An Empirical Analysis on the Relationship between Health Care Expenditures and Economic Growth in the European Union Countries

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Abstract

This paper empirically investigates the relationship between health expenditure and economic growth in the European Union countries over the period 1995-2014. By using the Dumitrescu-Hurlin Test (Dumitrescu and Hurlin, 2012) which is developed to test Granger causality in panel datasets (Lopez and Weber, 2017), it is found that there is a unidirectional relationship between these variables and gross domestic product (GDP) per capita Granger causes health expenditure per capita. After determining the direction of the relationship between health expenditure per capita and GDP per capita we estimate the short run and the long run effects of GDP per capita on health expenditure per capita by using Mean Group (MG) and Pooled Mean Group (PMG) estimators which are developed by Pesaran and Smith (1995) and Pesaran, Shin and Smith (1999) respectively. According to the estimation results, GDP per capita has a positive effect on health expenditure per capita both in the short run and the long run.

Keywords: Health care expenditures, Economic growth, Panel Granger causality analysis, European Union

1. Introduction

Health is one of the significant factors which can have dramatic effects on economic performance of a country. Increasing health care expenditure leads to higher social security, safety and welfare and hence, it improves labour efficiency (Mladenovic et al., 2016).

There are quite a few studies which investigate the impact of health/health care expenditure on economic growth in the existing literature. These studies generally

find that health/health care expenditure has a positive influence on economic growth (see for instance; Rivera and Currais, 2003; Bloom et al., 2004 and LI and Huang, 2009). However, the number of studies which analyse the causality between health care expenditure and economic growth is very low. Unlike previous analyses, in this study we examine the causality between health care expenditure and economic growth in the European Union countries over the period 1995-2014. Moreover, after determining the direction of causality between these variables we estimate the short run and the long run effects of GDP per capita on health expenditure per capita.

The remainder of the paper is structured as follows: in section 2 we present a brief literature review, in section 3 we explain our methodology and data, in section 4 we discuss the results of our empirical analysis and finally in section 5 we conclude.

2. Literature Review

Although there is a vast literature which investigates the effect of health on economic growth the number of studies that focus on the direction of the relationship between health expenditure and economic growth is very low. Here, we briefly summarize the results of recent literature which examine the relationship between health and economic growth.

Rivera and Currais (2003) investigate the influence of health investment on productivity in OECD countries over the period 1960-2000. The authors estimate an Augmented Solow Model by using ordinary least squares and two stages least squares estimators and find that health expenditure has a positive effect on economic growth (Rivera and Currais, 2003).

Bloom et al. (2004) analyse the impact of work experience and health on economic growth for a panel of countries by estimating a production function over the period 1960-1990. According to the estimation results, Bloom et al. (2004) conclude that good health has a positive impact on economic growth.

LI and Huang (2009) examine the effect of health and education on economic growth for Chinese provinces between 1978 and 2005 by estimating Mankiw, Romer and Weil (1992)'s model. The results of this analysis show that both health and education positively affect economic growth (LI and Huang, 2009).

Narayan et al. (2010) analyse the relationship between health and economic growth for 5 Asian countries by drawing on panel unit root, panel cointegration with structural breaks and panel long run estimation over the period 1974-2007. According to the empirical results, Narayan et al. (2010) suggest that there is a long run relationship between health and economic growth and health positively influences economic growth.

Hartwig (2010) examines the impact of health capital formation on GDP growth by drawing on panel Granger causality analysis. Hartwig (2010) uses a data set covering

the period between 1970 and 2005 for 21 OECD countries and finds that health care expenditure does not Granger cause GDP per capita growth.

Wang (2011) investigates the causality between health care expenditure rise and economic growth for 31 countries by using both panel regression and quantile regression techniques over the period 1986-2007. According to the panel estimation results, Wang (2011) argues that while health care expenditure growth has a positive impact on economic growth economic growth decreases health care expenditure growth. However, the results of quantile regression indicate that the effect of health care expenditure growth on economic growth is positive in countries which have medium and high levels of economic growth (Wang, 2011).

Amiri and Ventelou (2012) examine the relationship between health care expenditure and economic growth in OECD countries by using a new version of Granger causality test suggested by Toda and Yamamoto (1995). In the empirical estimations, a data set for 20 OECD countries which covers the period between 1970 and 2009 is used. According to the estimation results, Amiri and Ventelou (2012) suggest that there is bidirectional causality between health care expenditure and economic growth.

Lago-Penas et al. (2013) analyse the relationship between health care expenditure and income for 31 OECD countries over the period 1970-2009. By estimating the short run and the long run elasticities Lago-Penas et al. (2013) investigate the adjustment process of health care expenditures to changes in GDP per capita and find that health care expenditures are more responsive to cyclical components of GDP per capita than to trend components.

To summarize, we can state that most of the empirical analyses in the existing literature focus on the effect of health/health care expenditures on economic growth and find a positive impact of health on income. However, the number of studies that examine the causality between health expenditure and economic growth is very low. The main contribution of our analysis is to investigate the direction of causality between health expenditure and economic growth empirically. Moreover, after determining the direction of causality we also estimate the short run and the long run effects of GDP per capita on health expenditure per capita.

3. Methodology and Data

In this paper we investigate the relationship between health expenditure and economic growth in the European Union countries. At first, we examine the direction of the causality between health expenditure and economic growth. In order to do this, we use the Dumitrescu-Hurlin Test (Dumitrescu and Hurlin, 2012) which is developed to test Granger causality in panel datasets (Lopez and Weber, 2017). The Dumitrescu-Hurlin Test can be explained by the following linear model (Dumitrescu and Hurlin, 2012):

$$y_{i,t} = \alpha_i + \sum_{k=1}^{K} \theta_i^{(k)} y_{i,t-k} + \sum_{k=1}^{K} \beta_i^{(k)} x_{i,t-k} + \varepsilon_{i,t}$$

(1)

In equation 1, x and y are two stationary variables observed for N individuals on T periods (Dumitrescu and Hurlin, 2012). Dumitrescu and Hurlin (2012) suggest testing Homogenous Non Causality hypothesis by considering both the heterogeneity of the regression model and the casual relation. The alternative hypothesis of the Dumitrescu-Hurlin Test allows a subgroup of individuals for which there is no causality and a subgroup of individuals for which there is Granger causality (Dumitrescu and Hurlin, 2012). The null hypothesis of the Dumitrescu-Hurlin Test can be stated as follows (Dumitrescu and Hurlin, 2012):

$$H_0: \beta_i = 0 \qquad \forall i = 1, \dots N$$

(2)

In order to test the null hypothesis Dumitrescu and Hurlin suggest using the average of individual Wald statistics (Dumitrescu and Hurlin, 2012).

After determining the direction of causality between health expenditure and economic growth, we draw on Mean Group (MG) and Pooled Mean Group (PMG) estimators which are developed by Pesaran and Smith (1995) and Pesaran, Shin and Smith (1999) to estimate the short-run and the long-run effects of the variable which Granger causes the other variable. The PMG presumes that long run coefficients are equal across groups but, allows the constants, short run coefficients and error variances to be different (Pesaran, Shin and Smith (1999). When MG estimator is used regressions are estimated for each group separately and then the means of coefficients over groups are calculated Pesaran and Smith (1995).

The MG and PMG estimators can be explained by the following autoregressive distributive lag (ARDL) (p, q_1, …, q_k) panel model (Blackburne and Frank, 2007):

$$y_{i,t} = \sum_{j=1}^{p} \varphi_{i,j} y_{i,t-j} + \sum_{j=0}^{q} \sigma'_{i,j} X_{i,t-j} + \mu_i + \varepsilon_{i,t}$$

(3)

In this equation, i= 1, 2, …, N is the number of groups, t= 1, 2, …, T is the number of periods, $X_{i,t}$ is a k x 1 vector of explanatory variables, $\sigma_{i,t}$ are the k x 1 coefficient vectors, $\varphi_{i,j}$ are scalars and μ_i is the group-specific effect (Blackburne and Frank, 2007). By using equation 3 the error correction model can be stated as follows:

$$\Delta y_{i,t} = \theta_i \left(y_{i,t-1} - \vartheta_i' X_{i,t} \right) + \sum_{j=1}^{p-1} \varphi_{i,j}^{*} \Delta y_{i,t-1} + \sum_{j=0}^{q-1} \sigma_{i,j}'^{*} \Delta X_{i,t-j} + \mu_i + \varepsilon_{i,t}$$

(4)

In equation 4, $\theta_i = -(1 - \sum_{j=1}^{p} \varphi_{i,j})$, $\vartheta_i = \sum_{j=0}^{q} \sigma_{i,j} / (1 - \sum_k \varphi_{i,k})$, $\varphi_{i,j} = -\sum_{m=j+1}^{p} \varphi_{i,m}$ j= 1, 2, …, p-1, and $\sigma_{i,j}^{*} = -\sum_{m=j+1}^{q} \sigma_{i,m}$ j= 1, 2, …, q-1 (Blackburne and Frank, 2007).

In this equation, θ_i is the speed of adjustment term (error correction term) and it is expected to be statistically significant and negative (Blackburne and Frank, 2007). The vector of ϑ_i' includes long-run relationships among the variables (Blackburne and Frank, 2007).

In our empirical analysis, we use gross domestic product per capita and health expenditure per capita in order to estimate the relationship between health expenditure and economic growth. Both of these variables are in current US Dollars and we draw on GDP deflator of the respective country to calculate the real values of the data. In the estimations, the logarithmic forms of the variables are used. The data set is annual and covers the period between 1995 and 2014 for 28 European Union countries. All of the data is obtained from the World Bank World Development Indicators (World Bank, 2018).

4. Results

Although the order of integration of the variables is not important for the MG (Pesaran and Smith, 1995) and PMG models (Pesaran, Shin and Smith, 1999) so long as the variables are integrated either in I(0) or I(1) the Dumitrescu-Hurlin Test assumes that the variables are stationary (Dumitrescu and Hurlin, 2012). So, we first estimate Im-Pesaran-Shin (Im, Pesaran and Shin, 2003) and Fisher type (Fisher-Augmented Dickey-Fuller (ADF)) (Choi, 2001) unit root tests in order to establish the order of integration of the variables. Table 1 shows the results of these unit root tests.

Table 1: Unit Root Test Results

Variables	Im-Pesaran-Shin	Fisher-ADF Inverse Normal	Fisher-ADF Inverse Logit
GDP per capita	-17.2327***	-9.6563***	-14.6831***
Health Expenditure per capita	-7.4784***	-6.3808***	-9.4002***

Note: *** indicates 1% significance level. The null hypothesis of Im-Pesaran-Shin Test and Fisher-ADF Test states that all panels contain unit roots. An intercept and a trend term are added to the models while estimating the statistics. For Im-Pesaran-Shin Test lag length is determined according to the Akaike Information Criterion.

Source: Authors' estimations.

According to table 1, both GDP per capita and health care expenditure per capita are stationary. So, we can estimate the MG (Pesaran and Smith, 1995) and PMG models (Pesaran, Shin and Smith, 1999) and the Dumitrescu-Hurlin Test (Dumitrescu and Hurlin, 2012).

Table 2 shows the results of the Dumitrescu-Hurlin Test (Dumitrescu and Hurlin, 2012). The results of the Dumitrescu-Hurlin Test indicate that while GDP per capita Granger causes health expenditure per capita there is no Granger causality from health expenditure per capita to GDP per capita. Therefore, it is argued that there is a unidirectional relationship between GDP per capita and health expenditure per capita and the direction of this relationship is from GDP per capita to health expenditure per capita.

Table 2: The Dumitrescu-Hurlin Test Results

Hypothesis	Test Statistic (Z-bar ~)
H_0: GDP per capita does not Granger-cause health expenditure per capita.	3.8082***
H_0: Health expenditure per capita does not Granger-cause GDP per capita.	0.4992

Note: *** indicates 1% significance level. Lag length is determined according to the Akaike Information Criterion.

Source: Author's estimations.

After determining the direction of causality between GDP per capita and health expenditure per capita we estimate the short run and the long run effects of GDP per capita on health expenditure per capita by using the MG (Pesaran and Smith, 1995) and PMG models (Pesaran, Shin and Smith, 1999). Table 3 shows these estimations. Before interpreting coefficient estimates we should determine which estimator is more efficient than the other one. According to the Hausman specification test (Hausman, 1978) result, PMG (Pesaran, Shin and Smith, 1999) is more consistent and efficient estimator than MG (Pesaran and Smith, 1995). So, we will evaluate the coefficient estimates which are obtained by using PMG estimator (Pesaran, Shin and Smith, 1999). The last two columns of table 3 show the coefficient estimates of PMG (Pesaran, Shin and Smith, 1999) model. When we look at these results we find that speed of adjustment term (ec) is statistically significant and negative as expected. Moreover, both the short run and the long run coefficient estimates of GDP per capita are statistically significant and have a positive sign. So, it is stated that GDP per capita has a positive effect on health expenditure per capita both in the short run and the long run. While a 1% percent increase in GDP per capita increases health expenditure per capita by 0.72% in the short-run this increase is 1.10% in the long run.

Table 3: MG and PMG Estimations

Variables	MG Model		PMG Model	
	Long Run	Short Run	Long Run	Short Run
GDP per capita	1.1526*** (0.1504)		1.1001*** (0.0177)	
ec		-0.3198*** (0.0422)		-0.2209*** (0.0402)
ΔGDP per capita		0.5676*** (0.0636)		0.7274*** (0.0647)
constant		-1.7145*** (0.3438)		-0.7860*** (0.1484)
Hausman Test Probablity		0.12 0.7294		

Note: *** indicates 1% significance level. Standard errors are in parenthesis. The chosen lag structure is ARDL(1, 1). Ec is the speed of adjustment term. The models are estimated by using xtpmg routine in Stata. Hausman test indicates that PMG estimator is more consistent and efficient than MG estimator.

Source: Authors' estimations.

In summary, our empirical results indicate that there is a unidirectional relationship between health expenditure per capita and GDP per capita and the direction of this relationship is from GDP per capita to health expenditure per capita. Moreover, when we investigate the short run and the long run effects of GDP per capita on health expenditure per capita we find that GDP per capita has a positive effect on health expenditure per capita both in the short run and the long run.

Conclusion

Without doubt, health care expenditure can have dramatic effects on economic performance of a country. In the existing literature, although there are numerous studies which analyse the impact of health/health care expenditure on economic growth the number of studies which focus on the causality between these variables is very few.

In this study, we empirically investigate the relationship between health expenditure and economic growth in the European Union countries over the period 1995-2014. Unlike previous studies, we first analyse the direction of causality between these variables and then, we estimate the short run and the long run effects of GDP per capita on health expenditure per capita.

The results of our empirical analysis indicate that there is a unidirectional relationship between health expenditure per capita and GDP per capita and the direction of this relationship is from GDP per capita to health expenditure per capita.

Moreover, we find that GDP per capita has a positive impact on health expenditure per capita both in the short run and the long run. So, we argue that economic growth is a significant determinant of health expenditure in the European Union countries over the period under investigation.

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