THE EFFICIENCY OF HIGHER EDUCATION STUDENT MOBILITY PROGRAMMES IN EUROPE IN 2015.

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Abstract: *Student mobility has become an important policy instrument in the higher education and it is essential for students' development and development of higher education in general. The success of mobility leades to increased quality of education and the cooperation between institutions and countries. Therefore, it is crucial for countries to maintain the high number of students enrolled in mobility programmes in order to be efficient and succesful from the aspect of student mobility. Data Envelopment Analysis (DEA), nonparametric method, is a very convenient tool for determining the efficiency rate. The ease with which DEA can handle multiple inputs and multiple outputs makes it an attractive choice of technique for measuring the efficiency of this problem. Therefore, in this paper, DEA models evaluate the efficiency rate of European countries from the aspect of student mobility programmes in 2015. The study was conducted through two scenarios. The first scenario tells us more about the efficiency of higher education in Europe in generally, not only about the efficiency of student mobility, whereas the second scenario is focused completely on the efficiency of student mobility programme. Based on the results, This analysis determines which countries in Europe are efficient and which are inefficient. For inefficient countries, comparing them to efficient ones, DEA is giving us an information about what is each country required to do in order to become efficient. Based on the results, we can conclude that all the efficient countries are countries with high level of GDP and number of students enrolled in mobility programmes. Countries that have higher percentage of mobile students, comparing to the number of students enrolled in tertiary education and the size of country, are the most efficient as well.*

Keywords*: Data Envelopment Analysis, efficiency, student mobility programmes, European countries, higher education.*

1. INTRODUCTION

Cross-border mobility among students is a key instrument in favoring peace between European countries: discovering that they share a common culture, common values, and, despite a history of wars and conflicts, knowing that they have much to gain by building a cooperative future together. For this reason, at least, cross-border mobility among students is politically desirable (Gérard and Sanna, 2017). Student mobility programmes are important for both students that are enrolled in the programmes, and for countries and institutions that are sending and receiving students through mobility programmes. Student mobility has a positive impact on student's personal and professional development. Universities become more competitive and therefore the quality of studying increases.

DEA began as a new management science tool used for technical efficiency analysis of non-profit sector decision-making units (DMU). It is a linear programming model and specially designed technique used for evaluating relative performance of homogeneous DMUs where there is no known relationship between the transformation of inputs used by an organizational unit and the outputs that it would produce (Taylor and Harris, 2004). The efficiency frontier is therefore not known, but it can be estimated by using data on the actual performance of the DMUs under consideration, in terms of the outputs that they produce for the level of inputs that they use. The essential characteristic of DEA is the transformation of the multiple-input, multiple-output DMU into a single "virtual output" value for all DMUs. The ratio of this single virtual input to virtual output provides a measure of technical efficiency. That ratio must not exceed the range from 0 to 1 (Fernando & Cabanda, 2007).

Student mobility was described in the first part of this paper, as well as it's benefits. After introduction of student mobility programmes, the concept of efficiency and Data Envelopment Analysis is being described in the second part. In the third part of this paper the efficiency analysis of student mobility programmes in Europe in 2015 is conducted and its results are being presented. And finally, the fourth part of this paper gives us the conclusions and closing discussion.

2. INTERNATIONAL STUDENT MOBILITY

Mobility has always been the objective of the Bologna Process, and it is a key instrument in developing the European Higher Education Area. Mobility of students and academic and administrative staff is seen as

crucial for academic and cultural as well as political, social and economic spheres (Communiqué, 2003). In the Bologna process agreement, mobility of at least 20% of higher-level educated students is targeted by 2020 (Barr et.al., 2009; Gvetadze, 2014).

UNESCO Institute for Statistics defines international (or internationally mobile) student as a student who has crossed a national or territorial border for the purpose of education and is now enrolled outside their country of origin (http://uis.unesco.org/en/glossary-term/international-or-internationally-mobile-students).

Student mobility programmes have been designed in order to provide students support in their education and professional development through opportunity to study in a new, international environment. Student mobility, especially studying abroad, is particularly important for student's personal development. It offers an unique opportunity to each candidate to gain new experience, to learn foreign language and develop interpersonal skills in new and culturally diverse environment. Therefore, one of the most valuable results of mobility programmes is the increased number of young professionals who can make a positive impact on their local environment, thanks to their exposure to wider experiences through studying abroad (Đokvučić et.al., 2014). Other than new knowledge, students develop an ability to adapt to a different culture, they learn of cooperation and exchange experiences; they become more competitive on the market, get better wages, better social status and reduce chance of unemployment. Besides the students, both countries and institutions that are enrolled in mobility programmes also benefit from them. Student mobility increases competition between universities through pressure for better and more courses in foreign languages, and more generally, pressure from more demanding students for improved quality. It also contributes labor mobility and supports research and innovations (Gérard and Sanna, 2017).

There are various student mobility programmes in Europe, among which are programmes Erasmus+, CEEPUS, summer school programmes. Students are able to choose the programme and type of their mobility that determines the duration of the programme (2-3 weeks, one semester or full academic year). One of the main criteria for students in choosing countries of destination is the availability of studies in English or other popular European languages, such as German, French or Spanish (Gvetadze, 2014).

One of the indicators of student mobility programmes success is increased number of realized mobilities. Therefore, it is of great importance to constantly work on improving the quality of programme and on increasing the number of students enrolled in programme. The key of increasing that number is in adequate promotion. Both receiving and sending countries and institutions must have different approaches in trying to reach the greater audience and raise the popularity of programmes.

It is vital that students know, before their exchange programme starts, that their study period and results will be recognized when they get back to their home institutions (https://www.uns.ac.rs/images/doc/medjunarodna/UNS_Guide_for_Mobility_Officers.pdf). The purpose of the Learning Agreement is to provide a transparent and efficient preparation of the exchange to make sure the student receives recognition for the activities successfully completed abroad and must be approved by the student, the sending and the receiving institution, organisation or enterprise before the start of the exchange. (https://ec.europa.eu/programmes/erasmus-plus/resources/documents/applicants/learning-agreement_en).

3. DATA ENVELOPMENT ANALYSIS

Data Envelopment Analysis is specially designed nonparametric technique used for measuring the efficiency of complex entities with diverse inputs and outputs. (Charnes et.al., 1978). It is a linear programming model used to measure technical efficiency. Efficient units are those that:

- produce a certain amount of or more outputs while spending a given amount of inputs, or
- use the same amount of or less inputs to produce a given amount of outputs, as compared with other units in the population (Vincová, 2005).

Using the results of this analysis, we can determine how much is each decision-making units inefficient comparing to units that are efficient. It also gives us an information on how much each unit must reduce its inputs and increase its outputs in order to become efficient unit. DEA determines the efficiency rate of each DMU, in the population of n decision-making units. Each unit produces s outputs, while consuming m inputs.

In that case, we can write an input matrix:

$$X = [x_{ij}, i = 1, 2, \dots, m; j = 1, 2, \dots k \dots, n], \quad (1)$$

and output matrix:

$$Y = [y_{rj}, r = 1, 2, \dots, s; j = 1, 2, \dots k \dots, n]. \quad (2)$$

For k-th unit, X_k and Y_k shows the quantified inputs/outputs of unit DMU_k. The efficiency rate of such a unit can then be generally expressed as (Vincová, 2005):

$$\frac{weighted\ sum\ of\ outputs}{weighted\ sum\ of\ inputs} = \frac{\sum_{r=1}^{s} u_r\, y_{rk}}{\sum_{i=1}^{m} v_i\, x_{ik}} \quad (3)$$

Before conducting the analysis, it is crucial to determine the orientation of model that will be used. There is input and output-orientation of DEA models. In purpose of this study, output-oriented DEA model will be used in order to determine the efficiency rate of each country, with constant returns-to-scale (CRS). Output-orientation is being used simply because the aim is to maximize the number of student enrolled in mobility programmes (outputs) with given amount of inputs. Model used in this study is the following:

$$\min h_k = \sum_{i=1}^{m} v_i\, x_{ik}$$

$$st$$

$$\sum_{r=1}^{s} u_r\, y_{rk} = 1 \quad (4)$$

$$\sum_{i=1}^{m} v_i\, x_{ij} - \sum_{r=1}^{s} u_r\, y_{rj} \geq 0\ , j = 1, 2, \dots k \dots, n$$

$$v_i \geq \varepsilon;\ i = 1, 2, \dots, m$$

$$u_r \geq \varepsilon;\ r = 1, 2, \dots, s$$

where:

- v_i, $i = 1, 2, \dots, m$, are weights assigned to i-th input,
- u_r, $r = 1, 2, \dots, s$, are weights assigned to r-th output and
- h_k is relative efficiency rate of DMU_k.

Model above is called primary CCR model. It is more often that the number of units is much greater than number of inputs and outputs. Because of that, in practice, dual model is more commonly used. The dual model can be stated as follows:

$$max Z_k + \varepsilon \left(\sum_{r=1}^{s} s_r^+ + \sum_{i=1}^{m} s_i^- \right)$$

$$st$$

$$\sum_{j=1}^{n} \lambda_j\, x_{ij} + s_i^- = x_{ik},\ i = 1,2, \dots, m \quad (5)$$

$$-Z_k\, y_{rk} - \sum_{j=1}^{n} \lambda_j\, y_{rj} + s_r^+ = 0, \qquad r = 1, 2, \dots, s$$

$$\lambda_j \geq 0;\ j = 1, 2, \dots, n s_r^+ \geq 0; \qquad r = 1, 2, \dots, s s_i^- \geq 0;\ i = 1, 2, \dots, m.$$

where $\lambda = (\lambda_1, \lambda_2, \dots, \lambda_n), \lambda \geq 0$ is a vector assigned to individual productive units, and s_r^+ and s_i^- are variables that show how much each individual unit must increase its outputs and reduce its inputs in order to become efficient unit. The variable Z_k indicates the need for increased output to achieve efficiency (Vincová, 2005).

DEA provides us information about units that are efficient and those that are not. However, this analysis also tells us what is it that each inefficient unit must do in order to become efficient. Variables s_r^+ and s_i^- are used for calculating target values: values of parameters that each inefficient DMU must achieve in favor of becoming efficient. Those values are possible to determine using equations (6):

$$X_k^* = X_k - s^-, \qquad Y_k^* = Z_k Y_k + s^+ \quad (6)$$

where X_k^* and Y_k^* are vectors of target values of input and output parameters for DMU_k. (Savić, 2011).

4. EMPIRICAL STUDY

The main objective of this study was to determine which country in Europe is efficient from the aspect of student mobility programmes. DMUs in analysis are members of European Union (EU-28) and partnered countries (Table 3).

The parameters used for analysis are shown in Table 2.

Table 1: The parameters used for analysis of European countries from the aspect of student mobility

	Scenario 1	Scenario 2
Inputs	▪ GDP per capita [$] ▪ Expenditure on tertiary education, as % of GDP ▪ Population	▪ GDP per capita [$] - **I1** ▪ Expenditure on tertiary education, as % of GDP – **I2** ▪ Population – **I3** ▪ Number of students enrolled in tertiary education – **I4**
Outputs		
	▪ Number of students enrolled in tertiary education ▪ Number of incoming mobilities ▪ Number of outgoing mobilities	▪ Number of incoming mobilities – **O1** ▪ Number of outgoing mobilities – **O2**

As seen in table 1, there are two scenarios of efficiency analysis of European countries from the aspect of student mobility. The only difference is that the parameter “number of students enrolled in tertiary education” is input into the model in the first scenario, and output from the model in the second scenario. The first scenario can be used to show us the efficiency of higher education in Europe in generally, not only the efficiency of student mobility, whereas the second scenario is focused completely on the efficiency of student mobility programme. The purpose of these two scenarios is to see how the change in parameters and the number of students enrolled in tertiary education, as an input, affects the efficiency of European countries.

The model used for the purpose of this study is output-oriented DEA model, since the goal is to increase the number of student of mobilities in Euope. The analysis is conducted using EMS software (Efficiency measurement system).

4.1. Analysis and results

Descriptive statistics of values parameters used in the analysis and correlation analysis are shown in table 2 and table 3. The tables for descriptive statistics and correlation analysis are the same for both scenarios.

Table 2: Descriptive statistics

	GDP per capita [$]	Expenditure on education (% of GDP)	Population	Number of students enrolled in tertiary education	Number of incoming mobilities	Number of outgoing mobilities
Mean	32,494.25	1.274	17,867,903.72	804,333.81	53,549.95	22,374.55
St. error	4,220.93	0.075	4,184,938.98	221,830.60	15,823.87	5,176.31
Median	24,453.35	1.265	7,544,249.50	305,103.50	22,390.00	9,555.50
Mode	-	-	-	-	821.00	-
St. dev.	23,877.19	0.427	23,673,589.88	1,254,863.35	89,513.33	29,281.66
Variance	570,120,219	0.182	5.60439E+14	1.57468E+12	8,012,636,685	857,415,417
Kurtosis	0.99	-0.070	1.15	9.42	10.40	5.38
Skewness	1.08	0.455	1.57	2.81	3.07	2.17
Range	99,631.97	1.804	82,138,104.00	6,055,990.00	430,012.00	129,075.00
Minimum	1,818.00	0.517	299,891.00	6,896.00	821.00	54.00
Maximum	101,449.97	2.320	82,437,995.00	6,062,886.00	430,833.00	129,129.00
Sum	1,039,816.11	40.758	571,772,919.00	25,738,682.00	1,713,598.35	715,985.50
Count	32	32	32	32	32	32

Table 3: Correlation analysis

Parameters	*GDP per capita [$]*	Expenditure on education (% of GDP)	Population	Number of students enrolled in tertiary education	Number of incoming mobilities	Number of outgoing mobilities
I1	1.000					
I2	0.290	1.000				
I3	**-0.085**	**-0.081**	1.000			
I4	**-0.127**	0.058	0.886	1.000		
O1	0.134	0.050	0.758	0.558	1.000	
O2	0.182	0.097	0.681	0.441	0.915	1.000

Based on results of correlation analysis, we can see that population and number of students enrolled in tertiary education positively affects number of students enrolled in mobility programmes.

Table 4 presents the results of the efficiency analysis for both scenarios.

Table 4: Efficiency analysis of student mobility in Europe

Scenario 1			Scenario 2		
DMU	**Efficiency rate**	**Rank**	***DMU***	**Efficiency rate**	**Rank**
Turkey	**19.97%**	**1**	**Luxembourg**	**34.58%**	**1**
Finland	**45.29%**	**2**	**United Kingdom**	**48.82%**	**2**
United Kingdom	**48.82%**	**3**	**Austria**	**59.59%**	**3**
Austria	**59.59%**	**4**	**Finland**	**72.24%**	**4**
Czech Republic	**92.20%**	**5**	**Czech Republic**	**88.06%**	**5**
Poland	**93.76%**	**6**	**Switzerland**	**97.31%**	**6**
Germany	103.14%	7	Poland	102.14%	7
Netherlands	112.04%	8	Cyprus	111.68%	8
Italy	114.54%	9	Turkey	122.95%	9
Switzerland	117.90%	10	Germany	126.38%	10
Luxembourg	121.40%	11	Netherlands	136.97%	11
Belgium	121.50%	12	Denmark	138.19%	12
France	124.92%	13	Belgium	144.50%	13
Denmark	124.94%	14	France	147.06%	14
Lativia	128.68%	15	Latvia	147.31%	15
Serbia	149.85%	16	Serbia	161.62%	16
Iceland	153.06%	17	Iceland	170.68%	17
Spain	157.40%	18	Romania	177.01%	18
Romania	173.36%	19	Italy	185.86%	19
Sweden	174.41%	20	Hungary	186.23%	20
Hungary	175.02%	21	Slovakia	223.48%	21
Ireland	177.00%	22	Ireland	230.60%	22
Bulgaria	180.14%	23	Bulgaria	254.91%	23
Norway	190.07%	24	Sweden	266.67%	24
Cyprus	198.07%	25	Malta	330.55%	25
Slovakia	200.53%	26	Estonia	332.86%	26
Lithuania	216.64%	27	Spain	333.38%	27
Portugal	235.00%	28	Portugal	370.90%	28
Croatia	248.44%	29	Norway	409.47%	29
Slovenia	256.84%	30	Lithuania	493.12%	30
Estonia	267.92%	31	Slovenia	526.25%	31
Malta	358.61%	32	Croatia	2935.24%	32

According to the results of analysis in first scenario, where number of students enrolled in tertiary education is output from model, we can see that the most efficient country is Turkey. DMU that produces big amount of outputs while consuming small amount of inputs is considered to be efficient. Turkey, as a country with amount of inputs, comparing to other countries, has a high number of students enrolled in tertiary education and therefore is most efficient. Comparing Czech Republic to Portugal, as countries with similar GDP per capita, expenditure on education and population, Czech Republic has a much greater number of students enrolled in mobility programmes than Portugal, thus is more efficient.

The results of analysis in second scenario is slightly different. Moving the number of students enrolled in tertiary education in 2015. from outputs to inputs affected some of the countries' efficiency rate. In the case of second scenario, Luxembourg and Switzerland (inefficient in first scenario) became efficient countries from the aspect of student mobility programmes, while Turkey and Poland are now inefficient. The reason why Turkey became inefficient, as a most efficient country in the first scenario, is because of the same reason it was efficient in the first one. Great number of students enrolled in tertiary education is now input in the model and thus it makes Turkey inefficient because it produces small amount of outputs with high number of inputs. Luxembourg becomes the most efficient because it is a really small country, but comparing to other countries, it has a great number of students enrolled in mobility programs for its size.

5. CONCLUSION

According to data published by UNESCO Institute for Statistics and Eurostat, and reports made by European Commission, the popularity of student mobility programmes is increasing each year. Both students and countries are aware of the benefits that those programmes carry. Comparing data of implementation of the programme Erasmus+ in 2014, first year of implementation of this programme, and in 2015. we can see that the number of students enrolled is 4% greater.

In the analysis that was done in this paper, it is obvious that the most popular countries are Austria, Czech Republic, Finland, United Kingdom, countries efficient in both scenarios and Luxembourg, Poland, Switzerland and Turkey, countries that are efficient depending on the scenario. Using DEA, it was determined which countries are efficient. For other countries, that are inefficient, DEA calculates target values that indicates how much each country must increase its outputs - students enrolled in mobility programmes (and students enrolled in tertiary education, in the case of first scenario) in order to become efficient. For those countries, it is important to invest more in promoting student mobility programmes to their students, in order to increase the number of their students enrolled in the programme. Also, the adequate promotion of one country and its universities in other countries is equally, if not more important, for increasing number of students that are coming to that country in purpose of studying. This study can be a significant contribute to improving the student mobility programmes in Europe considering that there hasn't been any paper published yet that uses DEA for the purpose of measuring the efficiency of European countries from the aspect of student mobility.

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