ihracatı da artmakta, medikal ürün ihracatı arttığında sağlık harcamaları da artmaktadır.

Anahtar Kelimeler: Sağlık harcamaları, medikal ürün ihracatı, panel nedensellik, E7 ülkeleri.

Atıf/ to Cite (APA): Bozduman, E.T. ve Erkan, B. (2022). The impact of health expenditures on medical product exports: A case of E7 countries. *İktisadi İdari ve Siyasal Araştırmalar Dergisi, 7*(19), 468-476

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1. Introduction

Spending on the health sector and the sector **(**current spending and investment spending) has steadily increased in recent years. The importance of health expenditures made by the public and private sectors increased, and the content of these expenditures began to change in the direction of research and development especially after the covid-19 pandemic. In short, spending on the sector, which is already obvious has reached more strategic dimensions day by day.

Countries' increasing health spending has led to an increase in the importance of medical product production and exports. The need for all kinds of medical equipment and apparatus, especially medicine, is becoming increasingly mandatory. This has led countries to export these products. In this perspective, we analyze the impact of health spending on medical product exports in E7 countries in this article. First, we conduct an extensive literature review on the subject and try to determine the possible contribution of this study to the literature. Then we try to find out the link between the two variables in question using the Panel data method in these countries. The emergence of a bi-directional causal relationship between health expenditures and medical product exports reveals the importance of the study.

2. Literature Review

When the literature on health expenditures of countries is examined, studies mainly on the relationship between health expenditures and economic growth (GDP, GDP per capita) are highlighted (Fazaeli et al. 2016; Yew and Uğur, 2015; Elmi and Sadeghi, 2012; Öztürk and Topçu, 2014; Sülkü and Caner, 2011; Cebeci and Ay, 2016; Wang et al. 2019).

Considering the studies analyzing the relationship between health expenditures and economic growth; Fazaeli et al. (2016) used Panel Data Unit root tests, cointegration analysis and ECM model in their analysis of 12 OPEC member countries in the period 1995-2012. According to the results, they revealed a relationship between health spending and GDP (Fazaeli et al., 2016). Results obtained by Yew and Uğur (2015) using meta-analysis showed that there was a negative relationship between two variables (Yew and Uğur, 2015). Elmi and Sadeghi (2012) found a bidirectional causality and long-term relationship between economic growth and health spending in their study on developing countries in the period 1990-2009 (Elmi and Sadeghi, 2012). Mehrara et al. (2012) analysed MENA countries in the period 1995-2005. As a result of the Panel co-integration analysis, they found that there was a long-term relationship between the two variables (Mehrara et al., 2012). Özturk and Topçu (2014) studied the G8 countries for the period 1995 and 2012 and used the Panel error correction model. The results showed a strong relationship between these two variables (Öztürk and Topçu, 2014). Cebeci and Ay (2016) discussed the relationship between two variables in the BRICS countries and Turkey in the period 2000-2014. As a result of the Panel data analysis, they found that health spending significantly affected economic growth (Cebeci and Ay, 2016). Wang et al. (2019) used the automatic regressive distribution delay (ARDL) model in his studies on the period 1995-2017 and Pakistan and found that there was both a short-and long-term causal relationship between the two variables (Wang et al., 2019). Sülkü and Caner (2011) also examined the long-term relationship between gross domestic product (GDP) per capita and health expenditures per capita in Turkey in the period 1984-2006. According to their results using Johansen's multivariate co-integration technique, a 10% increase in GDP per capita resulted in an 8.7% increase in total health expenditures per capita (Sülkü and Caner, 2011).

When the literature is examined, studies on the determinants of countries' health expenditures are also often found (Matteo, 2005; Khan, Razali, and Shafie, 2016; Kennedy, 2015; Nghiem and Connelly, 2017; Bilgel and Tran, 2013). Matteo (2005) aimed to examine the determinants of actual health expenditures per capita with regression analysis in order to assess the impact of age distribution, income and time. He used health spending data from the United States (1980-1998) and

Canada (1975-2000) in the article. The results showed that as income, time and age levels increased in these countries, health spending also increases (Matteo, 2005). Kennedy (2015), Nghiem and Connelly (2017), and Bilgel and Tran (2013) analyzed the subject with the help of Panel data analysis. Kennedy (2015) included per capita income, exchange rates and the number of medical personnel in the model in his analysis of the period 1980-2012 in Kenya. As a result, per capita income and exchange rates were determinants of increased health spending in Kenya (Kennedy, 2015). Nghiem and Connelly (2017) concluded that the main driver of health spending was technological progress in their study of the period 1975-2004 in OECD countries (Nghiem and Connelly, 2017). Bilgel and Tran (2013) also aimed to uncover the impact of non-revenue determinants of health care spending in Canada. According to the results obtained, the most important determinant of health expenditures was the quality of health services (Bilgel and Tran, 2013). In the literature, there were also publications that examine the relationship between health expenditures and health outcomes (Gaag and Barham, 1998; Boachie et al., 2018; Farag et al. 2013; Bokhari et al., 2007; Anyanwu and Erhijakpor, 2009; Berger and Messer, 2002). Among these studies, Gaag and Barham (1998) analyzed the impact of World Bank Structural Adjustment operations on health expenditures and outcomes in different countries during the period 1985-1993. They analyzed the effects of real public expenditures per capita on health, private consumption and child mortality indicators. All country groups significantly increased state health spending during the period 1989-1993 (Gaag and Barham, 1998). Boachie et al. (2018) examined the connection between state health expenditures and various health outcomes (child deaths, life expectancy at birth, etc.) in Ghana between 1980-2014. They used Ordinary Least Squares (OLS) and two-stage least squares (2SLS) estimates. According to the results available, public health expenditures contribute to improvements in health outcomes in Ghana (Boachie et al., 2018). Bokhari et al. (2007) analyzed the impact of per capita government health expenditures and per capita income on two health outcomes (deaths under five years of age and maternal mortality) in developing countries in 2000. In the study, they used the Generalized Method of Moments (GMM) and The Ordinary Least Squares (OLS) estimators. According to the results obtained, both economic growth and government health spending had an impact on the health outcomes in question (Bokhari et al., 2007).

Anyanwu and Erhijakpor (2009) examined the relationship between health expenditures and per capita income and health outcomes (infant mortality and deaths under the age of five) between 1999 and 2004 in 47 African countries. According to the results of Panel data regression analysis, the said health outcomes were positively affected as health expenditures and per capita income increase (Anyanwu and Erhijakpor, 2009). Berger and Messer (2002) also investigated the impact of health insurance and public health expenditures on health outcomes between 1960 and 1992 in 20 OECD countries. Increases in the publicly funded share of health spending were associated with higher death rates. However, increased health insurance coverage reduced the mortality rate (Berger and Messer, 2002).

Studies that measure the relationship between public health spending and income flexibility are also frequently found in the literature (Wang and Rettenmaier, 2007; Sülkü and Caner, 2011; Bilgel and Tran, 2013; Hosoya, 2014; Nghiem and Connelly, 2017) explained the issue through Panel data analysis. Wang and Rettenmaier (2007) examined the relationship between public health spending and income flexibility in the period 1980-2000 in all 50 states of the United States. According to the results, the income flexibility of health spending varies by state and decreases over time (Wang and Rettenmaier, 2007). Bilgel and Tran (2013) aimed to identify the magnitude of revenue flexibility of health spending in Canada and the impact of non-revenue determinants of health spending across Canada. According to the results, the income flexibility of health care spending was lower over the long term. So, these expenditures were mandatory (Bilgel and Tran, 2013). Hosoya (2014) conducted a study of 25 OECD countries between 1985 and 2006 and determined that health spending was less than 1 in income flexibility (non-luxury service) (Hosoya, 2014). Nghiem and Connelly (2017) concluded that the income flexibility of health spending during the period 1975-2004 in OECD countries was less than 1 (Nghiem and Connelly, 2017). Sülkü and Caner (2011) also used Johansen's

multivariate co-integration technique in their study of the 1984-2006 period in Turkey and found that the income flexibility of public health expenditures in Turkey was less than 1, and the income flexibility of private health expenditures is greater than 1 (Sülkü and Caner, 2011).

There are also different studies in the literature in which health expenditures are associated. For example, Yıldırım and Sezgin (2002) and Özsoy (2002) examined the relationship between health, education and military expenditures. Yıldırım and Sezgin (2002) analyzed the relationship between health, education and military expenditures in Turkey between 1924 and 1996 in a multi-equation framework using the Seemingly Unrelated Regression (SUR) estimation method. According to the results, there was a compromise between defense spending and welfare spending. Similar situation does not apply to education and health (competition is in question) (Yıldırım and Sezgin, 2002). Ozsoy (2002) investigated the existence of a budget compromise between military, education and health expenditures in Turkey between 1925 and 1998. He used yhe multi-variable single equation regression model in the study. The increase in defense spending reduces education and health spending. In addition, there was a positive relationship between education and health expenditures and GNP per capita (Ozsoy, 2002).

Jakovljevic et al (2019) examined the impact of health spending on public health in the BRICS countries in 2017 and 2018. Increased health spending increases life expectancy at birth. However, rising prices in the healthcare sector increased income inequalities (Jakovljevic et al., 2019). Furthermore, Govindaraj et al. (1997) analyzed the public and private share of health spending in Latin America and the Caribbean (Govindaraj et al., 1997). Marc Lautier (2008) examined the health care exports of developing countries with the example of Tunisia (Lautier, 2008). Sartia et al. (2017) also analyzed the relationship between private health spending and poverty in Italy during the crisis period 1997-2013. In the two applied multilevel (linear and logistic) regression models, the dependent variable was health expenditure, and the independent variable was the level of household poverty. Compared to non-poor families, the health spending trends of poor families had decreased more during crisis periods in recent years (Sartia et al., 2017). Potrafke (2010) also empirically assessed whether government ideology and election motivations influenced health spending growth in 18 OECD countries during the period 1971-2004. In this context, he applied dynamic Panel data analysis in the model. The results showed a strong correlation between government ideologies, election periods and budget policies during this period and health spending (Potrafke, 2010).

When we examine the literature, we come across one publication that analyzed the relationship between medical product exports and competitiveness. Anderton and Schultz (1999) analyzed medical product export performance and competitiveness in Germany and the United Kingdom. They noted that the increase in R and D expenditures in both countries had a positive effect on the export performance of these products. In the United Kingdom, medical product production costs were higher compared to Germany, so their competitiveness was lower (Anderton and Schultz, 1999).

Our extensive literature review shows that there are not enough studies measuring the relationship between countries' health expenditures and medical product exports. When we consider today's conjuncture (Covid-19 Pandemic), the importance of the issue is obvious. In this context, we believe that this study can contribute to the literature.

3. Methodology

3.1. Cross-Section Dependency

One of the tests used to measure whether there is a relationship between units is the Breusch-Pagan LM test. If the unit size is less than the time size (N < T), the LM test gives more accurate results (Tatoğlu, 2018). The Breusch-Pagan LM test is formulated as follows (Breusch and Pagan, 1980):

$$LM = \sum_{i=1}^{N-1} \sum_{j=i+1}^{N} \hat{P}_{ij}^2 \quad (1)$$

$\hat{P}_{ij}^2$ refers to the correlation coefficient between the remnants of I and J units. The empty hypothesis is that there is no cross-section dependence, while the alternative hypothesis is that there is a cross-section dependence.

3.2. Unit Root Test

In the study, we used the Multivariate Extended Dickey Fuller (MADF) test to test the stationarities of the series. This test, which was first applied by Abuaf and Jorion (1990) to examine purchasing power parity in the long run, was developed by Taylor and Sarno (1998). MADF test is formulated as follows (Tatoğlu, 2018):

$$\text{MADF}= \frac{(\iota - \Psi\hat{\beta})\{\Psi\,[Z'(\hat{\Lambda}^{-1} \otimes I_T)Z]^{-1}\Psi'\}\,(\iota - \Psi\hat{\beta})N\,(T-k-1)}{(Y - Z\hat{\beta})'(\hat{\Lambda}^{-1} \otimes I_T)(Y - Z\hat{\beta})} \quad (2)$$

While the null hypothesis of the test is that all series contain unit root, the alternative hypothesis is that all series are stationary. The test is based on a higher order autoregressive equation rather than a first order autoregressive equation. MADF test doesn't restrict the autoregressive coefficients to be the same throughout the Panel; it allows for individual Panel (Furuoka, 2012).

3.3. Homogeneity Test

The S test developed by Swamy is used to determine whether the variables are homogeneous. It is determined whether the variables are homogeneous or not by looking at the probability value of the analysis results. The null hypothesis states that the variables are homogeneous, while the alternative hypothesis states that the variables are not homogeneous. The S test is formulated as follows (Swamy, 1970):

$$\hat{S} = X_{k(N-1)^2} = \sum_{i=1}^{N}(\hat{\beta}\iota - \overline{\beta})'\,\hat{V}_i^{-1}\,(\hat{\beta}\iota - \overline{\beta}) \quad (3)$$

With the Swamy S test results, it is determined whether the variables are homogeneous or not and tests are selected accordingly.

3.4. Causality Test

Causality tests are used to determine whether there is a causality relationship between variables, and if so, in which direction the relationship is. The Dumitrescu-Hurlin test can be applied to Panels with or without cross-section dependence (provided that it is heterogeneous). The Dumitrescu-Hurlin causality test is formulated as follows (Dumitrescu and Hurlin, 2012):

$$Y_{it} = \alpha_i + \sum_{j-1}^{J} \lambda_i^j y_{i(t-j)} + \sum_{j-1}^{J} \beta_i^j X_{i(t-j)} + e_{it} \quad (4)$$

The null hypothesis of this test is that there is no causality relation, while the alternative hypothesis is that there is a causality relation.

4. Results

We exploratory the impact of health expenditures on medical product exports in the E7 countries (Turkey, China, India, Russia, Indonesia, Brazil and Mexico) in this study covering the years 2000-2017. We make the analyzes using annual data. We obtain health expenditure data from the World Bank database and health product exports from the COMTRADE database. We use the health expenditures variable as % of GDP and health products exports as million dollars. However, we use

the logarithm of the health product exports variable to facilitate analysis. We perform the analyzes using the STATA 14.2 program. The model we create is as follows:

$$EXLN= \beta 0 +\beta 1\ HEit + uit \quad (5)$$

Equation 5 shows how health spending affects health product exports. The constant term β0 in the model shows the slope coefficient that belongs to β1 health expenditures, and u shows the error term.

Table 1. Descriptive Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
he	126	4,94	1,70	1,90	9,46
exln	126	13,70	1,48	11,13	16,52

We have shown the descriptive statistics of the series we use in Table 1. We conducted a cross-section dependency test to determine whether there is a correlation between the series.

Table 2. Cross-section Dependency

LM Test		
Test	Statistic	p-value
LM	118.2	0.0000*
LM adj*	34.36	0.0000*
LM CD*	9 216	0.0000*

(*) It indicates cross-section dependence at the %1 significance level.

We measure whether there is a cross-section dependence between the series of health products exports and health expenditures. Test results show cross-section dependence between series at 1% significance level.

Table 3. MADF Unit Root Test (Level)

Level Values			
EXLN			
Obs	Lags	MADF	Approx 5% CV
17	1	29 751	49 619
HE			
Obs	Lags	MADF	Approx 5% CV
17	1	38 972	49 619

The MADF unit root test is a test that can be applied provided that it is N < T. The null hypothesis of the test is that series contain unit roots. The alternative hypothesis is that series do not contain unit roots, that is, they are stationary. According to the results of the MADF unit root test, the null hypothesis cannot be rejected because the MADF value obtained at the level values is less than the critical value. So series contain unit root in level values.

Table 4. MADF Unit Root Test (First Difference)

First Difference Values			
EXLN			
Obs	Lags	MADF	Approx 5% CV
16	1	170 944	55 310
HE			
Obs	Lags	MADF	Approx 5% CV
16	1	259 561	55 310

According to the results of the MADF unit root test, the null hypothesis is rejected because the resulting MADF value is greater than the critical value. In other words, series are stable in the first difference values.

Table 5. Homogeneity Test

EXLN	Coef.	Std. Err.	z	P>|z|	[95% Conf. Interval]	
HE	-0.0074	0.502799	-0.01	0.988	-0.99287	0.978068
_cons	13.9585	2.0685	6.7500	0.0000	9.9042	18.0128
Test of Parameter Constancy: chi2(12) = 831.83 Prob > chi2 = 0.0000*						

(*) It indicates that series at the 1% significance level are heterogeneous.

According to the results of the homogeneity test, the empty hypothesis that the slope coefficients of the series are homogeneous is rejected at the 1% significance level. The alternative hypothesis that the slope coefficients of the series are not homogeneous (heterogeneous) has been accepted. So series are heterogeneous.

Table 6. Causality Test

HE→ EXLN
Optimal number of lags (AIC): 1 (lags tested: 1 to 4).
W-bar = 4.0247
Z-bar = 5.6586 (p-value = 0.0000)*
Z-bar tilde = 4.0195 (p-value = 0.0001)*
H0: Health expenditures is not the cause for health product exports.
H1: Health expenditures is the cause for health product exports.
EXLN → HE
Optimal number of lags (AIC): 1 (lags tested: 1 to 4).
W-bar = 2.5431
Z-bar = 2.8869 (p-value = 0.0039)*
Z-bar tilde = 1.9358 (p-value = 0.0529)**
H0: Exports of health products are not the cause of health expenditures.
H1: Exports of health products are the cause of health expenditures.

(*) It indicates a causal relationship at the %1 significance level.
(**) It indicates a causal relationship at the %5 significance level.

According to the results of the causality test, the empty hypothesis that "health expenditures are not the cause of health product exports" was rejected at the 1% significance level. In other words, health spending is the reason for the export of health products. The empty hypothesis that" exports of health products are not the cause of health expenditures" was rejected at the level of 5% significance. In other words, exports of health products are the cause of health spending. In other words, there is a two-way causal relationship between health expenditures and health product exports.

5. Conclusion

The health sector has been among the critical sectors globally in recent years. In particular, countries have had to increase both health spending and demand for medical products with the Covid-19 pandemic taking place in the world. Countries have increased their spending in both private and public areas, which has led to an increase in the share of sectoral imports in total imports. In other words, most countries of the world have become externally dependent on medical products. On the contrary, innovative countries in the sector have begun to increase their exports, making other countries more dependent on them, both economically and politically.

Trade in almost all sectors around the world has come to a standstill due to the pandemic. The most important exception is the health sector. Such an increase in health spending and the trade in medical products has made it necessary for us to conduct this study. Because, the relative lack of medical products has caused the death of millions of people in many countries.

The aim of the study is to measure the impact of health expenditures on medical product exports in E7 countries, which are among the developing country groups. For this purpose, we investigate the correlation state between these variables and determine the stability of the series through unit root tests. We conduct causality analysis by determining the homogeneity-heterogeneity of the slope coefficients of the series. As a result of the analysis, we find that there is a bi-directional causal relationship between health expenditures and medical product exports. In other words, just as health expenditures affect medical product exports, medical product exports also affect health expenditures.

Countries should act with the idea that a health problem, especially an epidemic, could arise at any moment anywhere in the world. Because in certain periods throughout history, both national and global-based diseases and epidemics have continued. In this context, countries have to reduce and/or eliminate external dependence in the health sector. Countries should invest more in the health sector in order to achieve their growth and development goals in the economic and social areas and consider this sector as a priority area.

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