The Evaluation of Performance of the Industrial Cities Using Data Envelopment Analysis Model (DEA)

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Abstract

Organizational performance has a significant impact on the organization's activities and methods and tools to evaluate the performance is one of important issues in institutional and academic research .Furthermore, DEA models power to meet application requirements has led to doing extensive research in various scientific fields. Several studies have been performed using this technique shows considerable potential of this methodology in evaluating performance and productivity measurement. Given the high importance of municipalities in the growth and development of countries, it is very important to evaluate the performance of municipalities. Evaluation the municipalities of province by studying the quality, performance and comparing them is a step towards continuous improvement of performance of these municipalities. In this regard,this paper has described a model to evaluate the performance of municipalities using DEA .The current research is considered of Applied Research in terms of the aim. Also in terms of data collection, this research is descriptive and causal – comparative. Inputs and outputs selected in this study due to similar studies, interviews and surveys were conducted by experts. Criteria are selected as inputs include total land area (meters) from the beginning of the whole cost of construction (RLS) and the output consists of transferable meter (m) to get the whole before beginning construction (RLS). Finally, it is selected among the various models of DEA, the input-oriented CCR modelto evaluate the performance according to the analysis performed. Efficient and inefficient units were identified that their first performance was an efficiency unit again using the model of Anderson - Patterson were rated which finally Parand Industrial town was

(DEA) is designed and compared their performance with each other .

identified as the most efficient and Charmshahr industrial town as the most inefficient .

Explaining the Problem

One of the major issues today has been considered in the economics literature dramatically is performance measurement units, institutions and various organizations. Indeed, since the performance measure is necessary which we are facing a shortage of facilities in the current situation and this resource should be allocated in such a way that the organization or institution in order to maximize the production of goods or services supplied through them .Industrial towns as engine of economic and urban development has been regarded by national and regional planners in Iran for long times. The first designs of industrial areas was conducted half a century ago. But the huge expansion of settlements raised in recent years. Small and medium industries can accumulate in various forms from simple coexistence in an industrial zone to a more developed form in the organized gatherings such as science parks or industrial clusters. Accumulation in all different forms adds small and medium businesses to the important aspects of the business environment. The simplest and most static buildup is found in the industrial cities, can share in the cost of

Introduction

The highly valued industry of every state is crystalized in industrial statesthat results in the development of the community. Evaluating the performance of industrial towns and measuring their efficiency is very important. Assessment of Industrial Estates purpose is to become aware of the quality and performance of them and can compare them and this process could take a step towards the continuous improvement of the town. Using basic and advanced techniques in order to achieve better performance can be one of the main goals of any organization that can more exploit the situation. The organization will be able to step to improve the weakness points using these basic techniques and bring the ship of goals in the raging sea of changes to the best possible beach by the most use of the capabilities and strengths. (Ghafourian, 1383). There is an attempt in the present study that also to identifying and analyzing measures of performance) efficacy (an industrial suburb of Tehran ,appropriate model for evaluating the performance of these towns using one of the techniques of operations research

raised questions about why Firoozkooh Industrial town by having 203 acres of land includes 120 contracts but Shams Abad Industrial by approximately 2,000 hectares is including about 1,600 industrial units , so this feeling of emptiness was to identify useful factors . In fact, the findings of the study and evaluating the performance of our industrial towns will help us in different parts of optimal investment in Tehran. In this research we want to measure industrial town of Tehran province the help of DEA. The Indicators include : Inputs such as land required in trying to build settlements, land cost and the cost of wages and outputs and income from the sale of industrial land and the employment rate and afterdetermining the efficiency DEA model , we will grade the functional units using the model of Anderson – Patterson .

The background of Research

The study of Parks: The method is designed to assess a bank's 35 branches in Calgary, Canada from other studies in this field. 13 inputs and 18 outputs of the system are chosen as the evaluation,however, so that not to be skewed in determining the efficiency of branches using data envelopment analysis methodology (When results are attributable to the number of units of the procurement of infrastructure to increase operational efficiency. Further. Accumulation could be a catalyst for innovation and efficiency through the promotion of social learning. The establishment of industrial cities in Iran has not been following the purpose or single subjectivism. In the case of large towns,the environment and shortage of land around the urban centers was the first concern. Industrial towns that are located near the small towns or rural areas with the goal of equal distribution of resources for local development and not with the aim of addressing the shortage of land or environmental targets established unpublished statistics which show from the companies that 90% of units located or in towns or small firms are fewer than 50 workers. Existing industrial towns are generally of a combination kind and have embedded very diverse and unrelated industries and there are only a few specialized towns that have been assigned to a particular industry or related industries. Charmshahr a good example of specialized industrial towns, especially why the industry has been built near Tehran. In the scope of this research is the industrial cities of Tehran, Tehran Province town industrial town comprises 12 active towns and 5 towns under construction. For example, this study has

a gathering of some inputs and outputs, inputs and outputs of each to the 6 cases. (Table 2-2).

Table 2.2 - Inputs and outputs in Park's study (1987)

Outputs	Inputs
1 - Number of Operations	1 - The total number of full-time equivalent staff
2 - The amount of opened trade accounts	2 - Annual rent
3 – The amount of opened micro – accounts	3 – The space of Branch
4 - The estimated rate customer service	4 - Telephone costs and fixed costs
5 - The number of loan applications	5 – The amounts of Terminals
6 - Number of amendments	6 - Marketing activity

Performance measurement using Data Envelopment Analysis

This method is known primarily as a method of measuring the efficiency , during the measurement of returns to scale production function also provides a breakdown for firms with the progress and development of the above methods, the DEA is currently one of the active areas of research in the measurement of performance has been greatly welcomed by the researchers . In this way, rather than to universalize general term to produce a single decision maker (DMU) is used. Including methods of nonparametric function estimation value is generated (Imam MEYBODI, 1379).

total number of units of the total number of inputs and outputs significantly larger) are reducedby using a rhythmic pattern for

The annual rent which underpins the function of two factors of local position and infrastructure Branch is used. The area of the building where the branch is customer service is classified among numbers of 7 to 35. The amount of branch chief's activity in marketing and attracting the customer as a factor in the performance of an index to measure branch is ranked among the numbers 0 to 50. In this pattern, each branch, the separation efficiency of inputs and the pattern of improving inefficient branch are identified. Yaaghoubi and Amiri have investigated in a research titled“Performance Based on data envelopment analysis model to estimate the weights of fuzzy random" data envelopment analysis with fuzzy data.

Therefore, the coefficients found in applying theories and thus, the calculation of total factor productivity will be limited.

CCR model in 1978 because it was known that the problem will resolve coefficients, interestingly, the coefficients obtained in this way represents the shadow price is 1. CCR model after determining the efficient frontier curve specifies that decision – making units are located in where the boundaries are and to achieve the efficient frontier, what combination of inputs and outputs must be able to choose which this not possible except by specific institutions and input-output coefficients for each unit .

It is indeed a masterpiece and a milestone was the model using linear programming to calculate the coefficients listed. Charnz, Cooper and Rhodes (CCR) in 1987 offered their model based on minimization of production factors and assuming constant returns to scale. In 1984, considering the variable returns to scale assumption by Bunker, Charnz and Cooper 2 (BCC) was developed to measure the performance of DEA. This field is required before presenting the theoretical explanations about the DEA, be details about the model input shaft (input orientation) of the output shaft (output orientation), and returns to scale. DEA models are generally divided

In general, estimation the functions of same production or estimation the frontier production function is as a standard of comparison, both methods are needed to measure performance (SFA, DEA).

DEA commonly is defined as the ratio. Innovators of this method generalized the definition of Performance Engineering to multi-factor and multi-product production which was produced as a product of factors (it is needed without predetermined weights). (Emami MEYBODI 1379).

As previously mentioned, productivity Index in the case of units which conclude one input (X) and one output (Y) contains the ratio of output to input (Y/X), if there is the multi-input and multi-output unit or organization, it shall recognize coefficients for input and output. But there was a problem that had previously seemed unsolvable was how to consider the coefficients for the inputs and outputs.For example, if all factors are equally involved in creating output and is their coefficients the same? Certainly the inputs' role is different in creating the outputs. It should be selected proportional weights to them. Some researchers took advantage prices, costs, or ... as coefficients, and U and V, that is:

$$\text{Overall productivity} = \frac{U_1Y_1+Y_2U_2+\cdots}{V_1X_1+V_2X_2+\cdots}$$

coordinates and in addition to the above definition requires that there are no fixed costs in the production . That is, it produces zero output with zero input (Jahan – Shahloo ,HosseinZadehLotfi , 1389) .

Returns to scale upward,Returns to scale Descending, Constant returns to scale

Figure (2-1) Types of returns to scale

CCR Model

CCR model is the nature of the input is known as CCR cover as follows:

$$Min\theta$$

$$s.t.\sum_{j=1}^{n}\lambda_j x_{ij} \leq \theta x_{io} \quad i=1,...,m$$

$$\sum_{j=1}^{n}\lambda_j y_{rj} \geq y_{ro} \quad r=1,...,s$$

$$\lambda_j \geq 0,\ j=1,....,n$$

If the optimal solution θ ^ * = 1, then the model is efficient DMUo. The above model is always possible because θ^ =1 and λ_o=1 and λ_j=1 is a possible answer. In addition, it is concluded of this possible answer that the optimum amount of θ does not exceed 1.

CCR model of multiple

$$Max\sum_{r=1}^{s}u_r y_{r\circ}$$

into "input-driven" and "output-oriented "that more we are familiar with the concept. Input models are models which reduces inputs with constant outputs and the output of the models that are driven model that increases outputs with constant inputs. (Mehrgan, 1383)

Scale efficiency denotes the relationship between input changes and outputs of a production system, service or an enterprise. Returns answer to this question that if "the amount of resources and raw materials to a factory be twice, will Production or output multiplier change it?" Three modes that may occur:

A:Doubling the amount of output also doubles the amount of resources

B: The amount of output be twice less than doubling the amount of resources.

C: Doubling the amount of output more than double the amount of resources.

The first state is called "Constant returns to scale", the second one is called "Returns to scale downward" and the third one is called "Returns to scale upward". Any changes in the constant returns to scale inputs causes the same ratio of change in output. In other words, the increase in inputs will cause nor saving and nor the rise in input costs and a function of output is half of the line from the origin of

Presenting inputs and outputs

In this section, the inputs and outputs have used to implement DEA techniques and also how calculating them is presented to enter the model.

1 – Ground: This index with total land area (m) is considered the construction of industrial towns.

2 – Costs: This index includes:all costs for construction of infrastructure facilities in industrial estates including the cost of constructing the irrigation system, Power grid, lighting, gas networks, telecommunications, construction of access roads, construction of clinics, fire station and generally construction of all infrastructure required for industrial production.

$$s.t.\sum_{i=1}^{m} V_i x_{i_\circ} = 1$$

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

$$u_r \ge 0 \quad , \quad v_i \ge 0, r = 1,..., s, i = 1,..., m$$

UR and VI dual variables corresponding to the constraints r TH output and ITH is the input in CCR cover. Namely UR and VI are RTH weight output and ITH weight input for unit under study (0 unit) respectively. YRJ and XIJ also denote the amount of RTH output and the amount of ITH input for JTHunit. S is the number of outputs, m the number of inputs and n the number of units too.

Table entries

output	Input		The name of industrial town / Index	Row
Income	Cost (Rial)	Value of land		
29,605,463,517	185,783,482,977	2,000,000,000	Charmshahr	1
112,065,400,667	102,409,354,896	5,040,000,000	Salarieh	2
144,486,397,251	168,565,0670,832	6,690,000,000	Capital (Ali Ababd)	3

879,576,799,348	879,576,799,348	8,910,000,000	Shams Abad	4
922,565,202,286	309,693,800,978	0,290,000,000	Abbas Abad	5
219,362,075,611	138,259,546,663	3,240,000,000	Kharazmi	6
390,405,183,192	255,417,355,345	2,600,000,000	Nasir Abad	7
81,325,816,191	125,723,844,851	2,030,000,000	FiroozKooh	8
111,504,335,170	291,016,693,977	3,520,000,000	Parand	9

Input-oriented and output-oriented CCR model trend results 4-4-

equivalent to 11% of the first settlements are settlements have (one) efficiency and in other words, things are CCR. The town has the lowest efficiency of inefficient industrial town Charmshahr.

Table 5 – 4 denotes the performance of industrial towns in Tehran. The performance of the model using input-oriented CCR trends were obtained. In the model with constant returns to scale,

Table 4 – 4 Efficiency of Industrial towns in CCR input oriented and output-oriented model

CCR output-oriented efficiency model	**Efficiency input-oriented CCR model**	**Name of the Municipality**	**Row**
1	**1**	**Parand**	**1**
1,294167	**0,772698**	**Abbas Abad**	**2**
1,600746	**0,595333**	**Shams Abad**	**3**
2,234467	**0,447534**	**Kharazmi**	**4**
4,287313	**0,321845**	**Nasir Abad**	**5**
4,852146	**0,206094**	**Salarieh**	**6**
4,8744408	**0,205153**	**FiroozKooh**	**7**
4,941365	**0,202373**	**Ali Abad**	**8**
5,33333	**0,053569**	**Charmshahr**	**9**

Industrial town of Parand with an area of 350 hectares, is located 45 km south of Tehran Province. In this town, metal industries in the areas of chemical, non-metallic mineral and is operating with making jobs for about 2000 people. It can be the benefits of town like nearness to good accessing the roads, railing and aerial. Flat land rests , reduce costs in the areas of road construction have been of industrial units .In this town , the settlement of mother manufacturing units in different areas of the garden have been welcomed a lot by artisans . Charmshahr industrial town as inefficient industrial town 85 kilometers southeast of Tehran is one of the oldest and most specialized industrial zones in Tehran on leather areas with making jobs for about 2000 people. The reason being inefficient industrial zone infrastructure costs required to generate and despite welcoming the industry of the town is not dissatisfying because fracture belief of leather industry in the country has stagnated the most units of town.

Sources:

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Conclusions : In this study we have examined the efficiency of the industrial towns of Tehran , the industrial towns include 9 industrial towns which contain : industrial towns of Parand , Shams Abad , The Capital , FiroozKooh , Kharazmi , Charmshahr , Salarieh , Nasir Abad . Data used in the industrial cities of Tehran is about 91s year. The input consists of the total land area (meters) from the beginning of the whole cost of construction (RLS) and outputs include transferable meter (m) to get the whole before beginning construction (RLS). Techniques used to calculate the efficiency of this industrial town is data envelopment analysis which done using model-driven input and output and then the efficient and inefficient units was determined and ranked using Peterson Anderson ranking efficient units.Proposals to increase the efficiency of inefficient industrial town will be provided until the functional units are able to model the appropriate use of available resources and to increase their efficiency.In this chapter, we have evaluated the results, the efficiency of the industrial towns in Tehran discussed the proposals will be presented to the industrial town inefficient and finally suggestions will be presented in the research and study limitations.

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