Regional scale efficiency evaluation by input-oriented Data Envelopment Analysis of tourism sector

[1]Elena TOMA

[1] *University of Agronomic Science and Veterinary Medicine Bucharest, Faculty of Management Economical Engineering in Agriculture and Rural Development, Romania*
[1]*E-mail:* elenatoma2001@yahoo.com

Abstract

Hotels and restaurants sector represented in 2012 almost 16% from national GDP. From over 23 thou active enterprises, 25% are represented by tourism accommodation structures from which over 70% are hotels and guesthouses (rural and agro touristic). They are distributed from a geographical point of view in all eight development regions with a major concentration in Centre Region (30%). Our purpose is to evaluate using a nonparametric method (DEA – data envelopment analysis; DEA frontier free software) the effectiveness of tourism activities at regional level. The application of this frontier method permits the calculation pf efficiency scores based on a series of inputs (employees, enterprises, investments, tourism places-days) and outputs (turnover, regional GDP, tourist numbers, foreign tourist numbers, overnights). Research finding indicate that a part of regions with a higher touristic volume don't reach technical and scale efficiency and need interventions to restructure their resources usage (labor, capital, infrastructure) or to implement real measures to increase demand and outcomes.

Key words   tourism, hotel and guesthouses, regional efficiency, nonparametric analysis

Introduction

This paper aims to analyze the efficiency of hotels and restaurants sector, hotel sector and guesthouses sector using the data envelopment analysis (DEA). The hotels and restaurants sector contributed 8817 million RON (around 1960 million euros) in gross domestic product in 2012. This sector comprises 23 thou active enterprises from which almost 25% are tourism accommodation structures. From these structures over 70% are hotels and rural/ agro touristic guesthouses. The number of tourists reached in 2012 a number of 7.6 million, 75% of them being accommodated in hotels and 13.5% in guesthouses.

From a geographical point of view these touristic accommodation structures are distributed as: 30% - Centre Region; 13% - North-West Region; 13% - North-East Region; 12% - South-East Region; 11% - West Region; 10% - South Region; 8% - South-West Region and 3% - Bucharest-Ilfov Region. The tourist's arrivals statistic shows that on the first places are Centre Region, Bucharest-Ilfov Region and South-East Region. Centre Region is preferred due to his cultural touristic objectives, Bucharest-Ilfov Region because Bucharest is the capital of the country and is an important business center and South-East Region due to his access to Black Sea. In these conditions we consider that we need to evaluate if the touristic activities from Romanian regions have a proper distribution of touristic capacity compared with expected outcomes.

We selected the input and output variables starting from the purpose of our research which wants to point out: the efficiency of labor use through analyzes of nonparametric connection with regional volume of turnover; the efficiency of labor and capital use at hotels and guesthouses level through analyze of nonparametric connection with arrivals and overnights stays. This selection of inputs and outputs took in consideration other research studies like: number of employees, investment expenditure, turnover, tourists, overnights. We want basically to respond to an important question *"Have the actual touristic inputs an adequate capa*city compared with the regional touristic outcomes?" and we consider that DEA method can offer a response.

Methodology of research

Data envelopment Analysis (DEA) is a "data-oriented approach for evaluating the performance of a set of peer entities called Decision-Making Units, which convert multiple inputs into multiple outputs". A DMU represents a "entity that is to be evaluated in terms of its abilities to convert inputs into outputs". The main idea is that "if none of inputs or outputs can be improved without worsening some of its other inputs or outputs" then a DMU is considered efficient. In other words, if a DMU fails to produce maximal outputs with minimal inputs levels will conduct to low efficiency scores. Regarding tourism activities research, DEA was used by many authors to evaluate hotel's efficiency and it's proved to be an efficient tool to compare the performance between regions.

To run the data envelopment analysis we used the software DEAFrontier[TM] Free Version, which is capable to generate CRS and VRS input-oriented analysis. We constructed our database from the data offered by National Institute of Statistic. Our study respects the DEA requirement that the number of inputs and outputs has to be smaller than the number of DMU and includes three levels: hotels and restaurants sector, hotels sector and guesthouses sector.

Table 1 shows the correlation coefficients of inputs and outputs. The relationships between the output and input indicators used in the analysis are significant at the 0.01 or 0.05 level of confidence (2-tailed). We point out that the evaluated regional efficiency scores only refer to the considered input and output variables.

Tab. no. 1 – Correlation coefficients of input and output

Hotels and restaurants sector				
		Employees	Investments	Turnover
Employees	Pearson Correlation	1	.920[**]	.959[**]
	Sig. (2-tailed)		.001	.000
Investments	Pearson Correlation	.920[**]	1	.950[**]
	Sig. (2-tailed)	.001		.000
Turnover	Pearson Correlation	.959[**]	.950[**]	1
	Sig. (2-tailed)	.000	.000	
Hotels sector				
		Places-days	Tourists	Overnights
Places-days	Pearson Correlation	1	.826[*]	.981[**]
	Sig. (2-tailed)		.011	.000
Tourists	Pearson Correlation	.826[*]	1	.744[*]
	Sig. (2-tailed)	.011		.034
Overnights	Pearson Correlation	.981[**]	.744[*]	1
	Sig. (2-tailed)	.000	.034	
Guesthouse sector				
		Places-days	Tourists	Overnights
Places-days	Pearson Correlation	1	.987[**]	.987[**]
	Sig. (2-tailed)		.000	.000
Tourists	Pearson Correlation	.987[**]	1	.998[**]
	Sig. (2-tailed)	.000		.000
Overnights	Pearson Correlation	.953[**]	.936[**]	.951[**]
Foreign tourists	Sig. (2-tailed)	.000	.001	.000

[**]. Correlation is significant at the 0.01 level (2-tailed).
[*]. Correlation is significant at the 0.05 level (2-tailed).

Results and discussions

Decision-making units (DMU), in the nonparametric analyze, are characterized by the transfer of a set of inputs into outputs through a uniform production function. In this data envelopment analysis, a region (DMU) will be considered more efficient than other regions equipped with similar or worse level of inputs if generates a higher level of outputs.

Use of labor resources efficiency in hotels and restaurants sector

He technical and scale efficiency achieved by South-East region reveals that the production frontier is reached with current human resources and we can affirm that it uses employees in a more efficient way that do other Romanian regions (Table 2).

Tab. no. 2 – DEA efficiency score – input-oriented CRS and VRS model

DMU	Input 1	Output 1	Technical efficiency			Scale efficiency
	Employees (Number)	Turnover (Million RON)	CRS Efficiency score	VRS Efficiency score	RTS*	CRS/VRS (%)
North-West	21063	1336	0.65843	0.73438	IRS	89.66
Centre	22815	1468	0.66792	0.72200	IRS	92.51
North-East	15665	977	0.64742	0.81308	IRS	79.63
South-East	19858	1913	1.00000	1.00000	CRS	100.00
South-Muntenia	13519	932	0.71564	0.91683	IRS	78.06
Bucharest-Ilfov	37349	3333	0.92635	1.00000	DRS	92.64
South-West	10485	681	0.67422	1.00000	IRS	67.42
West	14991	857	0.59343	0.78874	IRS	75.24
Mean			0.73543	0.87188		

* IRS-increasing; CRS-constant; DRS-decreasing

Under CRS assumption Bucharest-Ilfov region presents a level of technical inefficiency of 7.4% due to higher number of employees compared with outputs. Even the region is VRS efficient, the deviation from the optimal scale outline a decrease scale return (DSR) and scale inefficiency. The other five regions are inefficient, having CRS scores between 0.59-0.72 and under the mean level of DMUs, and due to the fact that the output increases more than that proportional change in inputs they have an increase return to scale. This IRS reflects the need to expand turnover scales in order to attain greater scale efficiency.

Use of capital resources efficiency in hotels and restaurants sector

Bucharest-Ilfov region reveals that the production frontier is reached with current investment expenditures and we can affirm that it uses capital factor in a more efficient way that does other Romanian regions (Table 3).

Tab. no. 3 – DEA efficiency score – input-oriented CRS and VRS model

DMU	Input 1	Output 1	Technical efficiency			Scale efficiency
	Investments (Million RON)	Turnover (Million RON)	CRS Efficiency score	VRS Efficiency score	RTS*	CRS/VRS (%)
North-West	3564	1336	0.37115	0.64724	IRS	57.34
Centre	3672	1468	0.39582	0.64608	IRS	61.26
North-East	2755	977	0.35112	0.77249	IRS	45.45
South-East	3313	1913	0.57171	0.78290	IRS	73.02
South-Muntenia	2192	932	0.42097	0.96069	IRS	43.82
Bucharest-Ilfov	3300	3333	1.00000	1.00000	CRS	100.00
South-West	1981	681	0.34036	1.00000	IRS	34.04
West	2722	857	0.31172	0.75993	IRS	41.02
Mean			0.47036	0.82117		

* IRS-increasing; CRS-constant; DRS-decreasing

South-East region is on second place with a CRS technical efficiency of 0.571 and a scale efficiency of 73.02%. The other regions have low CRS scores and an increase return to scale which demonstrate that they can improve their performance by increasing the inputs, but due to the nature of these input, the

more efficient way to reach their targets will be to augment the outputs. The scale efficiency values indicate that the majority of regions operated below optimal scale.

Touristic technical and scale efficiency - hotels

With actual touristic capacity, the most efficient regions from technical and scale point of view are Bucharest-Ilfov and South-West (Table 4). The regions Centre and South-East are closer to an efficiency frontier but they need to decrease inputs or increase outputs with 0.05% and 1.56% to improve their performance. Their scale efficiency proves that present offer is too high for the number of tourists that arrived here. North-East, South-Muntenia and West regions have CRS efficiency under mean value (technical efficiency) and they can reach an optimal scale by increasing their inputs with 3-8%.

Tab. no. 4 – DEA efficiency score – input-oriented CRS and VRS model

DMU	Input 1	Output 1	Output 2	Technical efficiency			Scale efficiency
	Places-days (Number)	Tourists (Number)	Overnights (Number)	CRS Efficiency score	VRS Efficiency score	RTS*	CRS/VRS (%)
North-West	5754475	610229	1681835	0.84796	0.84814	DRS	99.98
Centre	7592803	1070171	2511638	0.99950	1.00000	DRS	99.95
North-East	3560905	457512	1078026	0.91377	1.00000	IRS	91.38
South-East	10634569	1037293	3841997	0.98443	1.00000	DRS	98.44
South-Muntenia	4541380	467626	1296015	0.82689	0.85004	IRS	97.28
Bucharest-Ilfov	7257957	1311208	2154855	1.00000	1.00000	CRS	100.00
South-West	3363722	304161	1259464	1.00000	1.00000	CRS	100.00
West	4389265	482104	1267409	0.84740	0.88048	IRS	96.24
Mean				0.92749	0.94733		

* IRS-increasing; CRS-constant; DRS-decreasing

Touristic technical and scale efficiency - guesthouses

North-East region reach the production frontier with current offer dimension, presenting technical and scale efficiency (Table 5). Centre region has a technical inefficiency of 26% and can reach a optimal scale by decreasing inputs because their offer is not adequate to the demand. The others regions can reach an optimal scale of efficiency by increase of inputs.

Tab. no. 5 – DEA efficiency score – input-oriented CRS and VRS model

DMU	Input 1	Output 1	Output 2	Technical efficiency			Scale efficiency
	Places-days (Number)	Tourists (Number)	Overnights (Number)	CRS Efficiency score	VRS Efficiency score	RTS*	CRS/VRS (%)
North-West	2144029	130862	230169	0.71230	0.71399	IRS	99.76
Centre	5136122	347466	706073	0.83865	1.00000	DRS	83.87
North-East	2236097	191607	366542	1.00000	1.00000	CRS	100.00
South-East	594690	41762	85115	0.87314	0.88496	IRS	98.66
South-Muntenia	1395346	101104	189587	0.84560	0.84947	IRS	99.54
Bucharest-Ilfov	122750	9589	18697	0.92922	1.00000	IRS	92.92
South-West	936320	73682	139054	0.91837	0.92587	IRS	99.19
West	1643109	137160	255030	0.97418	0.97616	IRS	99.80
Mean				0.88643	0.91881		

* IRS-increasing; CRS-constant; DRS-decreasing

Overall touristic efficiency in hotels and guesthouses

The analysis of offer expressed by number of places-days and demand expressed by the number of overnight stays reveal that five regions reach technical and scale efficiency which demonstrate that the production frontier is reached with current touristic offer.

Under CRS assumption North-West region presents a level of technical inefficiency of 21.4% due to a higher number of places-days compared with outputs (Table 6). The deviation from the optimal scale outlines a decrease scale return (DSR) and a scale inefficiency. This region can reach optimal functionality with a reduction of 1.88% of inputs.

Tab. no. 6 – DEA efficiency score – input-oriented CRS and VRS model

DMU	Input 1	Input 2	Output 1	Output 2	Technical efficiency			Scale efficiency
	Hotels Places-days (Number)	Guesthouse Places-days (Number)	Hotels Overnights (Number)	Guesthouse Overnights (Number)	CRS Efficiency score	VRS Efficiency score	RTS*	CRS/VRS (%)
North-West	5754475	2144029	1681835	230169	0.79652	0.81179	DRS	98.12
Centre	7592803	5136122	2511638	706073	1.00000	1.00000	CRS	100.00
North-East	3560905	2236097	1078026	366542	1.00000	1.00000	CRS	100.00
South-East	10634569	594690	3841997	85115	1.00000	1.00000	CRS	100.00
South-Muntenia	4541380	1395346	1296015	189587	0.84406	0.86609	IRS	97.46
Bucharest-Ilfov	7257957	122750	2154855	18697	1.00000	1.00000	CRS	100.00
South-West	3363722	936320	1259464	139054	1.00000	1.00000	CRS	100.00
West	4389265	1643109	1267409	255030	0.94906	0.95887	IRS	98.98
Mean					0.94871	0.95459		

* IRS-increasing; CRS-constant; DRS-decreasing

South-Muntenia and West regions are inefficient, having CRS scores of 0.85 and 0.95 and due to the fact that the output increases more than that proportional change in inputs they have an increase return to scale. The scale efficiency of around 98% demonstrates the need of these regions to increase with 2% the offer to assure an optimal use of demand.

Conclusions

The statistic information from 2012 permitted us to observe that the touristic offer is much higher in *Centre, North-West and North-East regions* and that demand is higher in *Centre, Bucharest-Ilfov and South-East* regions. The DEA approach permitted us to conclude that:

- *South-East* was the most efficient region regarding the use of labor resources and Bucharest-Ilfov was the most efficient region regarding the use of capital resources;
- *Bucharest-Ilfov and South-West regions* were the most efficient region regarding the offer of touristic capacities compared with the level of demand **in hotels sector**;
- *North-East region* was the most efficient region regarding the offer of touristic capacities compared with the level of demand **in guesthouses sector**;
- *Bucharest-Ilfov and South-West regions* were the most efficient region regarding the offer of touristic capacities compared with the level of demand **in hotels and guesthouses sector**;
- *West region* was the most technical and scale inefficient regarding the use of labor and capital resources and regarding the hotel offer, demonstrating that the touristic resources aren't adequate with the dimension of outputs;
- *Central region* was on the last place regarding technical and scale efficiency in guesthouses sector; this aspect is important if we take in consideration that this region concentrate the higher offer and demand proportions.

In conclusion, this paper provides a viable DEA model to evaluate the efficiency of touristic sectors at regional level which can offer additional information and can indicate the necessary decisions to reach an optimal touristic market size.

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