Efficiency of Tertiary Education Expenditure in CEE Countries: Data Envelopment Analysis

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Summary:

This paper studies the efficiency of tertiary education expenditure in the EU Member States from Central and Eastern Europe in comparative terms. For this purpose the method of Data Envelopment Analysis that can be classified as non-parametric is used. The efficiency is investigated via three models due to the different character of output results of tertiary education that could be direct and indirect. The results from the conducted study have shown that Latvia is the most efficient country in comparative perspective in the area of the tertiary education expenditure and achieved direct and indirect output results.

Key words: expenditure efficiency, tertiary education, DEA, efficiency frontier, CEE

JEL Classification: C14, H52, I21, I23

1. Introduction

Attaining efficiency of tertiary education expenditures is essential for any country given the limited resources and the importance of the sector. By ensuring a more inclusive and high quality tertiary education, a number of positive effects can be achieved both for the individual service user and for the economy as a whole, since it is instrumental in shaping human capital. In view of that, tertiary education ought to be regarded as a priority area for spending public and private resources.

Despite the special attention devoted to investigating the efficiency of education expenditure in recent years, the issue has not been extensively covered, in particular from tertiary education perspective. While the definition and use of the efficiency concept is well known from the point of view of the economic theory of the firm, it is still seldom applied in assessing government performance or implemented expenditure at the macro level. Normally, securing efficiency is linked to achieving a certain effect with as minimum resources as possible or by spending a certain resource to obtain the maximum gains possible.

In order to define efficiency of tertiary education expenditures, public and private alike, attention should be paid to the purpose of education and the resulting effects, and the level of accomplishing these results should be compared against the expenditure (public and private) incurred. Generally, the purpose of tertiary education learning is to increase the competencies and knowledge of students, which would increase their

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chances of getting a job and earning a higher salary; would lower the risk of poverty and social exclusion, and thus would also impact favourably a country's economic development. That is achievable through increasing the share of the population with tertiary education, improving the quality of educational services, and enhancing students' motivation.

Determining the goals and effects of education is a complex methodological task and it is all the more difficult to define in advance the exact quantitative correlation between the inputs and outputs in this area which would allow us to measure expenditure efficiency. That is exactly the reason why the specialised literature commonly applies non-parametric methods of investigating efficiency, where the efficiency frontier is not determined in advance but is instead calculated using concrete empirical data on a particular group of countries. This way, a comparison is made between these countries, classifying them as efficient or inefficient according to the displayed deviation from the efficiency frontier. The paper will use this type of method (DEA – Data Envelopment Analysis) and will make a comparison between the EU Member States from Central and Eastern Europe, which are historically linked and normally share a common model of socio-economic development (Petrova, 2014). They are also often grouped together in analyses of various aspects of development in the EU, including fiscal policy, economic development, etc. (e.g. Velichkov (2015), Georgieva (2012)).

The paper focuses on studying the efficiency of tertiary education expenditures in accordance with all specific features of the sphere. While tertiary education is not compulsory and its financing differs from that at the lower education levels, its role in shaping human capital is obvious. Therefore positive developments are observed towards increasing the tertiary educational attainment in the European countries. State university education can be regarded as quasi-public good, whereby a way exists for exclusion of consumers and absence of competition (up to the extent of the supply capacity) in consumption. In this regard, the mechanism of students' exclusion can be identified with the payment of the tuition fee. It is essential that higher education at state universities as a quasi-public good is available so that children from less well-off families can also have learning opportunities given that private universities normally charge higher tuition fees. Student scholarships granted by the state are therefore also very important. Private university learning can in turn be qualified as a pure private good.

The paper furthers the efforts of other authors in studying the efficiency of education expenditure in the European countries. Its purpose is to investigate the efficiency of tertiary education expenditure in the EU Member States from Central and Eastern Europe in comparative terms by applying a non-parametric method (DEA – Data Envelopment Analysis), indicating the place of Bulgaria in particular.

The paper is structured as follows: The next part analyses the characteristics of funding of tertiary education. Part 3 looks at the effects of tertiary education. Part 4 gives a brief overview of the specialised literature on the issue under consideration. Part 5 looks at some conceptual issues concerning the adopted methodology of analysis. Part 6 presents the results from the conducted original empirical research, thereby identifying the countries achieving highest efficiency in the field, showing in particular the place of Bulgaria.

2. Funding of tertiary education

State financing of tertiary education at the individual country level can be provided in different ways, hence the amount of public expenditure in support of the sector

can vary. Subsidies can be directed towards educational institutions or to students, as well as given as grants, accommodation and food, etc. Apart from state expenditure, tertiary education normally involves private expenditure as well, which is largely determined by the amount of fees that students need to pay for their education.

The ratio between public and private expenditure and their size normally depends on the amount of fees paid by the students, the amount of public funding to universities, the scope of state support for students (accommodation, grants, food, etc.), and the number of private universities providing education, etc. As to the size of the fees charged by state universities, it should be noted that they differ from country to country, with some countries (some provinces in Germany and Sweden) not even charging fees.

Tertiary education in the CEE countries is currently funded from combined sources and both state and private higher education institutions exist. During a past period in the development of these countries higher education was provided only by state universities, but the systems gradually reformed and improved over time. Clearly, there are differences across countries which have emerged with time due to the diverse reform approaches. That is precisely the reason why this particular group of countries is interesting to analyse in terms of achieved efficiency of tertiary education expenditures. In some of the countries such as Bulgaria, Hungary and Lithuania the share of public expenditure in total expenditure on tertiary education[1] is lower (Bulgaria – 58.1 % for 2013, Hungary – 58.5 % for 2012, Lithuania – 71.4 % for 2013 according to Eurostat data). The rest of the countries concerned[2] display a level of above 80%. The countries also differ in terms of number of students attending public and private universities. The highest share of students enrolled in tertiary education in private government independent institution, is observed in Latvia (27 % for 2014) and in Poland (26 % for 2014), and the least – in Slovenia (7.8 % for 2014) and Hungary (8.2 % for 2014). It should be noted, however, that in some of the CEE countries concerned there are students studying at private government dependant institutions. In Bulgaria, Lithuania, Poland, and Romania this type of higher education institutions does not exist, whereas in countries such as Estonia and Lithuania this type of institutions are a significant number and provide education for a large number of students (in Estonia 74,6 %, in Lithuania 65,2 % in 2014).

3. Effects of tertiary education

Tertiary education indisputably entails a number of positive effects. Acquiring a higher education degree by a larger number of young people will affect positively their competitiveness and would thus have a favourable impact on reducing the unemployment rate among them and improving their living standard. Youth unemployment has been identified as a major problem in all European economies especially since the beginning of the last economic crisis, as it affects young people the most. In the CEE countries, the problem got worse in 2009 when the level of youth unemployment rate among the population up to 29 years in these countries grew on average to reach a level of above 17.8 % compared to 10 % in 2008, according to Eurostat data. Whereas in 2008 the value of the indicator was lower than that for EU-28, in 2009 it stood higher (on average for EU-

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[1] The total expenditure in tertiary education is calculated as a sum of the public expenditure and the private expenditure of households.

[2] The CEE countries covered in the paper are: Bulgaria, the Czech Republic, Estonia, Latvia, Lithuania, Hungary, Poland, Romania, and Slovenia.

28 the youth unemployment rate among the population up to 29 years was 12 % in 2008 and 15.5 % in 2009). The data from recent years shows that despite the drop in youth unemployment rate in the CEE countries relative to the peak value in 2010 (19.3 %), the level remains high (12.8 % in 2015). In Bulgaria, youth unemployment rate reached a peak in 2013 (21.8 %), while in 2015 the level was above the average for the CEE countries – 14.4 %.

Youth unemployment is a major concern in all European economies, therefore tertiary education is one of the ways of curbing it since a higher educational degree has a positive impact on the chances for starting a career. According to Eurostat data in 2015 on average in the CEE countries 12.7 % of the population aged between 15 and 29-year-olds with secondary education and 8.6 % with tertiary education was unemployed. The difference in the unemployment rate for the population having secondary education and the population with tertiary education can be observed in each of the countries. In Bulgaria the difference between the values of the indicator was even higher in 2015 (13.7 % of the population with secondary and 8.4 % of the population with tertiary education aged between 15-29 years were unemployed). Of course, the people with tertiary education have better opportunities for getting a job when total working age population is taken into account.

In addition to the better opportunities for starting a career, a higher education degree can impact favourably productivity and thus the income level of the employed. According to Eurostat's Structure of Earnings Survey, in 2014 the mean monthly earnings of a person with secondary education in the CEE countries was € 711 on average, and of a bachelor's degree holder – € 1048. For comparison, the values of the two indicators in Bulgaria are the lowest among the CEE countries and in EU as a whole – the mean monthly earnings of a person with secondary education is € 338, while a person with a bachelor's degree earns € 518.

Increasing the share of people with higher education can reduce the level of poverty in a country. According to Eurostat data, in 2015 10.7 % of the population with tertiary education was at risk of poverty and social exclusion in the CEE countries, whereas this rate was twice as high among the population with secondary education (26 %). For Bulgaria, the values for both indicators were higher compared to the level in the CEE countries – 34 % of the population with secondary and 17.6 % of the population with tertiary education.

The acquisition of knowledge and skills goes beyond the individual dimension. Tertiary education entails positive external effects which go further than the benefits for the individual – beneficiary of the service. Thus, for example, the higher household incomes could boost tax revenues from income tax in the state budget due to the higher tax base. Tertiary education attainment by an increasingly larger number of people affects favourably the long run economic development and contributes to strengthening the knowledge-based economy, since it could be regarded as human capital investment.

The access to and completion of tertiary education is an important determinant of human capital formation, and according to the endogenous growth models human capital is an important factor generating long-run economic growth (e.g. Romer (1986)). Extending the possibility for attaining tertiary education to 40 % of the population aged 30-34 years in the European Union is exactly one of the objectives of the Europe 2020 Strategy for achieving smart growth. As a result of implementing the objectives of the Strategy and assessing the significance of tertiary education, in EU-28 on average and in most of the Member States the

tertiary educational attainment has been growing. According to Eurostat data this indicator has increased on average for the CEE countries from 31 % in 2010 to 39 % in 2015. In Bulgaria, this share was also on the increase – from 28 % for 2010 to 32.1 % for 2016 with 36 % as a national target.

Given the positive effects education has for every economy, it is important to ensure that the expenditure for its funding is spent in the most efficient way and the best possible results are sought.

4. A brief literature review

The most widely used methods of investigating the efficiency of the public sector or expenditure (public) in the various areas at the national level are non-parametric as is the method of analysis adopted in this paper (DEA - Data Envelopment Analysis). Studies of this kind are conducted mainly in the fields of education and healthcare. The reason is the relatively easier defining of inputs and outputs, and the narrower scope of analysis. DEA enables an international comparison in other spheres as well. Thus, for example, Alfonso, Schuknecht and Tanzi (2006) investigate public sector efficiency in general.

Previous research dedicated to the efficiency of education expenditure such as that of Afonso and Miguel S. Aubyn (2005), Herrera and Pang (2005), Jafarov and Gunnarsson (2008), Aristovnik (2013), Fonchamnyo and Sama (2016) has led to findings indicating large differences across countries in terms of attained efficiency. These studies examine the efficiency of expenditure on education across all educational levels. In this regard, a note should be made of the absence in the specialised literature of a more thorough as well as more specific research into the efficiency of tertiary education expenditure

with all specificities ensuing from it. That is exactly one of the aspects distinguishing this paper from all previous studies. Aristovnik's research (2013) also partially analyses the effectiveness of public expenditure on tertiary education in the countries from Eastern Europe, however the choice of indicators regarding output results (unemployed with tertiary education (% of total unemployment), labour force with tertiary education (% of total), school enrolment, tertiary (% gross)) leaves the indirect effects from education, which are essential, largely unaddressed. Such an indicator can only be the total number of unemployed with tertiary education (% of total unemployment). It is also important to note that the previous studies of the efficiency of expenditure on education traditionally took into account only public expenditure on education leaving the private aspect of spending uncovered. That could be considered as their weakness, because tertiary education in state universities is a quasi-public good, while that in private universities is a pure private good.

5. Methodology

The approach adopted in this paper for measuring efficiency is based on the concept of efficiency frontier (production possibility frontier). There are various techniques of calculating or evaluating the shape of the efficiency frontier. Most of them are based on parametric or non-parametric methods[3]. The main difference between them is that the parametric methods require that the functional form of the efficiency frontier or, in other words, a specific functional form of the link between the inputs and outputs, be determined in advance. Non-parametric approaches, on the other hand, construct an efficiency frontier by using concrete empirical data on the inputs and

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[3] For comparison between the methods of measurement of the efficiency frontier see Hughes, A., 2002, Guide to the Measurement of Government Productivity, International Productivity Monitor, № 5, p. 65.

outputs through mathematical programming. The calculated frontier constitutes the model by which efficiency is measured. In this regard, when analysing efficiency of expenditure on tertiary education, a non-parametric method would be more appropriate to use, as it is difficult to define in advance an exactly defined functional relationship between an input resource and an output result considering that the essential effects from tertiary education are indirect.

The non-parametric methods of analysis of the efficiency of (public) expenditure across the different spheres are widely used, in particular in most of the similar studies examined in the preceding paragraph. One of the non-parametric methods most often employed recently, especially in assessing the performance of the public sector (public expenditure) and similar research of the efficiency of expenditure on education is DEA (Data Envelopment Analysis). This is a method of assessing the efficiency frontier, which according to Aristovnik (2013) "compares functionally similar entities described by a common set of multiple numerical attributes". The DEA method determines entities as efficient and inefficient, as the absence of efficiency indicating that the entity is below the efficiency frontier. In this relation, the efficiency to be measured through DEA is by its essence determined in a comparative aspect. The investigation to be applied here will analyse the efficiency of expenditure on tertiary education among the CEE countries and will identify those countries which are efficient according to the selected input resources and output results.

The DEA method uses linear programming and other forms of mathematical programming methods in order to derive efficiency coefficients. The method has a number of advantages. According to Mihaiu (2010), it identifies a complex non-linear (concave or convex) relationship between the output and the input resources, while non-parametric methods normally limit this relation on the basis of linear or simple forms of non-linear relationship. Also, the method can work with a large number of input resources and output results of diverse measurement units. Another advantage of DEA is that when applied more than one indicator for output result can be used.

It is possible to use the DEA method for analysis of the efficiency of input resources or output results. The inefficiency in input resources indicates the extent to which input resources must be reduced so that the inefficient country can lie on the efficiency frontier. In case of inefficiency of output results, the latter should be increased in order for the country to become efficient. The analysis of the efficiency of input resources and output results according to Afonso and Aubyn (2005) "provide the same results under constant returns to scale but give different values under variable returns to scale. Nevertheless, both output and input-oriented models will identify the same set of efficient/inefficient decision-making units". The classification of each individual country can be achieved by solving a linear program. In studying the efficiency of expenditure on education, the paper will apply the DEA method of analysis of the efficiency of input resources[4] under variable returns to scale, because in this way the different scales of individual units are determined and that allows for defining different ratios of input recourses – output results as efficient[5].

Defining the indicator that will be used as an input resource is important. The specificity is that the expenditure in tertiary education is both

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[4] The reason for choosing input-resource DEA model is the better opportunity to make recommendations to the policy makers. Input resources can be directly affected. The influence on output results is more complicated as they cannot be directly addressed and influenced.

[5] When studying the efficiency in a comparative aspect under constant returns to scale, only one correlation between input resources - output result is assumed as efficient, and all other units have to be compared against it without taking into account the scale in which the individual units, subject to classification, act.

public and private. As already mentioned, state university education is a quasi-public good, whereby the role of exclusionary mechanism is the payment of tuition fee by the students. At the same time, there are also private universities with relatively higher fees where the costs of education are paid entirely by students. In this relation, despite the larger share of the public expenditure in total expenditure on education, when analysing the efficiency of expenditure in tertiary education it is necessary to take into account all the costs incurred. That is also connected with the difficulties in defining output results in terms of quality, which are an indirect effect (employment rate of population with tertiary education, monthly earnings of a person with tertiary education, etc.), resulting only from public expenditure. The study here employs total expenditure on tertiary education[6] as an input indicator. By making this choice, the study differs from similar studies which normally cover only public expenditure. Total expenditure on tertiary education will be presented as expenditure per student as a percentage of GDP per capita. This approach is appropriate for measuring efficiency in comparative terms, as it uses a relative indicator due to the fact that it is calculated based on GDP per capita and has sufficient differentiation capacity.

Determining the output results requires greater attention since they set the boundaries of the study and must reflect the aims sought in expenditure on tertiary education. The results of education can be direct with a quantitative character (tertiary educational attainment, tertiary education graduates, number of tertiary education students, etc.), as well as indirect, which result from the quality of the educational services (employment rate of population with tertiary education, unemployment rate of population

with tertiary education, monthly earnings of a person with tertiary education, population with tertiary education at risk of poverty and social exclusion, labour productivity, etc.). As regards the indirect results, however, it is difficult to quantify the impact of education on them only, as they are influenced by other factors as well. Thus, for example, according to the human capital theory, education leads to higher productivity of labour, which has a direct impact on the increase of incomes. At the same time, however, the increase in income may also come from other factors, which are not necessarily related to the individual level of education and the knowledge obtained, but also to talent, the intelligence coefficient, knowledge, personal qualities (responsibility, steadfastness, diligence) and so on with regard to the particular individual. Therefore, the conclusions from the analysis of the efficiency of tertiary education expenditure according to the level of indirect results achieved cannot be taken in absolute terms.

The indicators used in the study as output result are several. First, tertiary educational attainment (age group 25-34 years), which can be considered as a direct result, is one of the objectives of Europe 2020 Strategy towards smart growth. This indicator essentially reflects the scope of tertiary education among the population and has a quantitative character.

Secondly, the indicators selected are those which reflect to one degree or another the quality of the educational service provided and can be regarded as indirect results, namely: employment rate of population with tertiary education (age group 25-29 years), population with tertiary education not at risk of poverty and social exclusion (age group 25-49)[7]. The output indicators are selected so that the economic logic can lead to

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[6] Total expenditure on tertiary education is calculated as the sum of public expenditure and private expenditure of households. The educational levels covered are from 5 to 8 according to the International Standard Classification of Education (ISCED 2011).

[7] The indicator population with tertiary education at no risk of poverty and social exclusion is obtained as the percentage of population with tertiary education at risk of poverty and social exclusion is subtracted from 100 %.

positive correlation between them and the input resources. Relative indicators are used because the input resource indicator is also of this kind.

The DEA analysis normally works with a cross section data at a particular point in time. The data on the above described indicators that will be used in the study have been taken from Eurostat as the single statistical body of the EU. The study includes nine EU Member States from CEE[8]. The data with regard to tertiary education expenditure (public and private) in Eurostat is available only for 2012, 2013 and 2014. The analysis will be built on data for input resources for 2012, because this is the earliest possible year. The input measure in 2012 should be linked to the output measures. However, in order to achieve a stronger link, data for indicators of output results for the most recent available year[9] in Eurostat are taken into account, due to the time difference between the moment when education spending occurs and when the outputs are observed. In this relation, also based on the availability of data in Eurostat, the three indicators for output resources are limited to age groups with the lowest possible upper limit. This is the reason why an indicator for earnings is not included as an output result. Even though it is an important indirect result from tertiary education, the latest possible available year in Eurostat is 2014. Furthermore, the data cannot be specified for a narrower age group. It is available only for the age group 20-64 years. These methodological decisions are made in order to obtain the theoretical link between the inputs and outputs selected for the implementation of the DEA model, and therefore, to achieve a larger base to

evaluate or interpret the results correctly. In this relation, the deficiency of data determines the limitations of the study – on the one hand with regard to the time period of research and on the other – the scope of the covered indicators.

Due to the different character of the selected output indicators, three models will be constructed. The first model will reflect the efficiency of tertiary education expenditure in terms of quantified result. Therefore, the model will use the tertiary educational attainment (age group 25-34 years) as an output result. The second and the third model will explore which of the countries achieve the most efficient use of tertiary education expenditure in terms of quality of the service provided. In this respect the second model will use as output the employment rate of population with tertiary education (age group 25-29 years). The output of the third model is population with tertiary education not at risk of poverty and social exclusion (age group 25-49). The reason for building two models instead of a common one, regarding indirect quality results, is the dependence of results on the DEA analysis on the number of the output results. The use of more outputs will classify more countries as efficient.

With the selected methodology of analysis, the paper offers to some extent a different approach to studying the efficiency of expenditure on education using a non-parametric method (DEA), which differs from the previous similar studies, reviewed in the previous paragraph, in a number of aspects. First, the efficiency of expenditure on tertiary education is examined in more specific terms and at greater depth. In his study Aristovnik (Aristovnik, 2013) analyses the efficiency

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[8] The countries covered in the study are: Bulgaria, the Czech Republic, Estonia, Latvia, Lithuania, Hungary, Poland, Romania, and Slovenia.

[9] Tertiary educational attainment data (age group 25-34 years) is for 2016. Employment rate of population with tertiary education data (age group 25-29 years) is for 2016. Population with tertiary education at no risk of poverty and social exclusion data (age group 25-49) is for 2015.

of public expenditure on tertiary education in the countries from Eastern Europe along with spending on other educational levels, however the selection of indicators for output results is different. Second, the selection of input resource, namely total expenditure on tertiary education per student as a percentage of GDP per capita. The previous studies on the efficiency of spending on education, which are discussed in the previous paragraph, traditionally take into account only the public expenditure on education. Third, the differentiation of three models, which examine separately the efficiency of the direct and indirect results from tertiary education. Fourth, the scope of the indicators of indirect results from tertiary education. In Aristovnik's research (Aristovnik, 2013) only unemployment with tertiary education (% of total unemployment) can be considered as such an indicator. By selecting a wider range of indicators for output results regarding tertiary education expenditure, a more thorough analysis of their efficiency can be made. Fifth, the selection of countries for comparison, by studying the efficiency across EU Member States from CEE.

6. Results

The efficiency testing in comparative terms among nine CEE countries concerning the efficiency of tertiary education expenditure according to the results shown in Table 1 has shown that only one country (Latvia) is identified as efficient under all of the three models. The same conclusion is reached in Jafarov and Gunnarsson's study (Jafarov and Gunnarsson, 2008). Lithuania is classified as efficient in the first and in the second model. The Czech Republic is efficient according to the third model. Latvia, Lithuania and the Czech Republic are also classified among the most efficient ones along with the OECD countries with respect to efficiency of tertiary education

expenditure according to Aristovnik's study (Aristovnik, 2013). According to the DEA model applied in this study all other countries qualify as inefficient with a different deviation from the efficiency frontier according to the three models. The most inefficient country according to the three models is Hungary. It is this country that shows the highest value of input resource, but not sufficient results (see Table 3). After Hungary, taking into account the efficiency coefficients from the three models, come Estonia and Bulgaria, Poland, Slovenia, Romania.

The results of the study indicate that Bulgaria ranks as an inefficient country under the three models according to DEA methodology because the efficiency coefficient is less than one. Less efficient than Bulgaria under the first and the second model are Estonia and Hungary, while under the third model – Estonia, Hungary and Lithuania.

Derived results also show that there are a lot of similarities between the three models in relation with the ranking of the counties. Absolutely the same rank according to the three models receive Hungary (Rank 8) and Romania (Rank 2). Very similar, with difference of 1, is Bulgaria (Rank 6 in the first model and Rank 5 in the second and in the third model), Estonia (Rank 7 in the first and in the second model and Rank 6 in the third model), Slovenia (Rank 4 in the first and in the second model and Rank 3 in the third model) and Poland (Rank 5 in the first model, Rank 6 in the second model and Rank 4 in the third model). The largest difference in the rank is observed with Lithuania, which is efficient country according to the first and the second model, but it ranks 7 in the third model. There is difference in ranking also when compared with the Czech Republic, but it is smaller compared to Lithuania.

Similarities between the results from the three models, using different indicators for output, give reasons for considering the

results reliable to some extent. Furthermore, in the building of the models the time lag between the input and the output results has been taken into account.

The average efficiency coefficient according to the first model is 0.845, which implies that with the same amount of resources on average a country provides by 15.5 % output results (tertiary educational attainment (age group 25-34 years)) less than if it had been efficient. The average efficiency coefficient under the second and the third model are lower – 0.839 for the second and 0.832 for the third, meaning that the CEE countries demonstrate slightly better results with regard to securing educational services direct results. The

value of the coefficient of the second model indicates that on average a country ensures 16.1 % less in terms of output result than if it had been efficient. Regarding the third model, with the same amount of resources on average a country provides by 16.8 % output results less than if it had been efficient.

An additional result from the DEA method is the target values of inputs and outputs in order to achieve efficiency, which are presented in Table 2. In order to achieve efficiency and reach the same output results all inefficient countries should decrease the level of expenditure on tertiary education. Efficiency could also be achieved through increasing the output results while keeping

Table 1. Efficiency of tertiary education expenditure

Country	First Model		Second model		Third model	
	Efficiency Coefficient	Rank	Efficiency Coefficient	Rank	Efficiency Coefficient	Rank
Bulgaria	0,806	6	0,806	5	0,806	5
Czech Republic	0,880	3	0,880	3	**1,000**	**1**
Estonia	0,777	7	0,777	7	0,783	6
Latvia	**1,000**	**1**	**1,000**	**1**	**1,000**	**1**
Lithuania	**1,000**	**1**	**1,000**	**1**	0,729	7
Hungary	0,578	8	0,578	8	0,578	8
Poland	0,814	5	0,782	6	0,817	4
Romania	0,901	2	0,901	2	0,948	2
Slovenia	0,850	4	0,828	4	0,828	3
Average	**0,845**		**0,839**		**0,832**	

Source: Eurostat and author's calculations based on DEA method

the value of input unchanged, which, of course, is more difficult to be accomplished by policymakers. The benchmark for Bulgaria under the three models is Latvia. This is why in order to keep the output results and reach efficiency the country should reduce total expenditure on tertiary education per student as a percentage of GDP per capita and reach Latvia`s level (22.54 %), which means reduction by 5.43 percentage points.

countries manage to ensure output results according to which they are positioned on the efficiency frontier. The data shown in Table 3 also make it clear that with regard to the tertiary educational attainment, which is used as an output result in the first model, Latvia ranks fourth in terms of performance, while at the same time it is classified as efficient. There are also divergences in the efficiency scores and the values of the indicators for output result for Latvia in

Table 2. Efficiency input and output targets

Country	First Model		Second model		Third model	
	Input target	**Output target**	**Input target**	**Output target**	**Input target**	**Output target**
Bulgaria	22,54	42,10	22,54	87,40	22,54	90,80
Czech Republic	22,54	42,10	22,54	87,40	25,61	96,20
Estonia	22,54	42,10	22,54	87,40	22,71	91,10
Latvia	22,54	42,10	22,54	87,40	22,54	90,80
Lithuania	31,08	54,90	31,08	92,00	22,65	91,00
Hungary	22,54	42,10	22,54	87,40	22,54	90,80
Poland	23,47	43,50	22,54	87,40	23,56	92,60
Romania	22,54	42,10	22,54	87,40	23,73	92,90
Slovenia	23,14	43,00	22,54	87,40	22,54	90,80

Source: Eurostat and author's calculations based on DEA method

The better understanding of the results requires taking into account the fact that under the first and second models the two efficient countries are characterised by different data for the input resources (Table 3). Among the studied countries, Latvia has the lowest value of total expenditure on tertiary education per student as a percentage of GDP per capita, whereas Lithuania demonstrates one of the highest values (Hungary is the only country with a higher value) of this indicator. This indicates that the achieved efficiency means that through the resources spent the two

the third model. The reason for this is that a country's efficiency in terms of tertiary education expenditure means that it has achieved the best possible result with a minimum resource. Achieving efficiency depends on how spending is implemented as well as on the process of providing the service.

It would be interesting to find out whether the efficiency results achieved depend on the share of public expenditure in total expenditure, which characterises to some extent the system of financing tertiary education. For that purpose, correlation

Table 3. Input resources and output results

	Total expenditure on tertiary education per student as a percentage of GDP per capita	Tertiary educational attainment (age group 25-34 years)	Employment rate of population with tertiary education (age group 20-64 years)	Population with tertiary education outside of risk of poverty and social exclusion	Mean monthly earnings of a person with tertiary education as a share in GDP per capita
Bulgaria	27,97	28,4	80,9	94,9	8,779661
Czech Republic	25,61	28,5	81,85	97,85	7,228188
Estonia	29,02	40,35	81,8	90,2	7,078947
Latvia	22,54	39,7	84,75	93,35	8,59322
Lithuania	31,08	49,55	87,3	93,85	6,395161
Hungary	39,03	30,85	78,65	97,3	10,31132
Poland	28,83	41,3	82,2	95,4	10,82243
Romania	25,03	24	82,55	97,85	10,68
Slovenia	27,21	36,35	83,3	96,2	10,52486

Source: Eurostat and author's calculations

coefficients have been calculated between this indicator[10] and the efficiency coefficients of the three constructed models separately. Although the coefficients are derived from short series, a connection could nevertheless be traced. It is interesting to note that according to the three models correlation the coefficients are positive. The absolute values indicate a medium correlation (0.395 for the first, 0.365 for the second and 0.456 for the third model). The positive values suggest that public expenditure in the CEE countries is more efficient than private expenditure in terms of achieving a larger scope of tertiary education (tertiary educational attainment) and the quality of the service provided or the indirect results achieved. The bigger the share of public expenditure, the higher efficiency coefficient could be achieved.

7. Conclusion

The empirical results from the conducted study illustrate that Latvia is characterised as an efficient country with regard to tertiary education expenditure under the three built models. Lithuania is defined as efficient according to the first and the second model. Although the first and the second model were applied using different outputs, it is interesting to note that according to both models these countries classify as efficient. The Czech Republic is efficient according to the third model. The obtained results for the efficient countries are also similar to the findings of other conducted studies. It is equally important to note that there are a lot of similarities between the ranking of the most inefficient countries under the three models. All these give reason to consider the results as reliable to some extent.

The results also show that Lithuania and Latvia are characterized by different values of input resources. This means that for the achievement of progress in the field of tertiary education not only the amount of expenditure spent is important, but it is also essential that the expenditure should be spent effectively.

The results from the study also suggest that in CEE countries the higher the share of public expenditure in the total spending,

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[10] In order to ocorrespond with the data for input resources, data for 2012 is used for the indicator.

the more efficient expenditure in terms of increasing the tertiary educational attainment and the quality of educational services is achieved. This gives ground to suggest that in the CEE countries the public expenditure spent are more efficient in view of tertiary educational attainment and the quality of the educational service.

Tertiary education leads to results that are undoubtedly very important. However, at national and supranational levels not only the quantitative aspects of the results related to the tertiary educational attainment should be monitored, which is associated with one of the objectives of the Europe 2020 Strategy. More significant attention should be paid to the indirect effects of education, since they show the benefits for the tertiary education for each individual and for the economy as a whole.

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