ECONOMIC AND FUNCTIONAL EFFICIENCY OF TERRITORIAL ORGANIZATION OF BOSNIA AND HERZEGOVINA

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Abstract

This paper presents a comprehensive assessment of territorial organization efficiency of the Federation of Bosnia and Herzegovina. During assessment, an output-oriented Charnes, Cooper and Rhods (CCR) and Banker, Charnes and Cooper (BCC) models have been applied on data representing the financial, demographic and functional capacities.

Furthermore, this paper analyzes the efficiency of the territorial organization of the Federation of Bosnia and Herzegovina through years 1990, 2000 and 2010. Results of CCR and BCC models show that the Local Government Unit (LGU) efficiency has been significantly reduced.

Paper consists of Introduction, Efficiency of the territorial organization of the Federation of Bosnia and Herzegovina, CCR model, Inefficiency of LGU, Conclusion, References.

Keywords: Territorial organization, Bosnia and Herzegovina, the Federation of Bosnia and Herzegovina, Efficiency, Data Envelopment Analysis methodology.

Introduction

Scientific, international, and political influences in Bosnia and Herzegovina constantly point out the problem of the inefficiency of territorial organization in the Federation and the whole Bosnia and Herzegovina. Therefore, this paper establishes a model; scientific, quantitative justification for the territorial organization of the

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Federation. Quantification was performed by applying mathematical methodology of the Data Envelopment Analysis on the Local Government Units in the Federation. This work researches efficiency territorial organization in the Federation. Federation of Bosnia and Herzegovina is administratively regulated so that it includes 10 lower administrative organizational units – cantons, and 79 municipalities. The paper includes analysis of statistical data input and output variables related to years 1990, 2000 and 2010. The data were played for four inputs and three outputs in order to estimate how well Local Government Unit (LGU) in Bosnia and Herzegovina utilizes their resources. Output-oriented constant returns to scale of DEA model have been composed for each LGU. Numbers of scientific papers with DEA mathematical methodology have been written so far. It has been used as a tool for testing the efficacy of various areas of management (Emrouznejad et al. 2008). Several models that differ in the type of assumed returns to scale effects (constant or variable returns to scale) are Charnes-Cooper-Rhodes (CCR) model and Banker-Charnes-Cooper (BCC) model (variable returns to scale), focusing on input and output variables. In assessing the effectiveness of operations, the DEA methodology is used in agriculture, education, health, and other areas, which proves its importance and various applications (Coelho 2009; Herrera 2005; Herrera and Pang 2006; Karbowaniki and Kulaï 2011; Koprič 2010; Man et al. 2012; Martić and Savić 2001; Nedeljković and Drenovac 2008; Rabar 2010; Rabar and Blažević 2011; Rahmayantia and Homb 2011; Šeg 2008; Zhang and Zheng 2007). In our literature DEA were very poorly used, only in the banking sector.

Methodology

The first step in modeling the efficiency of LGU is to review the results (outputs) that reflect the desired goals, and major resources (inputs) that are used. Those among them that are the best representative of the process should be singled out. The choice of relevant inputs and outputs is one of the most important and relatively difficult steps in the analysis. Inputs are density, number of teachers, number of physicians and number of employees at LGU. Outputs are GDP per capita, number of students, secondary and primary education, and LGU revenues (Afonso et al. 2008; Arzeni et al. 2002; Benazić 2009; Chobanov and Mladenova 2009; Emrozunejad and Podinovski 2011; Koprič 2010). The choice of relevant inputs and outputs is one of the most important and also the most difficult step, which must reflect the interest of analysts and managers, and justify the implementation of objective analysis. By reviewing the standard functional capacity of the different government levels, it was found that most important inputs and outputs were following (Coelho 2009a, 2009b; Herrera 2005; Herrera and Pang 2006; Karbowaniki and Kulaï 2011; Koprič 2010; Man et al. 2012; Martić and Savić 2001; Nedeljković and Drenovac 2008; Rabar 2010; Rabar and Blažević 2011; Rahmayantia and Homb 2011; Šeg 2008; Zhang and Zheng 2007):
The set of inputs:
• X1 (density)
• X2 (number of teachers)
• X3 (number of physicians)
• X4 (number of employees at LGU)

The set of outputs:
• Y1 (GDP per capita)
• Y2 (number of students, secondary and primary education)
• Y3 (LGU revenues)

CCR model implies constant returns to scale, which means that the value of output variables increases proportionally in relation to the increase in input values.

In this model, the maximum efficiency of the production (DMU) is achieved at maximum weight than the sum of the value of output and the sum of weighted values of inputs.

\[
\max \Theta_0 = \frac{\sum_{r=1}^{s} u_r y_{r0}}{\sum_{i=1}^{m} v_i x_{i0}} \\
\sum_{r=1}^{s} u_r y_{rj} \leq 1 \quad (j = 1,2,...,n) \\
\sum_{i=1}^{m} v_i x_{ij} \\
\sum_{r=1}^{s} u_r y_{rj} \leq 1 \quad (j = 1,2,...,n) \\
u_1, u_2, ..., u_s \geq 0; v_1, v_2, ..., v_m \geq 0
\]
Results and discussion

Applying DEA ONLINE SOLVER software solutions, we obtained the results on the efficiency of local government of the Federation of BIH. Relatively efficient and inefficient units were tested on CCR model.

Table 1: Results of CCR model focused on output

<table>
<thead>
<tr>
<th>Results of CCR model focused on outputs</th>
<th>1990</th>
<th>2000</th>
<th>2010</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average relative efficiency</td>
<td>0,9135</td>
<td>0,8532</td>
<td>0,8578</td>
</tr>
<tr>
<td>Standard deviation</td>
<td>0,1109</td>
<td>0,1945</td>
<td>0,1539</td>
</tr>
<tr>
<td>Lowest value of relative efficiency</td>
<td>0,520079</td>
<td>-0,25859</td>
<td>0,22286</td>
</tr>
<tr>
<td>Number of relatively efficient JLS</td>
<td>32 (42.6%)</td>
<td>25 (31.64%)</td>
<td>25 (31.64%)</td>
</tr>
<tr>
<td>Number of relatively inefficient JLS</td>
<td>43</td>
<td>54</td>
<td>54</td>
</tr>
<tr>
<td>Number of JLS which have relative efficiency lower than average</td>
<td>30</td>
<td>30</td>
<td>38</td>
</tr>
</tbody>
</table>

Author’s calculation

Indicator obtained by CCR model assumed a much lower value, unlike the results of the two models which are not negligible even in years 1990 and 2000. So in 2000 the minimum value of relative efficiency as measured by CCR model even has a negative value. Applying CCR model in 2010, the results indicate a significantly lower value than the one in 2000 and 1990. In order to reach the limits of efficiency one should increase output variables by 14.22%, while retaining the same values to the input variables. In the same year the CCR model has detected 32 relatively efficient LGU. To obtain the functionality of independent administrative-territorial organs, it is difficult to decide whether to use constant or variable income securities, which determines whether to apply CCR or BCC model, so the analysis was performed using CCR model.

Number of efficient units measured by CCR model offered the same number of effective units in year 2000 and 2010. Mathematical DEA methodology, in addition to presenting the results for relatively efficient units offers a choice of those units among efficient ones.

In 1990, according to CCR model there were 32 units that can be considered effective and the most efficient among them can be considered Neum and Zavidovići. The reasons for these results were seeking a more detailed analysis of input and output parameters for each unit. For Zavidovići it is found that their effectiveness makes 23% of population density, then the number of teachers participated with 36.2% and the number of physicians with 40%, and the number of employees in the
administration did not take part as a variable in efficiency measurement. On the other hand, in the output side, the GDP per capita as a variable participated with 39.2%, while the number of students with 39.2%, their own incomes did not participate in the formation of the limits of efficiency. In terms of efficiency of Neum, contribution of population density was 40.9% and the number of teachers 59.1%, while in the output the GDP per capita participation was 67.5% and the number of students participated with 32.5%. A detailed overview of the matrix input and output variables indicate how important variable density is, and that in Zavidovići ratio is below average for 1990. The number of teachers is above average, while on the output side the number of students and government revenues are also significantly above average in 1990, while the amount of GDP per capita is slightly lower than the average for the same year. Furthermore, it is necessary to point out that the significance of the inclusion of population density significantly affects the formation of the efficiency level. Most of the units with lower population density are efficient. Municipalities where the population density is very high, like in some Sarajevo municipalities, namely Centre, had inefficient coefficient (0.82663), although other input and output variables were significantly above average in 1990.

Table 2: Sources of efficiency

<table>
<thead>
<tr>
<th>Variable</th>
<th>Zavidovići</th>
<th>Neum</th>
</tr>
</thead>
<tbody>
<tr>
<td>X1</td>
<td>23.6%</td>
<td>40.9%</td>
</tr>
<tr>
<td>X2</td>
<td>36.2%</td>
<td>59.1%</td>
</tr>
<tr>
<td>X3</td>
<td>40.2%</td>
<td>0.0%</td>
</tr>
<tr>
<td>X4</td>
<td>0.0%</td>
<td>0.0%</td>
</tr>
<tr>
<td>Y1</td>
<td>39.2%</td>
<td>67.5%</td>
</tr>
<tr>
<td>Y2</td>
<td>60.8%</td>
<td>32.5%</td>
</tr>
<tr>
<td>Y3</td>
<td>0.0%</td>
<td>0.0%</td>
</tr>
</tbody>
</table>

Author’s calculation

For each of the inefficient units projections have been carried out and they were compared with the empirical values. The causes of inefficiency are established as well as the percentage values for each of the variables, input and output. Larger projected values of deviations of empirical indicators are also higher because inefficiencies identified inefficient units. So for Bihać in 1990 the coefficient of inefficiency 0.765 determined that the variable Y4 (number of employees in administration) deviated by 4.5% more than their composite, or from its effective projection.
The number of students and the GDP per capita were 19\% lower than the effective projection for Bihać, while its own revenues were lower by 21\%. Efficient Frontier
Bihać had 40% efficient use of Bosanska Krupa variable, 19% of Zvornik variable, 40% of Mostar and 1% of Trebinje.

**Figure 3: Relative efficient and inefficient JLS**

![Bar chart showing relative efficient and inefficient JLS from 1990 to 2010.](image)

Note: Number of relative efficient Local Government Unit (LGU). Author’s calculation.

Analyses efficiency over three decades shows how varied the average relative efficiency were. Number of relatively efficiency units decreased from 32 to 25. Number of relatively inefficiency units increased from 43 to 54. And, number of units which had lower efficiency than the Federation average increased from 30 to 38. Given that the newly formed local governments, most of them in the two years analyzed (2000 and 2010), are ineffective, we can conclude that they are unable to effectively perform their function with existing resources.

A further analysis shows that in the period from 1990 to 2010 the greatest transformation in efficiency experienced in Canton Tuzla is in year 1990 (LGUs are fully organized by the later territorial scope of this Canton), which had five efficient units according to calculations by CCR model, and six efficient units according to BCC model. The number of units that have less than average relative efficiency also increased significantly, especially in 2000 and 2010 year, when 38 local governments had a relative efficiency of less than average (Koprić 2010).
Efficiency analysis of territorial units which form the Federation indicates that only 34% of local authorities, of the total number that covers the territory of the Federation BIH, are efficient. The analysis shows that Posavina Canton contributes most to the overall inefficiency of the Federation where all three local authorities were inefficient according to both models. Four JLS of West Herzegovina Canton contribute significantly to the overall inefficiency of the Federation, because applying CCR model for 2010 showed that four local authorities have proved to be inefficient, and the BCC model is an efficient different to LGU.

Moreover, next canton that contributes significantly to the overall inefficiency is Bosnian-Podrinje. Tuzla Canton also in its composition had all inefficient local governments according to CCR model, while the BCC model produced one efficient unit. Additionally, it is necessary to point out that in the territory that includes Tuzla Canton, four newly established JLS are ineffective on both models, CCR and BCC. Further analysis showed that the Sarajevo Canton includes 3 efficient local governments. By the number of effective units, Una-Sana Canton follows with six efficient local governments, and finally Zenica with five efficient units. Cantons with the lowest number of effective units are Tuzla Canton, which had only one efficient unit and JLS by applying BCC model, and Canton 10, which according to the results of CCR model also had 4, and according to BCC model 5 efficient units.

Conclusion

According to the CCR DEA model, the average relative efficiency was higher in 1990 than in 2000 and 2010. It can be concluded that according to CCR almost 2/3 of local government is relatively inefficient. Number of inefficient local governments
increased in 2000 and 2010, compared to 1990. Number of local governments that have smaller than average efficiency also increased in 2000 and 2010 compared to 1990. This is evident in increasing number of inefficient JLS.

References


*Comprehensive Text with Models, Applications, References, and DEA-Solver Software*, Springer Science + Bussines Media, LLC


Internet sites
http://www.fzs.ba/
http://epp.eurostat.ec.europa.eu/portal/page/portal/eurostat/home/
http://stats.oecd.org/