

# A COMPARATIVE ANALYSIS OF HOUSEHOLDS EXPENDITURE ON HEALTH IN THE EU COUNTRIES

Marlena Piekut – Magdalena Kludacz

---

## Abstract

In the hierarchy of values, health care is at the top of the list. In 2012 the average share of the the EU households expenditure on health in the total EU households expenditure was 3,7%. However, there are considerable differences in health care expenditure among EU member countries. The aim of this paper is to analyze the household expenditure on health in the European Union countries. The research problems concern such issues as: an indication of the degree of differentiation and the rate of change in households expenditure on health in 1995-2012 in European countries; a comparison of the expenditure on health in selected countries and Clusters Analysis of European countries grouped by the similar share of health expenditure in the total expenditure of households. We used three clustering methods in the following study, such as: complete- linkage clustering, Ward's method and a K-means clustering method. The selection of the countries for cluster analysis was based on the value of the *Tabular Accuracy Index*. The ongoing demographic processes and gradual growth of the wealth of nations have significant impact on increased demand for medical services including increased household expenditure on health.

**Key words:** health care financing, health measures, clustering methods

**JEL Code:** C1, D12, I13

---

## Introduction

In the hierarchy of values, health care is at the top of the list. The ongoing demographic processes and gradual growth of the wealth of nations have significant impact on increased demand for medical services including increased household expenditure on health. The aim of this paper is to analyze the household expenditure on health in the European Union countries and confront these results with indicators describing the health state of communities.

In this article, we attempt to characterize the level and share of health expenditure in households from EU countries. Information presented in this article represents only a narrow slice of very broad issues connected with health care financing. Data, which was analysed using various research tools, come from a public database Eurostat.

## 1 Health expenditure in the years 1995-2012

In EU countries, household expenditure on health is continuing to increase. The average spending per capita in 1995 was almost 204 euros, in 2005 - more than 403 euros, and in 2012 around 531 euros (Table 1). The coefficient of variation indicates a large variation in health spending between EU countries. The values of the coefficient of variation indicates a very large variation in the level of health expenditure in the second half of the 90s - the coefficient of variation was greater than 60%. In the first decade of the twenty-first century, the coefficient of variation has been reduced steadily reaching about 49% in 2008. In 2009, the considered coefficient increased nearly by 52%. This suggests that the financial and economic crisis has affected the increasing disproportion in expenditure among European households. During the next years, the coefficient of variation has been reduced reaching a value of incomplete 45% in 2012.

Coefficient of skewness indicates that until the mid-decade of the 21st century, the health expenditure of most of the EU countries were above the average. Since 2004, when 10 Central European countries entered the European Union, and then after EU accession of the next countries from poorer European regions, we observe a right-sided asymmetry in the distribution of health expenditure.

Kurtosis values indicate that health expenditure in the households of the European countries achieve the platykurtic distribution throughout the whole analysed period.

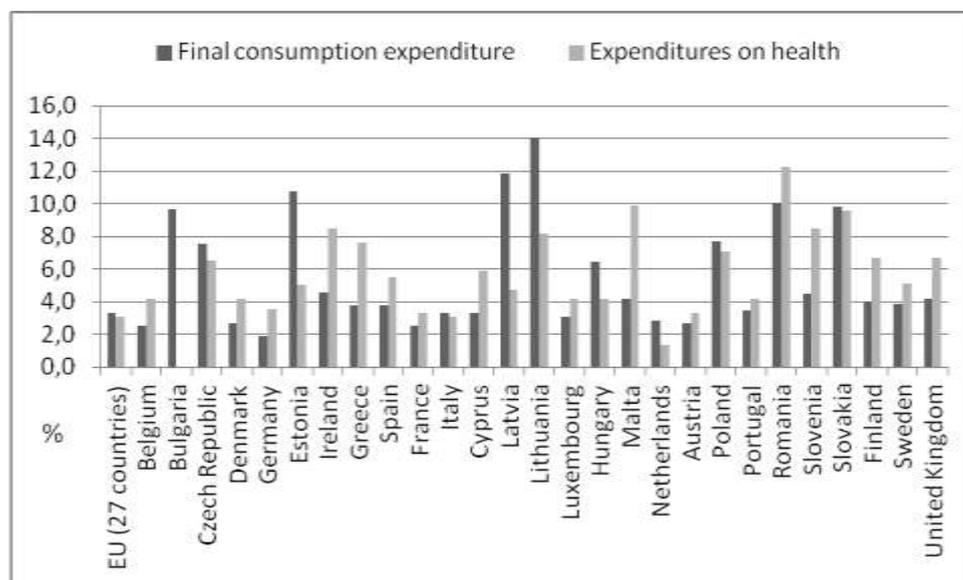
**Tab. 1: Statistical measures for analyzing health expenditure of households, period of 1995-2012**

Specification	Means	Standard deviation	Coefficient of variation	Skewness	Kurtosis
1995	203,6	166,6	81,9	0,09	-1,27
1996	217,9	165,7	76,0	-0,04	-1,27
1997	250,0	173,2	69,3	-0,25	-1,29
1998	264,3	174,7	66,1	-0,03	-1,02
1999	271,4	178,2	65,6	-0,13	-1,15
2000	296,6	186,1	62,8	-0,05	-0,83
2001	320,7	193,4	60,3	-0,09	-0,97
2002	344,8	199,3	57,8	-0,03	-1,01
2003	365,5	209,2	57,2	-0,18	-1,21
2004	382,8	215,6	56,3	-0,11	-1,32
2005	403,4	224,4	55,6	0,06	-1,12
2006	413,8	210,0	50,7	0,15	-0,96
2007	437,9	232,1	53,0	0,22	-0,79
2008	479,3	236,6	49,4	0,32	-0,63
2009	479,3	248,4	51,8	0,27	-0,82
2010	486,2	244,5	50,3	0,28	-0,88

2011	517,9	249,5	48,2	0,20	-0,87
2012	530,8	237,9	44,8	0,20	-0,89

Source: own work based on data from Eurostat

**Fig. 1: The dynamics of changes in total expenditure and household expenditure on health for the period of 1995-2012, (in %)**



Source: own work based on data from Eurostat

Household expenditure on health care per capita in the EU countries are diverse, which is the result of differences in the level of economic development. They grew in most of EU countries (in 16 out of 27 analyzed countries) usually at a faster rate than the total expenditure of households. The greatest differences were observed in Malta (total expenditure increased by 4.2% year-on-year, and health expenditure by 9.9%), Ireland (4.6% and 8.5%), Greece (3.8% and 7.7%) and Spain (3.8% and 5.5%) and Romania (10.1% and 12.2%). In the EU-27 countries the growth of total expenditure (the average annual increase in expenditure was 3.3%) and the growth of household expenditure on health (expenditure increased by 3.1% year-on-year) was at a similar level. Only in Estonia, Latvia and Lithuania and Hungary were observed significantly higher growth in total expenditure compared to household expenditure on health.

## 2 Clusters of EU countries due to the share of health expenditure

To create groups of states, and thus to illustrate the similarities and differences in the share of health expenditure in the EU countries, we used two hierarchical clustering methods: complete-linkage clustering and Ward's method, and one non-hierarchical method – the K-means clustering method.

In complete linkage method, the distance between the clusters is determined by the maximum distance between any two objects belonging to different clusters (i.e. "the farthest neighbors"). Creating the clusters begins with treating all objects as one element cluster. In the next steps, the clusters separated by the shortest distance are combined, and their distance is determined by minimizing the distance between the clusters obtained in the previous step. The clusters are then sequentially combined into larger clusters, until all elements end up being in the same cluster. This method is generally useful in cases where the objects actually form the naturally separated groups. It is not applicable when the clusters are some way elongated or have a nature of the "chain" (*Analiza...*, [http; Schilcher, Michaëlsson, Aspenberg, 2011](http://Schilcher, Michaëlsson, Aspenberg, 2011)).

Alternative approach for performing cluster analysis is Ward's method, which deploys the analysis of variance approach to determine the distances between clusters. This method minimizes the increase of the total within-cluster sums of squares, which is also known as the error sums of squares (ESS). ESS measures the extent to which the analyzed variables in a given cluster differs from clusters mean. At the beginning of the procedure, it is assumed that each object is a separate cluster. Then the pair of most similar clusters (with minimum between-cluster distance) are merged. At the initial step, all clusters are singletons (clusters containing a single point). This method is considered effective because it ensures the homogeneity of objects within the cluster, while the heterogeneity between clusters (Ward, 1963). Then, in the dendrogram of the clustering result, the longer branches of clusters (where the distances between cluster are bigger) are cut off to obtain the optimal number of clusters.

K-means clustering involves determining the number of clusters associated with their centroids (center of gravity). The distance is calculated for each object from the centroid and then each object is assigned to the cluster with the closest centroid (e.g., in accordance with Euclidean distance). After such assignment centroids are modified based on the current contents of the cluster and then objects are again assigned according to the same principles. This procedure leads to a moment in which the objects stop moving. If two objects are relatively similar, they are placed in the same group, and criteria of similarity are updated taking into account a new set of items in cluster. K-means clustering is very Fast, robust and easily understandable. Main disadvantage is a need of predefined cluster centers and in this algorithm, complexity is more as compared to others.

The selection of the countries for cluster analysis was based on the share of health expenditure in the total expenditure of households in the period 1995-2012.

The selection of the countries for cluster analysis was based on the value of the Tabular Accuracy Index (TAI). This index was suggested by G.F. Jenks (Jenks, 1971). The numerator is the sum of the differences (in absolute values) between the data values and the mean of each class where the data values are found. The denominator is the sum of the differences (also in absolute values) between the observed values and the general mean value of the entire data set (Evans, 1977) (2). The TAI is given by the following formula:

$$TAI = 1 - \frac{\sum_{j=1}^k \sum_{i=1}^{n_j} |x_{ji} - \bar{x}_j|}{\sum_{i=1}^n |x_i - \bar{x}|} \quad (2)$$

where:

$x_i$ - observed values of the data set,  $n$ - the total number of observations,  $\bar{x}$ - the general mean of the data set calculated with all the values  $x_i$  (i runs from 1 to n),

$x_{ji}$ - values  $x_i$  of the class  $j$  (i runs from 1 to  $n_j$ ),  $n_j$ - number of observations in the class  $j$ ,  $\bar{x}_j$ - the class mean calculated with the observed values of the class  $j$ . (j runs from 1 to k,  $k$ = number of classes).

The TAI varies between 0 and 1. The higher number of classes, the higher is value of TAI. One of the advantages of this index is its high sensitivity.

The use of different clustering methods yielded the slightly different results (tab. 2). The highest TAI indexes was obtained using Ward's method. For further analysis, we used the cluster groups classified by using this method. The clusters included from 1 to 6 objects.

**Tab. 2: Clusters of countries due to the share of health expenditure in total households expenditure and the average growth rate of these expenditures in the period 1995-2012 according to various clustering methods**

Skupienia	Complete linkage	Ward's method	K-means method – 5 clusters	K-means method – 6 clusters
1	Romania	Romania	Romania, Greece, Lithuania, Malta	Romania
2	Malta, Lithuania, Poland, Ireland, Greece	Malta, Lithuania, Poland, Ireland, Greece	Belgium, Portugal	Malta, Lithuania, Poland, Ireland, Greece
3	Finland, Germany, Cyprus, Slovenia, Slovakia, Hungary, Bulgaria, Portugal, Belgium	Finland, Germany, Cyprus, Slovenia, Slovakia, Hungary, Bulgaria	Finland, Germany, Cyprus, Slovenia, Slovakia, Hungary, Bulgaria, Ireland, Poland	Bulgaria, Cyprus, Finland, Germany, Hungary, Slovakia, Slovenia
4	The Netherlands	Portugal, Belgium	Czech Republic,	Czech Republic,

			France, Spain, Sweden	France, Spain, Sweden
5	The United Kingdom, Luxembourg, Estonia, Denmark, Sweden, Czech Republic, Latvia, Italy, France, Spain, Austria	The United Kingdom, Luxembourg, Estonia, Denmark, Sweden, Czech Republic	The United Kingdom, Luxembourg, Estonia, Denmark, Austria, Italy, Latvia, the Netherlands	Austria, Denmark, Estonia, Italy, Latvia, Luxembourg, the Netherlands, the United Kingdom
6		The Netherlands, Latvia, Italy, France, Spain, Austria		Belgium, Portugal
<b>TAI</b>				
<b>the share of expenditures on health</b>	0,475	0,554	0,567	0,579
<b>the average growth rate</b>	0,680	0,673	0,567	0,507

Source: own work based on data from Eurostat

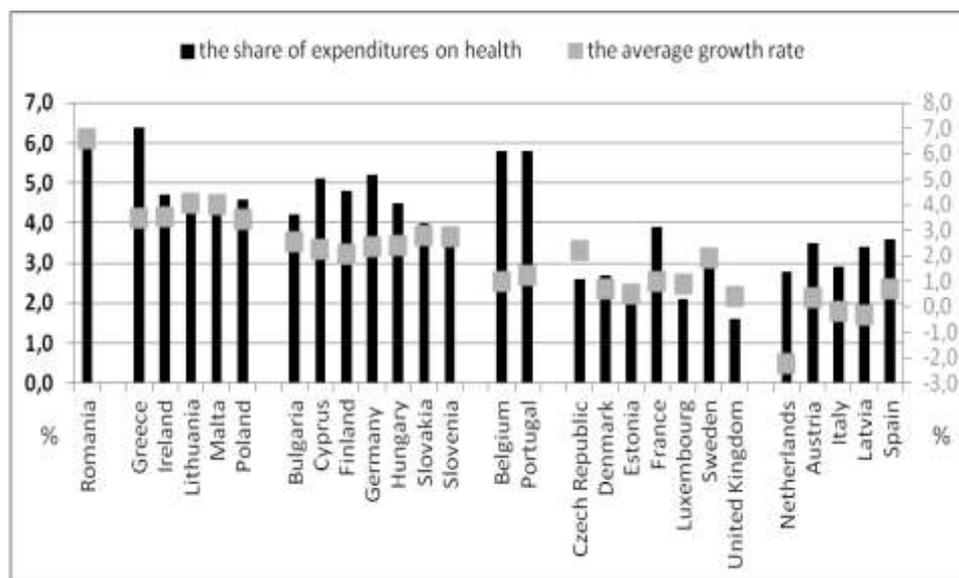
The first cluster contains only one element, which is Romania. A characteristic feature of Romania is one of the highest shares of health expenditure in the total expenditure of households and the highest growth rate of those expenditure in the analysed period.

Additional health insurance introduced in 1999 resulted in a significant increase in expenditure on health. It is indicated (Doboş, 2008) that the payments for drugs and medical care in Romania are high. Some drugs in outpatient care are paid out of pocket. The dynamically increasing share of private medical and dental clinics increases the share of household expenditure on health in Romania.

The results of EU-SILC project<sup>1</sup> indicate, that in Romania, a relatively high proportion of the population is satisfied with their health, especially in comparison to other countries from Central and Eastern Europe. In 2012, nearly 81% of Romanians found that is satisfied or very satisfied with their health. However, the expected average life expectancy for babies born in 2011 in Romania was 74 years, which places the Romanians on one of the last places in the EU.

<sup>1</sup> EU-SILC - European Union Statistics on Income and Living Conditions, more about the study: [http://epp.eurostat.ec.europa.eu/portal/page/portal/microdata/eu\\_silc](http://epp.eurostat.ec.europa.eu/portal/page/portal/microdata/eu_silc)

**Fig. 2: Clusters of countries due to the share of spending on health in 2012 and the average growth rate of health spending in the years 1995-2012 in European households**



Source: own work based on data from Eurostat

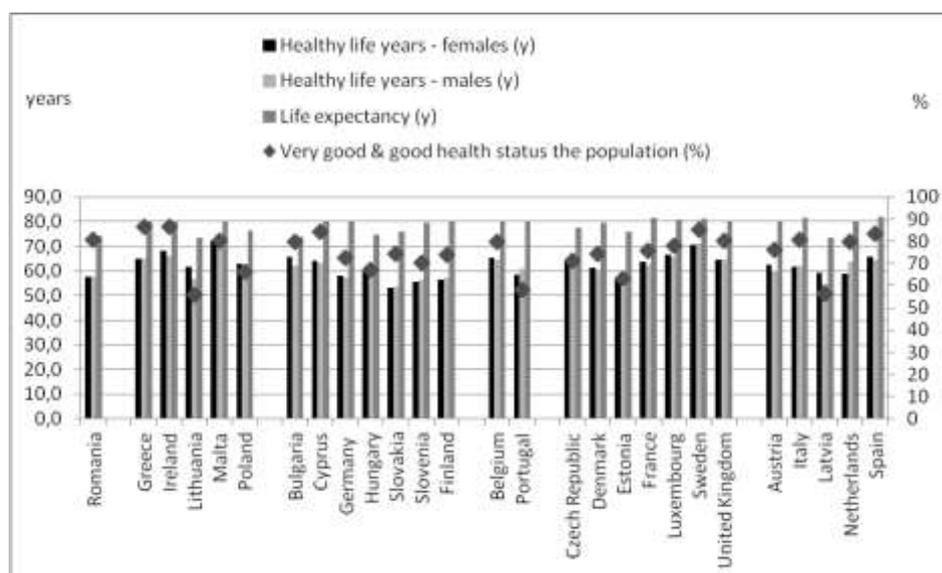
The second cluster contains the countries (Table 2), in which the growth rate of spending on health, with the exception of the first cluster, was highest among the analyzed clusters. The share of health expenditure in the total expenditure of households stood at 4.5-4.7%, only in Greece was 6.4%.

Shares of health expenditure in households from different countries are in part the result of health care financing model functioning in the country. The health care financing system in the countries from the second cluster is characterised by a public sector, financed through general tax revenue. Additionally there are voluntary health insurance available. The Greek healthcare system has constitutionally guaranteed access to health care services, but fast-growing private healthcare results in increased household expenditure on health. Greeks more and more often use the medical services offered by the private clinics because they are afraid of lower quality public care and they desire to shorten the waiting time for the health services. The study (Liaropoulos, Siskou, Kaitelidou, Theodorou, Katostaras, 2008) showed, that 42% of respondents from Greece paid extra "informally" fee because they were afraid of

worse services, and one in five Greeks claimed that the doctor demanded additional charges. Hence, such a high growth rate in the share of health expenditures in household budgets.

The research EU-SILC shows that the Greeks is one of the nations that better assess their health. Nearly 87% of Greeks found that is satisfied or very satisfied with their health. A similar share of respondents from Ireland declared satisfaction with their health. In the second cluster, Lithuanians and Poles were the least satisfied with their health. Approximately 56% of the Lithuanians and over 66% of Poles declared that their health is good or very good. Poland and Lithuania were the countries with relatively shorter life expectancy compared to other European countries. Moreover, it was reported that Greece and Ireland have a longer healthy life expectancy than Poland and Lithuania. It was noted that inhabitants of Malta have the longest healthy life expectancy (about 72 years) among all EU countries.

**Fig. 3: Measures of health for the clusters of countries according to the method of Ward in 2012.**



Commentar: y = years; % = percent

Source: own work based on data from Eurostat

The third cluster contains the countries where the share of health expenditure ranged from 3.8% in Slovenia to 5.2% in Germany. The share of health expenditure in total households expenditure increased year-on-year from 2.1% to 2.8%. This cluster contains the countries with a dominant public health care financing system, but in Germany, the main source of funds for health service expenditures is obligatory health insurance, and in Finland, the tax revenues.

In the third cluster, the country with a highest proportion of the population satisfied with their health status was Cyprus - around 85% in 2012. A relatively high percentage of satisfied respondents was also noted in Bulgaria - 80%. The lowest share of the population indicating at least satisfactory health status was noted in Hungary - 67%. The countries with the longest average life expectancy for babies born in 2011 were: Germany and Cyprus (more than 80 years old) and country with the shortest average life expectancy was Bulgaria – 74 years. It was also noted that the Slovaks, Slavs and Finns are communities with the shortest healthy life expectancy in the EU.

The fourth cluster contains the countries with a relatively high share of health expenditure - 5.8%. The share of these expenditure in total households expenditure increased about 1-1,2% in the period 1995-2012. In Portugal, the health care system is financed through general tax revenue, and out of pocket payments are an additional source of healthcare funding. On the other hand the health care in Belgium is financed through compulsory and voluntary health insurance schemes, out of pocket payment and tax revenue.

The research EU-SILC suggests that in 2012, the Portuguese were one of the nations less satisfied with their health status. Approximately 58 percent of Portuguese respondents declared satisfaction with their health, at least at good or very good level. Belgians much better assessed their health – 80 percent of respondents declared that their health is good or very good.

The fifth Cluster contains seven countries, where reported one of the lowest shares of health expenditure in total households expenditure - from 1.6% in the UK to 3.9% in France. Average rate of change ranged from 0.4% to 2.2% per year. The health care system in these countries is financed mainly from the public funds.

The level of satisfaction with health is varied in the countries of the fifth cluster. The results indicate that a country with best assessment of a health status is Sweden- more than 85% of Swedes were satisfied or very satisfied with their health, and then British - over 80 percent of respondents are satisfied or very satisfied. The worst in this respect are the Estonians - 63 percent of respondents declared that they have a good or very good health. The Swedes were in second place after Malta in terms of healthy life expectancy. The statistical Swede should live without a disability about 66 years.

The sixth Cluster contains three countries: the Netherlands, Italy and Latvia. A characteristic feature of this cluster was a negative rate of change in the share of health expenditure in total households expenditure. In other countries, there was a positive rate of

change, which, however, did not exceed 0.7% per year. The share of health expenditure in the total expenditure of households stood at 2,8%-3,6%. In the Netherlands, health care is financed from a combination of public and private sources, i.e. from compulsory social health insurance and voluntary private health insurance.

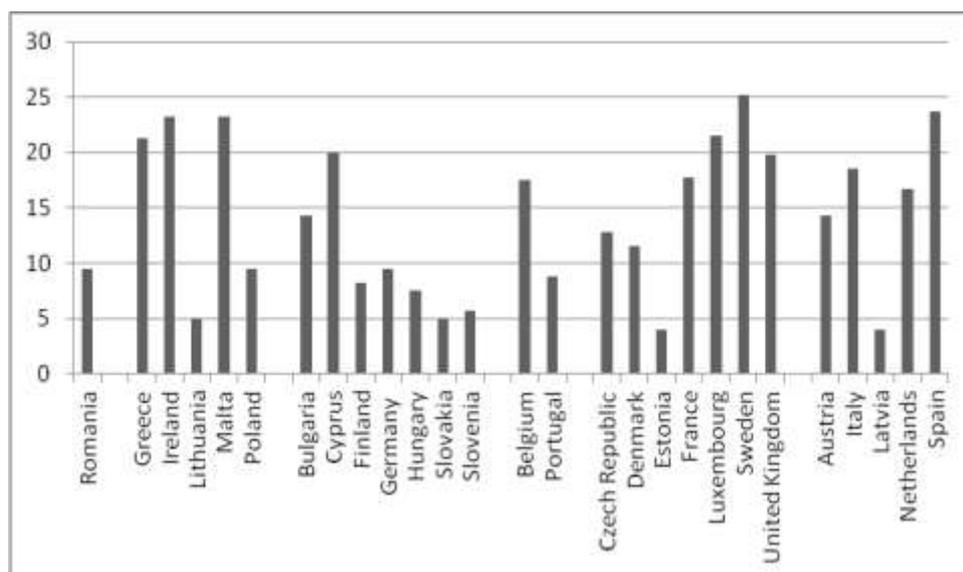
The inhabitants of Spain, Italy and the Netherlands have the best opinion about their health status - in 2012 over 80 percent of respondents declared that their health is good or very good.

In Spain and Italy there was also the longest life expectancy among inhabitants of EU - approximately 82 years. The results indicate that a country with worst assessment of a health status is Latvia - only 56 percent of respondent declared that they have at least good health. According to statistics, the relatively short life expectancy is projected for the inhabitants of Latvia, it means more than 56 years for babies born in 2011. It is almost the worst indicator among EU countries (next to the Lithuanians and the Portuguese).

It is pointed out (Kludacz 2013; Zalewska 2013) that the health indicators in the European Union are improving in many dimensions, such as: decreasing gap between the life expectancy of men and women, decreasing mortality from chronic diseases, decreasing declared nuisance due to noise, decreasing exposure of population to air pollution. On the other hand the favorable trends can be affected by the recessions and economic slowdown (Czech 2012; Piekut 2014).

The synthetic measure calculated for each country on the basis of health status indicators is not dependent on a share of health expenditure in the household budgets. It means that health situation of the population in the countries with higher share of such expenditure is not more favorable than in other countries (the synthetic measure is not higher).

**Fig. 4: Synthetic measure\* for health status indicators for groups of EU countries**



\*Commentary: Each member of the EU has received the value from 1 to 27 for each health status indicators (Life Expectancy for women, Life Expectancy for men, Healthy Life Years, Very good & good health status of the population). The value of 1 meant the least favorable situation (the shortest life expectancy, the shortest healthy life expectancy, the lowest proportion of the population satisfied with the state of health), and a value of 27 meant the most favorable situation. Then all the values were summed and the mean was calculated, which is called a synthetic measure.

Source: own work based on data from Eurostat

## Conclusion

It's difficult to assess what determines the share of household expenditure on health in total expenditure. Undoubtedly, it is the result of health care system solutions implemented by the country, as well as a consequence of historical circumstances, social and economic opportunities and ideological reasons. The analysis shows that measures of health status which were calculated for populations with a similar share of health expenditure are different.

On the basis of this analysis we can conclude that there is a wide variation in household expenditure on health in different EU countries. In most countries, health expenditure remains below the EU average.

The highest share of health expenditure in the total expenditure was noticed in the households from Romania, Greece, Belgium and Portugal, and the lowest in the households from UK, Estonia and Luxembourg. In the years 1995-2012, the highest positive rate of change in the share of expenditures on health was observed in Romania, and the highest negative rate of change in the Netherlands.

The conclusion from the analysis of health status measures was that the countries of North and South Europe have the most favorable indicators (longer life, greater

satisfaction with health status). The worst in this respect are the countries of Central and Eastern Europe, particularly the Baltic countries.

In this paper, using multivariate statistical methods, we obtained a specific classifications of EU countries due to the the similar share of health expenditure in the total expenditure of households. Cluster analysis is a statistical technique that allows to summarise a dataset by grouping similar observations together into clusters. Its aim is to construct groups in such a way that the profiles of objects in the same groups are relatively homogeneous whereas the profiles of objects in different groups are relatively heterogeneous. This enables to draw conclusions, but using the methods of the cluster analysis we should be cautious about the results. Statistical methods are useful in the research, however, they should be supported by expert knowledge in a particular field. The methods used in the paper (complete-linkage clustering, Ward's method, k-means) provide the ability to quickly analyze data and jump to interesting conclusions. It is appropriate to use more than one statistical method in order to fully exploit the information contained in the data and for more comprehensive analysis.

## References

- Czech A. (2012). Metodologiczne aspekty badań konsumpcji w ujęciu bezpośrednim, *Ekonomia i Zarządzanie* 4, 7-17
- Doboş, C. (2008). Finanțarea sistemelor de sănătate în țările Uniunii Europene. România în context European. *Calitatea vieții*, (1-2), 107-123.
- Evans, I. S. (1977). The selection of class intervals. *Transactions of the Institute of British Geographers*, 98-124.
- Everitt, B. S., Landau, S., Leese, M., & Stahl, D. (2011). Optimization clustering techniques. *Cluster Analysis, 5th Edition*, 111-142.
- Eurostat. Database 2014. <<http://epp.eurostat.ec.europa.eu/>>
- Kłudacz M. (2013). Wycena usług szpitalnych na szczeblu centralnym w wybranych krajach europejskich. *Przedsiębiorczość i Zarządzanie*, no. XIV, 261-273
- Jain, A. K. (2010). Data clustering: 50 years beyond K-means. *Pattern Recognition Letters*, 31(8), 651-666.
- Jenks ,G. F., Caspall, F. C. (1971) *Error on choroplethic maps: definition, measurement, reduction*. „Annals of the Association of American Geographers”. 61(2), s. 217-244.
- Liaropoulos, L., Siskou, O., Kaitelidou, D., Theodorou, M., & Katostaras, T. (2008). Informal payments in public hospitals in Greece. *Health Policy*, 87(1), 72-81.
- Piekut, M. (2014). Wydatki na zdrowie w gospodarstwach domowych–porównanie międzynarodowe. *Economics and Management*, 1, 79-96.
- Schilcher, J., Michaëlsson, K., & Aspenberg, P. (2011). Bisphosphonate use and atypical fractures of the femoral shaft. *New England Journal of Medicine*, 364(18), 1728-1737.
- Ward Jr, J. H. (1963). Hierarchical grouping to optimize an objective function. *Journal of the American statistical association*, 58(301), 236-244.

Zalewska M. (2013). Analiza wybranych wskaźników zdrowia publicznego w świetle strategii zrównoważonego rozwoju w krajach UE. *Problemy Zarządzania* 11 (1), 53-71

Zeliaś, A. (2002). Some notes on the selection of normalization of diagnostic variables. *Statistics in transition*, 5(5), 787-802.

### **Contact**

Marlena Piekut

Warsaw University of Technology, The College of Economics and Social Sciences

ul. Łukasiewicza 17, 09-400 Płock

piekutm@pw.plock.pl

Magdalena Kludacz

Warsaw University of Technology, The College of Economics and Social Sciences

ul. Łukasiewicza 17, 09-400 Płock

m.kludacz@pw.plock.pl