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Research Article

STUDYING EFFICIENCY AND RANKING OF MEHR EQTESAD BANK BRANCHES THROUGHOUT SHIRAZ CITY, USING DATA ENVELOPMENT ANALYSIS

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ABSTRACT

Data envelopment analysis is a linear programming method that is used for relative performance evaluation of homogeneous groups from decision making units. Standard DEA models calculate separately the maximum relative efficiency for each DMU. DMUs are divided into efficient and inefficient units. Efficiency scale is one and less than one for efficient and inefficient DMUs. Various methods of ranking have been introduced in DEA in order to evaluate performance of units. One such method is Common Set of Weights (CSW). In this study, the performance and ranking of Mehr Eqtesad bank branches throughout Shiraz city have been studied until 2013, using BCC and Common Set of Weights (CSW).

***Keywords**: Data Envelopment Analysis, Efficiency and Ranking*

INTRODUCTION

Data envelopment analysis is a linear programming method that is used for relative performance evaluation of homogeneous groups from decision making units (Charnes *et al.,* 1978). Standard DEA models calculate separately the maximum relative efficiency for each DMU. DMUs are divided into efficient and inefficient units (Ramazani *et al.,* 2013). Efficiency scale is one and less than one for efficient and inefficient DMUs. Various methods of ranking have been introduced in DEA in order to evaluate performance of units. Some of these methods have been used for ranking efficient and strongly efficient DMUs. For example, Cook *et al.,* tried to select one dominant DMU among efficient DMUs through testing a variety of situations on multiples and offer a view to distinguish relations on frontiers (Cook *et al.,* 1990).

Common Weights Ranking is a method for evaluation of decision making units on this basis. Common Set of Weights method (CSW) is used for ranking because it can rank all units including efficient and inefficient DMUs. In these methods, an inefficient DMU may have high rank compared to efficient DMU because in some cases an inefficient DMU may be dominant on efficient DMU but not in all cases, thus an inefficient DMU may have higher, lower or equal efficiency compared to an efficient DMU that is not dominant on inefficient DMU (Ramazani *et al.,* 2013).

Targersen *et al.,* proposed a method for ranking efficient DMUs. They measure importance of each efficient DMU as a basis for inefficient DMUs and rank them accordingly (Torgersen *et al.,* 1996). Mehrabian *et al.,* presented a method for ranking strongly efficient DMUs. They removed DMUs under evaluation from Production Possibility Set and then added all input elements by the same process to new Production Possibility Set (Mehrabian *et al.,* 1994).

For the first time, Cook and Roll used common weights method in order to measure the relative efficiency of highway patrol and maintenance unit (Cook *et al.,* 1990). Sinayi *et al.,* developed a new analytical method for (DR / DEA) ratio that produced common weights for all DMUs based on the best resolution compared to efficient and inefficient DMUs. They used common weights for ranking DMUs on a continuous scale (Sinuany-Stern and Friedman, 1998). Jahanshahlu *et al.,* introduced another ranking method using Common Set of Weights (CSW). They introduced multi-objective programming in order to find CSW and increase the group efficiency of DMUs. The multi-objective programming like previous model is under variable returns to scale and uses the worst possible way in order to solve the problem. In this way, two models are solved for ranking all DMUs (Jahanshahloo *et al.,* 2005).

According to the important role of banks in economy of today world as well as the close relationship and interaction between these institutions and other economy and service sectors in a wide range of individuals and society, measuring and comparing efficiency of banking activities becomes necessary. Measuring and comparing the efficiency of banks, efficient banks can be used as a model for other banks so that they can move toward optimal performance through proper planning.

Today, financial institutions, especially banks are most important economic institutions and fundamentals of any country that growth and development of country economy depend on them. Banks as the main components of financial institutions have important tasks, such as, mobilizing savings, intermediation, facilitating payment, allocating credit and maintaining financial discipline in economy.

In fact, banks have key tasks in medium and long-term economic programs of society due to its intermediary role in money market and no adequate development of capital markets.

On the other hand, according to the process of market liberalization and links with international markets and also because of need to improve financial standards in these communities, the need for use precise criteria for performance evaluation of banks becomes more explicit. In this study, evaluating the efficiency of Mehr Eqtesad bank branches throughout Shiraz city has been considered (Abrishami *et al.*, 2005).

Research Question

1. What percentage of Mehr Eqresad bank branches is efficient in Siraz city?
2. Mean efficiency of which modes is more in input oriented and input oriented?

Literature

Data Envelopment Analysis

Data envelopment analysis (DEA) is a quantitative, standard and widely used tool in studies of efficiency measurement. DEA measures relative efficiency of units that have similar inputs and outputs. We call these units decision maker units (DMU). DEA evaluates efficiency of a DMU compared to other DMUs; therefore efficiency scale of DMU will be a relative scale. Evaluating the efficiency of similar units is an important part of managing a complex organization. DEA offers strategies to better management of resources in order to achieve expected output. Efficiency or inefficiency of DMU depends on the unit's performance in transfer of inputs and outputs compared to other DMUs (Mehrgan, 2014).

CCR Model

In 1957, Farrell measured the efficiency of manufacturing unit using a method such as measuring efficiency in the field of engineering. A case that Farrell considered to measure efficiency included an input and an output. Farrell used his model in order to estimate the efficiency of America agricultural sector compared to other countries. However, his method was not successful in presenting a method that includes multiple inputs and outputs.

Charnz, Cooper and Rhodes developed Farrell view and offered a model that had ability to measure efficiency with multiple inputs and outputs. The first data envelopment analysis model was called CCR based on initials of approvers.

In this model, the objective of measuring and comparing relative efficiency of organizational units is similar such as schools, hospitals, bank branches and municipalities with multiple inputs and outputs (Mehrgan, 2014).

Production Possibility Set of T that applies five principles of DEA is shown with T_c and T_{CCR}.

$$T_c = \left\{ \begin{pmatrix} x \\ y \end{pmatrix} \middle| x \geq \sum_{j=1}^{n} \lambda_j x_j \;\&\; y \leq \sum_{j=1}^{n} \lambda_j y_j \;\&\; \lambda_j \geq 0,\; j = 1, \ldots, n \right\} \tag{1}$$

Suppose that DMU_j and $(j=1,...,n)$ are n homogeneous decision-making units that produce output vector of y_j and $(j=1,...,n)$ using input vectors of x_j and $(j=1,...,n)$, therefore $x_j \in R^{m\geq 0}$ and $y_j \in R^{s\geq 0}$ therefore x_j vector has m components and y_j vector has S components.

Assume that the objective of performance evaluation is DMU_o where $o \in \{1,2,...,n\}$. To say, if there is no production possibility in T_c like (x,y) which is dominant on (x_o, y_o), therefore DMU_o has relative efficiency. Otherwise is inefficient. How we can say that there is no production possibility in T_c that is dominant on DMU_o? This can be done through three ways.

1. If we can find a production possibility in T_c which has greater than or equal to y_o output with input less than x_o.

2. If we can find a production possibility in T_c which has greater than y_o output with input less than or equal to x_o.

3. If we can find a production possibility in T_c which has greater than y_o output with input less than x_o (Shayeste, 2011).

Below, we introduce CCR models.

Input Oriented CCR Model

Consider the production possibility set of $(\theta x_o, y_o)$ where $0 \leq \theta x_o \leq x_o, y \geq y_o$ (D 2)

$$\theta \; Min$$
$$(\theta x_o, y_o) \in T_c \; S.t \tag{2}$$

Input Oriented CCR Model is defined as follows:

$$\begin{aligned}
& Min \quad \theta \\
& S.t \quad \sum_{j=1}^{n} \lambda_j x_{ij} \leq \theta x_{io} \qquad i=1,...,m \\
& \qquad \sum_{j=1}^{n} \lambda_j y_{rj} \geq y_{ro} \qquad r=1,...,s \\
& \qquad \lambda_j \geq 0 \qquad j=1,...n
\end{aligned} \tag{3}$$

This model is known as envelopment CCR model. In optimum solution of above model, If $\theta^* = 1$, then DMU_O is located on T_c frontier and is efficient. It is always possible because $\theta = 1$ and $\lambda_o = 1$ and $\lambda_j = 0$. Moreover, this feasible solution concludes that optimal θ does not excess one.

Duval envelopment model is known as a multiple and is as follow:

$$\begin{aligned} & Max \quad \sum_{r=1}^{s} u_r y_{ro} \\ & S.t \quad \sum_{r=1}^{s} u_r y_{rj} - \sum_{i=1}^{m} v_i x_{ij} \le 0 \qquad j = 1,\dots,n \\ & \qquad \sum_{i=1}^{m} v_i x_{io} = 1 \\ & \qquad u_r \ge 0, v_i \ge 0, r = 1,\dots,s, i = 1,\dots,m \end{aligned} \tag{4}$$

Where u_r and v_i are dual variables corresponding to r-th output constraint and i-th input constraint of CCR envelope (Shayeste, 2011).

Output Oriented CCR Model

Consider production possibility set that produces φy_o output with x_o input $(\varphi > 1)$, clearly, $(x_o, \varphi y_o)$ defeats the decision-making unit of (x_o, y_o). $(\varphi > 1)$. For which amount of φ $(x_o, \varphi y_o)$ is located on frontier. This amount is shown with φ^* that is achieved by below model.

$$\begin{aligned} & Max \quad \varphi \\ & s.t \quad (x_o, \varphi y_o) \in T_c \end{aligned} \tag{5}$$

The requirement of membership in T_c is that $\varphi y_o \le \sum_{j=1}^{n} \lambda_j y_j$ and $x_o \ge \sum_{j=1}^{n} \lambda_j x_j$ that is, we must solve the following model to obtain the maximum φ:

$$\begin{aligned} & Max \quad \varphi \\ & S.t \quad \sum_{j=1}^{n} \lambda_j x_j \le x_o \\ & \qquad \sum_{j=1}^{n} \lambda_j y_j \ge \varphi y_o \\ & \qquad \lambda_j \ge 0, j = 1,\dots,n \end{aligned} \tag{6}$$

Above model is called Output Oriented CCR Model. In this model $\varphi = 1$, $\lambda_j = 0$, $\lambda_o = 1$, and $j \ne 0$ is optimal solution. Therefore, $1 \le Max\varphi$. The above problem is a linear programming problem. If $\varphi^* > 1$, then $(x_o, \varphi^* y_o)$ is in T_c, then $\varphi y_o > y_o$. This means that $(x_o, \varphi y_o)$ is predominant on (x_o, y_o) .therefore, DMU_O is not on efficient frontier, and then DMU_O is inefficient (Shayeste, 2011).

BCC Model

We present a set that applies for principles including observations, convexity, and Minimum interpolation with T_v or T_{BCC} and define as below (d 7)

$$T_v = \{(x,y) | x \geq \sum_{j=1}^{n} \lambda_j x_j \ \& \ y \leq \sum_{j=1}^{n} \lambda_j y_j \ \& \sum_{j=1}^{n} \lambda_j = 1, \lambda \geq 0\} \qquad (7)$$

Input Oriented BCC Model

Suppose that there are n decision making units of DMU_j with input vector of $x_j \geq 0$ and $x_j \neq 0$ and output vectors of $y_j \geq 0$ and $y_j \neq 0$. The below model must be solved in order to measure the relative efficiency of DMU_o:

$$\begin{aligned} & Min \quad \theta \\ & S.t \quad (x_o \theta, y_o) \in T_v \end{aligned} \qquad (8)$$

The equation (8) is obtained as follows with respect to T_v structure.

$$\begin{aligned} & Min \quad \theta \\ & S.t \quad \sum_{j=1}^{n} \lambda_j x_{ij} \leq \theta x_{io} \qquad i = 1,\ldots,m \\ & \qquad \sum_{j=1}^{n} \lambda_j y_{rj} \geq y_{ro} \qquad r = 1,\ldots,s \\ & \qquad \sum_{j=1}^{n} \lambda_j = 1 \\ & \qquad \lambda_j \geq 0 \qquad j = 1,\ldots n \end{aligned} \qquad (9)$$

This model is known as Input Oriented BCC Model or envelopment BCC model. It is observed that this model is envelopment CCR model that constraint $\sum_{j=1}^{n} \lambda_j = 1$ is added to it. This model is possible and has finite optimum (Shayeste, 2011).

Output Oriented BCC Model

Envelopment of Output Oriented BCC Model is as follows:

$$\begin{aligned} & Max \quad \varphi \\ & S.t \quad \sum_{j=1}^{n} \lambda_j x_j \leq x_o \\ & \qquad \sum_{j=1}^{n} \lambda_j y_j \geq \varphi y_o \\ & \qquad \sum_{j=1}^{n} \lambda_j = 1 \\ & \qquad \lambda_j \geq 0, \ j = 1,\ldots,n \end{aligned} \qquad (10)$$

Ranking using a Common Set of Weights

Logical relationship between weights must be established in order to achieve a common weight of input and output set of weights. Firstly, in this method we obtain weight and efficiency of all decision-making units by CCR model. In the second stage, we study on the set weight of inputs and outputs that are obtained in the first stage by CCR model and Common set of input weights (CSW) is obtained from the following equation:

$$v_i^* = \frac{\sum_{j=1}^{n} v_{ij} e_j}{\sum_{j=1}^{n} e_j} \qquad \forall i \tag{11}$$

Where v_i^* is the input characteristic weight, v_{ij} is i-th input weight of DMU_j, e_j is efficiency of DMU_j that that is achieved by CCR method.

Similarly, the common set of output weights is obtained from the following equation: (m-12)

$$u_r^* = \frac{\sum_{j=1}^{n} u_{rj} e_j}{\sum_{j=1}^{n} e_j} \qquad \forall r \tag{12}$$

Where, u_r^* is the output characteristic weight, u_{rj} is i-th output weight of DMU_j, e_j is efficiency of DMU_j that that is achieved by CCR method, where the common set of output weights is depended on efficiency.

$$e_j^* = \frac{\sum_{r=1}^{s} u_r^* y_{rj}}{\sum_{i=1}^{m} v_i^* x_{ij}} \qquad \forall j \tag{13}$$

In this equation, e_j^* is characteristics efficiency of DMU_j. After calculating the characteristics efficiency of decision-making units, ranking of units is changed and only a unit is selected as the best functional unit (Torgersen *et al.*, 1996).

Existing Approaches on using Inputs and Outputs in Banks

There are different attitudes in the case of measuring banking industry inputs and outputs.

Production Approach

In this approach, banks are considered as service institutions that produce various types of deposits and utilities using capital and work force. In this way, physical variables such as work force, capital, raw materials, and space and information systems are considered as input. Also, provided services to customers include facilities and maintenance of funds, types of deposits and using them in various investments as bank outputs.

Intermediation Approach
In this approach, banks are considered as collectors of funds. According to this method, banks invest collected deposits on behalf of people in different projects using capital and work force. In fact, banks are considered as an intermediary financial institution.

Operational Approach
This approach believes that banks pay cost like Commercial Units in order to realize revenue. Accordingly, total revenue (interest and non-interest), bank output and total expenses (interest and operating expenses) are considered as bank inputs.

In this study, intermediate approach is considered due to the following reasons:

1. Interfaces approach matches better with philosophy and principles of Islamic banking where bank is agent of depositors.
2. The payable fee for supply of deposits is one of the main items of banks' financial statements and financial and accounting approach requires that this is considered in inputs row.
3. The maximum domestic and foreign literature on the choice of inputs and outputs.

MATERIALS AND METHODS

Attempts have been done in order to analyze and calculate the efficiency of Mehr Eqtesad bank branches throughout Shiraz city by DEA model. But one of the main preconditions of scientific research, especially researches that require statistics and figures are related to different variables, availability, adequacy and updating of relevant statistics, so that situation can be well explained in terms of available data. On this basis, efforts were done in this research in order to produce needed statistics that will be briefly mentioned.

Table 1: inputs of each branches leading up to 03.20.2014

Row	Resources	Costs	Properties	Number of personnel	Branch Code	Branch name
1	0.045904866	0.042194749	0.049530871	6	6901	Amirkabir
2	0.063449762	0.060788059	0.072293333	8	6902	Nasr
3	0.054157874	0.058964755	0.033501487	7	6903	Mirzaye Shirazi
4	0.078724056	0.07571497	0.019353014	7	6904	Golestan
5	0.044325257	0.046576639	0.055374289	7	6905	Vali Asr
6	0.099486268	0.093715747	0.119530375	8	6906	Pasdaran
7	0.049112016	0.053935668	0.089522785	6	6907	Maali Abad
8	0.042946072	0.048395407	0.003689188	6	6908	Hejrat
9	0.069192004	0.082983261	0.024953133	9	6909	Markazi
10	0.04509657	0.045101758	0.01832628	7	6910	Dastgheyb
11	0.056591783	0.049463184	0.010175914	7	6912	Enqelab
12	0.07894168	0.075365036	0.004692806	7	6914	Afif Abad
13	0.046242627	0.050031395	0.048031413	7	6915	Farhang shahr
14	0.030912971	0.024308118	0.109494197	5	6916	Hafez
15	0.045787479	0.048052252	0.024963047	7	6918	Shir Ali Soltani
16	0.0135765	0.010987369	0.009732024	4	6919	Qaani
17	0.044322887	0.044516703	0.117368082	6	6932	Zand
18	0.045438536	0.039749508	0.051474097	8	6975	Emam Ali
19	0.045790791	0.049156418	0.137995457	6	6976	Emam Khomeini

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After data classification by DEA-Solver Software and according to theoretical foundations of DEA model, we estimate the model empirically and perform statistical analysis on numerical results and coefficients. The point to be noted here is that normal matrix is used due to the confidentiality of branches data.
In Table 1, inputs of Mehr Eqtesad bank branches will be shown separately by the end of fiscal year 2013. In Table 2 the outputs of each branch are shown by the end of fiscal year 2013.

Table 2: The outputs of each branch leading up to 03.20.2014

Row	Incomes	Facilities	Branch Code	Branch name
1	0.042569642	0.051316572	6901	Amirkabir
2	0.052612447	0.064049371	6902	Nasr
3	0.062143726	0.06143288	6903	Mirzaye Shirazi
4	0.079594099	0.067794102	6904	Golestan
5	0.042922131	0.044966736	6905	Vali Asr
6	0.084208475	0.081519644	6906	Pasdaran
7	0.051635227	0.070189729	6907	Maali Abad
8	0.046158938	0.045913352	6908	Hejrat
9	0.092964999	0.039911877	6909	Markazi
10	0.049864352	0.057997671	6910	Dastgheyb
11	0.067071312	0.053567883	6912	Enqelab
12	0.080765558	0.045982313	6914	Afif Abad
13	0.045237568	0.069325266	6915	Farhang shahr
14	0.018974911	0.044857208	6916	Hafez
15	0.050759106	0.051083585	6918	Shir Ali Soltani
16	0.009894376	0.018939466	6919	Qaani
17	0.035142003	0.037257321	6932	Zand
18	0.040291354	0.033338901	6975	Emam Ali
19	0.047189777	0.060556121	6976	Emam Khomeini

Data Analysis
Measuring Efficiency of Shiraz Mehr Eqtesad Bank Branches
After collecting information about inputs and outputs, efficiency of Shiraz Mehr Eqtesad Bank branches is measured with the assumption of variable returns to scale in both input oriented and output oriented modes. The reason for emphasis on assumption of variable returns to scale is that assumption of constant returns to scale is applicable only if units operate at optimal scale. But different issues such competitive effects, limitations, etc. cause that units do not operate at optimum scale. The efficiency of each branch is shown using variable returns to scale method in input oriented in the table (3).

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Table 3: The performance of each branch in BCC-I mode

Row	Performance	Branch code	Branch name
1	0.948662	6901	Amirkabir
2	0.824302	6902	Nasr
3	1	6903	Mirzaye Shirazi
4	1	6904	Golestan
5	0.874214	6905	Vali Asr
6	1	6906	Pasdaran
7	1	6907	Maali Abad
8	1	6908	Hejrat
9	1	6909	Markazi
10	1	6910	Dastgheyb
11	1	6912	Enqelab
12	1	6914	Afif Abad
13	1	6915	Farhang shahr
14	1	6916	Hafez
15	0.9737	6918	Shir Ali Soltani
16	1	6919	Qaani
17	0.848735	6932	Zand
18	0.799056	6975	Emam Ali
19	0.973769	6976	Emam Khomeini

The efficiency of each branch is visible using the assumption of variable returns to scale in output oriented mode in table (4).

Table 4: The performance of each branch in BCC-O mode

Row	Performance	Branch code	Branch name
1	0.942158	6901	Amirkabir
2	0.904474	6902	Nasr
3	1	6903	Mirzaye Shirazi
4	1	6904	Golestan
5	0.85702	6905	Vali Asr
6	1	6906	Pasdaran
7	1	6907	Maali Abad
8	1	6908	Hejrat
9	1	6909	Markazi
10	1	6910	Dastgheyb
11	1	6912	Enqelab
12	1	6914	Afif Abad
13	1	6915	Farhang shahr
14	1	6916	Hafez
15	0.96995	6918	Shir Ali Soltani
16	1	6919	Qaani
17	0.718166	6932	Zand
18	0.769592	6975	Emam Ali
19	0.969644	6976	Emam Khomeini

As can be seen, DEA SOLVER software is not able to rank efficient units, so below efficient units will be ranked based on CSW.

Ranking Branches using Common Set of Weights (CSW)

In evaluating the efficiency of organizations and institutions, the most important objective is to rank units based on importance. According to the fact that ranking decision-making units in data envelopment analysis may lead us to several efficient units, choosing the best efficient unit from efficient units is one of the main problems in data envelopment analysis. Using CSW we can achieve the best efficient unit.

Firstly, in this method we obtain weight and efficiency of all decision-making units by CCR model. In the second stage, we study on the set weight of inputs and outputs that are obtained in the first stage by CCR model using equations 7 and 8 and Common set of weights (CSW) is calculated and finally, using equation9, efficiency of each branch is obtained.

Thus, firstly we calculate the efficacy by CCR method. Table (5) shows the efficiency of each branch by constant returns to scale in input oriented mode.

Table 5: The performance calculation by CCR-I method

Row	**Performance**	**Branch code**	**Branch name**
1	0.93526	6901	Amirkabir
2	0.821218	6902	Nasr
3	1	6903	Mirzaye Shirazi
4	1	6904	Golestan
5	0.851359	6905	Vali Asr
6	1	6906	Pasdaran
7	1	6907	Maali Abad
8	1	6908	Hejrat
9	1	6909	Markazi
10	1	6910	Dastgheyb
11	1	6912	Enqelab
12	1	6914	Afif Abad
13	1	6915	Farhang shahr
14	1	6916	Hafez
15	0.964677	6918	Shir Ali Soltani
16	1	6919	Qaani
17	0.704519	6932	Zand
18	0.758219	6975	Emam Ali
19	0.961939	6976	Emam Khomeini

Table (6) shows the efficiency of each branch by constant returns to scale in output oriented mode.

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Table 6: The performance calculation by CCR-O method

Row	Performance	Branch code	Branch name
1	0.93526	6901	Amirkabir
2	0.821218	6902	Nasr
3	1	6903	Mirzaye Shirazi
4	1	6904	Golestan
5	0.851359	6905	Vali Asr
6	1	6906	Pasdaran
7	1	6907	Maali Abad
8	1	6908	Hejrat
9	1	6909	Markazi
10	1	6910	Dastgheyb
11	1	6912	Enqelab
12	1	6914	Afif Abad
13	1	6915	Farhang shahr
14	1	6916	Hafez
15	0.964677	6918	Shir Ali Soltani
16	1	6919	Qaani
17	0.704519	6932	Zand
18	0.758219	6975	Emam Ali
19	0.961939	6976	Emam Khomeini

In the second stage, we calculate the weight of inputs and outputs by CCR model. Tables (7) and (8) represent the weights. Table (7) shows weight of inputs and outputs that is obtained by constant returns to scale in input oriented mode.

Table 7: Weight of inputs and outputs by CCR-I method

Branch code	Personnel	Properties	Costs	Resources	Facilities	Incomes
6901	0.037896	0.615555	17.58834	0	12.16995	7.299578
6902	0.026747	0.43446	12.41388	0	8.589567	5.152053
6903	0.065844	2.374228	0	8.485427	9.728952	6.474064
6904	0.142857	0	0	0	7.951724	5.790881
6905	0	0	0	22.5605	4.922468	14.67801
6906	0.125	0	0	0	6.957759	5.067021
6907	0.166667	0	0	0	14.2471	0
6908	0.154005	20.59275	0	0	21.78016	0
6909	0	0	0	14.45254	3.153394	9.402917
6910	0	17.44316	15.08438	0	17.24207	0
6912	0.007	18.40807	15.43936	0	18.6679	0
6914	0.128929	20.77625	0	0	14.19513	4.299791
6915	0.108695	2.715798	2.172519	0	14.42476	0
6916	0.128401	0	14.72737	0	22.29296	0
6918	0	0	0	21.84003	4.765269	14.20927
6919	0	48.21878	48.30398	0	52.7998	0
6932	0.008254	0	1.590128	19.84733	4.84626	14.9098
6975	0	0	17.22044	6.943361	9.047035	11.33248
6976	0.007963	0	1.534115	19.14819	4.675548	14.3846

Table (8) shows the input and output weights of each branch by constant returns to scale in output oriented mode.

Table 8: Weight of inputs and outputs by CCR-O method

Branch code	Personnel	Properties	Costs	Resources	Facilities	Incomes
6901	0.040519	0.658164	18.80583	0	13.01236	7.804862
6902	0.03257	0.529043	15.11642	0	10.45954	6.27367
6903	0.00852	0.072089	1.060143	16.16449	4.059685	12.07848
6904	0.142857	0	0	0	7.951724	5.790881
6905	0	0	0	26.4994	5.781895	17.24069
6906	0.12577	0	0	0	7.000602	5.098221
6907	0.166667	0	0	0	14.2471	0
6908	0.154005	20.59275	0	0	21.78016	0
6909	0	0	0	14.45254	3.153394	9.402917
6910	0.035423	0.575383	16.44051	0	11.37572	6.823201
6912	0	0	20.21706	0	6.7601	9.510412
6914	0.142857	0	0	0	0.645251	12.01415
6915	0.111144	2.852126	0	1.838212	14.42476	0
6916	0.128401	0	14.72737	0	22.29296	0
6918	0	0	0	22.63974	4.939757	14.72956
6919	0	1.200093	18.75225	57.62035	52.7998	0
6932	0.011715	0	2.257041	28.17146	6.878821	21.1631
6975	0	0	22.71169	9.157459	11.93195	14.94618
6976	0.008278	0	1.594816	19.90583	4.860545	14.95375

Now, we calculate common weights using equations (11) and (12). For example, v_1^* is calculated in input oriented mode as below:

$$v_1^* = \frac{((0.037896*0.93526)+(0.026747*0.821218)+....+(0.007963*0.961939)}{17.99107} \Rightarrow$$

$$v_1^* = 0.061003$$

Common weight values of inputs and outputs in input oriented mode as follows:

$v_1^* = 0.061003$ $v_2^* = 7.307042$ $v_3^* = 7.671842$ $v_4^* = 5.607249$

$u_1^* = 13.63978$ $u_2^* = 5.624962$

Common weight values of inputs and outputs in output oriented mode as follows

$v_1^* = 0.060904$ $v_2^* = 1.464196$ $v_3^* = 6.755809$ $v_4^* = 10.02803$

$u_1^* = 11.97619$ $u_2^* = 7.929092$

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Now, we calculate efficiency of efficient branches using equation (13).
For example, efficiency of Mirzaye Shirazi branch in input oriented mode is calculated as follows:

$$e^{*}_{6903} = \frac{((0.06143288 * 13.6397846) + (0.062143726 * 5.624961573))}{((7 * 0.061003285) + ... + (0.054157874 * 5.60724923))}$$

The efficiency of each branch is visible using CSW in input oriented mode in table (9).

Table 9: The performance of each branch by CSW-I method

Row	Performance	Branch code	Branch name
1	0.717616	6901	Amirkabir
2	0.636181	6902	Nasr
3	0.831653	6903	Mirzaye Shirazi
4	0.862753	6904	Golestan
5	0.594617	6905	Vali Asr
6	0.600995	6906	Pasdaran
7	0.730002	6907	Maali Abad
8	0.881423	6908	Hejrat
9	0.607819	6909	Markazi
10	0.923907	6910	Dastgheyb
11	0.924678	6912	Enqelab
12	0.729679	6914	Afif Abad
13	0.844435	6915	Farhang shahr
14	0.490522	6916	Hafez
15	0.79549	6918	Shir Ali Soltani
16	0.660264	6919	Qaani
17	0.389182	6932	Zand
18	0.47853	6975	Emam Ali
19	0.543468	6976	Emam Khomeini

Table (10) shows the calculation related to efficiency of each branch using CSW in output oriented mode.

Table 10: The performance of each branch by CSW-O method

Row	Performance	Branch code	Branch name
1	0.717616	6901	Amirkabir
2	0.636181	6902	Nasr
3	0.831653	6903	Mirzaye Shirazi
4	0.862753	6904	Golestan
5	0.594617	6905	Vali Asr
6	0.600995	6906	Pasdaran
7	0.730002	6907	Maali Abad
8	0.881423	6908	Hejrat
9	0.607819	6909	Markazi
10	0.923907	6910	Dastgheyb
11	0.924678	6912	Enqelab
12	0.729679	6914	Afif Abad
13	0.844435	6915	Farhang shahr
14	0.490522	6916	Hafez
15	0.79549	6918	Shir Ali Soltani
16	0.660264	6919	Qaani
17	0.389182	6932	Zand
18	0.47853	6975	Emam Ali
19	0.543468	6976	Emam Khomeini

Now, we rank branches based on efficiency and results by CSW.
Table (11) shows ranking of each branch using CSW in input oriented mode.

Table 11: Ranking branches using CSW-I method

Rank	Branch code	Branch name
1	6912	Enqelab
2	6910	Dastgheyb
3	6908	Hejrat
4	6904	Golestan
5	6915	Farhang shahr
6	6903	Mirzaye Shirazi
7	6918	Shir Ali Soltani
8	6907	Maali Abad
9	6914	Afif Abad
10	6901	Amirkabir
11	6919	Qaani
12	6902	Nasr
13	6909	Markazi
14	6906	Pasdaran
15	6905	Vali Asr
16	6976	Emam Khomeini
17	6916	Hafez
18	6975	Emam Ali
19	6932	Zand

Table (12) shows ranking of each branch using CSW in output oriented mode.

Table 12: Ranking branches using CSW-O method

Rank	Branch code	Branch name
1	6907	Maali Abad
2	6971	Farhang shahr
3	6910	Dastgheyb
4	6912	Enqelab
5	6903	Mirzaye Shirazi
6	6904	Golestan
7	6918	Shir Ali Soltani
8	6908	Hejrat
9	6976	Emam Khomeini
10	6901	Amirkabir
11	6916	Hafez
12	6902	Nasr
13	6906	Pasdaran
14	6905	Vali Asr
15	6914	Afif Abad
16	6909	Markazi
17	6919	Qaani
18	6932	Zand
19	6975	Emam Ali

Conclusion

As was observed, 12 branches have equal efficiencies using BCC-I and BCC-O methods. In other words, 63% of branches are efficient, and on the other hand, mean efficiency is equal to 0.96 using BCC-I method and mean efficiency is equal to 0.954 using BCC-O method. So, mean efficiency using variable returns to scale in input oriented mode is more compared to output oriented mode. According to results, rankings branches using above methods is not possible. Using CSW method, in input oriented mode, Enqelab branch and in output oriented mode, Maali Abad branch are introduced as efficient branches. CSW method is used more compared to other methods of ranking because it can rank all units including efficient and inefficient DMUs. In these methods, an inefficient DMU may obtain higher rank compared to efficient DMUs because an inefficient DMU may be dominant in some cases, although not in all cases, compared to efficient DMUs, thus an inefficient DMU may have higher, lower or equal to efficient compared to efficient DMU that is not dominant on inefficient DMU. Each ranking method can be used for special applications. This method may be more logical than other ranking methods. The method used in this research has fewer computations and proper accuracy, the reason for this issue is that selecting CSW is without removing and rounding off weights. Set of defined weights allows us to rank all branches and to have only one efficient unit. CSW leads us to the best efficient unit without solving new model, only using CCR model results.

Suggestions

According to results, following suggestions are offered in order to enhance and improve the effectiveness of Mehr Eqtesad Bank inefficient branches throughout Shiraz city.

1. Considering the optimal scale of inefficient branches assets according to generated outputs.
2. Considering the optimal levels of human resource recruitment, considering their education and improving their material and spiritual motivations in order to provide better services through proper and continuous training and practical courses.
3. Creating motivational and incentive system such as bonus payments to employees and management of efficient branches and those that have positive productivity growth in order to further enhance their efficiency and productivity and encourage others inefficient branches do more efforts.
4. Increasing the number of inputs and outputs that are used to do more accurate calculations. For example, other parameters, such as education of branches employees, location of branches, number of daily transactions, branch rank, branch environment, customer oriented personnel and satisfaction of clients and other environmental factors. Because environmental factors other than internal factors effect on performance of branches that identifying and inserting them in model can result in better results.

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