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## MEASURING RELATIVE EFFICIENCY IN HEALTH AND EDUCATION SECTOR: THE CASE OF EAST EUROPEAN COUNTRIES

*The main purpose of the article is to review and to discuss different conceptual and methodological issues related to the performance measurement in public sector. In particular, free disposal hull (FDH) and data envelopment analysis (DEA) techniques are presented and then applied to selected East European countries (EEC). The article employs indicators related to efficiency in a selected policy areas such as education and healthcare. The results show that efficiency differs significantly across the selected countries. However, in general, a relatively average performance in most of the selected EEC is accomplished with too many inputs so that efficiency is quite low. In other words, the selected countries could use less resource to attain the same outcomes if they were fully efficient. In addition, the article points out some deficiencies relating to the employed techniques and definitions.*

*Keywords: performance measurement; efficiency; DEA; FDH; health; education; Eastern Europe.*

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## ВИМІРЮВАННЯ ВІДНОСНОЇ ЕФЕКТИВНОСТІ В ГАЛУЗЯХ ОХОРОНИ ЗДОРОВ'Я І ОСВІТИ: НА ПРИКЛАДІ КРАЇН СХІДНОЇ ЄВРОПИ

*У статті розглянуто і обговорено різні концептуальні і методологічні питання, пов'язані з вимірюванням продуктивності державного сектору. Зокрема, представлено такі технології аналізу: метод вільної оболонки і аналіз середовища функціонування (DEA), які потім застосовані до деяких країн Східної Європи. Використано показники, що стосуються ефективності в окремих сферах політики, таких як освіта і охорона здоров'я. Результати показують, що ефективність значно відрізняється по окремих країнах. Проте, в цілому, відносна середня продуктивність у більшості вибраних східноєвропейських країн здійснюється з дуже багатьма вхідними, так що ефективність досить низька. Іншими словами, досліджені країни могли б використовувати менше ресурсів для досягнення тих же результатів, якщо вони би були повністю ефективними. Крім того, вказано на деякі недоліки, пов'язані із застосованими методами і визначеннями.*

*Ключові слова: вимірювання продуктивності; ефективність; аналіз середовища функціонування; метод вільної оболонки; охорона здоров'я; освіта; Східна Європа.*

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## ИЗМЕРЕНИЯ ОТНОСИТЕЛЬНОЙ ЭФФЕКТИВНОСТИ В ОТРАСЛЯХ ЗДРАВООХРАНЕНИЯ И ОБРАЗОВАНИЯ: НА ПРИМЕРЕ СТРАН ВОСТОЧНОЙ ЕВРОПЫ

*В статье рассмотрены и обсуждены различные концептуальные и методологические вопросы, связанные с выполнением измерений производительности в государственном секторе. В частности, представлены такие технологии анализа: метод свободной оболочки и анализ среды функционирования (DEA), которые затем применены к некоторым странам Восточной Европы. Используются показатели, касающиеся эффективности отдельных отраслей, таких как образование и здравоохранение. Результаты показывают, что эффективность значительно отличается по отдельным*

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*странам. Однако, в целом, относительная средняя производительность в большинстве выбранных восточноевропейских стран осуществляется со слишком многими вводными, так что эффективность достаточно низка. Иными словами, изученные страны могли бы использовать меньше ресурсов для достижения тех же результатов, если бы они были полностью эффективными. Кроме того, указано на некоторые недостатки, связанные с примененными методами и определениями.*

*Ключевые слова:* измерения производительности; эффективность; анализ среды функционирования; метод свободной оболочки; здравоохранение; образование; Восточная Европа.

**Introduction.** Measuring performance has been increasingly important in public sector recently. However, for many reasons, both political and technical performance measurements have become an integral part of relatively few governments' management or decision-making systems yet. The threat of privatization and spending cutbacks, made without due consideration for impact of these changes in the future, has certainly helped to increase the interest. In addition, several other factors led to the recent focus on performance measurement, such as the pervasive dissatisfaction with government employees' unresponsiveness to the public, the dynamics of Wagner's law, which systematically increases the relative size of government, and hence puts pressure on public finances, and the implementation of New Public Management paradigm. But the introduction of performance indicators into public management has been carrying both a potential for greater effectiveness and a substantial risk. It is thus necessary to unbundle the concept of performance, and review the country- and sector-specific conditions that provide for public sector reform success or failure. The key determinant of success or failure is whether the changes were realistic, introduced gradually, and consistent with both the methodological complexity of a topic and the specific country realities (especially administrative capacity and governance regime).

The purpose of the article is to discuss and review some previous researches on the performance and efficiency of public sector as well as different conceptual and methodological issues related to the performance measurement in public sector. In particular, a definition and measurements of efficiency and effectiveness will be discussed. Additionally, free disposal hull (FDH) and data envelopment analysis (DEA) techniques are presented and then applied to the selected East European countries (EEC)<sup>2</sup>. However, the focus of the article is not on the ways to cut public expenditures, but rather on investigating potential reserves to increase the value for money of public spending, i.e. how to make the most of limited public resources<sup>3</sup>.

The article is organized as follows. In the next section we present a brief literature review on measuring public spending efficiency. Section 3 shows a theoretical background and empirical results of free disposal hull (FDH) and data envelopment (DEA) analysis. Additionally, this section also presents empirical applications of the presented techniques which are applied to the selected EEC (in comparison to EU-

<sup>2</sup> In the article, the selected EEC are Bulgaria, Croatia, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovak Republic and Slovenia

<sup>3</sup> Note, however, that it is not only public expenditure but also tax regulatory policies that affect the efficiency of public sector. While expenditure is a relatively good proxy of the tax burden, we ignore the composition of tax revenue and other characteristics of tax system.

15 and OECD countries). The final section provides concluding remarks and some policy implications.

**1. A brief literature review on public spending efficiency.** The debate of the role of the public sector has shifted in recent years to empirical assessments of the efficiency and usefulness of public sector activities. A growing academic literature has been investigating the stabilisation, allocation and distribution effects of public expenditure (see, e.g., Tanzi and Schuknecht (2000); Afonso et al. (2005, 2006, 2008), Sanchez and Bermejo (2007), Mandl et al. (2008) etc.) as well as the role of rules and institutions, and the scope for privatising public sector activities (see, e.g., Rodrik (2000), Strauch and von Hagen (2000), Persson and Tabellini (2001), Drake and Simper (2001), Gwartney (2002)). Most studies conclude that public spending could be much smaller and more efficient than today. However, for this to happen, governments should adopt better institutions and should transfer many non-core activities to the private sector.

Many empirical studies on the performance and efficiency of the public sector (at national level) that applied non-parametric methods (e.g., data envelopment analysis - DEA) find significant divergence of efficiency across countries. Studies include Gupta and Verhoeven (2001) for education and health in Africa, Clements (2002) for education in Europe, St. Aubyn (2003) for education spending in the OECD, Afonso et al. (2005, 2006) for public sector performance expenditure in the OECD and in emerging markets, Afonso and St. Aubyn (2005, 2006a, 2006b) for efficiency in providing health and education in the OECD countries. Gunnarsson and Mattina (2007) assessed the efficiency of public spending by comparing expenditure on health, education and social protection in Slovenia. De Borger and Kerstens (1996) and Afonso and Fernandes (2008) found evidence of spending inefficiencies for the local government sector. In addition, Afonso et al. (2008) assessed the efficiency of public spending for redistributing income. Other authors (e.g., Mandl et al., 2008; Jafarov and Gunnarsson, 2008) tried to improve the work of Afonso et al. (2005). Moreover, Johnes and Johnes (1995), Grasskopf and Mourtray (2001), Johnes (2006), Castano and Cabanda (2007), Jafarov and Gunnarsson (2008), Cherchye et al. (2010), Obadic and Aristovnik (2011) focused on measuring efficiency in the education sector.

**2. Assessing efficiency and effectiveness in public sector.** The measurement of efficiency and effectiveness generally requires: (a) estimation of costs; (b) estimation of output/outcome; and (c) comparison between the two. Applying this concept to the spending activities of governments, we can say that public expenditure is efficient when, given the amount spent, it produces the largest possible benefit for a country's population<sup>4</sup>. Often efficiency is defined in a comparative sense: the relation between benefits and costs in a country X is compared with that of other countries. This can be done for total government expenditure, or for expenditure related to specific functions such as health, education, poverty alleviation, infrastructures etc. If in a country X the benefits exceed the costs by a larger margin than in other countries, then public expenditure in a country X is considered more efficient. However, the measurement of public efficiency is relatively complicated as comparison and measure-

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<sup>4</sup> The word "benefit" is used because economists often make a distinction between output and outcome.

ment of both costs and benefits may be difficult. Deficient budgetary classifications, lack of reliable data, difficulties in allocating fixed costs to a specific function, and failure to impute some value to the use of public assets used in the activity can also hamper the determination of real costs<sup>5</sup>.

The link between input, output and outcome, the main components of efficiency and effectiveness indicators, can be interpreted as follows<sup>6</sup>. The monetary and non-monetary resources deployed (i.e. input) produce an output. For example, education spending (input) affects number of students completing a grade (output). The input-output ratio is the most basic measure of efficiency<sup>7</sup>. However, compared to productivity measurement, the efficiency concept incorporates the idea of the production possibility frontier, which indicates feasible output levels given the scale of operations. The greater the output for a given input or the lower the input for a given output, the more efficient the activity is. Productivity, by comparison, is simply the ratio of outputs produced to input used.

On the other hand, effectiveness relates input or output to the final objectives to be achieved, i.e. the outcome. The outcome is often linked to welfare or growth objectives and therefore may be influenced by multiple factors (including outputs but also exogenous environment factors). The effectiveness is more difficult to assess than efficiency, since the outcome is influenced by political choice. The distinction between output and outcome is often blurred and output and outcome are used in an interchangeable manner, even if the importance of the distinction between both concepts is recognized. For example, outputs of a health system are often measured in terms of the number of operations performed or days spent in a hospital. The final outcome, however, could be the number of patients who got well enough to return to an active life. Thus, the effectiveness shows the success of the resources used in achieving the objectives set.

**2.1. Parametric and Non-Parametric Methods for Measuring Public Sector Performance and Efficiency.** A common approach is based on the concept of efficiency frontier (productivity possibility frontier). There are multiple techniques to calculate or estimate the shape of the efficiency frontier. Most investigations aimed at measuring efficiency are based either on parametric or nonparametric methods. The main difference between the parametric and the non-parametric approach is that parametric frontier functions require the ex-ante definition of the functional form of the efficiency frontier.

A very common parametric approach is the stochastic frontier analysis (SFA). It is a statistical method to fit the frontier and it is based on econometric methods. This approach assumes a specific functional form for the relationship between input and

<sup>5</sup> More about measuring costs and efficiency of public spending in Drake and Simper (2001) and Afonso et al. (2006).

<sup>6</sup> Another relevant issue for the analysis of public spending inefficiencies is the fact that public expenditure financing must rely on distortional taxation. This implies that both direct and indirect costs are relevant when estimating the economic impacts of inefficiency in public services provision. Afonso and Gaspar (2007), in simple numerical exercises, with a calibrated model, found that indirect costs, associated with excess taxation burden, amplify the cost of inefficiency by between 20 and 30%.

<sup>7</sup> When measuring efficiency, a distinction can be made between technical and allocative efficiency. Technical efficiency measures pure relation between inputs and outputs taking the production possibility frontier into account. On the other hand, allocative inefficiency occurs if distribution of particular public sector outputs is not in accordance with personal preferences (Bailey, 2002, p. 119).

output. The advantage of this method is that it is able to cover the effects of exogenous shocks, i.e. nondiscretionary factors. The model can specify the equations based on such assumptions (Mandl et al., 2008, p. 9).

On the other hand, the non-parametric approach constructs an efficiency frontier using input/output data for the whole sample following a mathematical programming method<sup>8</sup>. This frontier provides a benchmark by which the efficiency performance can be judged. This technique is therefore primary data-driven. Among different non-parametric methods the free disposal hull (FDH) technique imposes the fewest restrictions<sup>9</sup>. It follows a stepwise approach to construct the efficiency frontier. Along this production possibility frontier one can observe the highest possible level of output/outcome for a given level of input. Conversely, it is possible to determine the lowest level of input necessary to attain a given level of output/outcome. This allows identifying inefficient producers both in terms of input efficiency and in terms of output/outcome efficiency (Afonso et al., 2003, p. 18).

An alternative non-parametric technique that has recently started to be applied to public expenditure analysis is data envelopment analysis (DEA)<sup>10</sup>. DEA approach is based on a linear combination of input and outputs in order to specify the efficiency frontier. Convexity of the set of input-output combinations is assumed since this method constructs an envelope around the observed combinations. According to DEA methodology, the general relationship can be given by the following function for each country  $i$  (Afonso et al., 2006, p. 21):

$$Y_i = f(X_i), \quad i = 1, \dots, n, \quad (1)$$

where  $Y_i$  - a composite indicator reflecting output measure;  $X_i$  - spending or other relevant inputs in country  $i$ . If  $Y_i < f(x_i)$ , it is said that country  $i$  exhibits inefficiency. For the observed input level, the actual output is smaller than the best attainable one and inefficiency can then be measured by computing the distance to the theoretical efficiency frontier.

**2.2. Empirical Evidence of Public Spending Efficiency in the EEC.** This section shows the empirical application of FDH and DEA to the EEC (in comparison to the EU-15 and OECD), and highlights potential reforms to enhance efficiency. As noted earlier, the analysis generates a best practice frontier of input-output combinations (e.g., health spending and outcomes) that dominate other combinations in the sample, and countries that are not on the frontier are then ranked according to the distance from the frontier. The data are drawn primarily from the World Bank's World Development Indicators database (IMF, 2008).

The results of the DEA analysis suggest significant inefficiencies in the EEC public health spending and, correspondingly, significant room to rationalize public spending without sacrificing, and potentially improving, health outcomes (see Table 1). Indeed, none of the EEC have been ranked in the first quartile. For instance, in terms of the efficiency scores for public spending, Croatia (as the only non-member of the EU among EEC) ranks in the 63rd percentile among 37 countries. With respect to individual outcome indicators, Croatia's ranking is in the last quartile for the stan-

<sup>8</sup>For an overview of non-parametric techniques see Simar and Wilson (2003).

<sup>9</sup>FDH analysis was first proposed by Deprins et al. (1984).

<sup>10</sup>Originating from Farrell's (1957) seminal work.

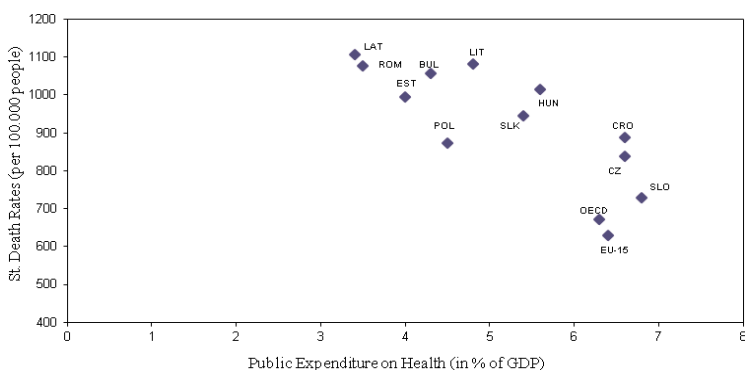
standardized death rates (SDR) and incidence of tuberculosis; in the third quartile for the child mortality rate, and infant mortality rate; and in the second quartile for maternal mortality rates (see IMF, 2008).

By applying DEA efficiency frontier technique to measure the health sector efficiency performance Latvia, Romania, Poland and EU-15 average are seen as efficient (Figure 1). Here an average public spending on health as percentage of GDP in 2001-2004 period measures the input and as outcome we use standardized death rates (per 100,000 people). One can see that some countries come very close to the frontier (e.g., Estonia and Slovenia) while other countries are further and therefore less efficient (e.g., Hungary and Croatia). The figure also shows that the majority of the countries under consideration are well inside the efficiency frontier. Moreover, countries like Slovenia, Croatia and Czech Republic report a higher ratio of health public expenditure to GDP than EU-15 average, but nevertheless they report higher standardized death rates. This suggests that most of the countries under consideration have a significant potential to reduce health expenditure without hampering the outcomes.

**Table 1. Relative Efficiency of the EEC in Health (Distribution by quartile of the ranking of efficiency scores)**

	1 <sup>st</sup> quartile	2 <sup>nd</sup> quartile	3 <sup>rd</sup> quartile	4 <sup>th</sup> quartile
Bulgaria		X		
Czech Republic		X		
Estonia			X	
Hungary				X
Latvia		X		
Lithuania				X
Poland			X	
Romania			X	
Slovak Republic			X	
Slovenia			X	
Croatia			X	

Source: IMF (2008); own presentation.



**Figure 1. Efficiency (DEA) Frontier for Health Outcome in the selected EEC**

Source: World Bank (2008); own presentation.

Table 2. DEA results for education efficiency in the selected EEC

Country	Output-Oriented VRS Efficiency	Rank	Peers
Bulgaria	1.19523	30	Greece, Japan
Croatia	1.07427	11	Greece, Japan
Czech Republic	1.01370	4	Greece, Japan
Estonia	1.04817	7	Finland, Japan
Hungary	1.09307	19	Finland, Japan
Latvia	1.13250	26	Finland, Japan
Lithuania	1.12536	25	Finland, Japan
Poland	1.07577	12	Finland, Japan
Romania	1.15601	29	Greece, Japan
Slovak Republic	1.04248	6	Greece, Japan
Slovenia	1.09282	18	Finland
Average	1.09455		Finland, Japan
EU15 average	1.09390		Finland, Japan

Note: Calculations are based on total expenditure on education (in % of GDP, 1999-2007 averages) as input and average PISA 2006 scores as output/outcome. Small government: public spending <40% of GDP. Medium government: 40% <public spending<50% of GDP. Big government: public spending>50% of GDP.

Source: World Bank (2010), UNESCO (2010); own calculations.

Further empirical analysis, which is in line with the previous findings (see, for instance, Afonso et al., 2006c), suggests relatively better efficiency results in the education sector in the region (in comparison to the EU-15 and OECD averages). In terms of the efficiency scores, some new EU member states even rank in the first quartile for education (in terms of PISA test scores) (Czech Republic, Estonia and Slovak Republic). The worse efficiency performers are Bulgaria, Romania, Latvia and Lithuania (see Table 2) which are ranked in the last quartile of the selected 30 countries (EU-27 and OECD members) and could improve their efficiency by augmenting their average PISA scores up to 19.5, 15.6, 13.3 and 12.5, respectively. The main reason for the education inefficiency in these countries lies in transforming intermediate education outputs into real outcomes (see IMF, 2008)<sup>11</sup>. This finding is confirmed by applying FDH technique to the education sector in the region.

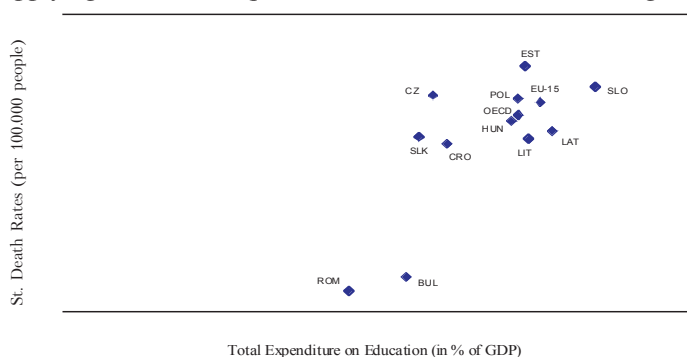


Figure 2. Efficiency (FDH) Frontier for Education Outcome in the selected EEC

Note: Based on total expenditure on education (in % of GDP, 1999-2007 averages) as input and average PISA 2006 scores as output/outcome.

Source: World Bank (2010), UNESCO (2010); own calculations.

<sup>11</sup>The DEA results also show that Croatia, for instance, in order to be efficient should increase the mean scores on the mathematics scale in PISA 2006 for even 13.47433 points (Croatia ranks in the 35th percentile among 30 OECD and EU countries under consideration) (see Table 2).

The results show that the best performers (in terms of efficiency) seem to be Slovak Republic, Czech Republic and Estonia. Interestingly, Czech Republic shows a much better PISA test scores with less resources than Croatia. However, in general, many of the new EU member countries (such as Latvia and Lithuania) are well behind the average efficiency performance level of the EU-15 countries (see Figure 2).

**3. Conclusion.** Tight budgets and demanding citizens put governments under increasing pressure to show they are providing good value for money. Information about public sector performance can satisfy the public's need to know, and could also be a useful tool for governments to evaluate their performance. In this respect, the aim of the article was to discuss and review different conceptual and methodological issues related to the performance measurement in public sector. In recent years, the debate of the role of the public sector has shifted significantly towards empirical assessments of the efficiency and usefulness of its activities.

The results show that efficiency in health and education sectors differs significantly across the selected countries. However, in general, a relatively average performance in most of the selected EEC is accomplished with too many inputs so that efficiency is quite low. In other words, the selected countries could use less resource to attain the same outcomes if they were fully efficient. The results suggest that health sector performance could be improved by containing demand for health services and changing the mix of resources spent on healthcare. Moreover, inefficiencies in the health sector are primarily related to high public spending rather than weak outputs. Similar to the health sector, the main inefficiencies in education in the region lie in transforming intermediate education output into real outcomes. However, in most of the EEC, relatively better efficiency results are presented (in comparison to the health sector efficiency results). All in all, the analysis finds evidence of significant potential to reduce government (health and education) expenditure. In this respect, countries under consideration have a great potential for increased efficiency and effectiveness in public spending.

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