DOI: 10.20472/IAC.2018.035.040

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ASSESSMENT OF THE EFFICIENCY OF INVESTMENT IN ENTREPRENEURIAL ZONESIN CROATIA USING DATA ENVELOPMENT ANALYSIS

Abstract:

The promise of entrepreneurial zones development in Northern Croatia has been huge. In the last decade 282,2 million kuna has been invested on the area of Varaždin and Međimurje county in the Republic of Croatia and the result has been activation of 52 zones financed from public sources and generation of 14,4 thousand working vacancies (Republic of Croatia, Ministry of Entrepreneurship and Crafts, 2015). Despite certain employment capacity there is still a large number of non-active or half-filled entrepreneurial zones that are a reason for suspicion in cost effectiveness of these investments.

In this paper investment efficiency of local self-government units (municipalities and towns) on the area of Varaždin and Međimurje county in the Republic of Croatia has been assessed by using data envelopment analysis. The analysis has been conducted by using CCR and BCC model oriented on outputs. Concretely, the results of the conducted analysis are valuable due to the fact that political management of towns and municipalities – that has been non-efficient investor in entrepreneurial zones – is given information on necessary changes and their extent and also on good practice examples from neighbour towns and municipalities.

Keywords:

entrepreneurial zones, relative efficiency assessment, data envelopment analysis, Varaždin county, Međimurje county

JEL Classification: L26

1 Introduction

The birth and growth of new companies in a certain region is more possible in situations where supporting climate and institutions are present. Also the role of new small and medium entrepreneurs in employment of regional population(Davidsson, Lindmark, Olofsson, 1998; Baldwin, Picot 1994), but also in stimulation of total regional welfare growth (Wong, Ho, Autio, 2005; Davidsson, Lindmark, Olofsson, 1995), of a certain region is leading to intensification of efforts in certain region oriented on encouragement of entrepreneurially oriented institutional surrounding. This kind of environment is not only encouraging individuals to realize their personal ambitions through entrepreneurial undertaking, but is also making a contribution in removing administrative, technical, financial and other barriers with which new entrepreneurs are faced with (Delić, Alpeza, Oberman Peterka, 2012).

The quality of institutional environment directed on entrepreneurship development on regional and local level is highly determined by quality and efficiency of local entrepreneurial infrastructure. More wide viewpoint on entrepreneurial infrastructure is implying every spatially specific take-off of different entrepreneurial activities developed based on planned spatial and development concept of local territory units, i.e. regional territory units or Republic of Croatia, while more specifically seen the term relates on entrepreneurial supporting institutions and entrepreneurial zones (Act On Promoting Entrepreneurial Infrastructure, 93/13).

Entrepreneurial zone is an area adequately equipped with infrastructure whose purpose is to practice different entrepreneurial or economical activities. Entrepreneurs who are performing business activities within the same zone are using infrastructurally equipped space together, which is making the use of resources more efficient (Act On Promoting Entrepreneurial Infrastructure, 93/13).The basic aim of all entrepreneurial zones is to strengthen local and regional economy through special support system whose aim is to attract domestic and foreign investors and it encompasses infrastructural support (construction of energetic, communal, traffic and communication infrastructure), support for competitiveness strengthening (export incentives, attraction of potential investors) and support for development of entrepreneurial competencies (education of entrepreneurs and strengthening their skills) (Republic of Croatia, State Audit Office, 2014b).

Having on mind that efficient investment in entrepreneurial zones on the level of local and regional self-government may be an incentive for equalizing the development of the Republic of Croatia and mitigate the unemployment problem of the Republic of Croatia on the local territory, the Program for development of entrepreneurial zones 2004.-2007. has been designed in order to define the entrepreneurial infrastructure as the basis for small and medium entrepreneurship located near every larger settlement (Republic of Croatia, State Audit Office, 2014a). According to this, the goal has been set to increase the number of entrepreneurial zones on 20 zones in every county on average (Lončar, 2008). This goal has mostly been achieved in most of the counties in the last ten years. By the end of the year 2013 almost 702 million kuna have been

invested on the area of the Republic of Croatia in building entrepreneurial zones (total of 348 zones) with average investment per zone amounting over 2 million kuna (Republic of Croatia,State Audit Office, 2014a). But the projects of entrepreneurial zones establishment have been a subject of significant failure in terms of intensifying the entrepreneurial activity on certain local areas. By the end of the year 2012 entrepreneurial activity has been in progress in only 196 zones and in only 27 zones the building has been on-going, while other zones have not been entrepreneurially active (Republicof Croatia, Ministry of Entrepreneurship and Crafts, 2015). Also, a significant number of active zones is characterized by the fact that only one or a few entrepreneurs are doing their business activity in the zone, while real capacity of the zone is far larger. Therefore, in the last two years there have been incentives to re-examine the justification of public investment in certain entrepreneurial zones. This is also the basic aim of the analysis that will be elaborated in this paper.

In this paper the efficiency of investment in entrepreneurial zones by the local self-government on the territory of Varaždin and Međimurje county has been estimated by the usage of data envelopment analysis. The following chapter is oriented on the description of the methodological concept of the used analysis and the remainder of the paper relates to model development and interpretation of the results. Finally, limitations of the conducted analysis and basic conclusions are discussed.

2 Data envelopment analysis

Data Envelopment Analysis is a method of non-parametric linear programming that enables estimation of the relative efficiency of more decision making units with the same input and output and different resource levels and activities within the process of transforming the inputs into outputs. DEA belongs to the methods for measuring efficiency of complex units and it is especially appropriate in analysis when it is not clearly defined which inputs are contributing to generation of certain outputs and in what extent. The method has been introduced in the scientific literature by Farrell in 1957 and significant contribution to the method has been made by Charnes, Cooper and Rhodes, who have developed a quantitative model for estimation of relative efficiency by using more inputs and more outputs (Bogović, 2014).Later on the data envelopment analysis has found significant application in efficiency estimation on agriculture, education, health, banking, tourism, trade, maritime affairs and many other areas (Rabar, Blažević, 2011).

The efficiency of specific decision maker is measured in relation to efficiency of other decision makers. Therefore, this is relative efficiency moving in range from 0 to 1, where variance from 1 implies surplus of outputs, i.e. deficiency of inputs. When estimating efficiency each decision maker is compared to the best one what makes this method specific because it is based on extreme observations and not on average values (unlike most classical statistical approaches). The existing (the best) decision makers are determining empirical level of efficiency which represent the goal for non-efficient decision makers and this is achieved by their projection in relation to the

efficiency frontier (Rabar, 2010).The empirical efficiency frontier may be treated as the maximum output that each decision-maker may achieve with inputs that are on his disposal. For example, by enveloping the data from the bottom, for each decision maker the ability to achieve the same results by using less inputs is questioned, where inputs of other units are taken into consideration and also the ability to achieve better results with same inputs (Bogović, 2014).

The weights of input and output variables are determined so that each decision making unit is assigned a set of most favourable weights, i.e. the ratio of inputs and outputs that is maximal for each unit when compared to other units with the same assigned weights for corresponding inputs and outputs for decision unit. Relative efficiency is determined for each of the *k*analysed decision makers DMU*j* (*j* = 1,..., *k*) that are using *m*inputs and achieving*n*outputs (Rabar, Blažević, 2011).

The basic concept of measuring decision makers' efficiency is formalized as mathematical model of fractional linear programming and may be mathematically noted as (Bogović, 2014):

$$Max\ h_0 = \sum_{j=1}^{n} u_j y_{jk0} \quad (1)$$

and:

$$\sum_{i=1}^{m} v_i x_{ik0} = 1 \quad (2)$$

$$\sum_{j=1}^{n} w_j y_{jk0} \leq \sum_{i=1}^{m} v_i x_{ik0} \quad (3)$$

where*k*represents the number of decision making units, *m*is the number of inputs, *n*the number ofoutputs, *u*is the weight of the output coefficient and *v*is the weight of the input coefficient.

In the previous thirty years many DEA models have been developed. Their differences are arising from the assumptions about return on scale (constant or changeable), geometrical features of the efficiency frontier possibilities(linear, log-linear, Cobb-Douglas) and model orientation (orientation based on inputs, orientation based on outputs)(Šporčić, Martinić, Šegotić, 2007).In order to evaluate efficiency the Charnes-Cooper-Rhodes (CCR) model and Banker-Charnes-Cooper (BCC) model are most widely used. These models differ according to assumed transformation of inputs into outputs (Bogović, 2014). When choosing the model, the context and the purpose of the analysis need to be taken into consideration (Rabar, Blažević, 2011).

Charnes-Cooper-Rhodes (CCR) model is the most renowned model of DEA and is based on the assumption of constant returns. In other words, for each positive number *t*, each feasibility of *xy*activity automatically implies the activity $x_t y_t$feasibility. This

model determines the total efficiency for each unit, where total efficiency is composed of technical efficiency and efficiency based on volume of business activity. The maximization of decision makers is achieved so that each variable is assigned the most favourable weight coefficient based on which virtual inputs and outputs are originated (Bogović, 2014).

Banker-Charnes-Cooper model is appropriate when increasingordecreasing returns are concerned, i.e. in case when increase of inputs is leading to non-proportional increase, i.e. decrease in outputs (Rabar, 2010).This model is making pure technical efficiency estimation possible and this means that when measuring efficiency, the influence of volume of business activity is neglected. This is achieved by comparing the *j*unit of decision maker only with the units that have similar scale(Bogović, 2014).

Basic advantages of the DEA method are as follows (Asić, 2011):

- method does not require functional forms related to input or output variables;
- decision makers are directly compared to other decision makers;
- input and output variables do not have to be expressed in the same units.

However, this method has some disadvantages. Since DEA is based on extreme points, mistakes may occur in measurement, while comparison of large number of decision makers is demanding. Also, the method enables measurement of relative, but not also the absolute efficiency. Due to the non-parametric nature of the method, hypothesis testing is very complex and not fully scientifically researched (Asić, 2011).

The data envelopment analysis has found very wide application in the last thirty years, both in profit and in public sector. According to Emrouznejad, Parker and Travers (2008) over 4,000 research has been done in this areas, both in scientific papers and in books, where the application of this method is most popular in baking, education economics and health economics.

Domestic authors have mostly followed the international trends and DEA has been used to assess efficiency in banking (Jemrić, Vujčić, 2002; Hunjak, Jakovčević,2003), insurance (Jurčević, Žaja, 2013), tourism (Rabar, Blažević, 2011), forrestry (Šporčić, Martinić, Šegotić 2007), public administration (Bogović, 2014), education (Aristovnik, Obadić, 2011; Sopek, 2012), health economics (Rabar, 2010), trade (Šegota, 2008) and marritime traffic (Asić, 2011). Up until now this method has not been used in the domestic literature in order to research efficiency of entrepreneurial zones, while internationally the similar problems have been researched by Yilmaz and Capraz (2013).

3 Model development and problem solving

In the continuation of this paper decision makers have been defined, the selection of inputs and outputs has been made, model of DEA has been selected (CCR/BCC)and mathematical notation of the problem has been conducted.

3.1. Defining decision makers

All of the active zonesin the area of Varaždin and Međimurje county that are totally or partially financed from public sources will be included in the relative efficiency analysis. Since local self-government units are investing and managing entrepreneurial zones, these units will be treated as decision makers. Some of the self-government units have founded and invested financial funds in more than one entrepreneurial zones therefore the input and output dana for these units will be treated aggregately.

There are 52 active entrepreneurial zones on the area of Varaždin and Međimurje county that are financed by public investment and who are managed by 35 local self-government units, i.e. 35 decision makers. So, in this analysis, decision makers are local government that is using available resources (input) and transforming them in economically measurable results (output). As mentioned a forehead, total number of decision makers amounts$n$=35; DMU_1, DMU_2,..., DMU_{35}, and they are presented in the presentation of the framework of empirical data on input and output variables(table1).

3.2. Selection of input and output variables

When determining indicators that are optimally reflecting the efficiency of analysed units (local self-government investment in entrepreneurial zones), basic rules of DEA need to be taken into account. The first criteria for determining inputs and outputs is that all variables values are greater than zero and therefore positive. Further on, there must be a clear relationship between input and output variables in sense that positive changes in input are resulting in positive changes of output, without decreasing the value of any input. Also, when selecting the variables, the rule must be obliged that total number of decision maker must be at least three to five times higher than the total number of input and output variables(Bogović, 2014).

When reaching the final decision on variable selection, the inputs and outputs that are best at describing the process and reflecting the efficiency of analysed units, are to be selected. Still, the final decision is on the researcher so that the phase of selecting inputs and outputs, as also the model selection, are a moment of researchers' subjectivity, which makes it a constraint of this analysis(Rabar, 2010).

The founders and managers of analysed entrepreneurial zones are local self-government units that are determining the building of zonesin their spatial plans. The land plots on which entrepreneurial zones are built upon are initially in the ownership of the self-government units or based on donation of the Republic of Croatia or by buying from legal or physical entities.

When taking into consideration that the land plots on which entrepreneurial zones are built upon are mostly the investment of self-government units, and may also be analysed in the context of the opportunity cost of their usage for some other purpose, the total surface of the entrepreneurial self-government plot is the input variable affecting their efficiency.

Further on, the funds for material investment in building entrepreneurial zones and their equipping by energetic, communal, traffic, communication and other

infrastructure are public. The highest share of investment is financed directly from the budget of local self-government units and a part of funds in building some of the entrepreneurial units is partially ensured from the central government budget. Therefore,the total value of investment and equipping certain entrepreneurial zone represents an input in efficiency analysis.

According to the goals determined by entrepreneurship development programs in the Republic of Croatia, basic effects of investment in entrepreneurial zones on local territory are intensifying economic activity by increasing the number ofcompanies and decreasing unemployment through opening new vacancies in companies located in the entrepreneurial zone. According to this, the analysis is determining two output variables: number of active companies and number of employees in entrepreneurial zones that are under certain local self-government authority.

In continuation a systematic overview of all input and output variables whose values are determined for each decision maker is presented:

- Input variables:
  - Entrepreneurial zones land surface (in ha);
  - The value of investment in entrepreneurial zones (in kn);
- Output variables:
  - Number of active entrepreneurs in entrepreneurial zones;
  - Number of employees in entrepreneurial zones.

These variables have values higher than zero and analysis includes totally 4 variables and 35 decision makers, therefore all the postulates of DEA are satisfied. Also, higher values of material investment and higher surface of entrepreneurial zone should result in higher number of „inhabited" entrepreneurs and number of employees which potentially satisfies the criteria according to which positive changes in input should result in positive changes in output. The verification of this condition is in chapter 3.4.

3.3. Empirical data on input and output variables

The empirical data on values of input and output variables for each decision maker are related to the situation in each entrepreneurial zone at the end of the year 2013. The source of data are reports of State Audit Office: „Foundation and investment in equipment and development of entrepreneurial zones on the area of Varaždin County" (2014) and „Foundation and investment in equipment and development of entrepreneurial zones on the area of Međimurje County" (2014). In these reports data on variables values in certain entrepreneurial zones are shown. For the requirements of this analysis the data are systematised and summed according to local self-government units, i.e. decision makers. Empirical values of input and output data for each decision maker are shown in Table 1.

Table 1:Empirical data on input and output variables values

Decision making unit	Land surface(in ha)	Value of investment (in kn)	Number of active entrepreneurs	Number of employees
Town Ivanec (DMU_1)	70,72	19.060.689,00	9	263
Town Lepoglava (DMU_2)	56,82	14.298.614,00	11	350
Town Ludbreg (DMU_3)	37,07	18.155.551,00	33	1.084
Town Novi Marof (DMU_4)	15,20	5.380.000,00	8	155
Town Varaždin (DMU_5)	343,29	25.155.391,00	61	2.899
Municipality Cestica (DMU_6)	30,42	4.931.973,00	3	57
Municipality Gornji Kneginec (DMU_7)	169,00	38.523.006,00	33	990
Municipality Jalžabet (DMU_8)	139,50	23.829.559,00	1	150
Municipality Mali Bukovec (DMU_9)	5,06	120.372,00	1	75
Municipality Martijanec (DMU_{10})	22,00	310.000,00	1	10
Municipality Petrijanec (DMU_{11})	4,70	3.843.426,00	1	25
MunicipalitySračinec (DMU_{12})	10,00	2.827.090,00	3	55
Municipality Sveti Ilija (DMU_{13})	24,50	620.000,00	5	64
Municipality Trnovec Bartolovečki (DMU_{14})	30,80	15.599.155,00	4	51
Municipality Veliki Bukovec (DMU_{15})	17,20	43.440,00	2	312
Municipality Visoko (DMU_{16})	14,00	176.243,00	1	55
Town Čakovec (DMU_{17})	76,05	9.300.000,00	21	1.870
Town Mursko Središće (DMU_{18})	9,20	2.889.908,00	7	164
Town Prelog (DMU_{19})	112,80	37.378.401,00	25	2.340
Municipality Belica (DMU_{20})	24,98	1.179.356,00	3	125
Municipality Dekanovec (DMU_{21})	12,50	3.425.760,00	1	17
Municipality Domašinec (DMU_{22})	4,01	3.778.903,00	2	15
Municipality Donja Dubrava (DMU_{23})	15,20	1.279.876,00	3	39
Municipality Donji Kraljevec (DMU_{24})	45,16	6.203.398,00	10	1.033
Municipality Donji Vidovec (DMU_{25})	3,41	262.982,00	3	30
Municipality Goričan (DMU_{26})	13,44	708.763,00	3	220
Municipality Kotoriba (DMU_{27})	29,74	4.457.476,00	17	326
Municipality Mala Subotica (DMU_{28})	15,18	13.066.739,00	4	588
Municipality Nedelišće (DMU_{29})	14,86	10.521.938,00	9	396

Municipality Pribislavec (DMU_{30})	13,30	5.300.000,00	15	248
Municipality Selnica (DMU_{31})	9,45	919.605,00	1	32
Municipality Sveta Marija (DMU_{32})	18,68	3.559.420,00	4	24
Municipality Sveti Juraj na Bregu (DMU_{33})	3,81	2.086.673,00	1	50
Municipality Sveti Martin na Muri (DMU_{34})	21,64	2.820.563,00	14	330
Municipality Šenkovec (DMU_{35})	20,66	165.576,00	1	4
TOTAL	**1.454,35**	**282.179.846,00**	**321**	**14.446**

Source: Republic of Croatia, State Audit Office, 2014a; 2014b; 2014c

Table 2. is related to descriptive statistics of input and output variables included in the DEA model.

Table 2. Descriptive statistics indicators for input and output variables

Indicator	Land surface(in ha)	Value of investment (in kn)	Number of active entrepreneurs	Number of employees
Arithmetic mean	41,55	8.062.281,31	9	413
Minimum	3,41	43.440,00	1	4
Maximum	343,29	38.523.006,00	61	2.899
Standard deviation	64,98	10.207.085,90	12,57	683,24
Coefficient of variation	156%	127%	137%	166%
Median	18,68	3.778.903,00	4	150

Source:Authors calculation in STATISTICA 10

Basic descriptive statistic indicates high variability in values of input and output variables and variation range in investment values of certain decision makers is of high significance.

3.4. Statistical data verification

As previously mentioned, one of initial assumptions of correct DEA is to satisfy condition according to which positive changes of input variables are resulting in positive changes of output variables(Šporčić, Martinić, Šegotić, 2007). It is, therefore, necessary to determine isotonicity before evaluating efficiency of investment in entrepreneurial zones.

Concretely, the correlation analysis of input and output variables is conducted by Pearson correlation coefficient. Generation of results (the correlation matrix) is conducted via STATISTICA 10 software and the results are in the Table 3.

Table 3:Correlation matrix for input and output variables

Correlations (DEA) Marked correlations are significant at p < ,05000 N=35 (Casewise deletion of missing data)				
	Land surface (in ha)	**Value of investment (in kn)**	**Number of active entrepreneurs**	**Number of employees**
Land surface (in ha)	1,00	0,73	0,82	0,78
Value of investment (in kn)	0,73	1,00	0,66	0,67
Number of active entrepreneurs	0,82	0,66	1,00	0,87
Number of employees	0,78	0,67	0,87	1,00

Source: Authors calculation in STATISTICA 10

Based on the presented data it can be concluded that there is high or moderately high positive correlation between all analysed variables. According to this it may be concluded that DEA may offer representative results based on analysed variables.

3.5. Model selection and analysis direction

The correct DEA model selection requires consideration on data features and the type of return on scale. Concretely, the efficiency of investment in entrepreneurial zones will be conducted by following steps:

- CCR model, based on assumption on constantreturns, and
- BCC model, based on assumption of variable returns.

The reasons for selecting these models are in the fact that the type of return on scalein this concrete case is not specifically identified. Also, using both models willenable comparison and more quality in interpreting results.

For both models output oriented analysis will be used since strategical thinking of political management is more often directed on achieving better result and rarely or almost never on rationalizing resources. This approach will enable identification of possibilities for increasing number of companies and number of employees in entrepreneurial zones of individual local self-territory units, by keeping their surface and the investment values unchanged.

3.6. Model notation and problem solving

In order to solve the problem, for decision maker DMU_1 (Town Ivanec) it is necessary to solve:

$$\min_{\theta,\lambda} \theta \qquad (4)$$

with constraints:

$$263*\lambda_1 + 350*\lambda_2 + ... + 4*\lambda_{35} \geq 263$$

$$9*\lambda_1+ 11*\lambda_2+...+1*\lambda_{35} \geq 9$$

$$-70,72*\lambda_1 – 56,82*\lambda_2-...- 20,66*\lambda_{35} + 70,72*\theta \geq 0$$

$$-19.060.689*\lambda_1 – 14.298.614*\lambda_2-...-*165.576\lambda_{35} + 19.060.689*\theta \geq 0$$

$$\lambda_1,\lambda_2,...,\lambda_{35} \geq 0$$

By solving this problem in DEA-SOLVER-LV(V3) according to CCR-I model following results are achieved: θ*= 0,172214, λ_1^*= 0,144527, λ_2^*= 3,86E-02, λ_3^*= 1,140211. In the second phase the problem is solved:

$$\max_{\lambda,s^+,s^-} (s^+ + s^-) \qquad (5)$$

$$263*\lambda_1+ 350*\lambda_2+...+4*\lambda_{35}- s_1^+ = 263$$

$$9*\lambda_1+ 11*\lambda_2+...+1*\lambda_{35} - s_1^+ = 9$$

$$-70,72*\lambda_1 – 56,82*\lambda_2-...- 20,66*\lambda_{35} + 70,72*\theta - s_1^- = 0$$

$$-19.060.689*\lambda_1 – 14.298.614*\lambda_2-...-*165.576\lambda_{35} + 19.060.689*\theta - s_1^-= 0$$

$$\lambda_1,\lambda_2,...,\lambda_{35},\boldsymbol{s_1^+ s_1^-} \geq 0$$

Since optimal solution for CCR-I model is obtained in two phases, it is valid:θ*= 0,172214, λ_1^*= 0,144527, λ_2^*= 3,86E-02, λ_3^*= 1,140211, $s^{+*} = 0$, s^{-*}= 0, and optimal solution for CCR-O model may simply be determined (Cooper, Seiford, Tone, 2007):

$$\eta^* = \frac{1}{\theta^*}=\frac{1}{0,172214} =5,8067 \qquad (6)$$

$$\mu_1^*=\frac{\lambda_1^*}{\theta^*} =\frac{0,144527}{0,172214} = 0,8392 \qquad (7)$$

$$\mu_2^*==\frac{\lambda_2^*}{\theta^*} =\frac{3,86E-02}{0,172214} =0,2239 \qquad (8)$$

$$\mu_3^*==\frac{\lambda_3^*}{\theta^*} =\frac{1,140211}{0,172214} =6,6209 \qquad (9)$$

According to this model it can be concluded that the Town Ivanec is relatively non-efficient in investing in entrepreneurial zones. By analogy this problem is solved for other decision makers.

4 Results of investment efficiency analysis in entrepreneurial zones

The evaluation of relative efficiency of local self-government investment in entrepreneurial zones is conducted by both models; CCR model which assumes constant returns and determines total efficiency and BCC model that assumes variable returns and indicates pure technical efficiency. In both cases the analysis is output oriented.

According to the results of the CCR-O model of investing in entrepreneurial zones is assessed as relatively efficient in six local self-government units: Town Ludbreg,

Municipality Veliki Bukovec, Town Čakovec, Municipality Donji Vidovec, Municipality Mala Subotica andMunicipality Pribislavec.

Since the BCC-O model is less restrictive, it implies that 13 local self-government units are relatively efficient: Town Ludbreg, Town Varaždin, Municipality Mali Bukovec, Municipality Sveti Ilija, Municipality Veliki Bukovec, Town Čakovec, Town Prelog, Municipality Donji Vidovec, Municipality Kotoriba, Municipality Mala Subotica, Municipality Pribislavec, Municipality Sveti Juraj na Bregu andMunicipality Sveti Martin na Muri.

In table 4 a comparative overview of results of local self-government investment efficiency in entrepreneurial zones by using CCR-O and BCC-O model of data envelopment analysis is presented.

Table 4:Comparison of data envelopment analysis CCR-O and BCC-O model results comparison

Item	CCR-O	BCC-O
Average Relative Efficiency	53,05%	63,98%
Maximum Relative Efficiency	100,00%	100,00%
Minimum Relative Efficiency	4,21%	6,66%
Standard Deviation	0,3340	0,3459
Number of Relatively Effective DMUs	6	13
Number of Relatively Inefficient DMUs	29	22

Source: Authors calculations in DEA-SOLVER-LV(V3)

According to the CCR model average relative efficiency amounts 53,05% which means that local self-government unit that is efficient averagely must achieve 88,49%[1] better results with same inputs. The BCC model indicates higher average relative efficiency and it amounts 63,98%. In other words, in order to make the investment in entrepreneurial zones efficient, average local self-government unit must ensure 56,29%[2]more output results with the same amount of inputs.

Further on, minimum relative efficiency is achieved by Municipality Jalžabet and in case of CCR-O modelit amounts 4,21%, while its value according to BCC-O model is somewhat higher (6,66%), indicating higher restrictiveness of the CCR model. It is also noticeable in Table 4 that the distribution of relative efficiency results indicates standard deviation for the CCR-O model amounting 0,3340, i.e. 0,3459 for the BCC-O model.

Comparison of efficiency distribution according to CCR-O and BCC-O model indicates that the number of efficient local self-government units according to theBCC-O model for selected set is higher for 7 (117%) in comparison to the results achieved by the CCR-O model. According toRabar and Blažević (2011) in this case probably the effect of return on scale is concerned. Therefore, in continuation of the paper solely the results of the BCC-O model are considered.

[1] According to: (1-0,5305)/0,5305.

[2] According to: (1-0,6398)/0,6398.

According to the results of the BCC-O model, 13 decision makers are efficient and are concretely defining the efficiency level. These units are appearing as benchmark for non-efficient decision-makers (table 5). For each non-efficient decision maker at least one referent benchmark is determined in a way that the efficient decision maker with input/output directionality that is the most similar to certain non-efficient decision maker is taken into the set (Bogović, 2014).

The coefficient(table 5)for each referential decision maker by certain non-efficient decision maker represents a vector of optimal variables values that are projecting efficiency indicators on the efficiency frontier. For each non-efficient decision maker, the projection on the efficiency frontier is linear combination of inputs and outputs of its role decision maker, where the coefficient is representing the share of certain role in forming the projection on the efficiency frontier. For example, Town Ivanec as a non-efficient decision maker has two referential decision makers: Town Ludbreg and Town Varaždin. The coefficient for Town Ludbreg is higher, i.e. this decision maker has had more significant influence in forming the projection on the efficiency frontier for Town Ivanec. Therefore, in this case the Town Ludbreg represent a case of better practice.

Table 5:Set of referential decision makers according to theBCC-O model

Number	Ineffective DMU	Exemplary DMU	Coefficient
1	Town Ivanec	Town Ludbreg	0,8901
		Town Varaždin	0,1099
2	Town Lepoglava	Town Ludbreg	0,6095
		Town Varaždin	0,0721
		Town Kotoriba	0,3184
3	Town Novi Marof	Town Ludbreg	0,0036
		Town Čakovec	0,0253
		Municipality Pribislavec	0,9441
		Municipality Sveti Martin na Muri	0,0271
4	Municipality Cestica	Town Ludbreg	0,0325
		Town Varaždin	0,0014
		Municipality Kotoriba	0,9661
5	Municipality Gornji Kneginec	Town Ludbreg	0,5692
		Town Varaždin	0,4308
6	Municipality Jalžabet	Town Varaždin	0,1803
		Town Čakovec	0,4041
		Town Prelog	0,4157
7	Municipality Martijanec	Municipality Sveti Ilija	0,4623
		Municipality Veliki Bukovec	0,5377
8	Municipality Petrijanec	Town Ludbreg	0,0110
		Municipality Donji Vidovec	0,9108
		Municipality Mala Subotica	0,0782
9	Municipality Sračinec	Town Čakovec	0,0130
		Municipality Donji Vidovec	0,4699
		Municipality Pribislavec	0,4534

		Municipality Sveti Martin na Muri	0,0637
10	Municipality Trnovec Bartolovečki	Town Ludbreg	0,7362
		Municipality Pribislavec	0,2638
11	Municipality Visoko	Municipality Sveti Ilija	0,1182
		Municipality Veliki Bukovec	0,5872
		Municipality Donji Vidovec	0,2946
12	Town Mursko Središće	Town Ludbreg	0,0902
		Town Čakovec	0,0139
		Municipality Donji Vidovec	0,7196
		Municipality Pribislavec	0,1763
13	Municipality Belica	Municipality Sveti Ilija	0,1155
		Municipality Veliki Bukovec	0,4995
		Municipality Sveti Martin na Muri	0,3851
14	Municipality Dekanovec	Municipality Donji Vidovec	0,2648
		Municipality Pribislavec	0,5172
		Municipality Sveti Martin na Muri	0,2180
15	Municipality Domašinec	Municipality Donji Vidovec	0,9393
		Municipality Pribislavec	0,0607
16	Municipality Donja Dubrava	Municipality Sveti Ilija	0,2449
		Municipality Donji Vidovec	0,3917
		Municipality Sveti Martin na Muri	0,3634
17	Municipality Donji Kraljevec	Municipality Mali Bukovec	0,3690
		Town Čakovec	0,5539
		Municipality Mala Subotica	0,0771
18	Municipality Goričan	Municipality Mali Bukovec	0,0885
		Municipality Veliki Bukovec	0,3985
		Town Čakovec	0,0604
		Municipality Donji Vidovec	0,4525
19	Municipality Nedelišće	Town Ludbreg	0,2293
		Municipality Donji Vidovec	0,4536
		Municipality Mala Subotica	0,3171
20	Municipality Selnica	Municipality Veliki Bukovec	0,0668
		Town Čakovec	0,0405
		Municipality Donji Vidovec	0,7733
		Municipality Sveti Martin na Muri	0,1193
21	Municipality Sveta Marija	Municipality Donji Vidovec	0,0177
		Municipality Pribislavec	0,3162
		Municipality Sveti Martin na Muri	0,6661
22	Municipality Šenkovec	Municipality Sveti Ilija	0,2118
		Municipality Veliki Bukovec	0,7882

Source: Authors calculations in DEA-SOLVER-LV(V3)

The frequency of benchmark decision makers in referential sets isan indicator of whether certain decision maker may be considered a good practice example (Rabar, Blažević, 2011).In other words, the higher the frequency of certain local self-government unit in referential sets, the higher is its probability to be a good practice example.

If frequency in referential sets and the number of non-efficient decision makers for this efficient member are determined, it may be concluded that the Municipality Donji Vidovec represents a reference for total of eight non-efficient local self-government units and is therefore the most efficient decision maker. It is followed byTown Ludbreg (4), Municipality Veliki Bukovec (4), Municipality Pribislavec (2) and Town Čakovec (1), Municipality Sveti Martin na Muri (1), Municipality Kotoriba (1) and Town Prelog (1). Town Varaždin, Municipality Sveti Ilija, Municipality Mala Subotica, Municipality Mali Bukovec and Municipality Sveti Juraj na Bregu do not have a leading share in any of the sets.

Table 6 represents an overview of decision makers based on their rank in efficiency level. It is noticeable that the most poorly ranked entrepreneurial zones are Municipality Selnica, Cestica, Trnovec Bartolovečki, Dekanovec and Jalžabet.

Table 6:Rank of decision makers according to efficiency in the BCC-O model

Rank	Decision making unit	Mark
1	Municipality Sveti Martin	1
1	Municipality Sveti Juraj na Bregu	1
1	Municipality Pribislavec	1
1	Town Ludbreg	1
1	Municipality Mala Subotica	1
1	Town Varaždin	1
1	Municipality Kotoriba	1
1	Municipality Donji Vidovec	1
1	Town Prelog	1
1	Municipality Mali Bukovec	1
1	Town Čakovec	1
1	Municipality Veliki Bukovec	1
1	Municipality Sveti Ilija	1
14	Municipality Donji Kraljevec	0,9317
15	Municipality Nedelišće	0,8827
16	Town Mursko Središće	0,8673
17	Municipality Goričan	0,8543
18	Municipality Gornji Kneginec	0,7323
19	Municipality Domašinec	0,5365
20	Town Novi Marof	0,5267
21	Municipality Belica	0,4306
22	Municipality Donja Dubrava	0,4007
23	Municipality Šenkovec	0,3794
24	Municipality Visoko	0,3775
25	Town Lepoglava	0,3676
26	Municipality Sračinec	0,3200
27	Municipality Martijanec	0,2952
28	Municipality Petrijanec	0,2934
29	Municipality Sveta Marija	0,2833

30	Town Ivanec	0,2495
31	Municipality Selnica	0,2010
32	Municipality Cestica	0,1706
33	Municipality Trnovec Bartolovečki	0,1416
34	Municipality Dekanovec	0,0862
35	Municipality Jalžabet	0,0666

Source: Authors calculations in DEA-SOLVER-LV(V3)

DEA, besides enabling rank of members according to efficiency, is also enabling the calculation of the aimed efficiency for non-efficient decision makers, as also the identification of sources and values of relative non-efficiency. The sources and size of non-efficiency are determined in comparison to achieved and projected values of input and output, where higher percentage difference between projected and real values of a certain input or output is an indicator of higher source of non-efficiency (Rabar, 2010).

Table 7 presents an overview of absolute and percentage average amounts of improvement in certain input and output variables. The average is related to corrections of input and output for all non-efficient decision makers.The highest source of non-efficiency is indicated by the variable*number of employees*. This variable needs to be corrected on average for 410,47% and it is the most significant source of non-efficiency in almost all non-efficient decision makers. With the projected average change amounting 263,61%, the output variable *number of companies*is also a significant source of non-efficiency. This variable is the most significant source of non-efficiency for Municipality Donji Kraljevec and ten others decision makers whose relative correction amount for this variable equals the output variable *number of employees*. The input variables *entrepreneurial zones land surface* and *investment amount* with their average required correction amounting 1,67% and 9,91% have no significant influence on efficiency. This is determined by the model selection oriented on outputs, i.e. results. The exception are results for Municipality Nedelišće where the most significant source of non-efficiency is the input variable *investment amount*.

Table 7:Average corrections of input and output variable values for non-efficient decision makers according to the BCC-O model

Input/output variable	Average performance correction for inefficient DMU	Average performance correction for ineffective DMU (%)
Land surface(in ha)	-0,3894	-1,67%
Value of investment (in kn)	-1.182.361,1951	-9,91%
Number of active entrepreneurs	8,5176	263,61%
Number of employees	350,9238	410,47%

Source: Authors calculations in DEA-SOLVER-LV(V3)

Further on, the Table 8 represents anoverview of sources and size of non-efficiency for five worst ranked decision makers. Empirical data on certain inputs and outputs, their aimed values and absolute and relative increase or decrease amounts for

achieving the aimed efficiency are presented. According to the data, most significant changes need to be made in Municipality Jalžabet, Municipality Dekanovec and Municipality Trnovec Bartolovečki. Correction of number of employees amounting 999,90% is required for these decision makers and the number of entrepreneurs is also a significant source of non-efficiency. Therefore, these units need to make significant effort in order to attract investors that may ensure opening new vacancies within the entrepreneurial zone.

In order to achieve the efficiency frontier, the non-efficient local self-government units needs to search for good practice examples in the domain of referential units within their referential set. For instance, Town Prelog is the best good practice example for worst ranked Municipality Jalžabet, since it represents the most realistically achievable benchmark that this non-efficient decision maker may achieve.

Table 8: Projection to the efficiency frontier for five worst ranked non-efficient decision makers according to the BCC-O model

Number	DMU/ IU	Realized input / output values	Projected input / output values	Difference	Percentage difference
1	**Municipality Jalžabet**	**15,01**			
	Land surface (in ha)	139,50	139,50	0,00	0,00%
	Value of investment (in kn)	23.829.559,00	23.829.559,00	0,00	0,00%
	Number of active entrepreneurs	1,00	29,87	28,87	999,90%
	Number of employees	150,00	2.250,86	2.100,86	999,90%
2	**Municipality Dekanovec**	**11,60**			
	Land surface (in ha)	12,50	12,50	0,00	0,00%
	Value of investment (in kn)	3.425.760,00	3.425.760,00	0,00	0,00%
	Number of active entrepreneurs	1,00	11,60	10,60	999,90%
	Number of employees	17,00	208,16	191,16	999,90%
3	**Municipality Trnovec Bartolovečki**	**7,06**			
	Land surface (in ha)	30,80	30,80	0,00	0,00%
	Value of investment (in kn)	15.599.155,00	14.764.541,12	-834.613,88	-5,35%

	Number of active entrepreneurs	4,00	28,25	24,25	606,30%
	Number of employees	51,00	863,48	812,48	999,90%
4	**Municipality Cestica**	**5,86**			
	Land surface (in ha)	30,42	30,42	0,00	0,00%
	Value of investment (in kn)	4.931.973,00	4.931.973,00	0,00	0,00%
	Number of active entrepreneurs	3,00	17,58	14,58	486,07%
	Number of employees	57,00	354,27	297,27	521,52%
5	**Municipality Selnica**	**4,97**			
	Land surface (in ha)	9,45	9,45	0,00	0,00%
	Value of investment (in kn)	919.605,00	919.605,00	0,00	0,00%
	Number of active entrepreneurs	1,00	4,97	3,97	397,49%
	Number of employees	32,00	159,20	127,20	397,49%

Source: Authors calculations in DEA-SOLVER-LV(V3)

In case that surpluses of input and output variables are analysed, the Municipality Gornji Kneginec is indicating the highest investment value surplus (amounting 17.351.686 kn), while the surplus in entrepreneurial zones land surface is most evident in Municipality Belica. When analysing deficit of employees in entrepreneurial zones, the worst result is obtained by Municipality Jalžabet and it is followed byMunicipality Trnovec Bartolovečki, Municipality Gornji Kneginec, Municipality Šenkovec, Town Ivanec, Municipality Sveta Marija and Municipality Martijanec.

Since DEA is enabling identification of sources and non-efficiency values, as also benchmarking, it may be extremely valuable source of data for decision makers (Bogović, 2014).Concretely, political management of non-efficient towns and municipalities is provided with information on scope and measure of necessary changes and good practice examples. Still, the model does not answer the question how to achieve this, i.e. what actions certain town or municipality need to make in order to make investment in entrepreneurial zone efficient.

5 Analysis restrictions and recommendations for further research

The restrictions of the conducted analysis are a result of restraints in input and output variables due to non-availability of empirical data. The input and output variables are

determined based on identification of basic resources and impacts made by entrepreneurial zones, taking into account the availability of data. But an all-encompassing efficiency analysis should take into account also financial indicators of companies situated in certain zones. For instance, Yilmaz and Capraz (2013) have conducted a research on investment efficiency in free zone in Turkey, where output variable is not only number of employees, but also sales income for companies located in the zone. In our research sales income has not been used as an input variable due to non-availability of the data for companies operating in certain zone at the end of year 2013. besides already mentioned, some companies are locating their sheds within certain zone, but are operating on more locations outside of the zone. Since this situation is legally treated as one business subject giving an overview of unique sales income in their financial reports, it is not possible to determine share of income achieved by operating in the zone itself.

Further on, one of the analysis restrictions is a one-time basis efficiency analysis. The analysis is conducted in one-time period not taking into account the time dynamics in efficiency of certain decision makers. In order to remove these limitations, future research should take into consideration the age of the entrepreneurial zone and window analysis, which implies efficiency analysis for several time periods (Rabar, Blažević, 2011), thus enabling the research of its dynamics.

6 Conclusion

In this paper relative efficiency analysis for local self-government units in Varaždin in Međimurje county has been conducted by using the data envelopment analysis. All active entrepreneurial zones on the area of Varaždin and Međimurje county totally or partially financed from public sources have been a subject to this analysis. Since local self-government units (towns and municipalities) are investing and managing entrepreneurial zones, these units (35) are treated as decision makers. For the analysis two input variables have been defined (the zone land surface and amount of investment in the zone) and two output variables (number of active entrepreneurs and number of employees). The used empirical data on values of input and output variables are related to the end of the year 2013. The source of data are reports byState Audit Office. Prior to conducting the analysis, statistical verification of the data has been conducted in order to provide conclusion that the DEA based on determined variables may offer reliable results.

DEA has been conducted by using the CCR and BCC models oriented on the output. Since the results based on these models have indicated significant differences in terms of relatively efficient decision makers, further analysis has been conducted only by using theBCC model. According to the results of the BCC-O model, 13 decision makers are relatively efficient. Based on the frequency analysis of efficient decision makers in referential sets, it has been determined that the Municipality Donji Vidovec represents a reference for total of eight non-efficient local self-government units and is therefore the most efficient decision-maker. On the other hand, the analysis has

indicated that worst ranked are municipalities Jalžabet, Dekanovec and Trnovec Bartolovečki.Finally, analysis of sources and amounts of non-efficiency has been conducted. Based on it, the most significant source of non-efficiency is the output variable *number of employees*.

Concretely, the conducted analysis is providing valuable results since political management of towns and municipalities that have turned out to be non-efficient decision makers, is provided the information on what and in what extent to change and which neighbour self-government units use as a good practice example.

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