ASSESSING THE EFFICIENCY OF THE ROMANIAN CONSTRUCTION INDUSTRY COMPANIES BASED ON DATA ENVELOPMENT ANALYSIS

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Abstract

Purpose – *The purpose of the study presented in this paper is to investigate the financial performance of the Romanian companies from construction industry using data envelopment analysis.*

Methodology/approach *- The present paper is using data obtained from companies belonging to construction industry listed on the Bucharest Stock Exchange for 2019. The input variables from data envelopment analysis model are materials, fixed assets and labor, whilst the output variable is represented by the operating revenues.*

Findings – *The results point out that among the investigated companies within the construction industry listed on the Bucharest Stock Exchange, ten are assessed as being fully efficient. The findings reveal that data envelopment analysis can be successfully employed for evaluating the efficiency of companies from construction industry.*

Research limitations/implications – *The limitation of this investigation is that it analyzes only the companies from one industrial sector, respectively in our case the ones belonging to the construction industry listed on the Romanian capital market. Notwithstanding, this paper provides useful information for decision makers from Romanian construction industry, enhancing the literature in the field.*

Practical implications – *The findings of this paper provide gainful insights concerning the development and efficiency of Romanian construction industry companies. Such findings can be useful for the managers from the companies identified as inefficient to enhance their business performance.*

Originality/value – *This paper, to the best of our knowledge, represents the first study that assesses the efficiency of the Romanian construction industry companies using data envelopment analysis.*

Key words: *data envelopment analysis, performance measurement, construction industry.*

Introduction

The construction industry represents a major pillar of economy for many countries worldwide (Yu and Yang, 2018). Construction is one of the most important industries in Romania, playing a major role in the national economy. The construction industry contributed about seven percent of the Romanian total gross added value in 2019 (National Institute of Statistics, 2020). Construction industry is one of the most significant industrial employers in Romania, providing about nine percent of the total employment in 2018 (National Institute of Statistics, 2020). Due to the economic importance of construction industry, the performance assessment of the companies that perform in this industry represents a major issue for ensuring its sustainability and the overall economy development.

Assessing the efficiency of companies from construction industry represents a major issue, being a permanent concern for investors, managers, shareholders. The efficiency assessment of companies indicates how effective their resources are used and objectives achieved (Perez-Gomez, Arbelo-Perez

and Arbelo, 2018). A company is less efficient if it uses more inputs to obtain smaller or equal amount of outputs, or if it processes less outputs by using more or equal inputs in comparison with similar firms (Yang, Shi and Yan, 2016).

One of the most suitable methods for evaluating the efficiency of a company is data envelopment analysis (DEA). Due to the fact that it can integrate multiple inputs and outputs for assessing the relative efficiency, this method has been employed in different sectors. Lin, Liu and Chu (2005) evaluated the relative efficiency of shipping firms in Taiwan based on DEA. The results indicated that less than a third were efficient, and also was determined a high level of overall efficiency in the sector. Soetanto and Fun (2014) assessed the performance of Indonesian property and real estate firms using DEA and found that only one company was technically efficient. Mantalis et al. (2016) examined the efficiency per vessel class of Greek-owned shipping firms listed on the New York stock markets based on DEA. They found that companies that operate most efficiently are those with dry bulk carriers. Haridasan and Venkatesh (2011) evaluated the effectiveness of Customer Relationship Management for a set of Indian mobile service providers using DEA. Hoe et al. (2018) studied the Malaysian construction companies' efficiency based on DEA. The results indicated that only ten percent of the listed firms were relatively efficient. Henning et al. (2013) examined the financial performance of South African agricultural producers based on a DEA model. The results revealed that DEA can be a useful tool for benchmarking the agricultural producers. In Italy, Agasisti and Dal Bianco (2006) investigated the efficiency of public universities using DEA, revealing that the most efficient are those located in the Northern part of the country.

In this paper, it was investigated the performance of companies from the construction industry listed on the Bucharest Stock Exchange for 2019 using DEA. No study, to the best of our knowledge, has evaluated the efficiency of the Romanian construction industry firms based on a DEA model.

The rest of the study is structured as follows: in the second section the methodology is presented, the results are exposed in the third section and, at the end, the conclusions are pointed out.

Methodology

The financial data used for this investigation were obtained from the financial statements and annual reports of the 36 companies operating in the construction industry listed on the Bucharest Stock Exchange.

DEA is a non-parametric linear programming technique that, based on various inputs and outputs, is used to evaluate a set of Decision-Making Unit (DMU)'s relative efficiency (Charnes, Cooper and Rhodes, 1978). In this study, the input oriented CCR (Charnes, Cooper and Rhodes) model is used. The relative efficiency of DMUs can be computed as follows (Charnes, Cooper and Rhodes, 1978):

$$\max h_k = \frac{\sum_{r=1}^{s} u_r \cdot y_{rk}}{\sum_{i=1}^{m} v_i \cdot x_{ik}} \quad (1)$$

where:

h_k – DMU_j's technical efficiency;

u_r – weights given to each output r;

v_i – weights given to each input i;

x – inputs;

y – outputs.

Subject to:

$$\sum_{r=1}^{s} u_r \cdot y_{rj} \leq \sum_{i=1}^{m} v_i \cdot x_{ij}, j = 1, \dots, n \quad (2)$$

$$u_r \geq 0, r = 1, \dots, s \quad (3)$$

$$v_i \geq 0, i = 1, \dots, m \quad (4)$$

The input variables taken into account in the data envelopment analysis model are materials, fixed assets and labor. The operating revenues represent the output variable. If the relative efficiency of DMU is equal to unity, then it is considered efficient. When the relative efficiency of DMU is less than unity, then it is determined to be inefficient.

Results

The description of the summary statistics concerning the input and output variables from this investigation are presented in Table 1. The statistical means and standard deviation are shown in the table below.

Table 1. Descriptive statistics of variables (in RON)

	Mean	Std. Deviation
Fixed assets	44855232	89831475.42
Labor	4796561	5868077.21
Materials	7462559	9852546.24
Operating revenues	30346934	51829792.05

The DEA efficiency scores for the analyzed companies operating in the construction industry listed on the Bucharest Stock Exchange are presented in Table 2.

Table 2. Efficiency scores for construction industry companies

DMU	Company name	Efficiency	Rank
CEON	Cemacon	0.859	13
CMCM	Constanța Construction-field Assembly Company	0.155	33
COMI	Condmag	1	1
ENP	Energopetrol Company	0.775	15
IMP	Impact Developer & Contractor	1	1
PREH	Prefab	0.419	29
COTR	Transilvania Construction Company	0.922	12
PREB	Prebet Aiud	0.61	24
NAPO	Napoca Construction Company	0.606	25
ELEL	Electroconstrucția Elco Suceava	0.974	11
ICSI	Icsim București	1	1
COKJ	Concivia Brăila	0.76	16
SCBC	Scut Bacău	0.467	28
ICMR	ICMRS Galați	0.721	17
ARCV	Imotrust Arad	1	1
CPLB	Buzău Complex Construction	0.669	19
MACO	Macofil Târgu Jiu	0.646	21
COBJ	Bihor Oradea Construction Company	0.856	14
CORO	Galați Railway Construction	1	1
CFED	Craiova Railway Construction	0.069	36
HEAL	Helios Astileu	0.574	27
LCSI	LCS Imobiliar Cluj-Napoca	0.612	23
SIOB	Simbeton Oradea	0.642	22
CHIA	Iași Hydro-technical Construction	0.384	30
EEAI	Elco Electro Construction Alba Iulia	0.706	18
ELJA	Electromontaj Carpați Sibiu	0.665	20
AUXI	ATM Construction Ploiești	1	1
CODG	Comtram Sibiu	1	1
DUPX	Duplex Făgăraș	0.583	26
CONJ	Crișeni Construction-field Assembly	0.089	35
ADMY	Admet Galați	0.191	32
PCTM	Prima Construct Timișoara	0.241	31
MINO	Mindo Dorohoi	1	1
SIEP	Sinter Ref Azuga	0.124	34
CONK	Concas Buzău	1	1
COLK	Conex Prahova București	1	1

The companies that obtained an efficiency score less than unitary are regarded as being inefficient. It can be noticed that a total amount of ten firms are assessed fully efficient, meaning that these companies are on the optimum production scale. The number of Romanian construction companies that registered a relative efficiency equal to unity is two half the number in comparison with the Malaysian construction companies (Hoe et al., 2018).

The average efficiency score of the construction companies listed on the Romanian equity capital market is 0.676, a value almost 63 percent better than that of the Malaysian construction firms (Hoe et al., 2018).

The efficiency scores of inefficient Romanian construction companies range between 0.069 and 0.974. Thus, the companies have to decrease the inputs consumption by up to 93.1 percent, while preserving the identical output level.

Conclusions

The efficiency assessment of companies operating in the construction industry represents a significant challenge for the industry managers. This study evaluates the efficiency of the Romanian construction companies listed on the equity capital market using DEA. The results indicate that less than one third of the investigated companies were determined to be fully efficient, highlighting the fact that there is a significant potential for efficiency enhancement in the field. The findings of this investigation provide useful information for the management of the firms, supporting them to enhance the resource efficiency, as well as for shareholders, analysts and investors.

References

Agasisti, T. and A. Dal Bianco
2006
Data envelopment analysis of the Italian University System: theoretical issues and policy implications, International Journal of Business Performance Management, 8(4): 344–367.

Charnes, A., W.W. Cooper and E. Rhodes,
1978
Measuring the Efficiency of Decision Making Units, European Journal of Operation Research, 2: 429-444.

Haridasan, V. and S. Venkatesh
2011
CRM Implementation in Indian Telecom Industry – Evaluating the Effectiveness of Mobile Service Providers Using Data Envelopment Analysis, International Journal of Business Research and Management 2(3): 110-127.

Henning, J.I.F. et al.
2013
Financial measurements to rank farms in the Northern Cape, South Africa, using data envelopment analysis, 19th International Farm Management Congress, SGGW, Warsaw, Poland.

Hoe, L.W. et al.,
2018
Evaluation on the efficiency of the construction sector companies in Malaysia with data envelopment analysis model, Journal of Physics: Conference Series 995(1), 012022

Lin, W.-C., C.-F. Liu and C.-W. Chu
2005
Performance efficiency evaluation of the Taiwan's shipping industry: an application of data envelopment analysis, Proceedings of the Eastern Asia Society for Transportation Studies, 5: 467 – 476.

Mantalis, G. et al.,
2016
Efficiency and Ship Class of Shipping Companies: The Case of Greek-owned Shipping Companies, International Journal of Supply Chain Management, 5: 78-84.

National Institute of Statistics,
www.insse.ro accessed on July 2020.

Perez-Gomez, P., M. Arbelo-Perez and A. Arbelo,
2018
Profit efficiency and its determinants in small and medium-sized enterprises in Spain, BRQ Business Research Quarterly, 21(4): 238-250.
Soetanto, T.V. and L.P. Fun,
2014
Performance evaluation of property and real estate companies listed on Indonesia Stock Exchange using data envelopment analysis, Journal Manajemen dan Kewirausahaan, 16(2): 121-129.
Yang, Z., Y. Shi and H. Yan,
2016
Scale, congestion, efficiency and effectiveness in e-commerce firms, Electronic Commerce Research and Applications, 20: 171-182.
Yu, D. and J. Yang,
2018
Knowledge Management Research in the Construction Industry: a Review, Journal of Knowledge Economy, 9: 782–803.