

IMPACT OF THE FINANCING STRUCTURE ON EFFICIENCY OF HEALTHCARE SYSTEMS IN THE FORMER EASTERN BLOC COUNTRIES

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Abstract: Out-of-pocket expenditures are a significant barrier in accessing health services. This paper aims to analyse the structure of financing system in the context of the performance indicators of healthcare systems. The study was conducted for the 28 countries of the former Eastern bloc in the years 2000 and 2013, based on data from the World Health Organization. In the DEA-CCR input-oriented model, inputs are the percentage share of private spending in the total expenditure on healthcare and the percentage share of out-of-pocket patient spending in total private spending. The outputs are life expectancy and mortality rate. A ranking of the countries was created and the differences between the two study periods, as well the desired directions of changes in the financing structure were pointed out.

Keywords: healthcare system, private expenditure, out-of-pocket spending, Data Envelopment Analysis

INTRODUCTION

All countries regardless of their level of economic development endeavour to improve the quality and accessibility of health services, which requires objective and reliable assessment of the functioning of their healthcare systems. The policy makers and the public expect the best possible effects due to the relatively high cost [González et al. 2010]. International comparative studies often use, among other resources, healthcare spending measured as the share of gross domestic product (GDP) or per capita. [Anell, Willis 2000]. Control of the healthcare financing system is a priority aspect of public policies design — especially in

recent years, due to soaring budget deficits and public debt caused by the economic crisis [de Cos, Moral-Benito 2014].

The access to medical care is affected by a number of factors, the most important of which are, according to the subject-matter literature: scope of access to healthcare, unmet needs related to medical care, out-of-pocket private medical expenses, geographic distribution of physicians and the time of waiting for planned treatment [OECD 2015].

An illness can cause worsening of economic security both directly and indirectly. For those without health insurance or with partial health insurance, medical expenses can be catastrophic, leading to debt or opting out of treatment at the expense of worsening health in the future. However, health insurance may cover different options and even the insured individuals may incur high costs, paying directly for some services or medicines [Stiglitz et al. 2009].

The purpose of this article is to find the relation between the share of private spending on healthcare (in particular the costs borne directly by the patient) and the results of the functioning of healthcare systems in countries of the former Eastern bloc. These are countries that at the beginning of the twenty-first century have to make radical changes in their health care systems. The study was conducted for 28 countries for the years 2000 and 2013, using Data Envelopment Analysis (DEA) method.

HEALTHCARE FINANCING

Health systems are usually funded from multiple sources, such as taxes, social insurance contribution and private insurance contributions or patients' out-of-pocket payments [Wagstaff et al. 1992]. The percentage of healthcare financing from public funds is used as an indicator enabling the assessment of the role of the state in this area. The strong role of the state, reflected by a high level of funding from the budget, points to better cost control and reduction of inequalities in access to medical services. On the other hand, the percentage of out-of-pocket patient payments or private insurance allows for the assessment of the financial burden imposed on society in the event of necessity to use health services. The high level of out-of-pocket expenses generally increases the difficulty of obtaining medical assistance for people with lower income and inferior health status [Wendt 2014]. The countries with a low share of public expenditure should aim at reducing the level of out-of-pocket payments in favour of prepaid private insurance. This way, the public could finance health services in a more predictable manner, without facing the problematic, sudden necessity to find the funds to pay for treatment in case of an unforeseen illness [Xu et al. 2005].

The financial security of patients provided by public or private health insurance substantially reduces the number of individuals paying for medical care directly, however in some countries the burden of out-of-pocket spending can create barriers in access to healthcare and in many cases prevent availing of it. The

households that encounter difficulties in paying medical bills may delay or even abandon the necessary healthcare [OECD 2015]. The large share of out-of-pocket payments in case of the poorer social groups exacerbates the risk of the so-called catastrophic spending, leading to impoverishment or abandonment of often necessary medical services [Xu et al. 2003; Xu et al. 2007]. Spending is defined as catastrophic if a household's share in financing healthcare exceeds 40% of the income remaining after satisfying the everyday needs [Xu et al. 2003]. Moving away from the out-of-pocket patients' payments towards mechanisms of prepaid private insurance is the key to reducing the possibility of a financial catastrophe [Xu et al. 2007].

RESEARCH ON THE EFFICIENCY OF HEALTHCARE SYSTEMS

The DEA method is widely used in testing the efficiency of healthcare systems at practically all levels, ranging from physicians (both primary and specialist care), through providers of medical services (hospitals, emergency assistance etc.), to global, country-level assessments. Depending on the purpose and scope of research, the models can have a more diverse structure. One of the fundamental difficulties indicated by many authors is providing the definition of the outcomes of healthcare systems [e.g. Retzlaff-Roberts et al. 2004; Afonso, Aubyn 2005; González et al. 2010; Hadad et al. 2013; Papanicolas, Smith 2013]. The main outcome of the system is the improvement of the health of society, however measuring such a parameter is difficult. It is much easier to define the inputs, which, when used properly, determine the overall efficiency. Usually the resource approach is used, based on quantifiable inputs such as the number of physicians or available infrastructure (e.g. number of beds, diagnostic equipment, financial resources etc.). It is also common practice to base models on variables indirectly reflecting outputs and inputs (proxies), which is a consequence of the availability of relevant data. Most often the public statistics are used. Institutions such as the World Health Organization (WHO), OECD and Eurostat, improve their data collection procedures, which increases the reliability of analyses.

Given the purpose of the article, the review of the literature focuses on the studies of the efficiency of health systems conducted in the world, treating expenditure and its structure as inputs.

The share of public spending in total healthcare expenditure [Or et al. 2005] was included as one of the inputs in the study of differences in physicians' efficiency of improving public health in OECD countries. In addition, the analysis takes into account the number of physicians, the level of GDP per capita, the level of education of the society, as well as the environmental variables: the consumption of alcohol and smoking. The outputs were based on the life expectancy at birth and at 65 years of age and the number of years of life lost due to heart diseases (for men and women separately), as well as mortality. These variables are commonly used as the outputs of healthcare systems.

The analysis carried out for the 165 countries for which data were available in the WHO database shows that the share of public healthcare spending and the size of healthcare spending in public budgets are two factors positively related to the functioning of healthcare systems [González et al. 2010]. A modified DEA model was used, allowing for the introduction of weight restrictions, which increases the discriminatory strength of the method. Two kinds of input, the total expenditure on health per capita and the expected length of education (as an environmental factor), as well as two outputs — healthy life expectancy and the disability adjusted life years — were taken into account. The level of public financing reached 64% in the most efficient countries from the sample, whereas in the least efficient ones the public funding did not exceed 50%. It can be said that in the countries whose governments show commitment to the development and financing of healthcare systems the available resources are used more efficiently, while allowing for achieving adequate health outcomes.

A similar approach to creating models of technical efficiency of healthcare systems can be found in other publications. In the case of OECD countries, a study of the efficiency of healthcare resources usage, measured by such parameters as the number of physicians, the number of beds per 1 000 inhabitants, the number of units of magnetic resonance imaging (MRI) per million inhabitants or healthcare spending as the percentage of GDP was conducted [Retzlaff-Roberts et al. 2004]. The authors adopted infant mortality rate and life expectancy at birth as the outputs. In the second stage, the analysis takes into account also the social and environmental factors, such as the Gini coefficient, the expected length of education or smoking. In another study of the same group of countries [Hadad et al. 2013] the authors built two models, which used life expectancy and infant mortality as outputs. The inputs in the first model were parameters considered controllable by healthcare systems, such as the number of physicians and hospital beds per 1 000 inhabitants, whereas the second one was based on inputs which cannot be controlled by healthcare systems, i.e. the GDP per capita and environmental factors such as the consumption of fruit and vegetables per capita. Both models also included the total expenditure on health per capita.

THE PROPOSED MODEL AND THE UTILISED DATA

'Efficiency', as used in this article, should be interpreted as technical efficiency, which evaluate by how much input quantity can be proportionally reduced without changing the output quantities [Afonso, Aubyn 2005].

The proposed model is based on two inputs: PRIV – the percentage share of private spending in the total expenditure on healthcare and OOP – the percentage share of out-of-pocket patient spending in total private spending (the remaining part of private spending is financed with prepaid health insurance). The overall health status of population is generally operationalized by indicators of longevity such as life expectancy, healthy life expectancy, overall mortality [Tchouaket et al.

2012]. In the opinion of OECD life expectancy at age 60 include advances in medical care combined with greater access to health care, healthier lifestyles and improved living conditions before and after people reach age 60. Increased life expectancy does not necessarily mean that the extra years lived are in good health [OECD 2015]. So the outputs are reflected by five variables: LE_F and LE_M – life expectancy at age 60 for men and women; HLE_F and HLE_M - healthy life expectancy at birth for men and women and MORT - mortality of adults aged 15–60 years per 1 000 people, which is the unwanted output and was included in the model as the difference 1 000-MORT. The assumptions are met that increased input reduces efficiency, whilst increased output increases efficiency [Dyson et al. 2001; Guzik 2009]. The basic descriptive statistics of variables for years 2000 and 2013 are presented in Table 1. The two last rows shows the differences between the mean and median values of the variables (2013–2000). The mean and median share of private spending did change in a small extent, however the mean and median share of patients' out-of-pocket expenditure decreased by 2.6 percentage points and 5.0 percentage points respectively, which is a proof of small development of the pre-paid health insurance. All outputs have improved: the mean value of LE_F and LE_M increased by about 7–8%, while the mean of remaining parameters increased by about 4–5%. The median value of all outputs grow up about 10%.

Table 1. The basic descriptive statistics of variables for years 2000 and 2013

Year	Statistics	PRIV	OOP	MORT	LE_F	LE_M	HLE_F	HLE_M
2000	Mean	41.2	91.2	813.0	19.5	15.8	64.6	58.3
	Stand. error	21.7	13.8	57.1	1.8	1.6	3.5	3.6
	Max	83.0	100.0	881.0	23.0	19.0	69.0	63.0
	Min	9.7	44.1	688.0	16.0	12.0	57.0	51.0
	Median	39.6	98.95	825.5	19.5	16.0	66.0	59.0
2013	Mean	41.2	88.6	848.7	21.1	17.0	67.3	61.1
	Stand. error	16.2	13.2	49.8	2.3	1.9	3.2	3.4
	Max	79.2	100.0	918.0	26.0	21.0	72.0	66.0
	Min	16.7	42.7	710.0	17.0	13.0	59.0	53.0
	Median	38.8	94.0	859.5	21.5	17.0	68.0	61.5
Change in the mean		0,0	-2.6	35.7	1.6	1.1	2.6	2.9
Change in median		-0,8	-5.0	34.0	2.0	1.0	2.0	2.5

Source: own computation

The non-parametric DEA method allows for assessing the relative efficiency of the compared objects, called Decision Making Units (DMUs), described by multiple inputs and multiple outputs. It is not necessary to know a functional relationship between the inputs and the outputs. The evaluation of the efficiency involves determining the DMUs creating the 'best practice' frontier and comparing them to other objects [Cooper et al. 2011].

The CCR (Charnes-Cooper-Rhodes) model, with constant returns to scale, was chosen as suitable when the set of evaluated objects is homogeneous [Eilat

et al. 2008]. Since only the inputs are controllable by the decision-makers shaping the health policy, an input-oriented model was adopted. In an input orientation improvement of efficiency is possible through proportional reduction of inputs. The efficiency score θ_o^* of DMU_o ($o = 1, \dots, n$) is calculated for given amounts of outputs y_{rj} , $r = 1, \dots, s$ and inputs y_{ij} , $i = 1, \dots, m$, where $j = 1, \dots, n$. The input-oriented CCR model is shown below. [Cooper et al. 2011]:

$$\theta_o^* = \min \theta_o \quad (1)$$

for the conditions:

$$\sum_{j=1}^n x_{ij} \lambda_{jo} \leq \theta_o x_{io} \quad i = 1, 2, \dots, m \quad (2)$$

$$\sum_{j=1}^n y_{rj} \lambda_{jo} \geq y_{ro} \quad r = 1, 2, \dots, s$$

$$\lambda_{jo}, \theta_o \geq 0 \quad j = 1, 2, \dots, n \quad (3)$$

where λ_j are intensity variables [Guzik 2009].

Using the above-described model, the 28 countries of the former Eastern bloc were analysed. Data from the years 2000 and 2013 from the WHO database were used. The calculations were carried out by means of the DEA-Solver-LV (3) software by Saitech.

THE RESULTS AND THEIR INTERPRETATION

The results of computation are shown in Table 2.

Table 2. The results of efficiency computation for the years 2000 and 2013

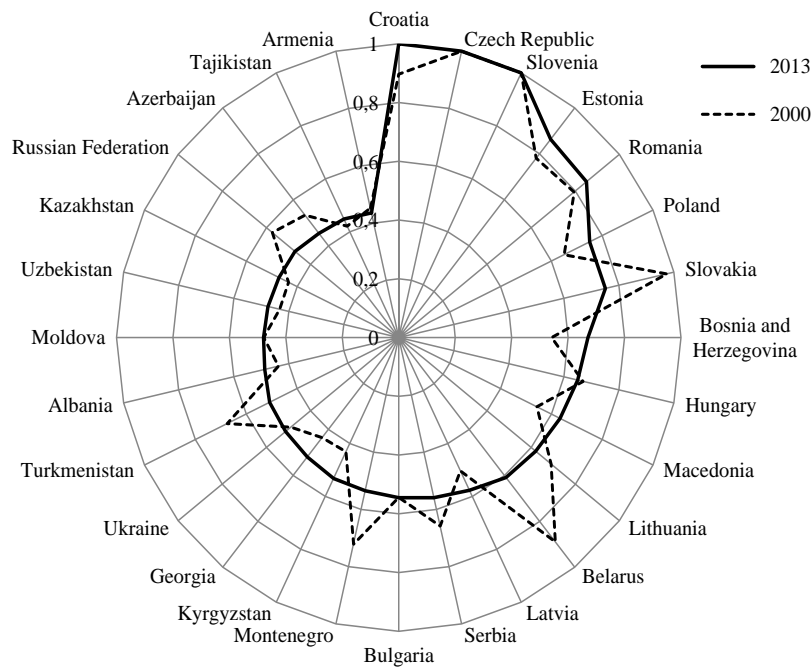
Country	2000		2013		Country	2000		2013	
	Ef	R	Ef	R		Ef	R	Ef	R
Albania	0.44	23	0.49	21	Lithuania	0.69	9	0.62	11
Armenia	0.45	22	0.44	28	Macedonia	0.54	16	0.63	10
Azerbaijan	0.53	18	0.45	26	Moldova	0.48	21	0.48	22
Belarus	0.89	5	0.61	12	Montenegro	0.72	8	0.53	16
Bosnia and Herzegovina	0.54	17	0.67	8	Poland	0.65	13	0.75	6
Bulgaria	0.54	15	0.55	15	Russian Federation	0.57	14	0.47	25
Croatia	0.90	4	1.00	1	Romania	0.79	6	0.85	5
Czech Republic	1.00	1	1.00	1	Serbia	0.66	12	0.56	14
Estonia	0.78	7	0.86	4	Slovakia	0.97	3	0.75	7
Georgia	0.44	24	0.52	18	Slovenia	1.00	1	1.00	1
Hungary	0.67	11	0.65	9	Tajikistan	0.42	28	0.45	27
Kazakhstan	0.43	25	0.47	24	Turkmenistan	0.67	10	0.51	20
Kyrgyzstan	0.43	27	0.53	17	Ukraine	0.49	20	0.51	19
Latvia	0.50	19	0.58	13	Uzbekistan	0.43	26	0.48	23

Source: own computation

Column "Ef" contains the efficiency score and column "R" the position in the ranking. In the year 2000 the full efficiency was achieved by the Czech Republic and Slovenia, which were among the best also in 2013. The full efficiency in 2013 was also reached by Croatia. These countries also had the best structure of spending in relation to the achieved results that were included in the model.

The figure below shows the efficiency scores in descending order, allowing for the analysis of the direction and magnitude of change.

Figure 1. Comparison of the efficiency scores in the years 2000 and 2013



Source: own elaboration

Table 3 contains the source data for selected countries. The Czech Republic and Slovenia, which are the leaders, improved all the outputs. The Czech Republic had the lowest value of PRIV (9.7% and 16.7%) of all the countries, with OOP equal to 100% in 2000 and 94% in 2013. Slovenia has private expenditure at the levels of 26.0% and 28.4% respectively, however OOP was equal to 44.1% and 42.7%. In 2000, Croatia had PRIV equal to 13.9%, whereas in 2013 it reached 20%. However, the share of OOP decreased from 100% in 2000 to 62.4% in 2013. Just as in the Czech Republic and Slovenia, all the outputs improved.

Table 3. Data from selected countries

Country	Year	PRIV	OOP	MORT	LE_F	LE_M	HLE_F	HL_M
Czech Republic	2000	9.7	100.0	875	21	17	69	63
	2013	16.7	94.1	907	24	19	71	66
Slovenia	2000	26.0	44.1	878	23	18	69	63
	2013	28.4	42.7	918	26	21	72	66
Croatia	2000	13.9	100.0	870	21	17	68	62
	2013	20.0	62.4	903	24	19	70	65
Belarus	2000	24.5	57.1	758	20	14	65	55
	2013	34.6	92.0	801	22	14	68	57
Slovakia	2000	10.6	100.0	853	21	16	68	60
	2013	30.0	73.9	882	23	18	70	63
Bosnia and Herzegovina	2000	43.3	100.0	881	21	18	68	63
	2013	30.0	96.9	899	22	19	70	66
Poland	2000	30.0	100.0	848	22	17	68	61
	2013	30.4	75.0	871	24	19	71	63

Source: own computation

The further analysis was based on countries which recorded the greatest increase or decrease of efficiency in the analysed period. The two countries which recorded the highest decline in efficiency, i.e. Belarus and Slovakia, had generally lower outputs than in the case of the leaders. Moreover, their improvement in the analysed period was lower than in the case of the best countries. The structure of expenditure deteriorated significantly in Belarus, PRIV increased from 24.5% to 34.5%, while OOP rose from 57.1% to 92.0%. On the other hand, in Slovakia PRIV increased from 10.6% to 30.0% but there was a decrease in OOP from 100% to 73.9%, but this is still near two times greater than minimum value 44,1%.

The two countries, which recorded the highest increase in efficiency (except Croatia), i.e. Bosnia and Herzegovina and Poland, had outputs similar to those of the leaders. In Bosnia and Herzegovina PRIV decreased from 43.3% to 30.0%, with almost constant OOP (100% and 96.9%). In Poland, on the other hand, PRIV reached 30.0% in both years, while OOP decreased from 100% to 75%.

The above analysis allows for indicating several typical situations. Achieving better health outcomes is observed in countries with a low level of private spending, such as the Czech Republic — in such circumstances the role of a large share of patients' out-of-pocket expenses is insignificant. Another situation is the example of Slovenia and Croatia, where the share of private spending is higher, while the out-of-pocket expenditure is low or decreasing. Increasing private spending in the context of a large share of out-of-pocket expenditure negatively affects the achieved health outcomes, especially in Belarus. On the other hand, reducing the share of private expenditure in the context of a constant share of out-of-pocket expenditure (Bosnia and Herzegovina) or maintaining the share

of private spending while reducing the out-of-pocket expenditure (Poland) results in the improvement of health outcomes.

The share of private expenditure in the total expenditure (PRIV) on healthcare and the share of patients' out-of-pocket expenses (OOP) are the variables which indirectly characterize the barriers in access to healthcare services. Of course, the obtained results should not be interpreted as meaning that a change in the financing structure has a direct impact on the improvement of health outcomes. However, the indirect effect has been demonstrated, which confirms the results of other authors dealing with research on the availability of medical services for patients, signalled at the beginning of the article.

The next stage of the analysis shows the possibilities of the model used as far as formulating recommendations for the inefficient countries is concerned. In order to achieve full efficiency, these countries should change the structure of financing — for example Belarus should reduce PRIV to 21.1% and OOP to 56.0%, Slovakia should reduce PRIV to 22.5% and OOP to 55.5%, Bosnia and Herzegovina should reduce PRIV to 20.1% and OOP to 56.1% and Poland should reduce PRIV to 22.9% and OOP to 56.3% (actual values are provided in Table 3).

SUMMARY AND CONCLUSIONS

All the analysed countries have made radical changes in their healthcare systems as a result of the political changes at the beginning of the XXI century. They were introduced in various ways but limited public funds were a common feature, which resulted in varying degrees of shifting the costs to the patients. Most of these countries have poorly developed systems of private health insurance. Such insurance is indicated in the literature as a good way to protect patients against catastrophic healthcare expenditure, often resulting in the resignation from the necessary medical services, which is reflected afterwards in outcomes related to public health. The purpose of this article was to find a relationship between the share of private spending, which indirectly determines the availability of medical services, and outcomes related to health. It must be emphasized once again that health outcomes depend on a number of other factors but the proposed model focuses on financial barriers related to access to medical services.

REFERENCES

- Afonso A., Aubyn M.S.T. (2005) Non-parametric approaches to education and health efficiency in OECD countries. *Journal of Applied Economics*, VIII/2, 227-246.
- Anell A., Willis M. (2000) International comparison of health care systems using resource profiles. *Bulletin of the World Health Organization*, 78(6), 770-778.
- Cooper W. W., Seiford L. M., Zhu J. (2011) *Handbook on Data Envelopment Analysis*. Springer, New York.

- de Cos P.H., Moral-Benito E. (2014) Determinants of health-system efficiency: evidence from OECD countries. *International Journal of Health Care Finance and Economics*, 14, 69–93.
- Dyson R.G., Allen R., Camanho A.S., Podinovski V.V., Sarrico S.C., Shale E.A. (2001) Pitfalls and protocols in DEA. *European Journal of Operational Research*, 132, 245–259.
- Eilat H., Golany B., Shtub A. (2008) R&D project evaluation: An integrated DEA and balanced scorecard approach. *Omega - International Journal of Management Science*, 36, 895–912.
- González E., Cárcaba A., Ventura J. (2010) Value efficiency analysis of health systems: does public financing play a role? *Journal of Public Health*, 18, 337–350.
- Guzik B. (2009) Podstawowe modele DEA w badaniu efektywności gospodarczej i społecznej. Wydawnictwo Uniwersytetu Ekonomicznego w Poznaniu, Poznań.
- Hadad S., Hadad Y., Simon-Tuval T. (2013) Determinants of healthcare system's efficiency in OECD countries. *European Journal of Health Economics*, 14 (2), 253–265.
- OECD (2015) *Health at a Glance 2015: OECD Indicators*, OECD Publishing, Paris.
- Or Z., Wang J., Jamison D. (2005) International differences in the impact of doctors on health: a multilevel analysis of OECD countries. *Journal of Health Economics*, 24, 531–560.
- Papanicolas I., Smith P.C. (2013) *Health system performance comparison. An agenda for policy, information and research*. McGraw-Hill Education, Open University Press, New York.
- Retzlaff-Roberts D., Chang C.F., Rubin R.M. (2004) Technical efficiency in the use of health care resources: a comparison of OECD countries. *Health Policy*, 69, 55–72.
- Stiglitz J.E., Sen A., Fitoussi J.P. (2009) Report by the commission on the measurement of economic performance and social progress. Paris, <http://www.stiglitz-senfitoussi.fr/en/index.htm> (dostęp 16.02.2016).
- Tchouaket E.N., Lamarche P.A., Goulet L., Contandriopoulos A.P. (2012) Health care system performance of 27 OECD countries. *The International Journal of Health Planning and Management*, 27, 104–109.
- Wagstaff A., van Doorslaer E., Calonge S., Christiansen T., Gerfin M., Gottschalk P., Janssen R., Lachaud C., Leu R.E., Nolan B. et al. (1992) Equity in the finance of health care: Some international comparisons. *Journal of Health Economics*, 11, 361–387.
- Wendt C. (2014) Changing Healthcare System Types. *Social Policy & Administration*, 48, (7), 864–882.
- Xu, K., Evans, D.B., Carrin, G., Aguilar-Rivera, A. M. (2005) Designing health financing systems to reduce catastrophic health expenditure. Technical brief for policy-makers, no. 2/2005, World Health Organization.
- Xu K., Evans D.B., Carrin G., Aguilar-Rivera A.M., Musgrove P., Evans T. (2007) Protecting Households From Catastrophic Health Spending. *Health Affairs*, 26 (4), 972–983.
- Xu K., Evans D.B., Kawabata K., Zeramardini R., Klavus J., Murray C.J.L. (2003) Household catastrophic health expenditure: a multi-country analysis. *The Lancet*, 362, 111–117.