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RELATIVE EFFICIENCY OF SECONDARY EDUCATION: A COMPARATIVE ANALYSIS OF SLOVENA AND CROATIA

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Abstract:
The paper joins the efforts of other scholars in investigating secondary education efficiency by applying a non-parametric methodology. In this respect, the paper's purpose is to review some previous researches on measuring the efficiency of public (secondary) education sector as well as some conceptual and methodological issues of a non-parametric approach. Most importantly, the Data Envelopment Analysis (DEA) technique is presented and then applied to a wide range of EU and OECD countries, with a special focus on Slovenia and Croatia, to evaluate the technical efficiency of secondary education. The empirical results show that technical efficiency in secondary education varies significantly across the great majority of EU and OECD countries. Many EU countries, including Slovenia and Croatia, show a relatively high level of technical inefficiency in their secondary education as they respectively only rank in the last two quartiles among selected countries. Therefore, taking advantage of the significant room to rationalise public secondary education spending without sacrificing while also redirecting resources to the tertiary education sector is recommended for both countries.

Keywords: secondary education, technical efficiency, DEA, Slovenia, Croatia, EU, OECD.

1. INTRODUCTION

Every economy is concerned about the efficient use of its scarce resources. The same problem exists in the public sector where resources are ever more limited. In particular, problems arise when public sector activity extends beyond theoretically justified areas and/or when it is carried out at excessive costs (Afonso et al., 2006). Accordingly, economists have tended to measure the output/outcome or benefit of public activities on the basis of the budgeted allocation: the higher the expenditure, the higher the benefit. Indeed, the larger the expenditure, the greater the benefits received by the intended recipients are assumed to be. However, due to scarce (public) resources measuring performance and efficiency in the public sector has become a key focus of policy leaders in recent years.

Education is one of the most important government expenditure items in the most developed economies and there is a rationale for this amount. Indeed, the public sector mainly finances and manages the Croatian and Slovenian educational systems, and this is also the case in most European and emerging market economies. In the 2001–2008 period, the overall proportion of GDP given over to education in the EU-27 remained stable at around 5 %. This stable European average hides disparities between countries, some of which experienced significant changes during the period. In Bulgaria, Cyprus and Iceland, the proportion of GDP allocated to education increased by over 20 % between 2001 and 2008 and by more than 30 % in Malta and Ireland over the same period. Significant growth – above 10 % – also occurred in the United Kingdom. The stability in the overall figures for 2001–2008 also masks spending disparities at the different levels of education. Expenditure rose by more than 5 % on pre-primary and tertiary education as a proportion of GDP in the 2001–2008 period. In contrast, expenditure on secondary education decreased slightly (Eurostat, 2012). However, due to the relatively high amount and importance of this type of government expenditure, the measurement of its efficiency should be high on the policy agenda of every government.

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 notably 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 OECD countries. Gunnarsson and Mattina (2007) assess 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) find evidence of spending inefficiencies for the local government sector. In addition, Afonso et al. (2008) assess the efficiency of public spending for redistributing income. Other authors (e.g. Mandl et al., 2008; Jafarov and Gunnarsson, 2008) have tried to improve on 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), Obadić and Aristovnik (2011) and Aristovnik (2012) have focused on measuring efficiency in the education sector.

Nevertheless, few studies examine technical efficiency in secondary education.[1] For example, Afonso and St. Aubyn (2006a) evaluated efficiency in providing secondary education across OECD countries by assessing outputs (student performance) against inputs directly used in the education system (teachers, student time) and environment variables (wealth and parents' education). In methodological terms, they employed a two-stage semi-parametric procedure. Firstly, output efficiency scores were estimated by solving a standard DEA problem with countries as DMUs. Secondly, these scores were explained in a regression with the environmental variables as independent variables. Results from the first stage imply that, on average, countries could have increased their results by 11.6 % using the same resources.

Since very insightful, cross-country analyses, particularly for the secondary education sector, are rarely used for policy analysis, we will apply the DEA approach to several EU (plus Croatia) and OECD countries, with a special focus on Slovenia and Croatia in the rest of the paper. DEA is chosen here because it is more reliable for measuring technical efficiency as it can be applied to multi-input and multi-output variables. The analysis includes 31 EU (plus Croatia) and OECD countries in 1999–2007 period. The paper is divided into three parts. After presenting some literature review of previous theoretical and empirical studies in this section, research methodology and the results of the DEA analysis are provided in the second part. Finally, the paper ends with a conclusion.

2. EMPIRICAL ANALYSIS

2.1. Methodology and Data

A common approach to measuring efficiency is based on the concept of the efficiency frontier (production possibility frontier). Many techniques are available to calculate or estimate the shape of the efficiency frontier. Most investigations aimed at measuring efficiency are based on either parametric or non-parametric methods. The main difference between the parametric and non-parametric approaches is that parametric frontier functions require the ex-ante definition of the functional form of the efficiency frontier. While a parametric approach assumes a specific functional form for the relationship between input and output, a non-parametric approach constructs an efficiency frontier using input/output data for the whole sample following a mathematical programming method.[2] The calculated frontier provides a benchmark against which the efficiency performance can be judged. This technique is therefore primary data-driven. Among the different non-parametric methods the Free Disposal Hull (FDH) technique imposes the fewest restrictions.[3] 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 needed to attain a given level of output/outcome. This allows inefficient producers to be identified in terms of both input efficiency and output/outcome efficiency (Afonso et al., 2005).

[1] Moreover, Barro and Lee (2001) find that student performance is positively correlated to the level of school resources, such as pupil–teacher ratios, and to family background (income and education of parents). Further, Hanushek and Kimko (2000) and Hanushek and Luque (2003) find little or no evidence of a positive link between more resources allocated to the education system and test performance. However, they find that adult schooling levels have a positive and significant effect on student performance.
[2] For an overview of non-parametric techniques, see Simar and Wilson (2003).
[3] FDH analysis was first proposed by Deprins et al. (1984).

An alternative non-parametric technique that has recently started to be commonly applied to (public) expenditure analysis is Data Envelopment Analysis (DEA). DEA is a non-parametric frontier estimation methodology originally developed by Farrell (1957) and popularised by Charnes et al. (1978). It compares functionally similar entities described by a common set of multiple numerical attributes. DEA classifies the entities into "efficient" or "performers" versus "inefficient" or "non-performers." According to DEA framework, the inefficiencies are the degrees of deviance from the frontier[4]. Input inefficiencies show the degree to which inputs must be reduced for the inefficient country to lie on the efficient practice frontier. Output inefficiencies are the needed increase in outputs for the country to become efficient. If a particular country either reduces its inputs by the inefficiency values or increases its outputs by the amount of inefficiency, it could become efficient; that is, it could obtain an efficiency score of one. The criterion for classification is determined by the location of the entities' data point with respect to the efficient frontier of the production possibility set. The classification of any particular entity can be achieved by solving a linear program (LP).

To measure efficiency, *DEA* is the choice here because it does not require us to specify the functional form or distributional forms for errors. In essence, it is more flexible than the parametric approach. Further, *DEA* has been extensively used to measure public sector efficiency in many countries by many researchers and, like Ouellette and Vierstraete (2004), Verma and Gavirneni (2006), Hauner (2007), Adam et al. (2011) point out, DEA has been so popular because it is easy to draw on diagrams and easy to calculate. Apart from the above reasons, *DEA* is chosen here because it is more reliable for measuring the technical efficiency as it can be applied to multi-input and multi-output variables.

As an example, consider a situation that has F DMUs, with each of them having M inputs and N outputs. Let X_l^f be the level of input l at DMU f and let Y_k^f be the level of out k at DMU f. Without loss of generality, it will be assumed that the inputs and the outputs are defined in a manner such that lower inputs and higher outputs are considered better. The relative efficiency of DMU f, denoted by w_f, is computed by solving the following linear program (Verma & Gavirneni, 2006):

$$Maximize\ w_f = \sum_{k=1}^{N} \beta_k Y_k^f$$

Subject to:

$$\sum_{l=1}^{M} \alpha_l X_l^f$$

$$\sum_{k=1}^{N} \beta_k Y_k^f - \sum_{l=1}^{M} \alpha_l X_l^f \leq 0 \ \forall f = 1, 2, \ldots, F$$

$$\alpha_l, \beta_k \geq 0$$

[4] The "efficiency frontier" is constructed as the linear combination of efficient input and output combinations in a cross-country sample (Gunnarsson and Mattina, 2007).

The basic idea in this approach is that, through the use of weights α and β, the sets of inputs and outputs are converted to a single "virtual input" and a single "virtual output". The ratio of the virtual output to the virtual input determines the efficiency associated with the DMU. In addition, when the efficiency of a DMU is being computed the weights are determined in such a way that its virtual input is set equal to 1. The resulting virtual output for that DMU determines its relative efficiency. Due to the presence of multiple measures of performance, each DMU would like to choose weights that put it in the best light and this linear programming formulation does just that. That is, when solving for DMU *f*, the weights chosen are those that result in that DMU achieving the highest efficiency possible. Any other set of weights would only result in the DMU having a lower efficiency rating. In order to complete the analysis, k linear programs (one each for a DMU) need to be solved and the relative efficiencies of the DMUs can be tabulated. The technique is therefore an attempt to find the "best" virtual unit for every real unit. If the virtual unit is better than the real one by either making more output with the same input or making a similar output with less input then we say that the real unit is inefficient. Thus, analysing the efficiency of N real units becomes an analysis of N linear programming problems.

In the majority of studies using DEA the data are analysed cross-sectionally, with each decision-making unit (DMU) – in this case the country – being observed only once. Nevertheless, data on DMUs are often available over multiple time periods. In such cases, it is possible to perform DEA over time where each DMU in each time period is treated as if it were a distinct DMU. However, in our case the data set for all the tests in the study includes average data for the 1999–2007 period (including PISA 2006 average scores) in order to evaluate long-term efficiency measures as the secondary education process is characterised by time lags in thirty-one EU (plus Croatia) and OECD countries. The program used for calculating the technical efficiencies is the DEA*Frontier* software. The data are provided by the OECD, UNESCO and the World Bank's World Development Indicators database.

The specification of the outputs and inputs is a crucial first step in DEA since the larger the number of outputs and inputs included in any DEA, the higher will be the expected proportion of efficient DMUs, and the greater will be the expected overall average efficiency (Chalos, 1997). Common measures of teaching output in education used in previous studies are based on graduation and/or completion rates (see Johnes, 1996; Jafarov and Gunnarsson, 2008), PISA scores (see Afonso and St. Aubyn, 2005; Jafarov and Gunnarsson, 2008), pupil-teacher ratio and enrolment rate (see Jafarov and Gunnarsson, 2008). Moreover, the literature shows that the specification of the inputs is generally in the form of domestic (public or total) expenditure (in % of GDP) (for education) or the number of hours in school (see Afonso and St. Aubyn, 2005). Nevertheless, these studies also demonstrate that DEA is an effective research tool for evaluating the efficiency of the education sector given the varying input mixes and types and numbers of outputs.

Table 1: Input and output/outcome set for the DEA

Model	Inputs	Outputs/Outcomes
I	○ Expenditure per student, secondary (% of GDP per capita) [1]	○ School enrolment, secondary (% gross) ○ PISA average (2006) [3] ○ Teacher-pupil ratio, secondary
II	○ Expenditure per student, secondary (% of GDP per capita) ○ Teacher-pupil ratio, secondary[1]	○ School enrolment, secondary (% gross) ○ PISA average (2006)
III	○ Teacher-pupil ratio, secondary	○ PISA average (2006)

		○ School enrolment, tertiary (% gross) [2]
IV	○ School enrolment, secondary (% gross) [2]	○ PISA average (2006) ○ School enrolment, tertiary (% gross)

Sources: [1]UNESCO; [2]World Bank; [3]OECD.

Hence, similar to the earlier empirical literature (particularly Afonso and St. Aubyn (2006)), in this analysis the data set to evaluate secondary education efficiency includes input/output/outcome data, i.e. (public) expenditure per student (secondary) (% of GDP per capita), teacher-pupil ratio (secondary), teacher-pupil ratio (secondary) or school enrolment, secondary (% gross), school enrolment, tertiary (% gross) and the PISA 2006 average score. Thirty-one countries are included in the analysis (selected EU (plus Croatia) and OECD countries). Different inputs and outputs/outcomes have been tested in four models (see Table 1).

2.2. Empirical Results

This subsection shows the empirical application of the Data Envelopment Analysis (DEA).[5] Summary statistics relating to the DEA analyses are displayed in Table 2. When looking at the education results[6] by using Model 1 (see Table 1) and applying the DEA efficiency frontier technique to Slovenia, Croatia and a select group of EU/OECD countries to measure the efficiency of secondary education, ten countries are seen as the most efficient. These most efficient countries include Greece, Ireland, Slovakia and Romania, although their secondary expenditures per student (in % of GDP) are very low and averaged out at less than 19 % (the EU/OECD average is 23.8 % in the considered period). One can also see that some countries come very close to the frontier (e.g. Denmark and Sweden), while other countries are further away and therefore less efficient (e.g. Italy and Portugal) (see Table 3). Some less efficient countries should significantly decrease their input (secondary expenditure per student) (e.g. Denmark from 36.0 % to 25.7 %) and/or increase their outputs/outcomes, i.e. school enrolment (e.g. Austria and Latvia), average PISA scores (e.g. Bulgaria and Denmark) and teacher-pupil ratio (e.g. Japan and Lithuania) in order to become efficient.[7] According to Model I, Slovenia is ranked 19th (its benchmark countries are Finland and New Zealand) and should decrease its secondary expenditures per student (in % of GDP) by about 2 percentage points and increase its average PISA scores by more than 10 points to become an efficient country. On the other hand, Croatia is only ranked 28th and should increase its average PISA scores by almost 19 points to be located on the efficiency frontier.

Table 2: Summary Statistics

	Average	St. Dev.	Min.	Max.	SLO	CRO
Expenditure per student, secondary (% of GDP per capita)	23.777895	4.7288054	15.0563 (ROM)	36.011203 (DEN)	27.66749	24.897357
School enrolment,	103.7513	12.73161	79.74	133.0922	100.48	88.3425

[5] All the calculated results are available from the authors on request.

[6] All of the results relate to DEA with an output orientation, allowing for variable returns to scale (VRS). An output orientation focuses on the amount by which output quantities can be proportionally increased without changing the input quantities used. Using an input orientation approach leads to similar efficiency results as those presented in the text.

[7] The average output efficiency score for secondary education (Model I) is 1.090, meaning that the average country could increase its outputs/outcomes by about 9.0 % if it were efficient. The results also confirm our expectations that new EU member states are less efficient than EU-15 states in secondary education.

secondary (% gross)			(MEX)	(BEL)		
School enrolment, tertiary (% gross)	59.02336	15.04901	22.7644 (MEX)	87.75778 (FIN)	69.51333	37.8975
PISA average (2006)	490.3095	32.99171	408.601 (MEX)	552,8498 (FIN)	505.8935	479
Teachers per 100 pupils. Secondary	9.0969	1.4873	5.2672 (MEX)	12.0387 (POL)	9.0954	9.4227

Sources: World Bank, 2010; UNESCO, 2010; OECD, 2010; own calculations

In terms of the efficiency scores for Model II, again ten of the analysed countries are labelled as efficient (see Table 3), although New Zealand and Poland are now replaced by Japan and Sweden in the efficient group. The average output efficiency score is 1.09119, which means that the average country could increase its outputs/outcomes by around 9.1 % if it were efficient. The worse performers are again Italy and Portugal with well above average secondary education expenditures and below average PISA scores (less than 490) and school enrolment (less than 103.6 %). Indeed, both countries should increase their outputs by more than 14.4% in order to become efficient. When comparing Slovenia and Croatia, the results of the DEA analysis for Model II again suggest a relatively high level of inefficiency in secondary education, particularly in Croatia. However, both countries have worse rankings, indicating the existence of significant room to rationalise public spending without sacrificing, while also potentially improving their secondary education outputs and outcomes (see Table 3). With respect to individual performance indicators, Croatia ranks in the last quartile (Slovenia is in the third quartile) for secondary education school enrolment and in the last quartile (Slovenia is in the second) for average PISA scores. In order to become efficient, both countries should reduce their (above average) teacher-pupil ratio (by about 0.5 teacher per 100 pupils) and increase the school enrolment rate by 4.8 percentage points in Croatia and 8.7 percentage points in Slovenia.

When testing the efficiency of secondary education with Model III, only four of the thirty-one countries analysed within the formulation for secondary education presented in Table 3 are estimated as efficient. These countries are Finland, Japan, Lithuania and Sweden. Other countries under consideration could improve their efficiency scores by decreasing their input (teacher-pupil ratio), in particular in Poland (by about 3.5 teachers per 100 pupils) and Czech Republic (by about 1.7). However, even more importantly, a significant increase in outputs/outcomes is needed in the form of school enrolment (tertiary) (in particular in Mexico and Czech Republic) and in the form of average PISA scores (in the USA and the Republic of Korea). In general, the output/outcome scores could on average be almost 13% higher. Similar to the previous model, Slovenia and Croatia are classified (in Model III) in the second and last quartiles, respectively. These DEA ranks also suggest that Slovenia's and Croatia's efficiency outputs/outcomes in secondary education should respectively be 9.3 % and 15.4 % higher than those under efficient conditions. Indeed, both countries should significantly improve their school enrolment (tertiary) to become efficient (Croatia by 44 percentage points, Slovenia by almost 12 percentage points).

In the final efficiency model (Model IV), only three countries (Finland, Korea and Mexico) are found technically efficient under VRSTE. However, Mexico is found to be efficient due to its extremely low (secondary) enrolment rate (79.74) and therefore this result should be interpreted with caution. The worst efficiency performers are Bulgaria and Greece due to their relatively poor average PISA scores (in both Bulgaria (416) and Greece (464)) and school

enrolment rate (tertiary) (in Bulgaria (43.7 %)). The results of the model also show Croatia becoming highly efficient in comparison to Slovenia. This efficiency outcome is a result of its relatively low level of input, i.e. its (secondary) school enrolment rate (88.3 %) in Croatia. Nevertheless, similar to Model III, the DEA analysis shows that both countries should significantly increase their output ((tertiary) school enrolment rate) if they are to be efficient. The best benchmark countries for these two countries are Finland and the Republic of Korea, with the former country showing the highest (tertiary) school enrolment rate and the highest result of average PISA scores among the selected group of countries (see Table 3).

To summarise, the presented empirical analysis makes it obvious that the secondary education sector in many of the considered countries suffers from relatively low technical efficiency, including in Slovenia and Croatia. The inefficiency is particularly evident in selected new EU member states (plus Croatia) and some less developed OECD members, i.e. emerging market economies (see Table 4). However, contrary to our expectations, some highly developed countries such as the USA and Norway also have poor efficiency results. The empirical results also show that Slovenia and Croatia are ranked in the third and last quartiles (considering all four models), respectively, reflecting relatively high levels of inefficiency in their secondary education. Obviously, both countries use too many scarce public resources to produce relatively average (in Slovenia) or even below average (in Croatia) output/outcome. Therefore, taking advantage of the significant room to rationalise public secondary education spending without sacrificing, while also redirecting resources to the tertiary education sector, is recommended for both countries.[8]

Table 3: DEA results for public secondary education efficiency in selected OECD and EU (plus Croatia) countries

No.	Country	Model I		Model II		Model III		Model IV	
		VRSTE	Rank	VRSTE	Rank	VRSTE	Rank	VRSTE	Rank
1	Austria	1.06329	17	1.10092	26	1.10092	15	1.08414	14
2	Belgium	1.00000	1	1.00000	1	1.07782	10	1.08288	13
3	Bulgaria	1.06865	18	1.09144	24	1.32790	29	1.30686	31
4	*Croatia*	*1.11404*	*28*	*1.14205*	*29*	*1.15418*	*24*	*1.01889*	*4*
5	Czech R.	1.04964	14	1.06915	18	1.10171	16	1.06565	9
6	Denmark	1.01937	11	1.03932	13	1.10320	17	1.10320	19
7	Estonia	1.06238	16	1.05353	15	1.06237	8	1.05299	6
8	Finland	1.00000	1	1.00000	1	1.00000	1	1.00000	1
9	France	1.10143	26	1.06957	19	1.08887	13	1.11470	23
10	Greece	1.00000	1	1.00000	1	1.19124	28	1.16980	30
11	Hungary	1.07605	21	1.07402	21	1.12018	20	1.10369	20
12	Iceland	1.05791	15	1.05832	16	1.11989	19	1.11130	22
13	Ireland	1.00000	1	1.00000	1	1.08607	12	1.07857	12
14	Italy	1.17293	31	1.15750	31	1.15750	27	1.15956	29
15	Japan	1.02600	13	1.00000	1	1.00000	1	1.05373	7
16	Korea	1.00000	1	1.00000	1	1.01351	5	1.00000	1
17	Latvia	1.10043	25	1.11722	27	1.13990	23	1.11922	24
18	Lithuania	1.08209	22	1.00000	1	1.00000	1	1.13076	25
19	Mexico	1.10619	27	1.06962	20	1.32791	30	1.00000	1
20	Netherlands	1.00000	1	1.00000	1	1.02583	6	1.06163	8
21	N. Zealand	1.00000	1	1.00079	12	1.05411	7	1.05244	5
22	Norway	1.09658	24	1.08237	23	1.08512	11	1.13126	26
23	Poland	1.00000	1	1.04851	14	1.10506	18	1.08884	16
24	Portugal	1.15753	30	1.14408	30	1.15467	25	1.15949	28
25	Romania	1.00000	1	1.00000	1	1.33009	31	1.09676	18
26	Slovakia	1.00000	1	1.00000	1	1.13924	22	1.06873	10
27	*Slovenia*	*1.06972*	*19*	*1.09258*	*25*	*1.09282*	*14*	*1.07670*	*11*

[8] For instance, Slovenia is the only OECD country where spending per student at the tertiary level is less than that at lower levels of education (OECD, 2011).

28	Spain	1.07095	20	1.07475	22	1.15666	26	1.15641	27
29	Sweden	1.02507	12	1.00000	1	1.00000	1	1.09620	17
30	UK	1.08686	23	1.06297	17	1.06297	9	1.08648	15
31	USA	1.12153	29	1.12466	28	1.12448	21	1.10489	21
	EU15 average	1.07732		1.08030		1.10991		1.10408	
	New EU member states	1.10027		1.09059		1.13409		1.13274	
	Non-EU average	1.08489		1.08432		1.12436		1.10715	
Number of efficient countries		10		10		4		3	
Mean		1.09030		1.09119		1.12755		1.11390	
Std. dev.		0.05071		0,051077		0,088666		0,060124	

Note: Relative efficiency scores (Models I-IV; see Table 1). Thirty-one countries are included in the analysis (EU-27, OECD and Croatia). Slovenia and Croatia are presented in italic.
Sources: World Bank, 2010; UNESCO, 2010; OECD, 2010; own calculations

Table 4: The relative efficiency of secondary education system in selected OECD and EU (plus Croatia) countries (Distribution by quartiles of the ranking of efficiency scores in all four models)

I. quartile	*II. quartile*	*III. quartile*	*IV. quartile*
Finland	Slovakia	UK	Norway
Korea	Estonia	*Slovenia*	*Croatia*
Netherlands	Lithuania	Austria	Spain
Japan	Poland	Iceland	Latvia
Belgium	Romania	Mexico	USA
New Zealand	Czech Republic	France	Bulgaria
Ireland	Denmark	Hungary	Portugal
Sweden	Greece		Italy

Note: Relative efficiency scores (models I-IV; see Table 1). Thirty-one countries are included in the analysis (EU-27, OECD and Croatia). Slovenia and Croatia are presented in italic.
Sources: World Bank, 2010; UNESCO, 2010; OECD, 2010; own calculations.

Speaking about the efficiency of secondary education in Slovenia and Croatia, it can be also concluded that both countries appear to perform inefficiently due to their high spending, but Croatia is also weaker in its outcomes than Slovenia. This low ranking of Croatian secondary education is due to the low enrolment rates and relatively low PISA scores (in mathematics). For example, Estonia, Poland, Slovakia, Latvia and Latvia have lower education expenditure but better PISA 2009 results than Croatia. Namely, the average Croatian PISA result is below the expected value for a given level of public spending on education (Sopek, 2011). Average class sizes in secondary education are comparatively small. In addition, Slovenian schools employ the highest number of professional support staff per pupil in the OECD (OECD, 2011).

3. CONCLUSION

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, implementing performance-based budgeting, i.e. spending at the individual school level, could be increasingly linked to outcome indicators. Moreover, reducing the number of secondary teachers through natural attrition and implementing a selective hiring freeze on new teachers is needed in the future. Further, merging some secondary schools over the coming years is another possible solution. As the secondary school-age population is expected to decline in the medium term, schools should also consider pooling their resources by jointly hiring and sharing new teachers (also see Jafarov & Gunnarsson, 2007). In this respect, taking advantage of the significant space to rationalise public secondary education spending without sacrificing, while also redirecting resources to the tertiary education sector is recommended for both countries.

In both countries, the secondary education system should also be modernised 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 rationalised 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 respect, taking advantage of the significant space to rationalise public secondary education spending without sacrificing, while also redirecting resources to the tertiary education sector is recommended for both countries in the near future.

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