RANK CORRELATION BETWEEN HEALTH CARE EXPENDITURES AND SOME SELECTED VARIABLES OF HEALTH STATUS

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Abstract

One of the main strategies of the EU is the strategy Europe 2020. The smart, sustainable and inclusive growth of the economy should be positively correlated with an increase of population health. Economic performance of a country influences the expenditures of health care. The rank correlation coefficient of 23 EU Member States between the rank of the gross domestic product per capita and the current health care expenditures per capita in 2010 is positive and very close to 1, what indicates, that between these variables exists a strong association. Also the Spearman correlation coefficient of the health care expenditures and health status is statistically significant but not so strong anymore. It means that the countries with the highest levels of the health care expenditures are not always rated so perfectly according to the health status of their population. More important for the self-perception of good health is the overall living standard measured by the GDP per capita.

Key words: Spearman´s rank correlation coefficient, health status, health expenditures, mortality rates, gross domestic product

JEL Code: C1, I00, J10

Introduction

The main aim of this paper is to discover, using the rank correlation measures, whether there exists a statistically significant relationship between the selected variables. The selected variables should cover the economic situation of a country and therefore the GDP per capita in purchasing power standards (PPS) was chosen. GDP is a characteristics of the output of economy and its growth can be used as a proxy of the country´s productivity (Pivoňka – Loster, 2013). On the other hand some variables that are related to health sector were selected: current health care expenditures per capita in PPS, health status, infant and neonatal mortality rates. All of the variables were collected from the databases of Eurostat and the comparison

was done for the most actual year (2010) with the minimum of missing values of selected variables. Unfortunately not all of the EU Member States were included in the analysis because some of the 28 Member States do not provide the necessary data for our comparison.

1 Measures of health status and health care expenditures

Our assumption is that there is a positive and statistically significant relationship between the variables that we have included in the analysis. We expect a positive relationship between the country's economic performance and health expenditure. Countries that spend little on health also have poorer health conditions (Poullier et al., 2002). The U.S. outspends its peers on health care, yet its population doesn't enjoy the world's longest life expectancy and the nations with the highest average life expectancies vary greatly in how much they spend on health care per capita (Glassman, 2013).

Economic performance of a country can be measured by various macroeconomic characteristics that depend on the size of the economy and the price level of the country. Therefore, we decided to choose the GDP per capita, expressed in purchasing power standards, i.e. in a common currency that eliminates the differences in price levels between countries, which allows a meaningful volume comparison of the GDP levels between countries. To measure the countries expenditures on health care the System of Health Accounts is used. Health care data on expenditure are largely based on surveys and administrative data sources in the countries. Current expenditure on health (CHE) measures the economic resources spent by a country on health care services and goods, including administration and insurance. Total expenditure on health (HE) represents CHE enlarged by the expenditure on capital formation of health care providers (Health care expenditure, Eurostat). To make the comparison between regions meaningful the CHE per capita in PPS were used. As it was mentioned the main aim is to discover the relationship between the economic situation in a country, the expenditures on health care and the health status of citizens in the EU Member States. One of the important question is how to measure or how to describe the health status of the population?

The commonly used measures to indicate the health status are (Day & Tousignant, 2005): potential years of life lost, infant mortality rate, perinatal mortality rate, age-standardized mortality rate, life expectancy. For the purpose of our analysis the infant mortality rate (InfMR) and neonatal mortality rates (NeoMR) were chosen. NeoMR represents the ratio of the number of deaths of children under 28 days during the year while

InfMR is the ratio of the number of deaths of children under one year of age during the year to the number of live births in that year (expressed per 1000 live births). Both mortality ratios reflect in general the standards of obstetric, pediatric care and the effectiveness of the attention paid to maternal and child health.

As a possible way how to describe the health status of the European citizens serve The European Statistics of Income and Living Condition (EU-SILC) survey, that contains a small module on health. The variables on health status measures the following concepts of health: self-perceived health, chronic morbidity, activity limitation-disability. For the analysis the self-perceived health indicator was selected. The self-perceived health concept gives answer to the question on how a person perceives his/her health in general using one of the answer categories: very good /good / fair / bad / very bad. For the analysis the cumulative percentages of the answer categories: very good and good as percentage of the total population aged 16 years old or over served as the characteristics of the health status (HS) of the population in a given EU Member States. Association between the HS and the economic situation in a country is expected. For example in countries with a high unemployment rate, in regions strongly affected by the economic crisis more often problems with mental health of adults are possible. Amount of earnings, as well as unemployment rate in regions, income distribution, inequality, poverty affects the entire economic process and the life of the population (Loster – Langhamrová, 2012).

2 Rank correlation

Spearman´s rank correlation coefficient r_s is a nonparametric measure of statistical association between two variables. Before calculating the pair ranks correlation coefficients between variables the data were converted into ordinal variables. The first order has got the country with the most positive situation in the data set of a selected variable and the last position was assigned to the country with the worst value of the variable. According to this conclusion three of the selected variables (CHE per capita, GDP per capita, health status) where we expect that the maximum value is a positive aspect of its development, the countries were sort from the maximum to the minimum and new columns with ranked values *1, 2, ..., n* were created. Similarly the variables (InfMR, NeoMR) where we expect that the minimum value is a positive aspect of its development the countries were sort from the minimum to the maximum values and again new columns with ranked values *1, 2, ..., n* were produced.

Spearman rank correlation coefficient is defined by the following formula

$$r_s = 1 - \frac{6\sum d_i^2}{n\left(n^2 - 1\right)} \qquad (1)$$

where n is the sample size and d_i is the difference in rank of corresponding variables.

The correlation coefficient value ranges between -1 and +1 and indicates how the scores are relating. In general if the coefficient r_s is closer to 1 it implies a positive agreement among ranks while r_s closer to -1 indicates agreement in the reverse direction.

In table 1 the results of the calculations of the Spearman rank correlation coefficients are presented. The correlation was calculated for 23 EU Member States in year 2010. Due to the missing values of the current health care expenditures per capita only following countries were included in the analysis: Belgium, Bulgaria, Czech Republic, Denmark, Germany, Estonia, Spain, France, Croatia, Cyprus, Latvia, Lithuania, Luxembourg, Hungary, the Netherlands, Austria, Poland, Portugal, Romania, Slovenia, Slovakia. Finland, Sweden.

Tab. 1: Spearman coefficient of ranked variables* (year 2010)

Spearman Correlation Coefficients, N = 23 Prob > |r| under H0: Rho=0					
	CHE	**GDP**	**HS**	**InfMR**	**NeoMR**
CHE	1.00000	0.95850 <.0001	0.59585 0.0027	0.44664 0.0326	0.42589 0.0427
GDP	0.95850 <.0001	1.00000	0.71443 0.0001	0.54051 0.0077	0.50198 0.0147
HS	0.59585 0.0027	0.71443 0.0001	1.00000	0.26877 0.2149	0.20158 0.3563
InfMR	0.44664 0.0326	0.54051 0.0077	0.26877 0.2149	1.00000	0.96542 <.0001
NeoMR	0.42589 0.0427	0.50198 0.0147	0.20158 0.3563	0.96542 <.0001	1.00000

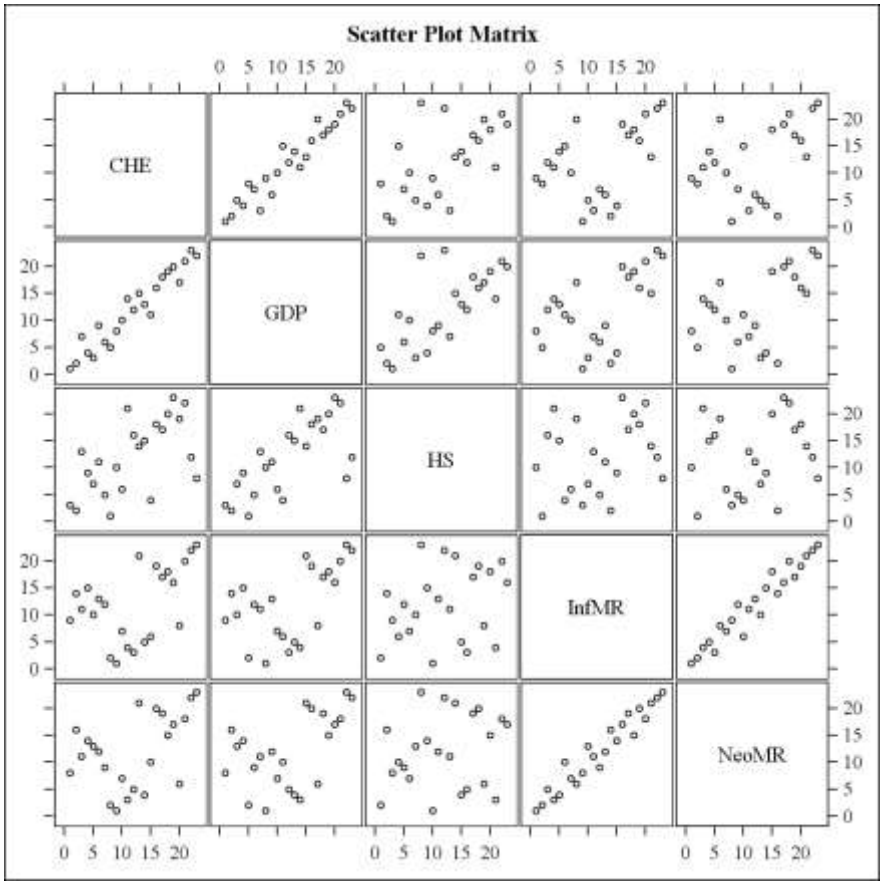
Source: Eurostat, own calculations (* CHE – Current health care expenditures in PPS per inhabitant, GDP in PPS per inhabitant, HS – self-perceived health status as very good and good in % of the total population aged 16 years old or over, InfMR – infant mortality rate, NeoMR – neonatal mortality rate)

The highest rank correlation coefficient r_s = 0.965 (P<0.0001) was reached between two selected mortality rates. It is an expected result. It gives us an answer that in a country with a low InfMR we can expect also a very low NeoMR and vice versa. The lowest InfMR

(2.3) and also the lowest NeoMR (1.5) were reached in Finland, which has got the first rank for both variables. The highest InfMR (9.8) an the highest NeoMR (5.5) were reached in Romania. These high mortality rates shift Romania to the end of the ranking.

Very high and statistically significant was also the rank correlation (r_s = 0.959, P<0.0001) between the GDP per capita and the current health care expenditures per capita in PPS. According to the way how the ranks were arranged we can give the following answer to this coefficient. Countries with a high GDP per capita have also the CHE per capita in high levels (and vice versa). The first rank with the highest GDP (64 000 PPS) and CHE (4 286 PPS) per capita were reached in Luxembourg. The last 23rd position in rank of GDP per capita (10 800 PPS) was engaged by Bulgaria, which reached the 22nd ranked position of the CHE per capita (709 PPS). According to this result we can expect, that as a countries GDP will increase so will increase also the current health care expenditures of that country. The next question is whether high CHE per capita are correlated with a better health status of the citizens.

Fig. 1: Scatter Plot Matrix



Source: Eurostat, own calculations

As it was described above the health status in this case measures the proportion of the population that rated their health as very good or good. Also in this case the rank correlation coefficient is statistically significant but it is not as high as it was in previous cases (r_S = 0.596, P = 0.003). The best, first position according the HS was reached in Sweden, where as much as 80 % of the adult population perceived their health as good or very good. In the same year Sweden has got only 8th position in ranking of the second variable (CHE per capita). Croatia got the last 23rd rank according the HS, while only 47 % of all adults considered themselves to be in good health, on the other side Croatia´s health expenditures per capita shift that country to the 19th position. A stronger relationship was discovered between HS and GDP per capita (r_S = 0.714, P = 0.0001). It means, that between the rank of countries according health status and CHE per capita exists a positive correlation, but it is not as high as the correlation between health status and GDP per capita. Self reported health is more correlated to the overall living standard measured by GDP per capita than by the health expenditures per capita. It is a very important finding, because the GDP per capita is more important of people´s overall perception of their own health than the health expenditures per capita. The overall living standard creates a more important influence on individual health judging.

Moderate correlation was typical for the GDP per capita and mortality rates and also for the CHE per capita and mortality rates. Interesting is again the comparison of the rank correlation results. A higher correlation is between the rank of the GDP per capita and the InfMR (r_S = 0.54, P = 0.008) or the NeoMR (r_S = 0.502, P = 0.015) then between the CHE per capita and InfMR(r_S = 0.447, P = 0.033) or the NeoMR (r_S = 0.426, P = 0.043). It seems like a very similar situation when compared the GDP per capita and HS and the CHE per capita and HS. The rank of a country by mortality rate was more influenced by the overall living standard than only by the current expenditures for health care. Also according to Hussey et al. (2013) the direction of association between health care cost and quality is inconsistent; the association is small to moderate. There exist other factors that influence the quality of health of an individual. Health care spending is an important contributor to quality, but the determinants of quality reach more deeply into a community's sociodemographic fabric (Cooper, 2009). The health status can be influenced by different social impacts, for example unemployment. Apart from the economic impacts, long-term unemployment can impress a loss of normal social life, but also psychological problems (Loster – Langhamrová, 2011).

The unemployment can affect migration from the less developed regions and cause problems with demographic trends in those areas. The most developed regions are characterized by high level of migration activities (Janotka – Gazda, 2012).

Conclusion

Due to a very high and positive association between GDP and CHE per capita is clear that countries with a high GDP have also very high health expenditures per capita. Ii means that as countries GDP will grow so will increase also the health care expenditures of that country. The correlation coefficient between the CHE per capita and other selected variables of the health status, mortality rates show also a positive but only a moderate association. A higher impact on health status, InfMR or NeoMR has the overall living standard measured by the gross domestic product per capita in PPS. The rank correlation coefficient was higher between the GDP per capita and selected variables of the health status than between the CHE per capita and the same variables. The increase of the health expenditures does not immediately mean that the health status of the population is better. In this paper only a few aspects of the health status were checked, but authors of some other scientific papers cited in the text got very similar results.

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References

Cooper, R. (2009). A. States with more Health Care Spending Have Better-Quality Health Care: Lessons About Medicare. *Health Affairs*, *28*, w103-w115.

Day, K., & Tousignant, J. (2005, June 1). Health Spending, Health Outcomes, and Per Capita Income in Canada: A Dynamic Analysis. Retrieved March 5, 2014, from https://www.fin.gc.ca/pub/pdfs/wp2005-07e.pdf

Glassman, M. (2013, December 5). U.S. Health-Care Costs vs. Life Expectancy. Bloomberg Businessweek.

Health care expenditure. (n.d.). Retrieved March 3, 2014, from http://epp.eurostat.ec.europa.eu/cache/ITY_SDDS/EN/hlth_sha_esms.htm

Hussey, P. S., Wertheimer, S., & Mehrotra, A. (2013). The Association Between Health Care Quality and Cost A Systematic Review. *Annals of Internal Medicine*, *158*, 27-34.

Janotka, M., & Gazda V. (2012). Modelling of the Interregional Migration in Slovakia. *Journal of Applied Economic Sciences*, vol. 7, 48-55.

Loster, T., & Langhamrova, J. (2011, September 22). Analysis of long-term Unemployment in the Czech Republic. Retrieved February 10, 2014, from http://msed.vse.cz/msed_2011/en/toc

Loster, T., & Langhamrova, J. (2012, September 13). Disparities between regions of the Czech Republic for non-business aspects of labour market. Retrieved February 22, 2014, from http://msed.vse.cz/msed_2012/en/toc

Pivonka, T., & Loster, T. (2013, September 19). Clustering of EU countries before and during Crisis. Retrieved March 10, 2014, from http://msed.vse.cz/msed_2013/en/toc

Poullier, J., Hernandez, P., Kawabata, K., & Savedoff, W. D. (2002, November). Patterns of Global Health Expenditures: Results for 191 Countries. Retrieved March 15, 2014, from http://www.who.int/healthinfo/paper51.pdf

Statistics Database. (n.d.). Retrieved March 1, 2014, from http://epp.eurostat.ec.europa.eu/portal/page/portal/statistics/search_database

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