RELATIVE EFFICIENCY OF HIGHER EDUCATION IN CROATIA AND SLOVENIA: AN INTERNATIONAL COMPARISON

Alka Obadić[1] and Aleksander Aristovnik[2*]
[1)] *University of Zagreb, Zagreb, Croatia*
[2)] *University of Ljubljana, Ljubljana, Slovenia*

Abstract
The article measures the relative efficiency of government spending on higher education in selected new EU member states (with special focus on Croatia and Slovenia) in comparison to selected OECD countries. The article applies a non-parametric approach, i.e. data envelopment analysis (DEA), to assess the relative technical efficiency of higher education across selected countries. When estimating the efficiency frontier we focus on measures of quantities outputs/outcomes. The results show that the relatively high public expenditure per student in Croatia should have resulted in a better performance regarding the outputs/outcomes, i.e. a higher rate of higher education school enrolment, a greater rate of labor force with a higher education and a lower rate of the unemployed who have tertiary education. On the other hand, regardless of the input-output/outcome mix, the higher education system in Slovenia is shown to have a much higher level of efficiency compared to both Croatia and many other comparable new EU member states and OECD countries.

Keywords: public expenditure, efficiency, higher education, data envelopment analysis, Croatia, Slovenia, new EU member states, OECD

JEL Classification: H52, I21, I23

Introduction

The review of different empirical evidence (Norman, 1998, p. 129) on the relationship between education and economic growth rates or income levels show that education influences economic growth. Most evidence comes from cross-section regression analysis on samples of developing and/or OECD countries, though increasingly times-series testing on individual (of groups of) countries are being pursued. Several studies have found that countries with more educated labour forces tend to grow faster, other thing equal; other studies have failed to find a significant education-growth relationship. Results also vary widely in terms of magnitude. The reasons for this are unclear, but may be related to differences and inaccuracies in the educational datasets (Keller, 2006; Norman, 1998).

[*] Corresponding author, **Aleksander Aristovnik -** aleksander.aristovnik@fu.uni-lj.si

Denison (1985) estimates that typically a quarter of the growth of output per person arises from increases in educational attainment. Higher education plays vital role in driving economic growth and social cohesion. Greater investment in universities increases the quality and quantity of highly educated graduates. The commonly held perception of universities as merely institutions of higher learning is gradually giving way to the view that universities are important engines of economic growth and development. Universities not only generate new knowledge through primary research, they also provide technical support and specialised expertise and facilities for on-going firm-based research and development (R&D) activities. Academic research and development is now seen as one of the key drivers of economic growth. Countries that have academic institutions performing large amounts of R&D are more able to attract and grow technology oriented companies. The most comprehensive evidence from cross-section regression comes from Barro and Sala-i-Martin, who finds that public educational expenditures significantly improve growth performance and confirm a positive role (Barro, Sala-i-Martin, 1995).

The attainment of an upper secondary education has become the norm in most countries today. In addition, the majority of students are graduating from upper secondary programs designed to provide access to tertiary education, in turn leading to increased enrolments at this higher level. Countries with high graduation rates at the tertiary level are also those most likely to develop or maintain a highly skilled labor force (OECD, 2009a, p. 64). The emerging knowledge-based information society requires a large supply of highly skilled people. There is strong demand for tertiary graduates (especially in the fields of science and engineering, along with other fields like languages and economics) in the economy. The characteristics of the higher education (HE) sector make it difficult to measure efficiency: it does not make a profit; there is an absence of output and input prices; and higher education institutions (HEIs) produce multiple outputs from multiple inputs (Johnes, 2006, p. 273).

The HE sector, however, has characteristics which make it difficult to measure efficiency: it is non-profit making; there is an absence of output and input prices; and HEIs produce multiple outputs from multiple inputs (Johnes, 2006, p. 273). This article tries to assess the relative efficiency of government spending on higher education in selected new EU member states and OECD countries, with special focus on Croatia and Slovenia. In this respect, the efficiency of higher education systems is computed using the non-parametric approach of data envelopment analysis (DEA) to capture the different dimensions of those systems and to measure their relative efficiency. The performance of higher education is measured by how well it transforms inputs into outputs. This is the first time DEA estimations have been used to measure the performance of HE systems in these two countries on the macroeconomic level by using a wide range of inputs and outputs/outcomes.

The article is divided into four main parts. After introductory part, second part analysis higher education systems, their expenditures and outcomes in selected new EU member states and OECD countries. The third part explicates methodology of data envelopment analysis for measuring higher education achievements. Research results of efficiency effects of higher education attainment in selected countries are presented in the fourth part od the research. Conclusions regarding the efficiency of the Croatian and Slovenian higher education in comparison to new EU member states and OECD countries are drawn in final section.

1. Descriptive Analysis

Croatian GDP per capita has been relatively low compared to Slovenian or other European countries. One of the many explanations of this difference could be the effectiveness and efficiency of the country's education system. From this perspective, universities generate spill-over effects from their academic research and teaching, thereby stimulating economic growth (Audretsch and Lehmann and Warning, 2003). Indeed, the close nexus between the university system and economic growth has seen significant attention being paid to the efficiency and quality of Croatian universities. The majority of Croatian and Slovenian universities are government-owned and largely funded by the Ministry of Education and Science[1]. Universities are autonomous bodies established by legislation allowing considerable freedom in their activities. The next section describes the Croatian and Slovenian tertiary systems in more detail.

1.1 The Higher Education Systems of Croatia and Slovenia and Its Expenditure

Higher education (HE) institutions in Croatia encompass universities, polytechnics and schools of professional higher education. Universities may include faculties and academies of arts as legal entities, and may establish a number of other constituent units (departments, institutes etc.). In contrast, polytechnics and professional higher education schools may not establish other TE institutions (MoSES, 2007, p. 33). There are seven public universities and two private universities and 16 private two-, three- or four-year colleges, polytechnics, or academic programs. The central government funds public higher education, although management is fully decentralized to the level of individual institutions (WB, 2008a, pp. 107-109). On the other hand, the higher education system in Slovenia is currently based on four universities with 49 faculties, three art academies or professional colleges, and 30 individual higher education institutions generally established as private institutions. The funds for financing academic activity are allocated from the national budget as aggregate funds for a university or an independent higher education institution (integral financing) and take into consideration the field of study and the numbers of enrolled students and graduates from regular first- or second-degree studies (MHEST, 2010a).

Education expenditure in both countries is financed by two distinct types of funding: public funding (public expenditure) and private funding. In all EU countries, public financing accounts for at least 75% of education expenditure when taking all education levels together (Eurostat, 2009, p. 129). However, since the early 1980s changes in the direction of diversified sources have been observed, with an emphasis on student contributions (Bevc and Uršič, 2008, p. 233). Namely, higher education has expanded and today is in need of better quality. The OECD believes that graduates should contribute to the cost of their tuition – balanced by measures to support students from poor backgrounds (OECD, 2006). Notwithstanding, a higher student contribution in higher education expenditures the total number of higher graduates has grown in the EU-27 since 2000 by 35% or 4.3% per year and hence twice as fast as the general student population. Of course, one reason for this is the Bologna Process, with a higher share of students taking second degrees (European

[1] Observing the higher education institutions as a whole, the ratio of public funds used exceeds 70%, in extreme cases – mainly in Scandinavia – it can reach even 97-98%. It is fair to ask why the state finances universities and colleges to such a high extent, that is, why the state should have a role in higher education (Tóth, 2008, p. 79).

Commission, 2009, p. 59). The overall growth in graduates was particularly strong (over 10% per year) in some selected new EU member states (Romania, the Czech Republic and Slovakia) in the 2000-2007 period (Figure no. 1).

The major inputs for education and higher education in EU and OECD countries come from public expenditures. Public expenditures for higher education in Croatia are less than those in the EU-27, selected new EU member states, OECD countries and Slovenia, which are nearly the same. Private spending on education in Croatia accounts for around 0.75% of GDP compared with ratios of around 0.4% in the EU-15 and EU-25. Despite the relatively high private spending on education there are very few private schools, although there is a growing number of private pre-school providers. School enrolment at the higher education level in Croatia is almost half that seen in Slovenia, but relatively close to the selected new EU member states average. Although the completion rates are low, in 2008 the number of higher education graduates in Croatia was higher than in Slovenia (Table no. 1). While the number of graduates is rising, there is still a mismatch between skills demanded by the market and the skills produced by the education system (World Bank, 2008, p. 104).

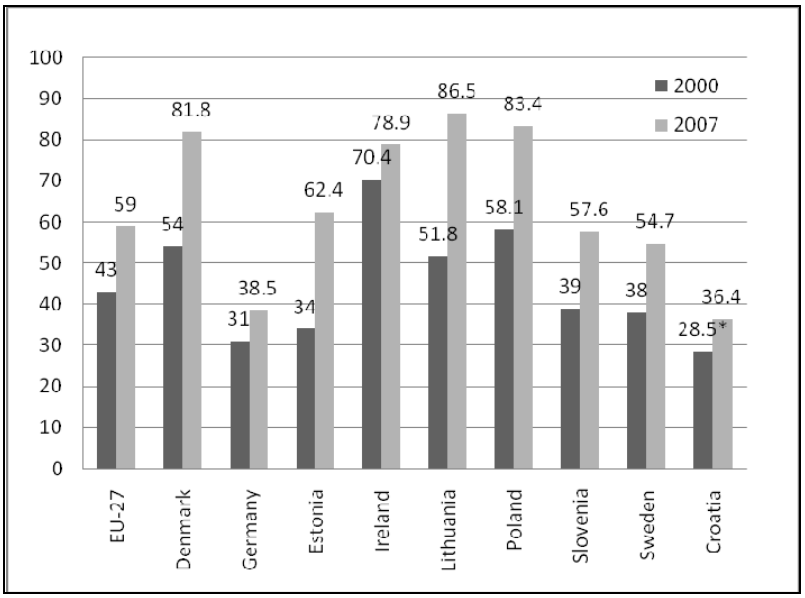

Figure no. 1: Tertiary graduates in selected EU-27 and Croatia (by ISCED levels 5 and 6 per 1,000 population aged 20-29/25-34), 2000-2007

*Note: * estimates*
Source: Eurostat according to the European Commission (2009).

Overall public expenditure on education as a share of GDP in both countries is comparable with the EU average. Slovenian government expenditure on higher education has shown a positive trend in recent years, with nominal expenditures tending to increase faster than the inflation rate. The total amount of government expenditure rose by 5.9% in 2005 and 7.2% in 2006, while the amount of funds for educational purposes went up by 6.4% and 8.4%, respectively, in the same years (Tajnikar and Debevec, 2008, p. 290). By contrast,

expenditure at the higher education level in Croatia is far behind that in the selected new EU member states and OECD countries. The Croatian higher education system currently has too little by way of assured financial funds compared to European standards. The amount of outlays on tertiary education as a percentage of GDP in 2007 was 0.81%, namely, much lower than the EU average (1.3%).

Table no. 1: Higher Education Indicators – Expenditure, Output and Outcomes in Croatia, Slovenia, New EU Member States and OECD in 2007

	Total Public spending on education (% of GDP)	Public Expenditure on Higher Education (% of GDP)	School Enrolment Tertiary (% gross)	Graduates of Tertiary Education (25 to 29)	Population with tertiary education (ISCED 5-6) aged 25-39
Croatia	4.1	0.8	44.1	20.7	18.2
Slovenia	5.2	1.0	88.0	20.1	21.0
EU-27	5.0	1.1	67.0	38.2	23.2*
OECD average	5.2	1.0	72.0	38.0	26.1*
Selected new EU member states average**	5.1	1.1***	51.1	43.3***	24.5

*Note: * Figure for 1999-2007 average. ** Selected new EU member states - Czech Republic, Bulgaria, Estonia, Hungary, Latvia, Lithuania, Poland, Slovakia.*** Selected new EU member states – Czech Republic, Estonia, Hungary, Poland, Slovakia.*

Source: Eurostat (2010b); OECD (2009a), OECD (2010), UNESCO (2010); World Bank (2010).

The main characteristics of Croatian education financing are: chronic under-funding, a lack of equity and transparency in budgetary allocation, an unbalanced structure of the education budget in terms of categories of expenditure and source of funds, and a lack of synergy (legislative, professional and institutional) for system change. The 4.1% of GDP share of total education expenditure in 2007 is well below the European average (5.0%), and the current level of funding is insufficient to support the reform process. Physical conditions vary widely from institution to institution, but facilities are often inadequate (OECD, 2001).

Conversely, the main objective of financing higher education institutions in Slovenia is to implement the goals of the national higher education program, along with respecting these institutions' autonomy in terms of the independent formulation of their institutional strategy and how they define the ways to achieve the set goals. The mechanisms of financing using public funds should enable higher education institutions to independently adopt decisions on expenditure and sustainable asset management. An important mechanism for ensuring the financial autonomy of higher education institutions is the integral (lump sum) financing of their academic activity. In the future, an internationally comparable share of GDP will have to be appropriated for the higher education and scientific and research activity of higher education institutions in Slovenia, meaning that the total funds allocated to higher education activity will have to rise (MHEST, 2010b). In this context, at least 1.3% of GDP from the budget and 0.3% of GDP from other sources is planned to be provided for higher

education in Slovenia by 2015, and a total of 2.5% of GDP by 2020, of which 2.0% of GDP would come from the budget. At the same time, a new system of financing higher education would be introduced, consisting of a basic and a development pillar as of 2011.

Another input of the higher education system in Croatia and Slovenia could be seen from public research and development (R&D) expenditures as a percentage of GDP. The lowest expenditures for R&D in the 1999-2008 were in the selected new EU member states (below 0.8% of GDP). Similar situation was in Croatia, especially from 2006 when expenditures for R&D diminished. The state sector is largely dominant sector in the Croatian R&D system, especially comparing to research potentials in the business sector (MoSES, 2007, p. 55). With expenditures around 1.5% of GDP for R&D, Slovenia stands much better and is catching EU-27 average. The United States, with public investments in R&D higher than 2.6% of GDP, are with good reason labelled „knowledge-economy" (Figure no. 2).

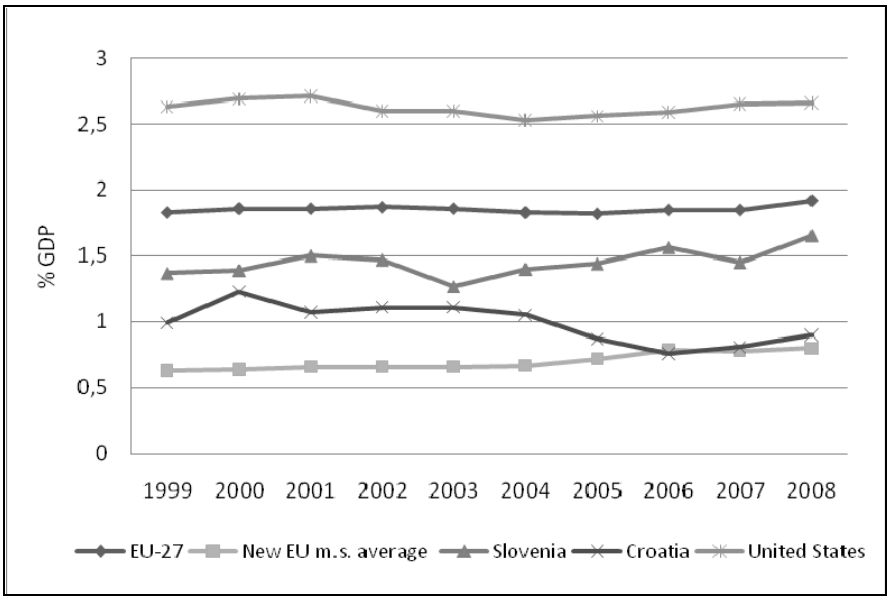

Figure no. 2: Research and development expenditures (% of GDP)

Source: Eurostat Database.

1.2 Outcomes of higher education system

The basic assumption is that higher education systems are multi-product organizations which "produce" at least two different outputs – research and teaching – using multiple inputs. Generally accepted outputs of the higher education production process are the number of graduates of tertiary teaching as a proxy for teaching and the number of publications as a proxy for research (Warning, 2004, p. 396). Number of higher education graduates by universities and single higher education institutions by ISCED 5 and 6 levels in some selected EU countries, Croatia and Slovenia is visible in Table no. 1. In last ten years there was a significant increase in the number of enrolled and graduates students in Croatia compared to Slovenia (Figure no. 3), as also the number of student programmes. In

Croatia, almost three-quarters of young people who successfully complete secondary school enter tertiary education. These changes correlate to the enlargement and re-organization of HE institutions, primarily establishment of polytechnics and schools of professional higher education (MoSES, 2007, p. 72). In such way, gross enrolment rates for tertiary level has been improving steadily over the past few years in Croatia, but they are still significantly lagging behind the Slovenian's. Gross enrolment at the tertiary level stood at 47.01 in 2007 compared to 85.47% in Slovenia.

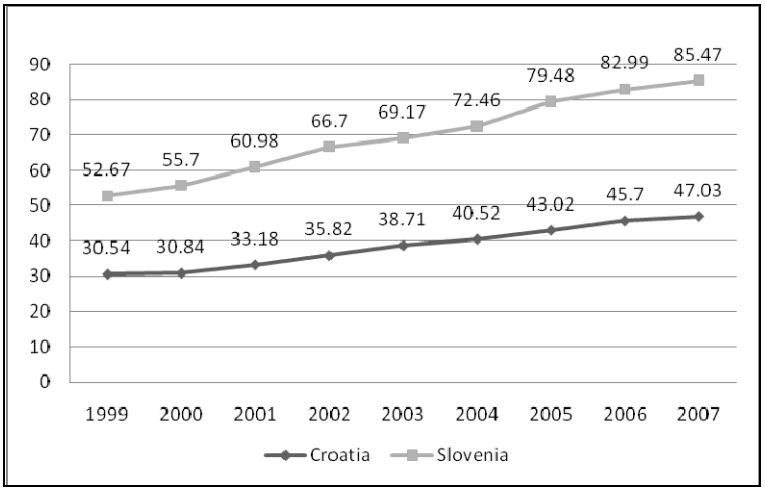

Figure no. 3: Tertiary school enrolment in Croatia and Slovenia, (% gross)

Source: World Bank, 2010.

Regarding outcomes in tertiary education, for example, although gross enrolment was about 46 percent in 2006 compared to around 53 percent in the EU-10 (Jafarov and Gunnarsson, 2008, p. 11), the proportion of graduates in Croatia is not high enough. Further, only one-third of students at the tertiary level reportedly complete their programs, with an average completion rate of 6.7 years for four-year programs (World Bank, 2008). Non-completion rates in tertiary education were also very high, with the Ministry estimating that only one-third of all those enrolled were completing their courses of study. The serious internal inefficiencies at the tertiary level do not seem to have diminished in recent years (World Bank, 2008, p. 114). The number of graduates in TE over the last 10 years has been rising constantly. A vast majority of students has finished their undergraduate programs (on average 92.3%), whereas 7.7% of students finished postgraduate studies (5.3% a Master of Science degree and 2.4% a doctoral degree). The average share of graduates in the natural sciences was only 4% and has been falling constantly since 1997 (from 4.9% to 2.9% in 2003) (MoSES, 2007, p. 73).

A similar situation can be found in Slovenia where the majority of graduates come from the social sciences, business sciences and law, accounting for nearly one-half of graduates at the tertiary education level; as many as 70% of them were women. The smallest number of graduates was recorded in the fields of science, mathematics and computer science as well

as agriculture and veterinary medicine – just 1,255 (slightly less than 7% of all) graduates. An observation over time of the trend in graduate numbers at the tertiary education level in Slovenia reveals that this number oscillated around 6,000 in the 1980s and at the start of the 1990s, and then started soaring after 1994. Twelve years ago it exceeded the 10,000 limit. By 2009 the number of all graduates had doubled compared to 1996 and even tripled compared to the period before 1990 (SORS, 2010).

An additional outcome of the higher education systems in Croatia and Slovenia could be seen from total number of researchers. The total number of researchers has remained almost the same during 1999-2008 years period in Croatia, at around 6,700 researchers making Croatia lag behind to developed European countries regarding research work force. During the same period this number has increased for almost 2,600 in Slovenia (Table no. 2).

Table no. 2: Total number of researchers (FTE) for teaching and research

	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Croatia	-	6,772	6,656	8,572	5,861	7,140	5,727	5,778	6,129	6,697
Slovenia	4,427	4,336	4,498	4,642	3,775	4,030	5,253	5,857	6,250	7,032

Source: Eurostat Database.

2. Methodology

This research measures the relative (technical) efficiency of higher education in Croatia and Slovenia, as well as in comparison with other selected new EU member states and OECD countries. Yet the characteristics of the higher education sector make it difficult to measure efficiency: it does not make a profit; there is an absence of output and input prices; and higher education institutions (HEIs) produce multiple outputs from multiple inputs (Johnes, 2006, p. 273). Therefore, a performance evaluation of higher education is based on multiple inputs and outputs and thus regressions based on only one output are unsuitable. To be precise, a non-parametric frontier analysis, namely data envelopment analysis (DEA), is the most recent methodology that is commonly used to examine the problems of measuring the performance of HE institutions (Athanassopoulos and Shale, p. 1997). Therefore, this research uses data envelopment analysis[2] as a methodological tool.

In a multi-output, multi-input production context, DEA provides estimates of the distance function, which is a generalisation of the single output production function (Johnes, 2006, p. 274). The DEA literature has meanwhile become one of the success stories of the operational research area. The estimation of frontier or best practice models found its way to a large variety of domains application (Kerstens and Woestyne, 2009, p. 1). In terms of empirical surveys, examples of DEA applications were analyzed in many sectors, as also in education. Some of the key empirical studies of the performance of higher education include those about measurement techniques (Worthington, 2001); performance differences in German higher education (Warning, 2004); comparative efficiency of higher education institutions in the UK (Athanassopoulos and Shale, 1997); efficiency of economic

[2] DEA was developed by Charnes, Cooper, and Rhodes (1978) following work by Dantzig (1951) and Farrell (1957), and estimates a piece-wise linear production function relative to which the efficiency of each firm or decision-making unit (DMU) can be measured (Johnes, 2006, p. 275).

departments at Australian universities (Madden et al., 1997); efficiency investigation of Canadian universities (McMillian and Debasish, 1997) and Japanese universities (Hashimoto and Cohn, 1997). Chapple et al. in their paper from 2005, presented evidence of the relative performance of U.K. university technology transfer offices (TTOs) using data envelopment analysis (DEA) and stochastic frontier estimation (SFE). U.K. TTO's are found to exhibit low-levels of absolute efficiency. There also appear to be decreasing returns to scale, implying that TTO's may need to be reconfigured into smaller units.

DEA is a non-statistical and non-parametric approach which makes no assumptions regarding the distribution of inefficiencies or the functional form of the production function (although it does impose some technical restrictions such as monotonicity and convexity). Instead, it uses the input and output data themselves to compute, employing linear programming methods, the production possibility frontier. The efficiency[3] of each unit is measured as the ratio of weighted output to weighted input, where the weights used are not assigned *a priori* but are calculated by the technique itself so as to reflect the unit at its most efficient *relative to* all others in the dataset. In a multi-output, multi-input production context, DEA provides estimates of the distance function which is a generalization of the single output production function (Johnes, 2006, p. 274).

In the first step, the frontier is drawn up by the efficient units. In the second step, hypothetical units are generated on the frontier to serve as reference units for inefficient higher education systems. These reference units are constructed as linear combinations of the most efficient units on the frontier. All inefficient units are enveloped by the frontier. On the basis of the empirical production function, in terms of best practice, DEA reveals those HE systems that are on the efficient frontier. It indicates the level of inefficiency of each system compared to the efficient systems[4].

The DEA method is essentially a linear program which can be expressed as follows:

$$\max h_k = \frac{\sum_{r=1}^{s} u_{rk} Yrk}{\sum_{i=1}^{m} v_{ik} Xik} \tag{1}$$

subject to

$$\frac{\sum_{r=1}^{s} u_{rk} Yrj}{\sum_{i=1}^{m} v_{ik} Xij} < 1;\ j = 1, \ldots, n. \qquad \text{All } u_{rk} > 0,\ v_{ik} > 0 \tag{2}$$

where Y is a vector of outputs; X a vector of inputs; i inputs (m inputs); r outputs (s outputs); n is the number of decision-making units (DMUs), or the unit of observation in a DEA study.

DEA fits a piecewise linear surface to rest on top of the observations. This is referred to as the "efficient frontier". The efficiency of each DMU is measured relative to all other DMUs, with the constraint that all DMUs lie on or below the efficient frontier. The linear programming technique identifies best-practice DMUs, or those that are on the frontier. All

[3] Efficiency is defined as the relationship between inputs and outputs (outcomes), wherein monetary inputs are considered. Inputs (educational expenditure, students etc.) are "transformed" into outputs/outcomes (number of graduates, their knowledge etc.) through the "production" (pedagogic) process (Bevc and Uršič, 2008, p. 234).
[4] Modified according to Warning (2004, p. 396).

other DMUs are viewed as being inefficient relative to the frontier DMUs (Chapple, et al., 2005, p. 371). As already mentioned, the article analyzes the relative efficiency of government spending on education in Croatia and Slovenia. It does so by comparing spending on these sectors and key higher education (outcome) indicators in the two countries. Relative efficiency is defined as the distance of a country's observed input-output combination from an efficiency frontier. This frontier is estimated using the DEA approach that was explained earlier and represents the maximum attainable outcome for a given input.

The data set in this research includes input data, i.e. expenditure per student, tertiary (% of GDP per capita) and output/outcome data, i.e. school enrolment, tertiary (% gross), labor force with a tertiary education (% of total) and the unemployed with a tertiary education (% of total unemployment) in thirty-seven countries are included in the analysis (selected new EU member states, and OECD countries). In order to assess different inputs and outputs/outcome relative to technical efficiency, two models have been tested. Model 1 is based on expenditure per student, tertiary (% of GDP per capita, 1999-2007 averages) (as input) and school enrolment, tertiary (% gross), labor force with a tertiary education (% of total, 1999-2007 averages) and the unemployed with a tertiary education (% of total unemployment, 1999-2007 averages) (as output/outcome). Relative efficiency scores for Model 2 are based on expenditure per student, tertiary (% of GDP per capita, 1999-2007 averages) (as input) and school enrolment, tertiary (% gross) and labor force with a tertiary education (% of total, 1999-2007 averages) (as output/outcome). The program used for calculating the technical efficiencies is the DEA*Frontier* software. The data are provided by Eurostat, the IMF, the OECD, UNESCO, and the World Bank's World Development Indicators database.

3. Research Results

When looking at the results[5], by using Model 1 and applying the DEA efficiency frontier technique within a selected group of the new EU member states and OECD countries to measure efficiency of higher education, Canada, Czech Republic, Finland, the Republic of Korea, Latvia, Lithuania, Poland, Russia, Slovakia and even Slovenia are seen as efficient. Here, the average expenditure per student, tertiary (% of GDP per capita) in the 1999-2007 period measures the input and as the output/outcome we use school enrolment, tertiary (% gross), labor force with a tertiary education (% of total, 1999-2007 averages) and the unemployed with a tertiary education (% of total unemployment, 1999-2007 averages). One can see that some countries come very close to the frontier (e.g. Hungary and Romania), while the other countries are further away and therefore less efficient (e.g. Cyprus and France) (Table no. 3).

The results of the DEA analysis (Model 1) also suggest a relatively high level of inefficiency in higher education in Croatia and, correspondingly, significant room to rationalize public spending without sacrificing, while also potentially improving, higher education outputs and outcomes (Table no. 3). Indeed, Croatia is ranked in the third quartile

[5] 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.

and in terms of the efficiency scores for public spending, Croatia ranks in the 69th percentile among the 37 countries. With respect to individual output/outcome indicators, Croatia's ranking is in the last quartile for higher education school enrolment, the third quartile for labor force with a tertiary education and the second quartile for the unemployed with a tertiary education. In order to become an efficient country, Croatia should significantly reduce its average expenditures on higher education per student by around 10 percentage points (to around 29% of GDP per capita), to bring it near to the OECD average level.

Table no. 3: The Relative Efficiency of Selected New EU Member States and OECD Countries in Tertiary Education – Model 1 (Distribution by quartiles of the ranking of efficiency scores)

I. quartile	*II. quartile*	*III. quartile*	*IV. quartile*
Canada	Italy	Norway	Cyprus
Czech R.	Ireland	*Croatia*	Mexico
Finland	Austria	New Zealand	Denmark
Korea	Australia	Japan	France
Latvia	Bulgaria	Sweden	Netherlands
Lithuania	Romania	United Kingdom	Spain
Poland	Hungary	Estonia	Switzerland
Russia		Portugal	Iceland
Slovakia		Greece	Turkey
Slovenia			Belgium
United States			

Source: World Bank, 2010; UNESCO, 2010; Eurostat, 2010a; OECD, 2010; own calculations

Further empirical analysis, now focusing on Model 2, suggests even worse relative efficiency results for Croatia. When using only two outputs/outcomes, Croatia's ranking is only 32 (out of 37). Similar to the results for Model 1, in order to become efficient Croatia should cut its average expenditures on higher education per student by 6.3 percentage points. In terms of the efficiency scores, the efficiency benchmark is represented by Canada, Finland, the Republic of Korea and the USA. In contrast, some new EU member states lag well behind (e.g. Slovakia, Romania and the Czech Republic), especially due to relatively poor output/outcome results (relatively low school enrolment and labor force with a tertiary education). Slovenia is ranked in 13th position and would improve its efficiency score by significantly expanding its labor force with a tertiary education (by around 8.5 percentage points) (Table no. 4).

According to our descriptive and empirical analysis, it is obvious that the higher education systems in Croatia and Slovenia suffer from relatively high technical inefficiencies (in particular in Croatia). To improve each system's efficiency, performance-based funding models for higher education should be developed and further emphasis should be placed on quality assurance in higher education and the integration of the facilities. Moreover, curricula in universities should also be reformed to better reflect the needs of the economy, whereas dialogue and cooperation between the private sector and universities should be greatly increased. Indeed, trade unions and employers should be actively involved in

education reform. That is especially important in the area of vocational higher education programmes in order to reduce labour market mismatches. Improvement of the education system should be a top priority of tripartitive dialogue.

Table no. 4: The Relative Efficiency of Selected New EU Member States and OECD Countries in Tertiary Education (Model 1 and Model 2)

	Model 1		*Model 2*	
Country	***Output-Oriented VRS Efficiency***	***Rank***	***Output-Oriented VRS Efficiency***	***Rank***
Cyprus	1.18366	37	1.67953	27
Czech R.	1.00000	1	2.22684	33
Estonia	1.04146	21	1.30988	16
Finland	1.00000	1	1.00000	1
Hungary	1.00243	12	1.68296	28
Lithuania	1.00000	1	1.24196	12
Poland	1.00000	1	1.48874	22
Republic of Korea	1.00000	1	1.00000	1
Romania	1.00460	13	2.31993	35
Slovakia	1.00000	1	2.32826	36
USA	1.00000	1	1.00000	1
Croatia	*1.06280*	*26*	*2.21438*	*32*
Slovenia	*1.00000*	*1*	*1.25579*	*13*

Source: World Bank, 2010; UNESCO, 2010; Eurostat, 2010a; OECD, 2010; own calculations.

Conclusion

Expenditures on higher education systems made an important role in improving economic growth and development. It is familiar that public educational expenditures significantly improve growth performance and confirm a positive role between educational attainment and economic growth. Countries with more educated labour have tended to grow faster over the post-1960 period (Norman, 1998, p. 133). At the same time, expenditures on higher education signify an important tax burden on taxpayers. The efficiency with which inputs produce the desired outputs is thus an important public policy issue. In this research, an attempt was made to measure the relative efficiency of higher education across selected OECD and new EU member states, in particular in Croatia and Slovenia, using data envelopment analysis (DEA) in a VRS framework. The findings of the article are generally supported by other similar studies by OECD, the World Bank, and Jafarov and Gunnarsson (2008). Indeed, the research results suggest the significant inefficiency of higher education spending in Croatia and therefore the considerable potential to reduce government expenditure and/or to increase the higher education output/outcome. Conversely, regardless of the input-output/outcome mix, the higher education system in Slovenia is shown to have a much higher level of efficiency compared to Croatia as well as many other comparable

new EU member states and selected OECD countries. The results also indicate that some developed nations (e.g. Korea, the USA and Finland) can serve as benchmarks for their efficient use of higher education resources. Nevertheless, the improvement of data quality and testing the influences of the environmental factors (such as climate, socio-economic background etc.) remain important issues for further research.

References

1. Athanassopoulos, A.D. and Shale, E., 1997. Assessing the Comparative Efficiency of Higher Education Institutions in the UK by Means of Data Envelopment Analysis. *Education Economics,* 5(2), pp. 117-134.
2. Audretsch, D.B., Lehmann, E. and Warning, S., 2003. University Spillovers: Strategic Location and New Firm Performance. *CEPR Discussion Paper,* no. 3837, London: CEPR.
3. Aver, B. and Čadež, S., 2009. Management accountants' participation in strategic management processes: a cross-industry comparison. *J. East Eur. manag. stud.,* 14(3), pp. 310-322.
4. Bevc, M. and Uršič, S., 2008. Relations between funding, equity, and efficiency of higher education. *Education Economics,* 16(3), pp. 229-244.
5. Barro, R. and Sala-i-Martin, X., 1995. *Economic Growth.* Boston: McGraw-Hill.
6. Burcea, M. and Marinescu, P., 2011. Students' Perceptions on Corporate Social Responsibility at the Academic Level. Case Study: The Faculty of Administration And Business, University of Bucharest. *Amfiteatru Economic*, XIII(29), pp.207-220.
7. Chapple, W., Lockett, A., Siegel, D. and Wright, M., 2005. Assessing the relative performance of U.K. university technology transfers offices: parametric and non-parametric evidence. *Research Policy,* Issue 34, pp. 369-384.
8. Charnes, A., Cooper, W.W. and Rhodes, E., 1978. Measuring the Efficiency of Decision Making Units. *European Journal of Operational Research*, Issue 2, pp. 429-444.
9. Dantzig, G.B., 1951. Maximization of a linear function of variables subject to linear inequalities. In: T.C. Koopmans, ed. 1951. *Activity analysis of production and allocation*. New York: Wiley, pp. 230-321.
10. Denison, E.F., 1985. *Trends in American economic growth, 1929-1982.* Washington, DC: Brookings Institute.
11. European Commission, 2009. *Progress towards the Lisbon Objectives in Education and Training – Indicators and benchmarks.* [online] Available at: <http://ec.europa.eu/education/lifelong-learning-policy/doc/report09/report_en.pdf> [Accessed 17 September 2010].
12. Eurostat, 2010a. *Education in Europe – Key statistics 2008.* [online] Available at: <http://epp.eurostat.ec.europa.eu/cache/ITY_OFFPUB/KS-QA-10-037/EN/KS-QA-10-037-EN.PDF > [Accessed 29 September 2010].
13. Eurostat, 2010b. *Indicators on education expenditure for 2007.* [online] Available at: <http://epp.eurostat.ec.europa.eu/cache/ITY_OFFPUB/KS-QA-10-038/EN/KS-QA-10-038-EN.PDF > [Accessed 15 September 2010]

14. Eurostat, 2009. *Key data on education in Europe – 2009.* [online] Available at: <http://eacea.ec.europa.eu/education/eurydice/documents/key_data_series/105EN.pdf > [Accessed 15 September 2010].
15. Farrell, M., 1957. The Measurement of Productive Efficiency. *Journal of the Royal Statistical Society*, Series A (General), 120(3), pp. 253-290.
16. Hashimoto, K. and Cohn, E., 1997. Economies of scale and scope in Japanese private universities. *Education Economics*, 5(2), pp. 107-115.
17. Jafarov, E. and Gunnarsson, V., 2008. *Government Spending on Health Care and Education in Croatia: Efficiency and Reform Options.* [online] Available at: <http://www.imf.org/external/pubs/ft/wp/2008/wp08136.pdf> [Accessed 28 September 2010].
18. Johnes, J., 2006. Data envelopment analysis and its application to the measurement of efficiency in higher education. *Economics of Education Review,* Issue 25, pp. 273-288.
19. Keller, K. , 2006. Investment in Primary, Secondary, and Higher Education and the Effects on Economic Growth. *Contemporary Economic Policy,* 24(1), pp. 18-34.
20. Kerstens, K. and Woestyne Van de, I., 2009. Negative Data in DEA: A Simple Proportional Distance Function Approach. *Lille Economie & Management*; Document de travail du LEM, 06, pp. 1-11.
21. Madden, G., Savage, S. and Kemp, S., 1997. The relative efficiencies of Canadian universities: a DEA perspective. *Research paper,* No. 97-4, Department of Economics, University of Alberta.
22. McMillian, M.L. and Debasish, D., 1997. The relative efficiencies of Canadian universities: a DEA perspective. *Research paper,* No. 97-4, Department of Economics, University of Alberta.
23. MHEST, 2010a. *Higher education: Directorate for Higher Education*. [online] Available at: <http://www.mvzt.gov.si/si/delovna_podrocja/visoko_solstvo/> [Accessed 20 November 2010].
24. MHEST, 2010b. *A draft of the National Higher Education Master Plan.* [online] Available at: <http://www.mvzt.gov.si/fileadmin/mvzt.gov.si/pageuploads/pdf/ odnosi_z_javnostmi/14.10._NPVS.pdf [Accessed 10 November 2010].
25. MoSES, 2007. *OECD Thematic Review of Tertiary Education – Country Background Report for Croatia.* [online] Available at: <http://www.oecd.org/document/5/ 0,3746,en_2649_39263238_35580240_1_1_1_1,00.html> [Accessed 5 November 2010].
26. Norman, G., 1998, Reviewing the New Growth Literature. *New Political Economy*, Issue 3, pp. 129-134.
27. OECD, 2010. *Education at Glance 2010.* [online] Paris: OECD Indicators. Available at: <http://www.oecd.org/document/52/0,3343,en_2649_39263238_45897844_1_1_1_ 1,00.html > [Accessed 9 November 2010].
28. OECD, 2009a. *Education at Glance 2009.* [online] Paris: OECD Indicators. Available at: <http://www.oecd.org/dataoecd/41/25/43636332.pdf> [Accessed 25 October 2010].

29. OECD, 2009b. *Higher Education to 2030*. [online] Paris: OECD. Available at: <http://www.oecd.org/document/18/0,3343,en_2649_35845581_43908242_1_1_1_1,00.html > [Accessed 29 September 2010].
30. OECD, 2001. *Thematic Review of National Policies for Education: Croatia*. Paris: OECD.
31. Rosca, I.G. et al., 2008. Quality Assurance Systems in Higher Education. *Amfiteatru Economic*, X(Sp. Iss. 2), pp. 6-12.
32. SORS, 2010. *Graduates from vocational colleges and higher education institutions, Slovenia, 2009 - final data*. [online] Ljubljana: Statistical Office of Republic of Slovenia. Available at: <http://www.stat.si/eng/novica_prikazi.aspx?id=3199> [Accessed 4 September 2010].
33. Stare, J. and Klun, M., 2008. Improving public administration performance demands investment in human resources. *Zbornik radova Ekonomskog fakulteta u Rijeci.* 26(1), pp. 151-173.
34. Tajnikar, M. and Debevec, J., 2008. Funding system of full-time higher education and technical efficiency: case of the University of Ljubljana. *Education Economics*, 16(3), pp. 289-303.
35. Tóth, R., 2008. *Using DEA to evaluate efficency of higher education.* [online] Budapest: Agroinform Publishing House. Available at: <http://ageconsearch.umn.edu/bitstream/53548/2/17_Using%20DEA_Apstract.pdf> [Accessed 18 December 2010].
36. Unesco, 2010. *Data Centre*. [online] Montreal: UNESCO Institute for Statistics. Available at:<http://stats.uis.unesco.org/unesco/TableViewer/document.aspx?ReportId=143&IF_Language=eng> [Accessed 28 December 2010].
37. Warning, S., 2004. Performance Differences in German Higher Education: Empirical Analysis of Strategic Groups. *Review of Industrial Organization,* 24(4), pp. 393-408.
38. World Bank, 2010. *World Development Indicators*. [online] Available at: <http://data.worldbank.org/indicator> [Accessed 15 December 2010].
39. World Bank, 2008. *Croatia Restructuring Public Finance to Sustain Growth and Improve Public Services: A Public Finance Review.* [online] Washington, USA. Available at: <http://siteresources.worldbank.org/INTCROATIA/Resources/Croatia_pfr_hr.pdf> [Accessed 20 January 2011].
40. Worthington, A., 2001. An Empirical Survey of Frontier Efficiency Measurement Techniques in Education. *Education Economics*, 9(3), pp. 245-268.