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OWNERSHIP VERSUS EFFICIENCY: A CROSS-COUNTRY COMPARATION OF HEALTH SYSTEMS

Original scientific paper
UDK: 614.2:005.336.1(4-69)
JEL classification: C14, H44, I11, I18

Abstract

Introducing market mechanisms to the health systems of transition countries in Central, Eastern and South-Eastern Europe (CESEE) after 1990, has not met expectations and the biggest changes are yet to come. The main objectives of this paper are to compare health systems' efficiency of CESEE countries and in the second stage to analyze whether the different ownership of health care providers is associated with the health system efficiency. Therefore, the relative technical efficiency of decision making units (DMUs), i.e. health system in CESEE countries, is obtained from the BCC model using data envelopment analysis (DEA) technique. The analysis of efficiency level of health systems in CESEE countries offers valuable information on possibilities for improving the efficiency. Furthermore, analyzing the impact of different ownership of health care providers on the efficiency is an important step towards improvement of the health system, on the basis of which it is possible to define the desired state as well as the way to achieve it.

Keywords: health system efficiency, ownership, transition economies

1. INTRODUCTION

Health care expenditure plays a significant role in the transition economies of Central, Eastern and South-Eastern Europe (CESEE). Countries face resource constraints for providing health services and that constraints are more prominent in low- and mid-income countries (Sun et al., 2017). Because of the financial pressure and concerns over long-term financial sustainability, improving the efficiency of health system is one of the most important management challenges. According to Mirmirani et al. (2008), transition economies embrace

myriad economic and social changes and transition has turned out to be vastly more complicated and extraordinary than first thought. As countries endeavor to move toward "marketization" many transitional countries have implemented and are still undertaking health care reforms aimed at introducing market mechanism in traditionally public health systems. (Nemec and Kolisnichenko, 2006).

Involving the private sector in infrastructure development is one of possible solutions for overcoming the gap between needs and possibilities that contemporary health systems have to face. The issue of balance between the public and private is a complex one. Despite the strengths on the paper, examinations of international experiences are necessary to point out the various issues of health care reforms. However, the problem of measuring performance of different providers of health services is especially complex in a cross-country analysis, i.e. in evaluating the overall health system's performance. (Cylus and Pearson, 2016) Furthermore, prior studies have rarely investigated the impact of private sector providers of inpatient health services on health system's performance. In order to understand the relationship between government spending and efficiency, Sun et al. (2017) emphasize the importance of further investigation into how service delivery systems are organized and financed.

Due to lack of knowledge about the impact of different agreements between the public and private sector aimed at providing health care services, further evaluations of their performance are required. A lot of research on differences between public and private health care providers, especially on the extent to which they benefit their society, remain inconclusive. This issue is especially important in transition economy, where the private sector was introduced in health system in the transition period, when the market was not completely development.

Hence, this study includes private sector participation in providing health care services in the analysis of health system in order to investigate their impact on health system's efficiency. Namely, the purpose of this study was to analyze the technical efficiency of health system in selected CESEE countries, using data envelopment analysis (DEA) technique. Furthermore, in the second stage the aim was to analyze whether different ownership of providers of inpatient health care services is associated with health system's efficiency.

The organization of the paper is as follows. The next section presents literature review of performance measurement in health systems, while the third section provides a detailed description of data and model specification. Results are presented in the fourth section. Conclusions are given in the last, fifth section.

2. MEASURING OF PERFORMANCE IN HEALTH CARE – LITERATURE REVIEW

In order to measure performance of health care services, different parametric and non-parametric methods have been employed over the last few decades. Performance can be defined as an appropriated combination of efficiency and effectiveness. Taking that into consideration, efficiency refers

to using minimum inputs for a given number of outputs. On the other hand, effectiveness evaluates the outcome which includes the dimension of quality, i.e. it refers to using inputs and outputs and produces the best possible outcome.

According to Ozcan (2016), the origins of efficiency in association with Farrell's study in 1857 and the theoretical development of the DEA approach begun in 1978 by Charnes et al. DEA is a nonparametric linear programming based technique which develops efficiency frontier by optimizing the weighted output/input ratio of each provider, with condition that this ratio can equal, but never exceed, unity for any other providers of data set. In the health care, DEA was first applied in 1983, when Nunamaker and Lewin measured nursing service efficiency.

Among the various methods of efficiency assessment, DEA has gained the attention of many researchers (see for example: Dash et al., 2010; De Nicola, 2011; Mangnussen, 1996; Mogha et al., 2012, 2015; Rabar, 2010; Slijepčević, 2014; Staat, 2006;). More recent applications of DEA to measure performance in health system are described below.

Measuring of health system's efficiency is one of the most challenging areas of health system performance. Hollingsworth (2008) established that only 4% of health care efficiency studies were cross-section. According to Mirmirani et al. (2008), as the containment of health care costs becomes more difficult, the focus of attention has been shifted to the efficiency of an entire health care system.

Furthermore, most cross-section studies measure effectiveness of health systems. Evans et al. (2001) investigated relative effectiveness and they concluded that it is positively related to health expenditure per capita. Furthermore, according to them, countries with the best level of health do not always have efficient health system. Haddat et al. (2013) examined health care system's effectiveness, and in the second step of analysis they concluded that institutional arrangements, population behavior, socioeconomic and environmental determinants are associated with health care system effectiveness. Sunn et al. (2017) examined effectiveness of health system from 173 countries from 2004 through 2011 and they concluded that HIV/AIDS prevalence, health financing mechanisms and governance are statistically associated with the effectiveness of national health systems. The aforementioned authors conducted a two-step analysis, where in the second step the results of the effectiveness analysis were compared to certain variables which were assumed to affect the relative effectiveness results. However, the structure of ownership is not analyzed throughout these studies.

The majority of research in the area of health care efficiency has focused on the organizational level. In a research of that kind, Farsi and Filippini (2006) explored the cost structure of Swiss hospitals, focusing on differences caused by teaching activities and those across different ownership and subsidization types. They didn't provide any evidence of significant efficiency differences across ownership and subsidization categories.

However, the wide variation in cultural and economic characteristics of the worldwide sample of countries can lead to wrong conclusions, i.e. heterogeneity can be declared as inefficiency (Green, 2004). Furthermore, the

aforementioned research papers did not focus on transition economy. Mirmirani et al. (2008) measured the relative effectiveness of health system in a sample of transition economy nations over the period of 1997-2001. To calculate relative effectiveness of health system with DEA approach, life expectancy and infant mortality are used as outcomes, while hospital beds, physicians, health care expenditure and percentage of children immunized for measles are incorporated as inputs. Limitation of their research is a large number of variables and a small sample of countries, which is not in accordance with the rule of thumb.

Additionally, it is challenging to appropriately attribute particular inputs to health outcomes because health is the result of complex processes which include medical care, wealth, education, occupation, housing, the environment, genetics etc. (Cylus and Pearson, 2016)

According to Linna et al. (2010), due to the difficulties in relation to the measurement of output as a consequence of case-mix, international comparisons of hospital efficiency are relatively scarce in the literature. They compared the performance of hospital care in four Nordic countries: Norway, Finland, Sweden and Denmark. They calculated cost efficiency in the production of somatic hospital care for public hospitals. They calculate cross-section evaluation, but they investigated hospitals as providers, not health systems. Also, they used cost variables, although measuring the technical efficiency leads to better comparability in international studies (for detail explanation see 3rd section).

Although it is difficult to clearly identify the reasons why different providers have different results (in terms of output or outcome) performance needs to be evaluated and compared across health care providers in order to detect changes throughout time, comparing with other providers, adjusting to public policy mandates and responding to reimbursement changes (Ozcan, 2016). Performance evaluation creates benchmarks and provides information to the entities in question on how to improve their performance. Therefore, this is exactly what we need in the health systems today.

3. HEALTH SYSTEM BENCHMARKING USING DEA

3.1. Data description

The original data set comprises sixteen selected CESEE countries. Due to lack of information on inputs and outputs of health system, as well as on private providers of inpatient health care, this paper analyzes nine CESEE countries[1]. According to Green (2004), the wide variation in cultural and economic characteristics of the worldwide sample of countries produces a large amount of unmeasured heterogeneity in the data. For that reason, the inefficiency estimation mistakenly measures that heterogeneity as inefficiency. Because of that, this paper is focused on CESEE countries with similar process of health care reforms, which commenced under similar circumstances after 1990.

[1] This paper intended to analyze these EU countries: Bulgaria, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovak Republic, Slovenia, five non-EU countries of former

In the first step of the analysis, the efficiency of national health systems was evaluated, while in the second step the relationship between the level of efficiency and the share of a private entity in inpatient health care was examined. Thus, this study considered two sets of variables for selected countries: variables for DEA (inputs and output) and number of private inpatient hospital beds (as a percentage of all beds).

The aim of this paper is to measure efficiency, i.e. to calculate technical efficiency using DEA technique. Technical efficiency shows the use of input factors for the provision of services, in which inputs and outputs are defined in non-monetary terms. The selection of inputs and outputs was guided by previous empirical studies and depended on the availability of data. According to Worthington (2004), difficulties in defining the cost of inputs in the public sector are the main reason for the domination of the measurement of the technical efficiency within the health system. In addition to the above mentioned, according to Mirmirani et al. (2008), measuring the technical efficiency leads to better comparability with international studies. Furthermore, labor and capital were considered as important inputs in the provision of health care services (Cheng et al. 2016). As this study investigated the efficiency of health systems, it used the number of physicians working in hospitals and number of hospital beds as inputs. The same authors argued that the number of inpatients is better output that the inpatient days. Because of the correlation between number of inpatients and the average length of stay, this study used the number of inpatients as the output. Due to the limitation of evaluating small number of DMUs, which use large number of inputs to provide large number of health services, analyst need to include only those inputs and outputs which provide the essential components of the service production process. Therefore, in order to have adequate numbers of degrees of freedom it is necessary to apply rule of thumb: ($n \geq 3*(m+s)$) where n is number of DMUs, m is number of inputs and s is number of outputs. (Ozcan, 2016)

All data were obtained from the European health for all database.

3.2. Model specification

DEA is a comparative approach for identifying performance by considering multiple resources that are used to achieve outputs (efficiency) or outcomes (effectiveness). DEA identifies the optimal ways of performance, rather than the average, which distinguishes it from other techniques. It does not required an assumption on the functional form and can handle multiple inputs and outputs. (Cheng et al., 2016)

Types of DEA models can be identified based on the scale and orientation of the model. CCR model assumes constant rate of substitution between inputs and outputs while BCC model presupposes existing the economy of scale. Furthermore, in order to become more efficient, model can be oriented towards input minimization or output maximization. According to Hadad et al. (2013),

Yugoslavia (Bosnia and Herzegovina, Croatia, FYR Macedonia, Montenegro, Serbia;), and Albania.

increasing needs and limited possibilities that contemporary health systems have to face, has brought a clear policy implication - the aim to maximize the value of investments in health system.

Due to the above mentioned and assuming variable returns to the scale, the output oriented BCC model was chosen for this analysis. Formulation of the chosen model is presented below (Hadad et al, 2013).

Consider n DMUs where each DMUj (j=1,...,n) uses m inputs $\overrightarrow{X_j} = (X_{1j}, X_{2j}, ..., X_{mj})^T > 0$ to produce S outputs $\overrightarrow{Y_j} = (Y_{1j}, Y_{2j}, ..., Y_{Sj})^T > 0$. For each unit k, model finds the best weights U_r^k (r=1,2,...,S) and V_i^k (i=1,2,...,m) that maximize the ration of total weighted output to the weighted input with $h_k = \underset{U_r^k V_i^k}{Max} \frac{\sum_{r=1}^{S} U_r^k Y_{rk}}{\sum_{i=1}^{m} V_i^k X_{ik}}$ (k=1,2,...,n). The BCC model adds a constant variable L_k to the weighted output in order to permit variable returns to the scale. The output-oriented BCC model is formulated as follows (Formulas 1-5):

$$h_k = Max \sum_{r=1}^{s} U_r^k Y_{rk} + L_k \quad (1)$$

s.t

$$\sum_{i=1}^{m} V_i^k X_{ik} = 1 \quad (2)$$

$$\sum_{r=1}^{s} U_r^k Y_{rj} - \sum_{i=1}^{m} V_i^k X_{ij} + L_k \leq 0, j = 1,..., n \quad (3)$$

$$U_r^k \geq \varepsilon > 0, r = 1,2,..., s \quad (4)$$

$$V_i^k \geq \varepsilon > 0, i = 1,2,..., m \quad (5)$$

DEA forms a frontier using the efficient DMUs. The efficient DMUs receive a score 1 and those that are not on the efficient frontier line, have scored less than 1, but greater than 0.

4. RESULTS OF EFFICIENCY ACROSS DIFFERENT STRUCTURE OF OWNERSHIP

Table 1 presents descriptive statistics for inputs and output of nine CESEE countries for 2013. Statistical data show very large differences in the size of the hospital system of selected countries, measured using selected inputs and generating output in this year. Selected hospital system, on average, had 580 beds and 55 physicians per 100 000 inhabitants, working in stationary/inpatient health care. On 100 000 inhabitants, average inpatient care discharges were 20, ranging from minimum 11.21 to maximum 30.62 patients.

Table 1

Descriptive statistics of inputs and output (per 100 000 inhabitants)

Statistics	Hospital beds	Physicians working in hospitals	Inpatient care discharges
Minimum	442.79	33.79	11.21
Maximum	728.20	64.79	30.62
Mean	579.6322	54.9833	19.8811
Standard Deviation	98.49324	9.32510	5.31743

Source: author's calculation

Table 2 evidences the technical efficiency scores obtained from the output oriented BCC model. The efficiency analysis was conducted using computer software Frontier Analyst Banxia Software.

Table 2

Technical efficiency scores of health system in selected CESEE countries

Country	Efficiency score	Rank	1/score
Bulgaria	1	1	1
Croatia	0.69	9	1.45
Czech Republic	0.72	8	1.39
Estonia	0.86	4	1.16
Latvia	0.75	7	1.33
Lithuania	0.80	6	1.25
FYR Macedonia	1	1	1
Romania	0.81	5	1.23
Slovenia	1	1	1

Source: author's calculation

As it can be observed from the first column, this model shows that three out of nine health systems are efficient. Health systems of Bulgaria, Macedonia and Slovenia received a score of 1 and are considered efficient. These systems are used to create an efficient frontier against which all other systems are compared. Observing the last column, those having the score greater than 1, are inefficient. These systems can improve their efficiency by augmenting their outputs. So, the Croatian health system needs to augment the output by 45% (1-1.45) in order to improve its efficiency.

The identification of optimal performance leads to benchmarking. Namely, identifying top performance of health system (Table 3), DEA provides information on alternative ways to raise efficiency (Table 4).

Table 3

Benchmarks for health system in selected CESEE countries

Country	Refs	Peers
Bulgaria	7	
Croatia	0	2 (Bulgaria, Slovenia)
Czech Republic	0	2 (Bulgaria, Slovenia)
Estonia	0	2 (Bulgaria, Slovenia)
Latvia	0	2 (Bulgaria, Slovenia)
Lithuania	0	1 (Bulgaria)
FYR Macedonia	2	
Romania	0	3 (Bulgaria, Slovenia, MKD)
Slovenia	6	

Source: author's calculation

Based on the set of reference values (Table 3), three of them turn out to be the leaders with the best performance (health system of Bulgaria, Macedonia and Slovenia). They are on the best practice frontier and thus form the "reference set". Namely, the third column (refs) presents number of references. For example, Bulgarian health system is a benchmark for six other health systems in the sample. Furthermore, for every inefficient health system, the model identifies a set of corresponding efficient health systems (peers). They present referent set which can be used as a benchmark for improving the performance of inefficient ones. Therefore the Croatia who has most inefficient health system, has two benchmark health system i.e. health system of Bulgaria and Slovenia.

Table 4

Target values of inputs and output (per 100 000 inhabitants)

Country	Hospital beds		Physicians working in hospitals		Inpatient care discharges	
	Target value	% of change	Target value	% of change	Target value	% of change
Bulgaria	681.64	0	54.23	0	30.62	0
Croatia	585.87	0	54.63	-7.8	25.35	44.9
Czech Republic	645.89	0	54.38	-7	28.65	38.5
Estonia	500.53	0	54.98	-15.1	20.65	16.5
Latvia	579.98	0	54.65	-0.4	25.02	33.4
Lithuania	681.64	-6.4	54.23	-16	30.62	25.5
FYR Macedonia	442.79	0	33.79	0	11.21	0
Romania	596.40	0	49.75	0	24.51	23.2
Slovenia	455.39	0	55.17	0	18.16	0

Source: author's calculation

According to Table 4 and using the example of the most inefficient health system of Croatia, it can be concluded that with the existing inputs, the Croatian health system needs to increase the number of discharged patients by 45% to become technically efficient (the same result was also obtained in Table 2, as only one output was analyzed). On the other side, despite the augmentation in the output, Lithuania should also reduce hospital beds by 6.4% and physicians by 16%, in order to achieve an efficient score.

In the final step of the analysis, the relationship between the level of efficiency and the share of a private entity in inpatient health care was examined (Table 5). Namely, to test whether the efficient and inefficient health systems differ significantly according to the structure of private and public providers of inpatient health care, F-test of difference between the two independent samples and corresponding analysis of variance (ANOVA) is used. Although this is a test of differences between means of the two groups as t-test, the F-test can be used equivalently. In addition, the F-test is robust to heteroscedasticity of the variance between the two samples, so it is not necessary to conduct the tests of homogeneity of variances.

Table 5

Descriptive statistics of efficient and inefficient health systems with F-test of differences in means (private inpatient hospital beds as % of all beds).

Statistics	Efficient health systems	Inefficient health system	F-test	p-value
Mean	7.0600	6.7833	0.003	0.955

Source: author's calculation

According to Table 5 it can be concluded that there is no statistically significant difference between the participation of private sector in provision of inpatient health care between efficient and inefficient health systems. However, Bulgarian health system is a benchmark for all inefficient health systems in the sample and it has the largest scale of private providers of stationary health care in the sample (17.13% private inpatient hospital beds in all beds). But, Macedonia and Slovenia have much smaller scale of private providers, 2.96% and 1.09% private inpatient hospital beds in all hospital beds.

The search for explanations of the observed result using the presented data proved to be difficult. Although more analyses are needed to reveal the causes of presented result, there are few possible explanations of this result. Private entities see their investment as something that will be profitable for them. At the level of the overall health system, private entity is more likely to offer more-profitable services, i.e. more accessible services for a large number of people (Kordić, 2013). However, in that case, a new question is immediately raised - who pays for preventive or primary health care, i.e. whether savings in the public budget, made on the basis of cheaper services, result in higher spending on expensive inpatient health services.

Health policy makers and governments must be careful when designing health policy and national regulations. One more potential dangerof involving private entities in the provision of health services is not declaring standards that define the appropriate level of quality and availability of health services. In this situation, private entities can compromise quality and availability with the aim of maximizing profit, resulting in a rise demand for expensive health services in the future.

5. CONCLUSION

In this paper, author has evaluated the technical efficiencies of health system in nine transition CESEE countries in 2013 in order to investigate whether there is a connection between different ownership of health providers and the achieved level of efficiency. Namely, selected countries have implemented and are still undertaking health care reforms aimed at introducing private sector in traditionally public health system. They see the private sector as one of possible solutions for overcoming the gap between the needs and possibilities that health systems have to face. However, the expected results of these activities have not been realized yet.

To calculate relative efficiency, DEA technique has been applied and more precisely estimates of efficiencies have been obtained by the output-oriented BCC model. The set of inputs consists of the number of doctors and the number of beds, while the number of the patients represents the output.

The results indicate that the level of technical efficiency of selected health system is 85 percent. Health system of Bulgaria, Macedonia and Slovenia received a score of 1 and are considered efficient, i.e. they represent the referential set for other relatively inefficient health systems. The results from the second stage of analysis indicated that there is no statistically significant difference between the participation of private sector in the provision of inpatient health care between efficient and inefficient health systems. Due to lack of knowledge on public-private partnership in transition countries, the current cooperation has not always had positive results.

Contributions of this research are measuring relative efficiency in homogeneity sample of transition CESEE countries aimed at investigating influence of private providers of inpatient health care on the efficiency of overall health system. Namely, most of cross-section analysis measure effectiveness of health system, but it is challenging to appropriately attribute particular inputs to health outcomes as health is the result of complex processes. Furthermore, most of cross-section analyses evaluate heterogeneous sample of countries thus jeopardizing the wrong interpretation of inefficiencies. In addition to the above stated, previous cross-sectional analyses compared the efficiency score to a certain variable, but, the structure of ownership has not been analyzed among these variables.

Although same theoretical questions can limit the interpretation of the results, this analysis offers valuable information about the possibilities for improving the efficiency and the role of private providers in achieving the desired state. This study can be improved and further extended. First limitation is the size of the sample due to data limitation. Furthermore, the study did not obtain information about the case mix. Finally, two step analyses can apply to investigate other factors which can influence the health system efficiency. A better insight into observed results, i.e. making conclusions on any causal relationship can only be achieved by collecting more detailed data.

REFERENCES

Cheng, Z. et al. (2016). Efficiency and productivity measurement of rural township hospitals in China: a bootstrapping data envelopment analysis. *BMJ* Open 6, n. pag.

Cylus, J. and Pearson, M. (2016). Cross-national efficiency comparisons of health systems, subsectors and disease areas. In Cylus et al. (eds.) *Health system efficiency, How to make measurement matter for policy and management*. European Observatory on Health Systems and Policies Series, WHO Regional Office for Europe, Copenhagen.

Dash, U. et al. (2010). Technical efficiency and Scale efficiency of District Hospitals: A Case Study, *Journal of Health Management*, Vol. 12, Issue 3, pp. 231-248.

De Nicola, A. et al. (2011): A two-stage DEA model to evaluate the efficiency of the Italian health system, *MPRA Paper*, No. 39126. http://mpra.ub.uni-muenchen.de/39126/ [Accessed 30.08.2012]

Evans, D. B. et al. (2001). Comparative efficiency of national health systems: cross national econometric analysis. *BMJ* 323.7308, pp. 307-310.

Farsi, M. and Filippini, M. (2006). Effects of ownership, subsidization and teaching activities on hospital costs in Switzerland. Quaderno N. 06-06, https://doc.rero.ch/record/5894/files/wp0606.pdf, [accessed 7.04.2017].

Greene, W. (2004). Distinguishing between heterogeneity and inefficiency: stochastic frontier analysis of the World Health Organization's panel data on national health care systems. *Health Economics,* 13.10, pp. 959-980.

Hadad, S. et al. (2013). Determinants of healthcare system's efficiency in OECD countries. *The European Journal of Health Economics*, 14(2), pp. 253-265.

Hollingsworth, B. (2008). The measurement of efficiency and productivity of health care delivery. *Health Economics*, 17, pp. 1107–1128.

Kordić, L. (2013). Influence of socioeconomic and demographic environment on private health care providers. *Croatian Operational Research Review (CRORR)*, Vol. 4, pp. 120-130.

Linna et al. (2010) Measuring cost efficiency in the Nordic Hospitals—a cross-sectional comparison of public hospitals in 2002, *Health Care Management Science*, 13, pp. 346–357.

Mangnussen, J. (1996). Efficiency measurement and the operationalization of hospital production, *Health Services Research*, 31 (1), pp. 21-37.

Mirmirani, S. et al. (2008). Health Care Efficiency In Transition Economies: An Application Of Data Envelopment Analysis. *International Business & Economics Research Journal (IBER)*, 7(2), pp. 47-56.

Mogha, S. K. et al. (2012). Performance Evaluation of Indian Private Hospitals Using DEA Approach with Sensitivity Analysis, *International Journal of Advances in Management and Economics*, 1 (2), pp. 1-12.

Mogha, S. K. et al. (2015). New slack model based efficiency assessment of public sector hospitals of Uttarakhand: state of India, *International Journal of System Assurance Engineering and Management*, 6 (4), pp.390-406.

Nemec, J. and Kolisnichenko, N. (2006). Market-based health care reforms in Central and Eastern Europe: lessons after ten years of change. *International Review of Administrative Sciences*, 72 (1), pp. 11-26.

Ozcan, Y. A. (2016). *Health Care Benchmarking and performance Evaluation: An Assessment Using Data Envelopment Analysis (DEA)*, Springer.

Rabar, D. (2010). Ocjenjivanje efikasnosti poslovanja hrvatskih bolnica metodom analize omeđivanja podataka, *Ekonomski preg*led, 61 (9-10), pp. 511-533.

Staat, M. (2006). Efficiency of hospitals in Germany: a DEA-bootstrap approach. *Applied Economics*, 38(19), pp. 2255-2263.

Slijepčević, S. (2014). Ocjena tehničke efikasnosti bolnica. In Vehovec, M. (ed.) *O zdravstvu iz ekonomske perspektive*, Zagreb, Ekonomski institut.

Sun, D. et al. (2017). Evaluation of the performance of national health systems in 2004-2011: An analysis of 173 countries. *Plos One,* 12(3), n. pag.

World Health Organization, European Health for All Database, http://data.euro.who.int/hfadb/, [accessed 7.02.2017].

Worthington, A. C. (2004). Frontier Efficiency Measurement in Health Care: A Review of Empirical Techniques and Selected Applications. *Medical Care Research and Review*, 61(2), pp. 135-170.