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Relative efficiency of government expenditure on secondary education

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Abstract. Governments of OECD countries are under pressure to improve public sector performance and at the same time to reduce the government expenditure. In the process of improvement of public sector performance it is necessary ensure the efficiency in the provision of education, at the same time, the countries are required to provide their educational services by minimizing the amount of public money directed to them. This prompted us to implement the comparative study to assess the efficiency of government expenditure on secondary education in European countries in 2015. First we analyze the government expenditure based on the data published by International Monetary Fund (IMF). Second, we analyze the quality of education through the PISA indicators published by OECD. Then we apply the Data Envelopment Analysis (DEA) to assess the relative efficiency of government expenditure on secondary education using output-oriented model under the assumption of variable return to scale. Based on the results could it be said that average efficiency was 0.955 which suggests that the efficiency in evaluated countries was relatively high.

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1. INTRODUCTION

The study of the efficiency of the educational system is very important, as the education contribute to economic and social well-being of individuals and nations. Well educated people are more likely to participate in the labor market and have better chances to be employed (Starček & Trunk, 2013). In the European Union, the unemployment rate of persons with only primary education is almost twice as high as the employment rate of persons with upper secondary education. It could be seen in the OECD Indicators 2012 published by the OECD (2012), where the unemployment rate of 25-64 year-olds bellow secondary education in European Union countries was in average 15.2% and in OECD countries was in average 12.5%. Compared to the unemployment rate of 25-64 year-olds upper secondary and post-secondary non-tertiary in EU countries was 8.5% and 7.6% in OECD countries (OECD, 2005). Another aspect is, that more educated people who get higher score in tests are associated with substantially higher labor force participation, lower unemployment rates and are associated with higher individual earnings. The level of education is not associated only with labor market outcomes (like employment, earnings, and so on), but education also affects decisions related to expenditure and savings (Vravec, 2014; Rutledge, 2010; Michalski, 2016a). There exists some evidence that higher schooling is associated with higher saving rates and higher level of control of spending (Szovics, 2012; Lusardi, 2008; Michalski, 2016b). Beside the economic effects, there is also considerable positive evidence of non-economic benefits of education, like life-satisfaction and happiness, health and life expectancy, and so on.

As seen above, the quantity and especially the quality of schooling carry substantial payoffs in terms of productivity and earnings in the labor market for the individual and whole society (Belás et al., 2016). Therefore, it is very important to study efficiency of schooling.

That is why the aim of the paper is to compare the relative efficiency of government expenditures on secondary education, in selected European countries in 2015 using Data Envelopment Analysis (DEA). The paper is organized as follow. In section 1 a review of the relevant literature in this field is provided. In the section 2, methodology and data are described. The section 3 illustrates the results, and they are discussed in the last section with concluding remarks.

2. LITERATURE REVIEW

The first systematic attempt to measure the relative efficiency of educational spending in European countries can be seen in paper of Clements (2002), who used Free Disposal Hull method. He compared the selected countries considering expenditure per student and teacher to student ratio as input variables, and international standardized test (TIMSS, Trend in International Mathematics and Science Study) as output variable. He found out that the resources were not use effectively and for achievement the same output the countries should use 75% of their resources.

Afonso and Aubyn (2006) addressed the efficiency of expenditure in education provision by comparing the output (PISA results) from the educational system of 25, mostly OECD, countries with resources employed (teachers per student, time spent at school) during the period 2000-2002. They estimated a semi-parametric model of the education production process using a two-stage procedure. By regressing Data

Envelopment Analysis output scores on nondiscretionary variables, both using Tobit and a single and double bootstrap procedure, they showed that inefficiency was strongly related to GDP per capita and adult educational attainment. According to OECD data, OECD countries expended an average of 6.2 percent of GDP in 2001 on education institutions, of which 4.8 percent of GDP were from public sources. Additionally, education spending is predominantly public in OECD countries, and for all education levels. For example, when we compare the public expenditure as a share of total spending for primary and secondary education, in 2001 the average in analyzed countries was 92.2%, ranging from 76.2% in Korea to more than 95% in several countries, namely Denmark, Finland, Italy, Portugal and Sweden. On the other hand, the average share of public spending in total spending for pre-primary and for tertiary education was 78.3% (pre-primary) and 79.3% (tertiary). In case of expenditure for these types of education the diversity among countries being now much higher. For example in Indonesia the level of spending for pre-primary education was only 5.3%. The lowest value from the EU countries can be seen in a case of Germany (62.3%). In a case of the level of spending for tertiary education the share moved from 15.9% (Korea) to 100% (Tunisia).

The DEA method was used to evaluate the efficiency of public spending on education in study prepared by Agasisti and Dal Bianco (2006). In their paper, an empirical study compares the spending efficiency on education in 20 European countries during the period 2006-2009. As the output variable they used the OECD PISA test, while the expenditure per student was used as the input. In their paper the relative efficiency was estimated using DEA. In the second stage, the efficiency scores were compared with a set of context variables, which represented the different socio-economic settings (e.g. GDP per capita, unemployment rate, etc.) as well as some structural characteristics of the educational systems (e.g. teacher salaries, internet usage, etc.) using regression analysis. The change in the efficiency between 2006 and 2009 was analyzed using Malmquist index, where the results showed that the average efficiency remained basically stable in the period. The regression analysis was used also in the paper of Sav (2013) who analyzed the efficiency of 331 U.S. public owned universities for academic year 2005 -2009.

Aristovnik and Obadic (2014) applied DEA to evaluate relative efficiency of secondary education in selected EU and OECD countries, including Slovenia and Croatia. In their case the data set for all the tests in the study included average data for the 1999-2007 period and PISA 2006 average scores in order to evaluate long-term efficiency measures as the secondary education process is characterized by time lags in thirty-one EU (plus Croatia) and OECD countries. According to the empirical results, Slovenia and Croatia suffer from relatively low technical efficiency in their secondary education as they are only ranked in the third and last quartiles among thirty-one OECD/EU countries, respectively. The inefficiency is particularly problematic in Croatia where the poor results mainly stem from low enrolment rates (secondary and tertiary) and low PISA scores. On the other hand, in Slovenia the relatively good output/outcome is achieved at relatively higher costs. Indeed, public spending on secondary education is relatively high in both countries, particularly in Slovenia, without achieving respectively better outputs/outcomes than other comparable states. Therefore, both countries should pursue a number of initiatives to enhance the efficiency of their secondary education sector. In this respect, the secondary education system in both countries should be modernized to reduce operating costs by merging and closing selected schools that serve too few students, and extending catchment areas, while taking other socio-economic considerations into account. Surplus teaching and non-teaching staff should be rationalized by not replacing retiring staff in full. Indeed, reducing the number of secondary teachers through natural attrition and implementing a selective hiring freeze on new teachers is needed in the future. In this sense, taking advantage of the significant scope to rationalize public secondary education spending without sacrificing outcome, while also redirecting resources to the tertiary education sector is recommended for both countries.

The relative efficiency of education expenditure in OECD countries was analyzed in paper of Hužvár and Rigová (2016). They analyzed the development of education expenditure in OECD countries in years 2000-2011. Significant differences among the highly developed countries were observed not only in the absolute values of the indicators, but also in their trends. While the majority of OECD countries increased the shares of education expenditure or kept them stable, some countries (Estonia, Hungary, Italy, Norway, and Poland) showed a reverse trend. Mexico and USA also significantly decreased education expenditure compared to the total government expenditure, but kept stable or even increased the share on GDP and GNI. Denmark, Iceland, and New Zealand show the highest share of education expenditure on both GDP and GNI, and along with Chile, Mexico, Norway, and Switzerland spend the highest portion of government expenditure on education. On the contrary, Czech Republic, Italy, Japan, and Slovakia attain low values in all three indicators. In the second part of our study they dealt with the students to teacher ratio which may be differently interpreted from different efficiency viewpoints, depending on whether we focus on the quality or on the economy of education systems. The ratio also exhibits surprisingly large differences among OECD countries as well as between primary, secondary and tertiary educational levels within the countries. They designed two DEA models which reflect the ambiguous character of students to teacher ratio and its different interpretations by alternating the roles of students and teachers as inputs and outputs of education systems. In both models, they considered youth employment rate as a controllable output and GDP per capita as a non-controllable output of education systems to provide external measures of their quality. They conclude that countries which are efficient by both models manage to have the students to teacher ratio well balanced regarding to their socio-economic environment (Michalski, 2014).

3. METHODOLOGY

This study is trying to analyze relative efficiency, meaning that the evaluated units (Decision-making unit, DMU) are doing things right, and it examines this mainly by looking at the relationship between used inputs and produced outputs. Data Envelopment Analysis, or DEA, is one of the available tools, which have become very popular in many sectors for assessing efficiency, and it has the advantage of being able to handle multiple inputs and multiple outputs.

The basic DEA model developed by Charnes, Cooper and Rhodes (1978) was based on the assumption of a constant return to scale. This basic model has been modified by Banker, Charnes, and Cooper (1984) to be based on a variable return to scale (VRS), as production units usually don't operate at their optimal size. Both these DEA models have been created in both forms – input and output-oriented.

The objective of input-oriented model is to minimize inputs while producing at least the given outputs levels. The another type of model, the output oriented attempts to maximize outputs while using no more than the observed amount of any input.

In a DEA model, technical efficiency is defined as the relative ability of each DMU (in our case, a country´s educational system) in producing outputs, and the term "relative" means that each unit is compared with any other homogeneous unit within the data set. According to Agasisti and Dal Bianco (2006) a theoretical note is important here. Indeed, as the unit is a whole country´s educational system, and the inputs reflects the amount of the money invested in secondary education, the definition of efficiency is specifically oriented, and concerns the "productivity" of each euro invested in education – that is the ability to maximize the educational achievement given the resources invested in the educational system.

In this study, an output-oriented model is employed, consider that the resources invested in secondary education for a single country is basically given, and the objective of the educational system is to maximize its (average) efficiency score.

Consider n educational systems (DMU_j, j=1,2,...,n), each consuming m different inputs (x_{ij}, i=1,2,...,m) to produce s different outputs (y_{rj}, r=1,2,...,s). The matrix of inputs is marked as follows $X = \{x_{ij}, i=1,2,\ldots,m; j=1,2,\ldots,n\}$ and the matrix of outputs $Y = \{y_{rj}, r=1,2,\ldots,s; j=1,2,\ldots,n\}$. We also consider that the units of analysis, educational systems, operate under the conditions of variable return to scale. DEA model based on the assumption of a variable return to scale is called BCC model according to its authors Banker, Charnes, and Cooper in 1984. The output-oriented BCC model could be defined by a set of linear problems, where each DMU tries to maximize the efficiency ratio (outputs over inputs) choosing the best set of weights. To solve BCC output oriented model, the dual form with slack variables is usually used, which can be formulated as:

Maximize
$$\phi_q + \varepsilon\left[\sum_{i=1}^{m} s_i^- + \sum_{r=1}^{s} s_r^+\right] \tag{1}$$

Subject to
$$\sum_{j=1}^{n} x_{ij}\lambda_j + s_i^- = x_{iq}$$
$$\sum_{j=1}^{n} y_{rj}\lambda_j - s_r^+ = \phi_q y_{rq} \tag{2}$$
$$\sum_{j=1}^{n} \lambda_j = 1$$
$$\lambda_j,\ s_r^+,\ s_i^- \geq 0$$
$$i = 1,2,...,m \qquad r = 1,2,....,s \qquad j = 1,2,...,n$$

Where y_{rq} are the produced amounts of r^{th} output (r=1,2,...,s) for DMU_q, x_{iq} are the consumed amounts of i^{th} input (i=1,2,...,m) for DMU_q, y_{rj} are the produced amounts of r^{th} output (r=1,2,...,s) for DMU_j (j=1,2,...,n), x_{ij} are the consumed amounts of i^{th} input (i=1,2,...,m) for DMU_j (j=1, 2,...,n), s_i^- and s_r^+ are the input or output slacks, ε is the non-Archimedean constant (10^{-6}or 10^{-8}), λ_j is the weight assigned to the DMU_j (j=1,2,…,n), Φ_q is the need for proportional increase in outputs to achieve efficiency.

The result of a BCC model is a set of scores (φ_q), where the output-oriented technical efficiency score (in this paper, the efficiency of expenditure in secondary education) is computed by the ratio $1/\varphi_q$ for each unit (country). The production unit is considered fully efficient when output-oriented technical efficiency score is equal to 1 and all the slack variables are equal to zero. If output-oriented technical efficiency score is equal to one but the slack variables are not equal to zero, we can talk about "pseudo-efficiency". If the slack variables are equal to zero but output-oriented technical efficiency score is lower than one, then the value of ratio $1/\varphi_q$ signals inefficiency. This inefficiency can be eliminated by a proportional (radial) increase in all outputs of DMU_q, and thus a shift on the efficiency frontier can be achieved. If the slack variables are not equal to zero and output-oriented technical efficiency score is lower than one, it is necessary to perform non-radial shift expressed by slack variables to achieve efficiency. Thus, we have a formula for potential improvement via the BCC-projection as follow:

$$\begin{aligned} X'_q &= X_q - s^- \\ Y'_q &= \Phi Y_q + s^+ \end{aligned} \tag{3}$$

The improved input and output variables (X'_q, Y'_q) are considered as fully BCC efficient.

The described methodology of output-oriented BCC model is used to measure the efficiency of government expenditure on secondary education in the European countries in 2015. Based on the literature studied, there was set up the set of the following input and output variables, which could influence the efficiency in each educational system. In our analysis, one input variable and three output variables were used. As the input variable was used government expenditure on secondary education. To eliminate the impact of size of the economy on the efficiency of the educational system we decide to use the value of government expenditure in relation to the gross domestic product (expenditure as % of GDP) of the country. Because we assume that the impact of expenditure has no effect on the efficiency of the educational system in the same year, considering the value of the government expenditure incurred one year earlier (2014). The dataset used for this paper was obtained from the database published annually by the International Monetary Fund (IMF).

We try to analyze how the government expenditures are transformed into the results of education. For measuring the success of education we decide to use the PISA indicator. The OECD Program for International Student Assessment (PISA), launched for the first time in 2000 (and realized every three years), constitutes an important source to study the competencies acquired by students in an international perspective. The PISA become the world´s premier yardstick for evaluating the quality, equity and efficiency of school systems in providing young people with these skills. The assessment focuses on reading, mathematics, science and problem-solving. It doesn't just ascertain whether students can reproduce what they have learned, it also examines how well they can extrapolate from what they have learned and apply that knowledge in unfamiliar setting, both in and outside of school. Therefore, on the output side, there were considered PISA test scores in three main areas: mathematics, reading and science in last evaluation realized in 2015.

4. EMPIRICAL RESULTS AND DISCUSSION

The aim of the paper is to compare the relative efficiency of the countries´ secondary educational systems. We try to evaluate the relative efficiency of government expenditure on secondary education in selected European countries in 2015. We use comparable data at a country level, allows us to empirically investigate the efficiency of government expenditure on secondary education in a cross-country perspective.

As was mentioned above the efficiency is affected by the set of input and output variables. With the increasing demand for more efficient educational systems, the European countries are required to provide their educational services by minimizing the amount of public money devoted to them, given the necessity to strictly control public budgets. The amount of government expenditures to education is particularly differentiable in the European countries, given their different characteristics and the policy orientations in this field. The next figure (Figure 1) shows the expenditures on secondary education in selected European countries in 2014. As can be seen the investment on secondary education rages between 0.7044% of Gross domestic product in market prices (Slovak Republic) to 2.7171% of GDP (Finland).

The second important aspect is, how efficient could individual countries use these government resources. Some countries seem to be able to maintain efficiency in their spending on education in form of good results in terms of educational outputs, while other did not reached similar results. In our study we decide to assess the success of secondary education by the PISA indicators in three main dimensions: reading, mathematics, science. Following figure (Figure 2) compare the success of secondary education in selected European countries according testing carried out in 2015. When we put together PISA scores in three main dimensions (PISA total = PISA math + PISA reading + PISA science) we can see, that the

highest success of education was reached in Estonia, Finland, Slovenia, Ireland and Germany. On the other side, the lowest values of PISA total scores were reached in Romania, Cyprus, Bulgaria and Greece.

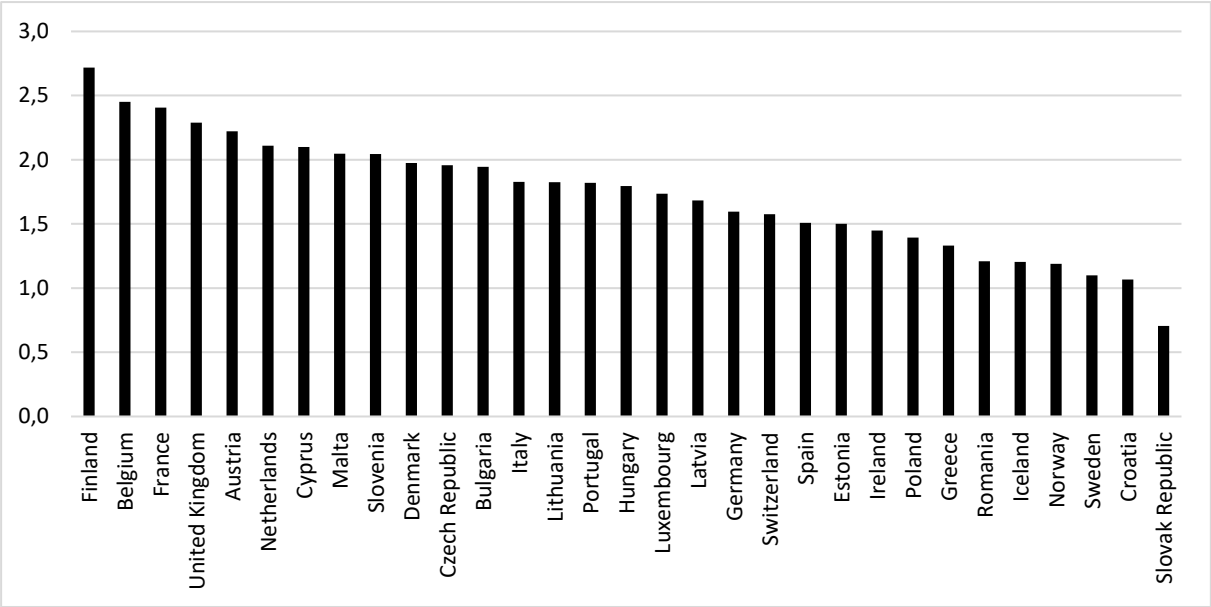

Figure 1. Government expenditure on secondary education (% of GDP); by country; 2014
Source: Authors´ calculations

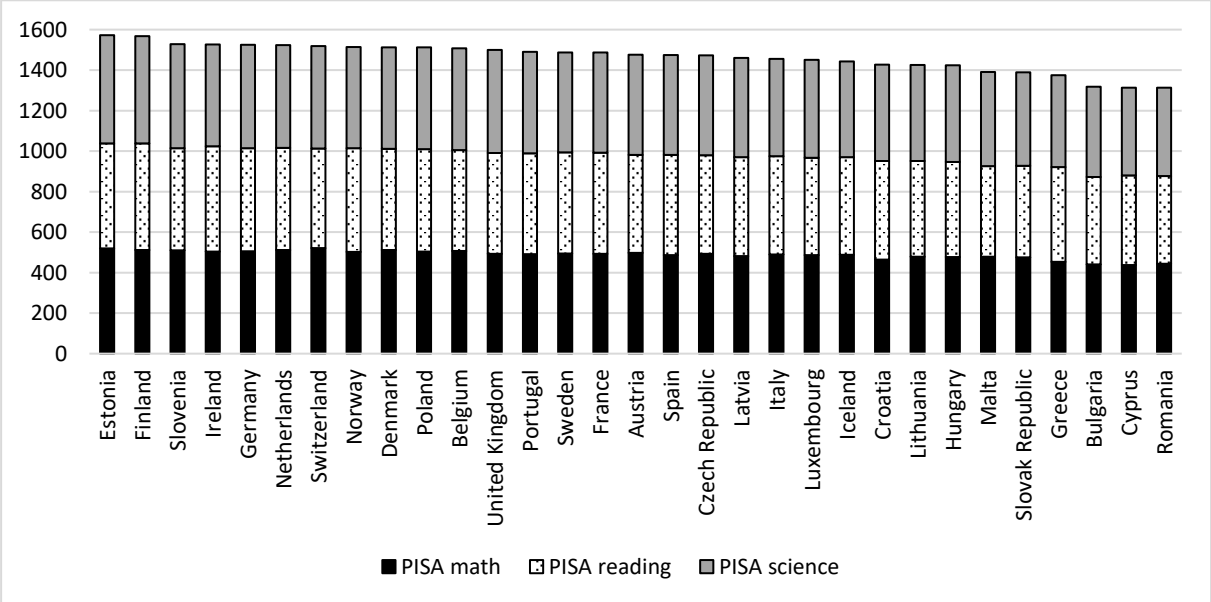

Figure 2. PISA score; by country; 2015
Source: Authors´ calculations

When we look at results separately in each dimension, we can see that the highest scores in mathematics were obtained in Switzerland, Estonia, Netherland, Denmark and Finland. And the lowest values in mathematics in countries like Cyprus, Bulgaria, Romania, Greece and Croatia. In the field of reading the

best results were reached by Finland, Ireland, Estonia, Norway and Germany; and the worst results by Bulgaria, Romania, Cyprus, Malta and Slovak Republic. The last dimension, science, identified as the most successful secondary education systems in Estonia, Finland, Slovenia, United Kingdom and Germany. And as the last successful was denote secondary educational systems in Cyprus, Romania, Bulgaria, Greece and Slovak Republic.

To explore eventual patterns in the linkage between government expenditure on secondary education and PISA total score, a scatterplot is reported in next figure (Figure 3).

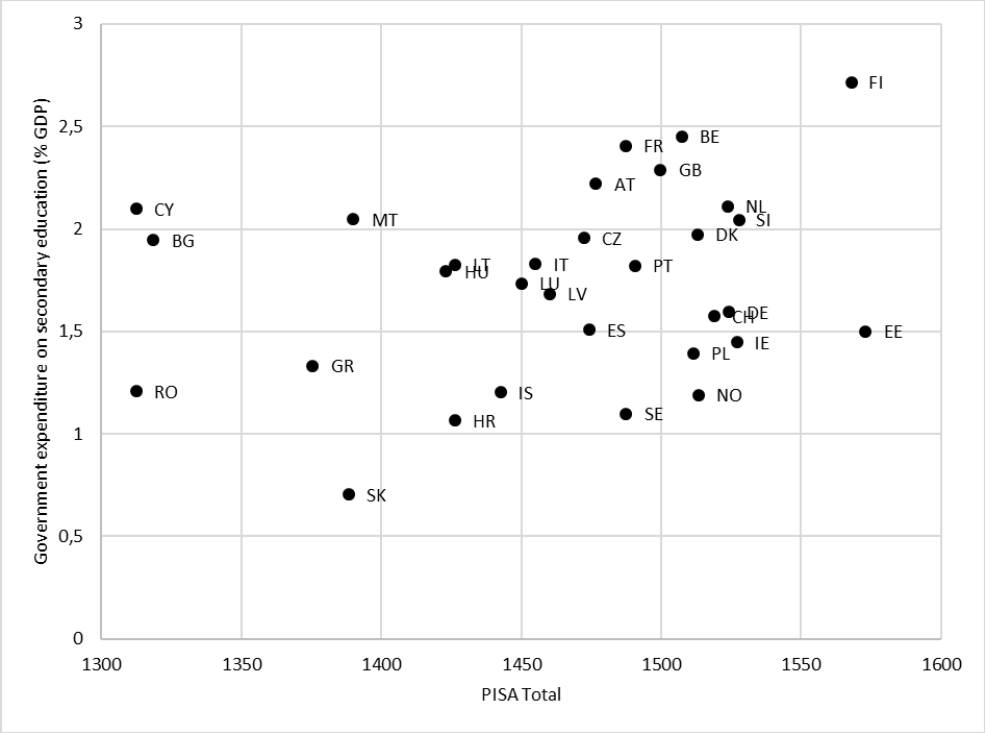

Figure 3. Government expenditure on secondary education versus PISA total score

Source: Authors´ calculations

The evidence shows different "groups", between them:

- Countries with high expenditure and good results (e.g. Finland, Belgium, Netherland, Slovenia, United Kingdom and Denmark).
- Countries with high expenditure and relatively low performances (e.g. Cyprus, Bulgaria, Malta).
- Countries with low expenditure and high results (e.g. Norway, Sweden, Estonia).
- Countries with low expenditure and relatively low performances (e.g. Slovak Republic, Romania, Greece).

Assuming that the amount of money devoted to secondary education is given (and decided by the politics), then the objective for educational systems is to obtain good results (e.g. PISA indicators) with the available resources. Therefore, in this study, an output-oriented DEA model is employed, consider that the resources invested in secondary education for a single country is basically given, and the objective of the educational system is to maximise its (average) efficiency score. As mentioned in paper of Hužvár and Rigová (2016) DEA is a non-parametric method allows us to calculate the relative efficiency of national educational systems based on multiple inputs and outputs that may be expressed in different units.

Table 1 introduces input and output variables and their descriptive statistics for selected 31 European countries to be assessed by DEA model. The other European countries were excluded from the analysis due to missing data for chosen indicator in analyzed year. In our DEA model we focus on the quality of education of secondary education which is providing from government sources in each country. A country is more efficient by this model if it manages can uses given value of government expenditure on secondary education to reach higher values of PISA scores. That's why the output-oriented model is applied.

Table 1

Input and output data for DEA model

Country	**Code**	**PISA math (score)**	**PISA reading (score)**	**PISA science (score)**	**Government expenditure on secondary education (% of GDP)**
Austria	AT	496.74	484.87	495.04	2.22
Belgium	BE	506.98	498.52	502.00	2.45
Bulgaria	BG	441.19	431.72	445.77	1.94
Croatia	HR	464.04	486.86	475.39	1.07
Czech Republic	CZ	492.33	487.25	492.83	1.96
Cyprus	CY	437.13	442.83	432.58	2.10
Denmark	DK	511.09	499.81	501.94	1.97
Estonia	EE	519.53	519.14	534.19	1.50
Finland	FI	511.08	526.42	530.66	2.72
France	FR	492.92	499.31	494.98	2.41
Germany	DE	505.97	509.10	509.14	1.59
Greece	GR	453.63	467.04	454.83	1.33
Hungary	HU	476.83	469.52	476.75	1.79
Ireland	IE	503.72	520.81	502.58	1.45
Italy	IT	489.73	484.76	480.55	1.83
Latvia	LV	482.31	487.76	490.23	1.68
Lithuania	LT	478.38	472.41	475.41	1.83
Luxembourg	LU	485.77	481.44	482.81	1.73
Malta	MT	478.64	446.67	464.78	2.05
Netherlands	NL	512.25	502.96	508.57	2.11
Poland	PL	504.47	505.70	501.44	1.39
Portugal	PT	491.63	498.13	501.10	1.82
Romania	RO	443.95	433.62	434.88	1.21
Slovak Republic	SK	475.23	452.51	460.77	0.70
Slovenia	SI	509.92	505.22	512.86	2.04
Spain	ES	485.84	495.58	492.79	1.51
Sweden	SE	493.92	500.16	493.42	1.10
United Kingdom	GB	492.48	497.97	509.22	2.29
Iceland	IS	488.03	481.53	473.23	1.20
Norway	NO	501.73	513.19	498.48	1.19
Switzerland	CH	521.25	492.20	505.51	1.57
Minimum		437.13	431.72	432.58	0.70
Maximum		521.25	526.42	534.19	2.72
Average		488.67	486.94	488.22	1.73
St. deviation		22.2001	24.8117	24.6595	0.4619

Source: Authors´ calculations

Table 2

Results of BCC model

	BCC efficiency	Rank	Benchmark
Austria	0.9548	19	Estonia, Switzerland
Belgium	0.9749	14	Estonia, Switzerland
Bulgaria	0.8484	30	Estonia, Switzerland
Croatia	0.9782	13	Slovak Republic, Norway
Czech Republic	0.9471	21	Estonia, Switzerland
Cyprus	0.8476	31	Estonia, Finland
Denmark	0.9825	9	Estonia, Switzerland
Estonia	1.0000	1	Estonia
Finland	1.0000	1	Finland
France	0.9558	16	Estonia, Finland
Germany	0.9791	12	Estonia, Finland, Ireland
Greece	0.9032	28	Estonia, Ireland, Norway
Hungary	0.9170	27	Estonia, Switzerland
Ireland	1.0000	1	Ireland
Italy	0.9421	22	Estonia, Switzerland
Latvia	0.9368	23	Estonia, Finland, Ireland
Lithuania	0.9202	25	Estonia, Switzerland
Luxembourg	0.9346	24	Estonia, Switzerland
Malta	0.9183	26	Estonia, Switzerland
Netherlands	0.9850	8	Estonia, Switzerland
Poland	0.9824	10	Estonia, Slovak Republic, Norway
Portugal	0.9554	17	Estonia, Finland, Ireland
Romania	0.8821	29	Estonia, Slovak Republic
Slovak Republic	1.0000	1	Slovak Republic
Slovenia	0.9810	11	Estonia, Switzerland
Spain	0.9526	20	Estonia, Finland, Ireland
Sweden	1.0000	1	Sweden
United Kingdom	0.9552	18	Estonia, Finland
Iceland	0.9703	15	Estonia, Slovak Republic, Norway
Norway	1.0000	1	Norway
Switzerland	1.0000	1	Switzerland
Minimum	0.85	15.32	
Maximum	1.00	31	
Average	0.95	1	
St. deviation	0.0428	10.01	

Source: Authors´ calculations

Table 2 compares the results of output-oriented DEA model under the assumption of variable return to scale (VRS). As can be see the average efficiency in the sample has value 0.955 which suggest that the efficiency of secondary educational systems in evaluated countries was relatively high. The outcomes from the analysis point to the following findings:

- The minimum efficiency score was recorded in case of Cyprus, where the score was 0.8476. Therefore, we can say that the secondary educational system could be considered the most inefficient in evaluated group of countries under the used criteria.

- On the other hand, as the efficient were marked educational systems in Estonia, Finland, Ireland, Slovak Republic, Sweden, Norway and Switzerland. These countries could be considered as efficient in term of usage of government expenditure on secondary education to reach the highest scores in PISA evaluation. The expenditures were used in the most possible way to reach the highest quality of education.
- Eleven educational systems have efficiency score higher than the average value (0.955), but were not involved in the group of efficient countries: Belgium, Croatia, Denmark, France, Germany, Netherland, Poland, Portugal, Slovenia, United Kingdom, and Iceland. As can be seen, this group brings together mostly the countries from Northern and Western Europe.
- Thirteen countries have efficiency score under the total average: Austria, Bulgaria, Czech Republic, Cyprus, Greece, Hungary, Italy, Latvia, Lithuania, Luxembourg, Malta, Romania, and Spain. It could be seen, that this group of countries consists mostly from the countries form Eastern and Southern Europe.

Based on the results of DEA analysis it is possible to indicate which countries have the highest efficiency (those classified highest on the rating list) and then compare the remaining countries with the "best" ones, which constitutes a certain kind of benchmarking. This means that the DEA method allows us to compute the so-called benchmarking formulas for inefficient units. A benchmark is understood as an indication of specific efficient units whose example ought to be followed in order to improve present efficiency. The inefficient educational systems could use these benchmarks as a model for achieving superior performance.

We can see that in the case of the Slovakia, the expenditures were the lowest compared to other countries. As the level of expenditures was the lowest, we could not expect that the quality of education will be the highest. According to the level of PISA scores can be seen that the overall PISA score was not the highest, but compared to level of expenditures, the government expenditure on secondary education was used in the maximal possible way.

Another set of two countries is located on the opposite end – Cyprus and Bulgaria. The DEA analysis indicates that their outputs could be increased by more than 50 percent if they would like to become efficient.

It is possible to observe from Table 2 that seven countries would be labelled as the most efficient with the standard DEA approach. These countries created benchmark for inefficient ones. As the most efficient countries were labelled: Estonia, Finland, Ireland, Norway, Slovak Republic, Sweden and Switzerland. Estonia and Finland were located in the efficient frontier because they performed well in the PISA survey, getting the first respectively the second position in the overall education performance index ranking (see Figure 2). Ireland, Norway and Switzerland are located in the efficient frontier because they performed well in one of the three main areas: mathematics, reading and science. Ireland was on the 2nd place in the reading, Norway on the 4th place in the reading, and Switzerland on the 1st place in mathematic. From the point of view of input variable, the Slovak Republic and Sweden were located in the efficient frontier because they had the lowest levels of expenditures which was able to use in maximum possible way to produce the similar level of outputs compared to other countries. For example to reach the similar level of the overall PISA index the Hungary must use 2.5 times higher government expenditure on secondary education (as % of GDP) compared to Slovakia. Or in a case of France and Austria which get the similar level of the overall PISA index as Sweden, it was necessary to use 2.2 respectively 2 times higher government expenditure on secondary education.

One of the advantages of DEA method is that it brings recommendations how to modify input and outputs variables to reach efficiency frontier. Optimal values of inputs and outputs could be calculated

through values of benchmark countries. Analysis of optimal values in average in the whole group of analyzed secondary educational systems point out to the fact, that in average to reach the efficiency in whole group it is necessary to make modifications on both, inputs and outputs side. As can be seen in Figure 4, to achieve the efficiency frontier the highest modification on the input side could be done in Belgium. In a case of this country the level of government expenditure on secondary education (as % of GDP) was 2.45%. Belgium used this expenditure not in maximal possible way, where the efficiency score was 0.9749. It could be seen on the output side where the overall PISA score (1507) was comparable with Poland (1511). But in a case of Poland it was able to reach this score with expenditures lower by about 50 percent. The similar situation can be seen in a case of France, which used two times higher level of government expenditures to reach the overall PISA score comparable with Sweden (see also in Figure 3). On the output side the highest modification could be done in a case of Cyprus and Bulgaria, as it was mentioned above. As can be seen Romania was able to reached the approximately the same level of overall PISA score with expenditures lower by about 40 percent.

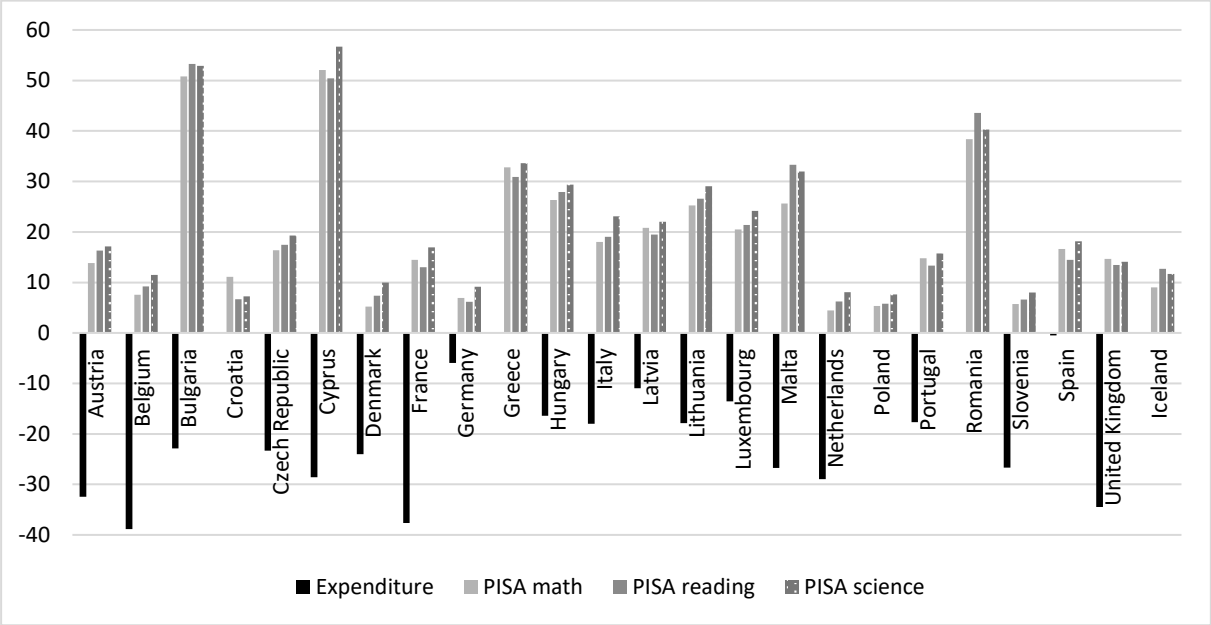

Figure 4. Potential improvements (in %)
Source: Authors´ calculations

The results of our analysis provide interesting information about the differential effects of the amount of government spending on efficiency of secondary education in selected European countries. The benefits of education are high for the entire society, so, in OECD countries up to 85% of expenditure on education are financed from public funds. This share is even more pronounced in the case of primary and secondary education, which is compulsory in most countries. Interesting results of an international comparison of selected indicators in the education sector gives us the latest report "Education at a Glance 2016: OECD Indicators" (OECD, 2016), which in the context of our results obtained offers several interpretive lines at the observed disparities in the effectiveness of education spending. Public expenditure on tertiary education in OECD countries make up to 70% of the resources, the remaining share is represented by private funds. In general, a higher level of education is declining unemployment rate for a given level of education. On average in OECD countries, acquiring upper education reduces the unemployment rate by almost one half,

while the average unemployment rate of persons without upper secondary education was 12.4% (higher secondary education – 7.3%). For comparison, in Slovakia, the unemployment rate of persons without upper secondary education was up to 34.2% (for persons with upper secondary education it was 9.9%). In the case of people with tertiary education is the unemployment rate in Slovakia almost on the OECD average (Slovakia – 5.6%; OECD average – 4.9%). Differences in unemployment rates among tertiary educated people and people without upper secondary education in Slovakia are the largest among OECD countries. Slovakia is also one of the OECD countries with above-average difference (70%) of the income of people with tertiary and upper secondary education (OECD average is 55%). Exceptions are those with Bachelor's degree, where this difference is significantly lower in Slovakia (Slovakia – 27%; OECD average – 48%). The facts mentioned above provide in connection with the results of our study a platform for subsequent complementary studies that would further investigate the impact of the volume and structure of government expenditure (share of education spending in total government spending) on the effectiveness of education, as measured by several indicators (e.g. indicators of a common methodology of OECD Eurostat and UNESCO – Report Education at a Glance (OECD, 2016)). Several methodological processes and the formation of the comparative platform for international benchmarking would be greatly supported by this. At the micro level, these outcomes have been very beneficial for regional policy makers in education, development of concepts for developing educational programs, as well as stabilizing and regulating mechanisms in the education sector.

5. CONCLUSION

Countries invest in education in order to contribute to the personal and social development and reducing social inequalities and to promote economic growth and productivity improvements. The level of expenditure in education is conditional, in particular by the size of the school population of the country, participation rates, salary levels of teachers and system organization and delivery of instruction.

Money are necessary to secure quality in educational process, but it is not sufficient. Only one country (Finland) with the highest share of government expenditure on secondary education on GDP, participating between first five countries classified according the total score reached in PISA tests. But on the other hand we can see here countries which share of expenditures on GDP is under the sample average.

The important question therefore is not the level of expenditure, but efficiency of their usage. Therefore the aim of this paper was to analyse the relative efficiency of government expenditures on secondary education, in selected European countries in 2015. We use comparable data at a country level, allows us to empirically investigate the efficiency of government expenditure on secondary education in a cross-country perspective. The DEA method was applied through the output-oriented model under the variable return to scale assumption. As the input variable the value of the government expenditure on secondary education was used. To eliminate the impact of size of the economy on the efficiency of the educational system we decide to use the value of government expenditure in relation to the gross domestic product (expenditure as % of GDP) of the country. Because we assume that the impact of expenditure has no effect on the efficiency of the educational system in the same year, considering the value of the government expenditure incurred one year earlier (2014). We try to analyze how the government expenditures are transformed into the results of education. For measuring the success of education we decide to use the PISA indicator in three main areas: mathematics, reading and science in last evaluation realized in 2015.

The results of analysis point to the fact that the average efficiency in the sample has value 0.955 which suggest that the efficiency of secondary educational systems in evaluated countries was relatively high. The

outcomes from the analysis point to the following findings. The minimum efficiency score was recorded in case of Cyprus, where the score was 0.8476. On the other hand, as the efficient were marked educational systems in Estonia, Finland, Ireland, Slovak Republic, Sweden, Norway and Switzerland. Eleven educational systems have efficiency score higher than the average value, and this group brings together mostly the countries from Northern and Western Europe. Thirteen countries have efficiency score under the total average, and this group of countries consists mostly from the countries form Eastern and Southern Europe.

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