Available online at http://ijdea.srbiau.ac.ir

Int. J. Data Envelopment Analysis (ISSN 2345-458X)

Vol.10, No.1, Year 2022, Article ID IJDEA-00422, pages 33-46
Research Article

International Journal of Data Envelopment Analysis

Science and Research Branch (IAU)

Evaluate the efficiency of municipalities in rate of issuance demolition and renovation permits Case Study: Municipalities of Tehran City A

V. Torkian, M. Navabakhsh*

Department of Industrial Engineering, Faculty of Industrial Engineering, South Tehran Branch, Islamic Azad University, Tehran, Iran

Received 29 October 2021, Accepted 15 January 2022

Abstract

The municipality can be considered a non-governmental and non-profit organization, which is one of the duties of this organization to issuance of construction permits and it is actually a permit that the municipality gives to the owner and the owner can thereby begin construction operations. Simultaneously with the gradual growth of Iran's population and the enlargement of the city of Tehran, the needs of citizens, citizens, and the number of constructions have increased so much that the number of municipalities has increased. The municipality of Tehran city consists of 22 districts and the management of each district is the responsibility of the mayor of that district. The purpose of this paper was to evaluate the efficiency of municipalities in 22 districts of Tehran city for issuing building demolition and renovation permits using data envelopment analysis and output-oriented BCC model to evaluate relative efficiency assuming variable returns to scale and ranking of efficient units using Anderson-Peterson model is for the first six months of 1399. The research inputs include area of the area, number of residential units and the outputs include the area of the land and the number of permits issued in the municipality of each region. The analysis of the present study was performed using GAMS software.

Keywords: Municipality, building, efficiency, data envelopment analysis, Anderson-Peterson method

* Corresponding author: Email: v.torkian93@gmail.com

1. Introduction

Today, the world of science is developing rapidly, in which innovations and discoveries play a very important role and scientific studies are always based on the optimal use of resources and facilities. This has led to the optimization process in most human sciences and scientific activities.

This has led to the optimization process in most human sciences and scientific activities. Lack of space and facilities, lack of energy resources, limitations of materials and raw materials, the dominance of economics in various sciences and the nature of human evolutionism have increased the importance and allocation of a special place for optimization science in various sciences. The optimization process in any science leads to the best design for the existing constraints [1]. The municipalities play a role today as the main custodian of public services in cities. The financial needs of municipalities have increased with the expansion of urbanization worldwide and, accordingly, municipal expenditures have grown. Financial independence and competition with other local administrations is one of the requirements of good urban governance and governments have sought to reduce the concentration and efficiency of governance by giving them more financial authority. Therefore, the self-sufficiency of municipalities in various fields such as finance, will reduce their focus and increase their efficiency. Construction revenues in Iran comprise more than 70% of the total revenues of metropolitan municipalities [2]. The municipality is a public and non-governmental institution that, in return for receiving approved funds and tolls, provide the services listed in Article 55 of the Municipal Law [3]. The municipality must make optimal use of its local financial resources to cover its expenses. Building permit fees are one of these local funding sources. Since the transaction value of real estate is the basis for calculating building permit fees, the need for accurate estimation is very important [4]. Complications of renovation and urban development not for property renovations rather, it is taken from all real estate in the city to renovate and improve public affairs, in which all people are involved and benefit. These tolls typically cover a small share of less than two percent of municipal revenues, all of which is spent on city-wide development projects; Therefore, the payment of these taxes is in fact money whose feedback goes directly to the citizens themselves. Many factors play a role in determining the effects of urban renewal and development, but using the features of residential and commercial units in how to calculate these effects to make it more realistic in addition to having a positive revenue impact for the municipality, it can be effective in achieving justice and bring satisfaction to citizens [5]. According to the building regulations, obtaining a building permit from the municipality is required for a construction or renovation project in areas that have a land use plan or no land use [6]. The present study examined the efficiency of municipalities in 22 districts of Tehran in issuing building permits, demolition and renovation using data envelopment analysis (DEA) then using the Anderson and Patterson model, the efficient municipalities were ranked among all the municipalities evaluated. This research is organized in 6 sections. In addition to the introduction, the second part refers to the literature review. The third part includes theoretical foundations, description and description of performance, ranking of efficient units and data envelopment analysis. In the fourth section, the research findings and the results of the model implementation are examined in the fifth section. Finally, the sixth section summarizes and future suggestions [6].

2. Literature review

Mahmoudi and Ghasemi [7] investigated the efficiency of municipalities in Kurdistan province using the DEA method and assuming variable returns to the output-oriented scale for the period 84-87, considering the area of the urban area, the number of municipal employees and municipal revenues as inputs and urban development costs as outputs. Juan [8], in a study focusing on sustainable buildings and architecture, evaluated 254 projects in Taiwan's five major cities using a dual model based on case reasoning techniques and data envelopment analysis methods. In research done provided a decision support process to resolve conflicts and asymmetries of tenants 'and contractors' expectations during the process of sustainable renovation of buildings in which the competitiveness of contractors and the satisfaction of tenants have been considered as the main criteria for evaluating the performance of this field. Maleki and Monfared [9] identified in a study extracted appropriate components and indicators by examining the duties of the municipal institution in Iran and according to the opinions of experts. Then several experts have rated these components and references and finally these components and references have been evaluated using the TOPSIS model. Asgari and Baghdadi [10] evaluated in a study the relative efficiency of eight projects-selected cities of Mehr housing program of cities with less than 500 thousand people in Tehran province with data envelopment analysis technique and input-driven BCC provided variable scale returns. Yousefi et al. [11] identified in a study the factors affecting the delay of construction projects using a review of previous studies, project documents and expert opinions by fuzzy data envelopment analysis and factor prioritization. Mostafavi and Sadra Abarghavi [12] evaluated the performance of municipal units of twenty-two districts of Tehran using data envelopment analysis technique. In this study, it is stated that the decline in service delivery and the decline in the ranking of each of these twenty-two districts municipalities affects the entire Tehran Municipality as a result, four inputs and seven outputs are defined for each municipal unit and the efficiency of each of these units is calculated using the CCR input -oriented. Konarizadeh and Andrewage [13] examined the impact of efficiency and productivity on the performance of municipalities. Lamichane and Tamang [14] evaluated the relative efficiency of municipal public sector services, for example, municipal solid waste management in Nepal, using the non-parametric DEA data envelopment analysis method. The relative efficiency of solid waste management 34 of Nepal Municipality has been assessed using two inputs, namely MSW generation and budget spent for MSWM, and one output, estimated waste collection for the 2012 period. Population and geographical areas as contextual variables and to evaluate the relative efficiency of municipal solid waste management, an output-oriented approach has been used. Soko and Zoric [15] estimated the productivity and economy of the municipal scale in Bosnia and Herzegovina using data envelopment analysis. The results showed the low overall productivity of the municipality on an economic scale, which was achieved in a small number of municipalities, and showed that the politically motivated division of municipalities with the aim of creating peace and stability in the country was not accompanied by improved economic efficiency.

3. Theoretical foundations

3.1 Explanation and describe the performance

Efficiency is an economic concept that indicates the performance of many economic activities in the field of an enterprise, an economic sector or a national or regional economy. This economic concept has been defined and evaluated in theoretical texts separately for technical, allocative and economic efficiency [16]. There are three concepts for efficiency, two of which are technical efficiency and allocation efficiency, and the third concept used to measure industry efficiency is economic efficiency [17]. The concept of efficiency may be confused with productivity and effectiveness in fact effectiveness expresses the degree of achievement of goals and productivity is a combination of effectiveness and efficiency. Performance calculation methods can be divided into two categories: parametric and non-parametric. Data envelopment analysis method is one of the non-parametric methods that evaluates the desired units using mathematical programming techniques [18]. Farrell proposed nonparametric method with performance estimation for the first time in 1957, and suggested that it be better to compare the performance of a firm or organization with the performance of the best firms or organizations in that industry. He measured the efficiency of a system with two inputs and one output in a non-parametric way and introduced the technical and allocation efficiencies [19]. Charans et al. [20] presented the CCR model data envelopment analysis pattern to evaluate performance and calculate efficiency which had the ability to measure the performance of systems with multiple inputs and multiple outputs. The concept of scale returns was introduced in DEA models by Bunker, Charans, and Cooper introduced a new model in data envelopment analysis called the BCC model. The CCR model assumes constant scale return [21]. Charens et al. [22] proposed the additive model. That same year, they proposed a technique called "window analysis" to record performance changes over time. Skelinen [23] showed that the outcomes may not be related only to the performance scores and rankings of individual DMUs rather, they relate to the importance that variables and their logical groups also have in evaluating performance. Darvish Motavalli et al. [24] developed a linear programming model for measuring technical efficiency in dealing with units that include multiple outputs and multiple inputs based on the ideas of Charans et al. (1984).

3.2 Data Envelopment analysis

Data envelopment analysis is one of the best tools to evaluate the performance of units and measure the relative efficiency of a unit with other units that have relatively similar inputs and outputs, as well as ranking and identifying efficient and inefficient units. Data Envelopment Analysis (DEA) is a relatively new data-oriented approach to evaluating the performance of a set of similar entities called Decision-making units which converts multiple inputs to multiple outputs [25]. DEA models are generally: CCR model, BCC model and Addaitive model [18].

3.2.1 CCR model

In the CCR model, to calculate the technical efficiency used instead of the ratio of one output to one input from the ratio of the weighted total of the outputs (virtual output) to the weighted total of the inputs (virtual input) [26]. In this model, to determine the highest efficiency ratio and to involve the amount of inputs and outputs of other decision-making units in determining the optimal weights for the unit under study, the following base model was suggested:

$$Max: \frac{\sum_{r=1}^{s} u_r y_{ro}}{\sum_{i=1}^{m} v_i x_{io}} \qquad (1)$$

$$s.t.: \frac{\sum_{r=1}^{s} u_r y_{rj}}{\sum_{i=1}^{m} v_i x_{ij}} \le 1,\ j = 1,2,...,n$$

$$u_r \ge 0, v_i \ge 0$$

The above fractional programming model is known as the CCR fractional model in which: u_r the weight of the output r، v_i the weight of the input i and o the index of the decision-making unit is under consideration $\left(o \in \{1,2,...,n\}\right)$. y_{ro} values of the output r and x_{io} of the input i for the unit under consideration (unit o). Also y_{rj} and x_{ij} are the values of the output r and the input value of i is for the unit j. Is the number of outputs s; m number of inputs and n indicant the number of units.

The efficiency definition in the CCR fractional model is:"The result of dividing the weight composition of the outputs by the weight composition of the inputs". The CCR envelopment model input-oriented is as follows:

$$MinY_0 = \theta \qquad (2)$$

$$S.t: \sum_{j=1}^{n} y_{rj}\lambda_j \ge y_{r\circ} \quad r = 1,2,...,n$$

$$\sum_{j=1}^{n} x_{ij}\lambda_j \le \theta x_{i\circ} \qquad i = 1,2,...,m$$

$$\lambda_j \ge \theta \qquad j = 1,2,...,n$$

$$\theta = free in \sin g$$

The answer of the envelopment model, in the nature of input directly shows the efficiency of the unit under study. If θ obtained for a unit is equal to one this means that the unit under review or DMU is efficient and if its value is less than one, the DMU or unit under review is inefficient.

3.2.2 BCC model

Bunker et al. [21] proposed the BCC model variable return to scale. If we minimize the weighted total data of the target unit and equate the sum of its outputs to one leads to the output oriented model. The multiplier (primal) model of the output oriented BCC is as follows:

$$Min\, z_0 = \sum_{i=1}^{m} v_i x_{io} + w \qquad (3)$$

$$s.t: \quad \sum_{r=1}^{s} u_r y_{ro} = 1$$

$$\sum_{i=1}^{m} v_i x_{rj} - \sum_{r=1}^{s} u_r y_{rj} + w \le 0,\ j = 1,2,3,...,n$$

$$u_r, v_i \ge \varepsilon$$

x_{rj} is the i input for the j unit, $i = 1,...,m$, y_{rj} is the output of r for the unit j, $r = 1,...,s$, v_i weight given to input i, $j = 1,...,n$ and u_r is the weight given to the output of r [18].

3.2.3 Additive Model

The additive model considers simultaneously reducing inputs and increasing outputs and was introduced for the first time in 1985 by Charans, Cooper, Golani, Seyford, Stouts [27]. The general form of the basic problem of this linear programming model is as follows:

$$Max\, z_0 = -\sum_{r=1}^{s} s_i^{+} - \sum_{i=1}^{m} s_r^{-} \quad (4)$$

$$s.t: \quad \sum_{j=1}^{n} \lambda_j y_{ij} - s_r^{+} = y_{r0} \quad r = 1,...,\mathrm{s}$$

$$\sum_{j=1}^{n} \lambda_j x_{ij} + s_i^{-} = x_{i0} \quad i = 1,...,\mathrm{m}$$

$$\sum_{j=1}^{n} \lambda_j = 1$$

$$\lambda_j, s_i^{-}, s_r^{+} \geq 0 \quad j = 1,...,n$$

3.3 Ranking of efficient units

Basic DEA models do not allow efficient units to be compared with each other due to the lack of complete ranking between efficient units. In other words, these models divide the units under study into two groups of efficient and inefficient units. Inefficient units can be ranked by earning efficiency points but efficient units are not rank able because they have an equal efficiency score (unit efficiency). Therefore, some researchers have suggested methods for ranking these efficient units, the most famous of which are the Anderson-Peterson (AP) model, and the reciprocal efficiency method. In the Anderson-Peterson model, it is excluded from the evaluation of the constraint corresponding to the unit under study and this constraint causes one to be the maximum value of the objective function. The efficiency of the unit under study can be more than 1 by removing this limitation [28]. The Anderson-Peterson model is the primal model (multiplier) as follows:

$$MAX\ Z_K = \sum_{r=1}^{s} u_r y_{rk} \quad (5)$$

$$S.\mathrm{t}: \ \sum_{i=1}^{m} v_i x_{ik} = 1$$

$$\sum_{r=1}^{s} u_r y_{rj} - \sum_{i=1}^{m} v_i x_{ij} \leq 0 \quad (j = 1,2,...,n) \quad j \neq k$$

$$u_r, v_i \geq \varepsilon$$

Super efficiency model (Anderson-Peterson) envelopment model is as follows which is added in the BCC model constrain $\sum_{r=1}^{s} \lambda_j = 1$ to the following constraints. The difference between the AP model and the BCC model is that in the AP model the omission unit is evaluated from the set of units.

$$MAX\ Y_0 = \theta - (\sum_{r=1}^{s} \varepsilon s_r^{+} + \sum_{i=1}^{m} \varepsilon s_i^{-}) \quad (6)$$

$$S.\mathrm{t}: \quad \sum_{\substack{j=1 \\ j \neq k}}^{n} \lambda_j x_{rj} + s_i^{-} = \theta x_{ik} \quad (i = 1,2,...m)$$

$$\sum_{\substack{j=1 \\ j \neq k}}^{n} \lambda_j x_{rj} - s^{+} = y_{rk} \quad (\mathrm{r} = 1,2,...\mathrm{s})$$

$$\lambda_j, s_r^{+}, s_i^{-} \geq 0$$

4. Research findings

This research is in terms of applied and developmental purpose and in terms of analytic-descriptive method. From the BCC model of data envelopment analysis of output-oriented to evaluate the efficiency of municipalities in 22 districts of Tehran in the first half of 1399, the efficiency score of each unit is obtained. The reason the model is output-oriented is that management has better control over the outputs and tends to increase the output rather than decrease the inputs to increase efficiency. Finally, they are ranked using from the AP model (Anderson-Peterson) in data envelopment analysis, municipalities with the desired score. The data of this research is based on the information issued by the Program and Budget Organization of the Statistics Center of Iran and in using the statistical information of this publication, it is necessary to pay attention to the fact that is presented in this journal of statistics information related to the physical characteristics of buildings and the number of their residential units, in the pre-construction stage and based on the

information contained in building permits issued by municipalities (Publication of the Statistics Center of Iran, 1399). In this study, the input variables include residential unit, land area and infrastructure area, and all permits issued are output variables. The research model was coded using GAMS software.

4.1 Definitions and concepts

4.1.1 Residential unit

A residential unit is all or part of a building that includes at least one room and service (at least one toilet) is independent and has direct or indirect entrance from the public passage. Its conventional form is an apartment and non-apartment residential unit is built to house a family.

4.1.2 building permission

A building permit is a building permit issued by a municipality or other competent authority. The permit applicant section consists of 3 sections: 1. Private: The applicant for a building permit is a private person, institution or company. 2. Cooperative: A cooperative company is an applicant for a building permit and a building permit has been issued in the name of that cooperative company.3. Governmental: The applicant for a building permit a government or government-affiliated organization. For example, the institutions of the Islamic Revolution, municipalities and similar organizations are governmental.

4.1.3 Type of building permit

1. Construction of the building (demolition and renovation, building permit): It is a building permit that is issued for the purpose of building and creating a new building. 2. Increase the building (additional floor, building development): It is a building permit that is issued in order to increase the area or volume of the existing building.

4.1.4 Land Condition before the construction of the building

1. Wasteland: means land that no economic activity (for example, agriculture, etc.) takes place on it and it has no buildings or facilities. 2. Garden, croft or farm: It is land that is a garden, green space or farm and where tree planting, agriculture and the like are done. 3. Building of destruction: In cases where the licensed land is related to the building which is due to old age or other reasons to intend to destroy it and build a new building.

4.1.5 Uses of building permits

1. Residential: It is a building permit that is issued with certain conditions in a specific property for residential occupation. 2. Commercial: A building permit that is issued under certain conditions in a specific property for commercial possession. 3. Educational: It is a building permit that is issued under certain conditions in a specific property for commercial possession. 4. Health or medical: It is a building permit that is issued with certain conditions in a specific property for health care. 5. Industrial: It is a building permit that is issued with certain conditions in a specific property for industrial possession. 6. Residential and commercial (residential and workshop): If the building, in addition to residential use has one or more other applications (for example, residential and commercial or residential and educational) considered residential and commercial.

5. Case study

The input data on the performance of municipalities in the 22 districts of Tehran for the first half of 1399 in Table (1) and

the results of the output-oriented BCC model are presented in Table (2).
Finally, the ranking of the mentioned units that have good performance by Anderson and Peterson m ethod using GAMS software are presented in Table (3).

Table 1 Data inputs and outputs for municipalities

	inputs		Outputs	
DMU	Area of the area	Number of residential units	Land area	Number of permits issued
1	46610926	1219	63026	127
2	47005552	1670	74609	213
3	29217372	859	48893	105
4	61554531	2631	99517	289
5	53161730	2719	101614	173
6	21367449	623	30088	84
7	15335057	1187	39632	171
8	13156442	1169	41188	165
9	19746502	349	10950	56
10	8185487	411	23446	96
11	12031225	946	34239	148
12	16007301	558	33776	107
13	12862735	851	31293	126
14	14552731	1520	51934	273
15	27739822	2662	96757	455
16	16512496	956	32267	149
17	8251825	893	28869	124
18	37869105	837	196984	116
19	20341440	670	22513	103
20	23583689	1111	40044	135
21	51525286	1082	80209	138
22	59002854	1109	70657	146

Table 2 efficiencies measured from the output-oriented model

DMU	DMU01	DMU02	DMU03	DMU04	DMU05	DMU06	DMU07	DMU08	DMU09	DMU10	DMU11
Efficiency	1.42	1.34	1.36	1.00	1.32	1.36	1.28	1.20	1.00	1.00	1.22
DMU	DMU12	DMU13	DMU14	DMU15	DMU16	DMU17	DMU18	DMU19	DMU20	DMU21	DMU22
Efficiency	1.03	1.31	1.00	1.00	1.23	1.00	1.00	1.33	1.44	1.09	1.32

Table 3 Efficiency of decision-making units by Anderson-Peterson output-oriented method

DMU	DMU01	DMU02	DMU03	DMU04	DMU05	DMU06	DMU07	DMU08	DMU09	DMU10	DMU11
Efficiency	0.61	0.74	0.67	0.80	0.66	0.67	0.78	0.83	1.01	1.02	0.82
DMU	DMU12	DMU13	DMU14	DMU15	DMU16	DMU17	DMU18	DMU19	DMU20	DMU21	DMU22
Efficiency	0.92	0.76	1.18	1.64	0.81	1.27	3.31	0.75	0.66	0.75	0.76

According to the data obtained from GAMS software, which is stated in Table (2), among the 22 units evaluated, 7 units are efficient and the rest of the units are inefficient. Table (3) shows the results of the Anderson-Peterson ranking method.

5. Conclusion and future research directions

Municipalities gained financial independence since the seventies and from this date on, the government cut off its financial support to municipalities in the form of budgets in the meantime, one of the most important sources of income for municipalities has been the issuance of building permits. This type of income is considered as unstable income of municipalities because it depends on the housing situation and economic conditions of the country and the municipality cannot predict a fixed budget based on them. It was illegal to carry out any construction operation without a building permit and will be stopped by the building supervision authorities. The main purpose of obtaining a construction permit is to ensure legal construction in accordance with technical specifications and to observe the principles of urban planning in accordance with the regulations and rules of the comprehensive urban plan. Other reasons for obtaining a building permit are benefiting from banking facilities, building insurance and people working in the building, preventing construction accidents and using technical and engineering experiences in building construction. This paper examines the efficiency of municipalities in 22 districts of Tehran city in issuing demolition and renovation licenses using data envelopment analysis technique for a period of 6 months. The criteria are divided into two general categories of input and output to evaluate the efficiency of municipalities in issuing permit. The model inputs include area of the area, number of residential units and outputs include the area of land built and building permits issued. Since the input indicators are not in control of the units and municipalities seek to obtain maximum licensing using inputs, therefore, therefore, the return model to the BCC variable scale with the nature of output has been selected as the appropriate model. The model presented in this study was solved by GAMS software version 25.02 and after running the model in the software, it was determined that among the twenty-two

regions, seven units have an efficiency number one. The data are then ranked according to the AP (Anderson-Peterson) model. Finally, it was found that DMU No. 4 has the highest efficiency among efficient units in issuing of building permit for the first six months of 1399. According to the results of this study, it is suggested to examine other performance ranking models of units in the future as well as the correlation test between performance scores.

References

[1] Kalat Jari, V., Talebpour, M. H., Hybrid meta-heuristic algorithm for optimal design of steel frame structures, Civil Engineering. 2018; No. 2/2, 45-57. [In Persian]

[2] Mahmoudi, M., Zomordian, G.r., Aghaei, M., Investigating the factors related to sustainable revenues of Tehran Municipality and their prioritization, Mashhad Economic Conference. 2011. [In Persian]

[3] Manafzadeh, H., Toofan, S., Investigation of the causes of citizens' dissatisfaction with the municipalities studied by Osko Municipality. 2021; No. 5, 119-126. [In Persian]

[4] Nemati, M., Roustaei, Sh., Teymouri, I., Comparative study of estimating the daily value of residential and residential real estate using artificial neural network. Case study: District 2 of Tabriz Municipality, Golestan University Quarterly. 2021; No. 37, 19-212. [In Persian]

[5] Hashemi, S. S., Zarei, M., Fazeli, A., Investigation of the effect of number and height of steel frame floors with flexural frame system on the weight of the structure by artificial neural network method, Civil Engineering Sharif. 2020; No. 1/1, pp. 81-89. [In Persian]

[6] Hashemi Feyzabadi, S. M., The nature of the effects of renovation in the municipal system, Quarterly Journal of New Research Approaches in Management and Accounting. 2019; No. 52, 91-99. [In Persian]

[7] Mahmoudi Khoshrou, O., Ghasemi, A., Evaluation of efficiency municipalities in Kurdistan province using data envelopment analysis (DEA), Quarterly Journal of Industrial Management, Faculty of Humanities, Islamic Azad University, Sanandaj Branch. 2010; No. 13. [In Persian]

[8] Juan, Y. K., "A hybrid approach using data envelopment analysis and case-based reasoning for housing refurbishment contractor's selection and performance improvement". Expert Systems with Applications. 2009; 36 (3). pp. 5702-5710.

[9] Maleki, S., Monfared, S., Analysis and ranking of the importance of municipal duties in Iran using TOPSIS model, Urban Management Studies. 2015; No. 21, 93-106. [In Persian]

[10] Asgari, M., Baghdadi, A., Evaluation of the relative efficiency of Mehr housing program (selected cities of Tehran), Quarterly Journal of Economic Research and Policy, 2016; No. 80, 142-119. [In Persian]

[11] Yousefi, S., Kakaei, S., Jahangshahi Rezaei, M., Presenting a combined method of cognitive mapping and fuzzy data envelopment analysis to investigate construction project delays, Journal of Industrial Management Studies. 2017; No. 45, 177-207. [In Persian]

[12] Mustafavi, F., Sadra Abarghavi, N., Evaluation of the performance of the seven districts of Greater Tehran Municipality with a data envelopment analysis approach, New Research in Geographical Sciences, Architecture and Urban Planning. 2018; No. 16, 191–210. [In Persian]

[13] Konarizadeh, I., Andrewage, L., The impact of efficiency and productivity on the performance of municipalities, Quarterly Journal of Accounting and Management Vision Volume 2; 2019, Number 20, Volume 5. [In Persian]

[14] Lamichhane, H. Tamang, T., Efficiency Assessment of Municipal Solid Waste Management in Nepal, International Journal of Progressive Sciences and Technologies. 2019; vol 14, No 2, 2509-0119.

[15] Soko, A. Zoric, J., Municipal Efficiency and Economies of Scale in Bosnia and Herzegovina, Exlocalis Journal of Local Self Government. 2018; vol. 16, No. 4, pp. 715-734.

[16] Chavoshi, F., Mahmoudzad, M., Gholam Abri, A., Evaluating the Efficiency of E Commerce in Iran's Provinces with a Coverage of Data Approach. Quarterly Journal of Economic Research and Policy. 2019; 27(89), 233-286.

[17] Akbari, N., Application of ranking methods and multi-criteria decision-making, Tehran, the Organization of Municipalities and Rural Affairs. 2008. [In Persian]

[18] Mehregan, M., Quantitative Models in Evaluating the Performance of Organizations (Data Envelopment Analysis) University Book Publishing. 2012. [In Persian]

[19] Farrell M. J., The Measurement of Productive Efficiency, Journal of the Royal Statistical Society: Series A (General). 1957.

[20] Charnes A., Cooper, W and Rhodes, E., Measuring the Efficiency of Decision Making Units", European Journal of Operational Research. 1978; (2), 429-444.

[21] Banker, RD., Charnes, A and Cooper, W.W., Some Models for Estimating Technical and Scale Inefficiencies in Data Envelopment Analysis. 1984; 1078-1092.

[22] Charnes, A., Cooper, W.W., Golany, B., LSeifordJStutz., B., Foundations of data envelopment analysis for Pareto-Koopmans efficient empirical production functions. 1985; Volume 30, Issues 1–2, Pages 91-107.

[23] Eskelinen, J., Comparison of variable selection techniques for data envelopment analysis in a retail bank. European Journal of Operational Research. 2017; 259(2), pp.778-788.

[24] Darvish Motevalli, M., Hosseinzadeh Lotfi, F., Shoja, N., Gholamabri, A., A new model for calculating the efficiency of existing cement companies with a network structure (an application of data envelopment analysis). Financial engineering and portfolio management. 2019; 10(38), 65-93.

[25] Cooper, W., & Seiford, L., &Tone, K., Data envelopment analysis a comprehensive text with models applications references, DEA solved software. Third Printing by Kluwer academic publishers. 2000.

[26] Martin D.H., G.Kocher and M., Sutter. Measuring Efficeincy of German Football Teams by DEA. University of Innsbruck, Australia. 2000; 4-5.

[27] Charnes A., Cooper,W., Lewin, A. Seiford, L.M., Data Envelopement Analysis: Theory, Methodology, and Application, Kluwer Academic Publisher. 1995.

[28] Per Andersen, N., Peterson. C., A Procedure for Ranking Efficient Unit inDEA, Management Scince. 1993; Vol.39, (10),1261-1294.