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Assessing the Performance of Branches of Refah Bank in Tehran Province by Combining Analytic Hierarchy Process (AHP) and Data Envelopment Analysis (DEA) Algorithms in Fuzzy Conditions

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Abstract

The main purpose of this study was to assess the performance of branches of Refah Bank in Tehran. The study is a descriptive survey with regard to methodology and nature. Reviewing the theoretical literature, the researcher tried to present a three-level theoretical model to analyze the efficiency and customer loyalty in Refah Bank. In this study, 2 inputs (operating costs and the number of employees) and 6 outputs (assessment of employees, customer loyalty, customer satisfaction, the number of opened accounts, the number of loans given and the amount customer expectations are met) were used to assess the efficiency of branches. The results indicated that customer satisfaction and the amount customer expectations are met have maximum weight or priority in achieving efficiency among recognized factors. The researcher investigated efficient units using a combination of fuzzy Data Envelopment Analysis (DEA) and fuzzy Analytic Hierarchy Process (AHP).

1. Introduction:

One of the important components of financial markets is the bank system of each country. Banks can bring financial capital for economic sections to provide appropriate conditions for investment and prepare grounds for removing recession and creating positive economic growth [20]. Financial markets always face the concept of competition. The concept of competition has led many institutes to try to increase *their efficiency and find a proper position in competitive markets by improving their performances to transform from an ineffective element in the market to a key player [13]. All financial institutes can define the concept of efficiency to obtain competitive advantage. Every institution that can select the criteria required to bring better performance and is in harmony with today complex situation will be able to have a better performance than competitors and obtain a better position in the market [23]. These developed criteria can even be appropriate factors for improving the recognition of the weaknesses and strengths of institutions [18]. In fact, after efficiency assessment, institutes can find out which factor has decreased the performance of their branches and decide to develop more effective plans to apply new strategies in order to improve their weaknesses [15]. On the other hand, they can develop comprehensive plans to keep their strengths. Various parameters and factors are used to assess the performance of banks in different research studies. Financial factors, operational factors, service quality factors, income, expenses and many other parameters in this regard are considered as important factors for the determination of efficiency of branches of banks [2]. One of the important issues for the assessment of efficiency of service organizations including banks is to attend to both internal and external customers, i.e., bank customers and employees [5]. Satisfying both kinds of bank customer can be a basis for assessing the performance of business units because the efficiency of service organizations ultimately results from mutual relation between employees as service

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providers and customers as recipients of services [22]. If financial institutions and Refah Bank be able to detect effective factors in the efficiency of their branches with a higher accuracy than their competitors, they will be able to separate efficient and inefficient units using correct assessment and use previously developed plans to keep a desirable condition among the efficient units through development of encouraging plans and necessary plans and measures for improvement of performance of inefficient units. This would give Refah Bank a better position compared with its competitors due to its better efficiency which will lead to a better competitive position in the long run. The main question in this research study was what factors can improve efficiency of branches of Refah Bank. And another research question was which branch is efficient or inefficient according to the recognized criteria using combinational technique of Data Envelopment Analysis (DEA) and Analytic Hierarchy Process (AHP).

2. Theoretical Framework:

Performance has a relationship with how an economic unit performs in the production process. Efficiency is the mean of how components of production process perform and its optimal combination in the flow of achieving maximum production rate. For example, if we are working with a production unit that produces goods or offers services with a specific level of capital and work force in a fixed technology, production is efficient when we can make maximum use of the available work force or capital to achieve production in a way in which it is not possible to increase technical production with the available facilities, or increase production with replacement of capital and work while production costs do not increase [4]. Thus, efficiency can be defined as the rate of achieving optimal production by an economic unit and the qualitative amount of production can be obtained from the ratio of current production to potential production [7]. On the other hand, based on the definition by Farrell [12], efficiency is the access of an economic unit to maximum production rate of combination of different inputs. In other words, efficiency is obtained from the ratio of current production of each unit to potential production of that unit. Simply put, efficiency is maximizing results in macro and micro scales. Therefore, research on efficiency including in institutions is one of the most important fields of economic research. Various factors exist that lead to improvement and change in the efficiency of branches. In the following, the researcher intends to extract these factors based on the theoretical literature and use them to assess the efficiency of branches of Refah Bank.

Review of Literature:

The first study on the efficiency of branches and banks was done in 1985 using Data Envelopment Analysis Technique by Sherman and Gold [17]. In their study, they investigated 14 branches of savings bank and concluded that only 6 out of the 14 branches have 100 percent efficiency. Other causes of inefficiency include weak management, size of branches, number of employees and operational costs [14]. In another study assessing the efficiency of branches of banks in Cyprus, Zenios and Soteriou [24] some factors were used to assess the efficiency of the branches such as number of accounts opened by customers, customer loyalty and satisfaction, current costs of branches, employee satisfaction and finally number of employees. As you can see, managers should simultaneously attend to employees as internal customers and also external customers and meet their expectations for a better efficiency. In another study, Athanassopoulos [6] assessed the efficiency of branches of business banks of England. In this research, factors like size of branches, competitiveness, location and the number of accounts opened were recognized as the criteria for the assessment of efficiency of banks. In another study by Bayraktar et al. [8], the researchers investigated the efficiency of brands using the concept of customer satisfaction and loyalty. In other words , the researchers tried to prove that business brands can become efficient by meeting

customers' expectations. The results of this study indicated that customer satisfaction and loyalty and meeting customers' expectations are important factors for brands to achieve efficiency. In another study, Samoilenko [16] assessed the efficiency of banks using Data Envelopment Analysis. In this study, researchers considered employee assessment, customer satisfaction and loyalty, meeting customer expectations and number of given loans as effective output factors in achieving efficiency. In addition, they considered current costs and number of employees as effective factors in obtaining efficiency and assessing units among input factors. In local studies, studies like Golbaz Khani et al. [5] can be mentioned. In their study, the researchers investigated the optimal structure for achieving efficiency in banks listed in Stock Exchange. In this research, the researchers used DEA Technique and found out that effective input factors in increasing efficiency of branches include operational costs of branches, structure of branches and management style. On the other hand, effective external factors in assessment of efficiency include loyalty, satisfaction, number of accounts and given loans. In another research study in 2014 by Ghanbari and Sadeghi [3], the researchers assessed the efficiency of branches of Meli Bank in Tehran. In this research which was done by DEA Technique, the researchers found that external factors such as customer satisfaction, number of opened accounts in a branch and employee satisfaction are highly important in achieving efficiency. On the other hand, input factors such as operational costs and number of employees are considered as recognized criteria in achieving efficiency. On the other hand, Kurd et al. [4] assessed the efficiency of branches in Sistan and Balouchestan Province. In this study, the researchers found that input criteria such as number of employees and communication styles of managers are very important and among the external criteria, the rate at which customers' expectations are met, customer satisfaction and loyalty, number of accounts and given loans are among important and effective criteria in improving efficiency.

Regarding the literature and the study the researcher has conducted, he used some criteria for paired comparison of branches to assess the efficiency of branches of Refah Bank. These criteria are presented as external and input criteria of this study in the following. The researcher selected 6 external criteria (customer satisfaction, customer loyalty, number of opened accounts, number of given loans, meeting the expectations of customers and employee satisfaction) and 2 input criteria (operational costs of branches and number of employees) to assess the efficiency of branches in this study.

3. Methodology:

The present study is applied with regard to purpose and descriptive-analytical with regard to data collection method. The data of this study were directly collected through a questionnaire. In this study, 28 branches were selected as sample branches through simple random sampling for paired comparisons. In the following, the researcher intends to give a short explanation about data analysis methods.

In the literature of multi-criteria decision-making analysis, prioritization of decision-making units is very common. It is very important that the decision-maker faces separate elements or options in the form of one or some criteria for decision-making and requires to assess, compare or select one or some of them. Here, Fuzzy Analytic Hierarchy Process (AHP) was considered a suitable strategy [11].

Fuzzy Analytic Hierarchy Process (AHP):

Laarhoven and Pedrycz [21] suggested Fuzzy Analytic Hierarchy Process Method. This method is an application of Analytic Hierarchy Process and Fuzzy Logic [1]. Language scale of Analytic Hierarchy Process Method can be stated as fuzzy uncertainty when the decision-maker is making

a decision. Thus, Fuzzy Analytic Hierarchy Process Method transform the comments of experts in previously defined values to fuzzy numbers and membership functions to achieve a more acceptable assessment. Regarding the suggested method by Lahurich and Pedrich, it is obvious that many concepts in the real world are vague. The phases of Fuzzy AHP Method are as follows:
Problem determination: First, the problem under study is determined to be solved. In this study, the problem is to prioritize effective factors in the assessment of efficiency of branches of Refah Bank.
Developing hierarchical structure: Determining a suitable structure to rate the criteria through the intended literature. In this study, the criteria were extracted through reviewing the related literature and rated using the comments of experts.

Fuzzy Data Envelopment Analysis (DEA) Method:

The main purpose of DEA Model is to determine the efficiency of various units based on their produced output against their consumed input. Fuzzy mathematical planning provides us with a tool that enables us to face some production processes that have uncertain natures. Other authors suggested random DEA formulation as a potential approach for dealing with data changes ([9], [10]).

There are numerous models for the measurement and assessment of relative efficiency of a set of decision-making units (DMU). Current models of DEA are usually limited with certain inputs and outputs. However, there are many problems in practice that have fuzzy input and output. In other words, data are usually collected and used as good, average and bad and reflect a kind of normal status [19].

Determining the inputs:

In this research, two factors, that were entitled as input, were recognized for Fuzzy DEA. These two criteria included organization operational costs and the number of employee. In this study, operational costs is the combination of some costs including administration and employee costs and costs related to the paid interests and financial supplies as managers of data banks obtained through checklists. On the other hand, number of employees was also extracted through checklists. In this study, the researcher considered number of employees as an effective input in efficiency. The number of employees in this study included those that are directly active in the branches.

Determining the outputs:

The second part of the parameters of Fuzzy DEA Model is related to model outputs including 6 factors, i.e., employee assessment, customer satisfaction, customer loyalty, number of opened accounts, number of given loans and meeting the expectations of customers. The first factor refers to employee assessment, i.e., assessing the knowledge and work level of employees working in branches of Refah Bank in terms of performance. The second factor in the assessment of efficiency of branches after the assessment of employees was customer satisfaction. As you know, satisfaction refers to an attitude that employees associate from the services they have received from the branches in their minds. If satisfaction is high, it can be considered as a positive output. The third discussion among the outputs refers to customer loyalty. Today, they believe that keeping and increasing customer loyalty from the used services by the institute can be a factor for achieving profit and competitive advantage in competitive markets. While programs leading to customer loyalty is rather more difficult than programs for attracting customers. Thus, branches with more permanent customers seem to have a better level of efficiency. The fourth available output in DEA Model is meeting the expectations of customers. Meeting the expectations of customers means that the presented services in Refah Bank should cover customer needs and prepare the grounds for improvement of customer satisfaction and loyalty. The fifth output which is a criterion for

attracting customers refers to the number of accounts opened in the branch. The more the number of opened accounts, the more successful the programs of attracting customers by the managers. This indicates increased efficiency in the branches; and finally, the number of given loans is another factor effective in efficiency of branches.

Fuzzy AHP-DEA Integrated Model:

The prioritization Fuzzy AHP-DEA Model includes two parts. The efficiency of branches was compared pairwise with other production units through Fuzzy DEA Method. The results of the first phase were written as matrix of pairwise comparison, and in the second phase, all branches were ranked using Fuzzy AHP Technique. In this study, input-based perspective was used for modeling decision problem in the form of a Fuzzy DEA Model. Each array of this matrix was considered a DMU.

For modeling the intended problem, first, DEA Model was designed for each pair of units without regard to other units. The modeling of two branches are given below as examples. For example, modeling was done as follows for branch number 1 and branch number 2. (E_{12} is the optimal value of unit 2).

E_{12}:

$$Max = 9u_1 + 9u_2 + 7u_3 + 7u_4 + 9u_5 + 9u_6$$

$$s.t.$$

$$27v_1 + 195v_2 = 1$$

$$9u_1 + 9u_2 + 7u_3 + 7u_4 + 9u_5 + 9u_6 \le 1$$

$$7u_1 + 5u_2 + 9u_3 + 9u_4 + 7u_5 + 9u_6 + 0.9*(33v_1 + 165v_2) \le 0$$

$$u_1, u_2, u_3, v_1, v_2 \ge 0$$

$$E_{12} = 0.98$$

E_{11}:

$$Max = 9u_1 + 9u_2 + 7u_3 + 7u_4 + 9u_5 + 9u_6$$

$$s.t.$$

$$27v_1 + 195v_2 = 1$$

$$9u_1 + 9u_2 + 7u_3 + 7u_4 + 9u_5 + 9u_6 \le 1$$

$$7u_1 + 5u_2 + 9u_3 + 9u_4 + 7u_5 + 9u_6 - 33v_1 - 165v_2 \le 0$$

$$u_1, u_2, u_3, v_1, v_2 \ge 0$$

$$E_{11} = 1$$

E_{22}:

$$Max = 7u_1 + 5u_2 + 9u_3 + 9u_4 + 7u_5 + 9u_6$$

$$s.t.$$

$$33v_1 + 165v_2 = 1$$

$$7u_1 + 5u_2 + 9u_3 + 9u_4 + 7u_5 + 9u_6 \le 1$$

$$9u_1 + 9u_2 + 7u_3 + 7u_4 + 9u_5 + 9u_6 - 27v_1 - 195v_2 \le 1$$

$$u_1, u_2, u_3, v_1, v_2 \ge 0$$

$$E_{22} = 0/9$$

E_{21}:

$$Max = 7u_1 + 5u_2 + 9u_3 + 9u_4 + 7u_5 + 9u_6$$

$$s.t.$$

$$33v_1 + 165v_2 = 1$$

$$7u_1 + 5u_2 + 9u_3 + 9u_4 + 7u_5 + 9u_6 \le 1$$

$$9u_1 + 9u_2 + 7u_3 + 7u_4 + 9u_5 + 9u_6 - 27v_1 - 195v_2 \le 1$$

$$u_1, u_2, u_3, v_1, v_2 \ge 0$$

$$E_{21} = 0/9$$

Therefore, the optimal solution to the problem is as follows bt solving these four modeling problems.

$$A_{12} = \frac{E_{11} + E_{12}}{E_{21} + E_{22}}, a_{ij} = 1$$

Therefore:

$$A_{12} = \frac{1 + 0/91}{0.9 + 0.9} = \frac{1/91}{1.8} = 1.06$$

With regard to the fact that DEA comparisons are fuzzy, three comparisons are made for each fuzzy comparison. The strengths and weaknesses of comparisons are written in an ascending order.

E_{12}:

$Max = 9u_1 + 7u_2 + 5u_3 + 5u_4 + 9u_5 + 9u_6$

s.t.

$27v_1 + 210v_2 = 1$

$9u_1 + 7u_2 + 5u_3 + 5u_4 + 9u_5 + 9u_{66} \le 1$

$7u_1 + 5u_2 + 7u_3 + 7u_4 + 3u_5 + 5u_6 - 0.885*(33v_1 + 203v_2) \le 0$

$u_1, u_2, u_3, v_1, v_2 \ge 0$

$E_{12} = 0.93$

E_{21}:

$Max = 7u_1 + 5u_2 + 7u_3 + 7u_4 + 3u_5 + 5u_6$

s.t.

$33v_1 + 203v_2 = 1$

$7u_1 + 5u_2 + 7u_3 + 7u_4 + 3u_5 + 5u_6 \le 1$

$9u_1 + 7u_2 + 5u_3 + 5u_4 + 9u_5 + 9u_{66} - 27v_1 - 210v_2 \le 0$

$u_1, u_2, u_3, v_1, v_2 \ge 0$

$E_{21} = 0/885$

Therefore:

E_{11}:

$Max = 9u_1 + 7u_2 + 5u_3 + 5u_4 + 9u_5 + 9u_6$

s.t.

$27v_1 + 210v_2 = 1$

$9u_1 + 7u_2 + 5u_3 + 5u_4 + 9u_5 + 9u_{66} \le 1$

$7u_1 + 5u_2 + 7u_3 + 7u_4 + 3u_5 + 5u_6 - 33v_1 - 203v_2 \le 0$

$u_1, u_2, u_3, v_1, v_2 \ge 0$

$E_{11} = 1$

E_{21}:

$Max = 7u_1 + 5u_2 + 7u_3 + 7u_4 + 3u_5 + 5u_6$

s.t.

$33v_1 + 203v_2 = 1$

$7u_1 + 5u_2 + 7u_3 + 7u_4 + 3u_5 + 5u_6 \le 1$

$9u_1 + 7u_2 + 5u_3 + 5u_4 + 9u_5 + 9u_{66} - 27v_1 - 210v_2 \le 0$

$u_1, u_2, u_3, v_1, v_2 \ge 0$

$E_{21} = 0/885$

$$A_{12} = \frac{1 + 0/93}{0.885 + 0.885} = \frac{1/93}{1.8} = 1.09$$

E_{12}:

$Max = 7u_1 + 5u_2 + 3u_3 + 3u_4 + 7u_5 + 7u_6$

s.t.

$27v_1 + 230v_2 = 1$

$7u_1 + 5u_2 + 3u_3 + 3u_4 + 7u_5 + 7u_6 \le 1$

$5u_1 + 3u_2 + 5u_3 + 5u_4 + u_5 + 3u_6 - 0.865*(33v_1 + 212v_2) \le 0$

$u_1, u_2, u_3, v_1, v_2 \ge 0$

$E_{12} = 0.94$

E_{22}:

$Max = 5u_1 + 3u_2 + 5u_3 + 5u_4 + u_5 + 3u_6$

s.t.

$33v_1 + 212v_2 = 1$

$5u_1 + 3u_2 + 5u_3 + 5u_4 + u_5 + 3u_6 \le 1$

$7u_1 + 5u_2 + 3u_3 + 3u_4 + 7u_5 + 7u_{66} - 27v_1 - 230v_2 \le 1$

$u_1, u_2, u_3, v_1, v_2 \ge 0$

$E_{22} = 0/865$

Therefore:

$$A_{12} = \frac{1 + 0/94}{0.865 + 0.865} = \frac{1/94}{1.73} = 1.12$$

E_{11}:

$Max = 7u_1 + 5u_2 + 3u_3 + 3u_4 + 7u_5 + 7u_6$

s.t.

$27v_1 + 230v_2 = 1$

$7u_1 + 5u_2 + 3u_3 + 3u_4 + 7u_5 + 7u_6 \le 1$

$5u_1 + 3u_2 + 5u_3 + 5u_4 + u_5 + 3u_6 - 33v_1 - 212v_2 \le 0$

$u_1, u_2, u_3, v_1, v_2 \ge 0$

$E_{11} = 1$

E_{21}:

$Max = 5u_1 + 3u_2 + 5u_3 + 5u_4 + u_5 + 3u_6$

s.t.

$33v_1 + 212v_2 = 1$

$5u_1 + 3u_2 + 5u_3 + 5u_4 + u_5 + 3u_6 \le 1$

$7u_1 + 5u_2 + 3u_3 + 3u_4 + 7u_5 + 7u_{66} - 27v_1 - 230v_2 \le 1$

$u_1, u_2, u_3, v_1, v_2 \ge 0$

$E_{21} = 0/865$

Therefore, a_{ij} elements can be calculated for all units in comparison with each other. The result of this plan for 28 branches is pairwise comparison matrix from 1512 linear planning models. The matrix related to the intended data is presented in the appendix 1. After obtaining pairwise comparisons matrix using Fuzzy AHP Method, the options were ranked. The appendix 2 shows the results of pairwise comparison for all DMUs.
The appendix 3 shows the results of weights or efficiency of DMUs based on Fuzzy AHP Method and Fuzzy DEA Method.

As you can see in table 1, ranking of DMUs based on Fuzzy AHP-DEA Integrated Method is as follows.

Table 1. Comparison of results of FDEA, Fuzzy AHP-DEA Ranking

Rank in the method Fuzzy AHP-DEA	Decision Making Unit:	Rank in the method Fuzzy AHP-DEA	Decision Making Unit:
20	DMU15	10	DMU1
15	DMU16	23	DMU2
13	DMU17	1	DMU3
27	DMU18	28	DMU4
11	DMU19	3	DMU5
19	DMU20	7	DMU6
4	DMU21	5	DMU7
9	DMU22	8	DMU8
26	DMU23	6	DMU9
14	DMU24	16	DMU10
17	DMU25	18	DMU11
22	DMU26	24	DMU12
12	DMU27	25	DMU13
2	DMU28	21	DMU14

As you can see from the outputs, units 3, 28, 5 and 21 have higher levels of efficiency among branches of Refah Bank while units 4, 18, 23 and 13 have lower levels of efficiency among branches of Refah Bank.

5. Conclusion:

Knowing that we are in the age of information and competition among organizations and each organization tries to progress and maintain and obtain competitive advantage and develop new methods to develop the organization, and also regarding the important role of efficiency in progress

of societies, investigation of all dimensions especially in a mathematical analytical method as a criterion for the measurement of performance is inevitable. The heart and the main part of the economy of a country is tied to banks, it is obvious that growth and promotion and correct progress of banks increase their efficiency. This leads to the development of economy and removal of financial crises. Business banks are financial institutions that collect the dead funds of people and give loans to businessmen, industrialists and other applicants. In fact, banks use their operations to transfer funds from people who do not want to or cannot participate in economic activities due to lack of knowledge, expertise or enormous capital and fear of investment to persons who require financial resources for investment. Since the goal of business banks is to obtain benefits, it is natural that banks should attract cheaper resources and give loans with maximum possible rates of interest. As this study stated, 28 branches of Refah Bank was compared pairwise. The results showed that units 3, 28, 5 and 21 are in better positions in terms of efficiency. On the other hand, inefficient units in this integrated method are units 4, 18, 23, and 13. With regard to the main goal of this research which was recognition of branches of Refah Bank in terms of efficiency, the following suggestions are made for inefficient banks. Based on the observations, branches 3, 28, 5 and 21are among units that are able to increase efficiency in terms of comparison of input and outputs using Integrated DEA-AHP Fuzzy Method. This is an indication of tactful management and very suitable strategy for competitive environments. According to the results, these branches should be selected as samples for units 4, 18, 13, and 23. In fact, senior managers of Refah Bank should select the best branches as samples for other branches. On the other hand, managers of Refah Bank are suggested to allocate resources based on efficiency and request branch managers to increase their efficiency in order to receive higher levels of resources. Managers of Refah Bank are suggested to invite some of the employees of inefficient branches to instructional courses to improve their performance or ask them to work for some time in efficient branches. Managers of Refah Bank are suggested to have a systematic look at the external and internal factors which were recognized as input and output factors in this study in the assessment of issues and problems of the branches.

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Appendix 1. Pairwise comparisons for decision units

	DMU1			DMU2			DMU3			DMU4		
DMU1	1.000	1.000	1.000	1.060	1.090	1.120	0.930	0.940	0.960	1.080	1.090	1.100
DMU2	0.893	0.917	0.943	1.000	1.000	1.000	1.100	1.130	1.180	0.760	0.780	0.790
DMU3	1.042	1.064	1.075	0.847	0.885	0.909	1.000	1.000	1.000	0.980	1.100	1.170
DMU4	0.909	0.917	0.926	1.266	1.282	1.316	0.855	0.909	1.020	1.000	1.000	1.000
DMU5	1.064	1.087	1.124	0.847	0.885	0.909	0.909	0.917	0.926	0.847	0.885	0.909
DMU6	1.000	1.000	1.000	0.855	0.909	1.020	0.840	0.877	0.893	1.266	1.282	1.316
DMU7	1.124	1.136	1.163	0.833	0.840	0.862	0.943	0.971	0.990	1.064	1.075	1.087
DMU8	1.266	1.282	1.316	0.952	0.980	1.010	0.935	0.962	0.971	0.855	0.909	1.020
DMU9	1.064	1.075	1.087	1.042	1.075	1.099	0.980	1.031	1.064	0.909	0.917	0.926
DMU10	1.000	1.000	1.000	1.266	1.282	1.316	1.031	1.064	1.099	0.935	0.962	0.971
DMU11	1.000	1.000	1.000	1.075	1.064	1.099	0.962	0.980	1.010	0.847	0.885	0.909
DMU12	0.855	0.909	1.020	1.124	1.136	1.163	1.053	1.087	1.136	0.943	0.971	0.990
DMU13	0.847	0.885	0.909	1.266	1.282	1.316	1.031	1.064	1.099	1.064	1.087	1.136
DMU14	0.840	0.877	0.893	0.962	0.980	1.010	0.935	0.962	0.971	1.176	1.205	1.266
DMU15	0.833	0.840	0.862	1.064	1.087	1.136	0.840	0.877	0.893	0.962	0.980	1.010
DMU16	0.862	0.901	0.917	0.935	0.962	0.971	1.053	1.087	1.136	0.952	0.980	1.010
DMU17	0.826	0.847	0.885	0.980	1.031	1.064	0.909	0.917	0.926	1.124	1.136	1.163
DMU18	0.813	0.820	0.833	0.935	0.962	0.971	1.266	1.282	1.316	0.833	0.840	0.862
DMU19	1.000	1.000	1.000	0.840	0.877	0.893	1.220	1.266	1.282	1.053	1.087	1.136
DMU20	0.935	0.962	0.971	1.031	1.064	1.099	1.220	1.266	1.282	1.124	1.136	1.163
DMU21	1.075	1.064	1.099	0.952	0.980	1.010	0.833	0.840	0.862	1.149	1.205	1.235
DMU22	0.980	1.000	1.010	0.833	0.840	0.862	0.943	0.962	0.990	1.124	1.136	1.163
DMU23	0.971	0.980	0.990	1.031	1.064	1.099	0.847	0.885	0.909	1.220	1.266	1.282
DMU24	1.075	1.099	1.149	1.176	1.205	1.266	0.840	0.877	0.893	0.980	1.000	1.010
DMU25	0.943	0.971	0.990	0.847	0.885	0.909	0.962	0.980	1.010	0.943	0.962	1.031
DMU26	1.099	1.124	1.136	0.935	0.962	0.971	1.053	1.087	1.136	1.031	1.064	1.099
DMU27	1.042	1.075	1.099	0.980	1.031	1.064	1.099	1.111	1.163	1.124	1.136	1.163
DMU28	1.010	1.020	1.031	0.935	0.962	0.971	1.266	1.282	1.316	0.943	0.971	0.990

	DMU5			DMU6			DMU7			DMU8		
DMU1	0.890	0.920	0.940	1.000	1.000	1.000	0.860	0.880	0.890	0.760	0.780	0.790
DMU2	1.100	1.130	1.180	0.980	1.100	1.170	1.160	1.190	1.200	0.990	1.020	1.050
DMU3	1.080	1.090	1.100	1.120	1.140	1.190	1.010	1.030	1.060	1.030	1.040	1.070
DMU4	1.100	1.130	1.180	0.760	0.780	0.790	0.920	0.930	0.940	0.980	1.100	1.170
DMU5	1.000	1.000	1.000	1.080	1.090	1.100	0.940	0.970	1.020	1.120	1.140	1.190
DMU6	0.909	0.917	0.926	1.000	1.000	1.000	1.100	1.130	1.180	0.990	1.020	1.040
DMU7	0.980	1.031	1.064	0.847	0.885	0.909	1.000	1.000	1.000	0.990	1.000	1.020
DMU8	0.840	0.877	0.893	0.962	0.980	1.010	0.980	1.000	1.010	1.000	1.000	1.000
DMU9	1.064	1.087	1.136	0.833	0.840	0.862	1.124	1.136	1.163	1.266	1.282	1.316
DMU10	0.962	0.980	1.010	0.980	1.000	1.010	0.855	0.909	1.020	0.840	0.877	0.893
DMU11	0.833	0.840	0.862	1.064	1.087	1.136	0.909	0.917	0.926	0.943	0.971	0.990
DMU12	0.935	0.962	0.971	0.980	1.000	1.010	1.031	1.064	1.099	0.980	1.031	1.064
DMU13	0.855	0.909	1.020	0.962	0.980	1.010	0.833	0.840	0.862	1.124	1.136	1.163
DMU14	0.909	0.917	0.926	0.952	0.980	1.010	0.943	0.971	0.990	1.266	1.282	1.316
DMU15	1.124	1.136	1.163	0.980	1.031	1.064	0.943	0.962	1.031	0.855	0.909	1.020
DMU16	0.855	0.909	1.020	0.943	0.971	0.990	1.176	1.205	1.266	0.833	0.840	0.862
DMU17	0.980	1.031	1.064	0.980	1.000	1.010	0.943	0.962	0.990	0.855	0.909	1.020
DMU18	0.952	0.980	1.010	1.053	1.087	1.136	0.962	0.980	1.010	0.909	0.917	0.926
DMU19	0.855	0.909	1.020	0.935	0.962	0.971	0.943	0.971	0.990	1.176	1.205	1.266
DMU20	0.909	0.917	0.926	1.064	1.087	1.136	1.176	1.205	1.266	0.840	0.877	0.893
DMU21	1.220	1.266	1.282	1.053	1.087	1.136	0.943	0.971	0.990	1.220	1.266	1.282
DMU22	1.176	1.205	1.266	0.952	0.980	1.010	0.855	0.909	1.020	1.099	1.136	1.149
DMU23	0.833	0.840	0.862	0.943	0.971	0.990	0.980	1.031	1.064	0.909	0.943	0.980
DMU24	1.053	1.087	1.136	1.099	1.136	1.149	0.847	0.885	0.909	0.980	1.031	1.064
DMU25	1.124	1.136	1.163	0.833	0.840	0.862	0.971	0.990	1.010	0.909	0.917	0.926
DMU26	1.176	1.205	1.266	0.855	0.909	1.020	0.943	0.962	1.031	0.980	1.000	1.010
DMU27	0.962	0.971	0.990	0.909	0.943	0.980	1.064	1.087	1.136	0.833	0.840	0.862
DMU28	1.064	1.087	1.136	0.840	0.877	0.893	0.909	0.917	0.926	1.053	1.087	1.136

	DMU9			DMU10			DMU11			DMU12		
DMU1	0.920	0.930	0.940	1.000	1.000	1.000	1.000	1.000	1.000	0.980	1.100	1.170
DMU2	0.910	0.930	0.960	0.760	0.780	0.790	0.910	0.940	0.930	0.860	0.880	0.890
DMU3	0.940	0.970	1.020	0.910	0.940	0.970	0.990	1.020	1.040	0.880	0.920	0.950
DMU4	1.080	1.090	1.100	1.030	1.040	1.070	1.100	1.130	1.180	1.010	1.030	1.060
DMU5	0.880	0.920	0.940	0.990	1.020	1.040	1.160	1.190	1.200	1.030	1.040	1.070
DMU6	1.160	1.190	1.200	0.990	1.000	1.020	0.880	0.920	0.940	0.990	1.000	1.020
DMU7	0.860	0.880	0.890	0.980	1.100	1.170	1.080	1.090	1.100	0.910	0.940	0.970
DMU8	0.760	0.780	0.790	1.120	1.140	1.190	1.010	1.030	1.060	0.940	0.970	1.020
DMU9	1.010	1.030	1.060	1.080	1.090	1.100	0.910	0.940	0.930	0.980	1.100	1.170
DMU10	0.909	0.917	0.926	1.000	1.000	1.000	0.860	0.880	0.890	1.120	1.140	1.190
DMU11	1.075	1.064	1.099	1.124	1.136	1.163	1.000	1.000	1.000	1.080	1.090	1.100
DMU12	0.855	0.909	1.020	0.840	0.877	0.893	0.909	0.917	0.926	1.000	1.000	1.000
DMU13	1.053	1.087	1.136	0.847	0.885	0.909	0.935	0.962	0.971	0.840	0.877	0.893
DMU14	0.855	0.909	1.020	1.031	1.064	1.099	1.124	1.136	1.163	1.053	1.087	1.136
DMU15	0.935	0.962	0.971	1.176	1.205	1.266	0.909	0.917	0.926	1.064	1.087	1.136
DMU16	0.971	1.020	1.064	0.943	0.962	1.031	0.980	1.031	1.064	0.980	1.000	1.010
DMU17	0.935	0.962	0.971	1.220	1.266	1.282	0.847	0.885	0.909	1.149	1.205	1.235
DMU18	0.943	0.962	0.990	0.847	0.885	0.909	0.855	0.909	1.020	0.943	0.971	0.990
DMU19	0.971	0.990	1.010	0.833	0.840	0.862	0.962	0.980	1.010	1.064	1.087	1.136
DMU20	0.943	0.962	0.990	0.980	1.000	1.010	1.053	1.087	1.136	0.971	0.990	1.010
DMU21	0.833	0.840	0.862	0.909	0.943	0.980	0.909	0.917	0.926	0.952	0.980	1.010
DMU22	1.064	1.087	1.136	0.971	0.990	1.010	1.266	1.282	1.316	0.935	0.962	0.971
DMU23	1.124	1.136	1.163	1.176	1.205	1.266	0.980	1.000	1.010	0.962	0.980	1.010
DMU24	0.971	0.990	1.010	0.855	0.909	1.020	0.935	0.962	0.971	0.952	0.980	1.010
DMU25	1.031	1.064	1.099	0.943	0.971	0.990	1.064	1.087	1.136	1.099	1.111	1.163
DMU26	1.099	1.136	1.149	0.980	1.031	1.064	1.266	1.282	1.316	0.833	0.840	0.862
DMU27	0.980	1.000	1.010	1.031	1.064	1.099	0.971	0.990	1.010	0.971	1.020	1.064
DMU28	0.971	1.020	1.064	0.971	0.990	1.010	0.855	0.909	1.020	1.099	1.136	1.149

	DMU13			DMU14			DMU15			DMU16		
DMU1	1.100	1.130	1.180	1.120	1.140	1.190	1.160	1.190	1.200	1.090	1.110	1.160
DMU2	0.760	0.780	0.790	0.990	1.020	1.040	0.880	0.920	0.940	1.030	1.040	1.070
DMU3	0.910	0.940	0.970	1.030	1.040	1.070	1.120	1.140	1.190	0.880	0.920	0.950
DMU4	0.880	0.920	0.940	0.790	0.830	0.850	0.990	1.020	1.040	0.990	1.020	1.050
DMU5	0.980	1.100	1.170	1.080	1.090	1.100	0.860	0.880	0.890	0.980	1.100	1.170
DMU6	0.990	1.020	1.040	0.990	1.020	1.050	0.940	0.970	1.020	1.010	1.030	1.060
DMU7	1.160	1.190	1.200	1.010	1.030	1.060	0.970	1.040	1.060	0.790	0.830	0.850
DMU8	0.860	0.880	0.890	0.760	0.780	0.790	0.980	1.100	1.170	1.160	1.190	1.200
DMU9	0.880	0.920	0.950	0.980	1.100	1.170	1.030	1.040	1.070	0.940	0.980	1.030
DMU10	1.100	1.130	1.180	0.910	0.940	0.970	0.790	0.830	0.850	0.970	1.040	1.060
DMU11	1.030	1.040	1.070	0.860	0.880	0.890	1.080	1.090	1.100	0.940	0.970	1.020
DMU12	1.120	1.140	1.190	0.880	0.920	0.950	0.880	0.920	0.940	0.990	1.000	1.020
DMU13	1.000	1.000	1.000	1.030	1.040	1.070	0.760	0.780	0.790	0.990	1.020	1.050
DMU14	0.935	0.962	0.971	1.000	1.000	1.000	0.880	0.920	0.950	1.120	1.140	1.190
DMU15	1.266	1.282	1.316	1.053	1.087	1.136	1.000	1.000	1.000	0.860	0.880	0.890
DMU16	0.952	0.980	1.010	0.840	0.877	0.893	1.124	1.136	1.163	1.000	1.000	1.000
DMU17	1.266	1.282	1.316	0.855	0.909	1.020	0.833	0.840	0.862	1.031	1.064	1.099
DMU18	1.053	1.087	1.136	1.124	1.136	1.163	0.935	0.962	0.971	0.952	0.980	1.010
DMU19	0.980	1.031	1.064	0.980	1.000	1.010	0.943	0.971	0.990	0.847	0.885	0.909
DMU20	0.840	0.877	0.893	0.833	0.840	0.862	0.952	0.980	1.010	0.909	0.917	0.926
DMU21	0.943	0.962	0.990	1.176	1.205	1.266	0.980	1.000	1.010	0.943	0.962	1.031
DMU22	1.031	1.064	1.099	0.943	0.971	0.990	1.075	1.099	1.136	0.909	0.943	0.980
DMU23	0.943	0.962	1.031	0.909	0.917	0.926	1.099	1.136	1.149	1.053	1.087	1.136
DMU24	1.031	1.064	1.099	0.833	0.840	0.862	0.909	0.943	0.980	0.943	0.971	0.990
DMU25	0.909	0.917	0.926	1.075	1.099	1.136	0.943	0.962	1.031	0.952	0.980	1.010
DMU26	1.075	1.099	1.136	1.031	1.064	1.099	0.909	0.943	0.980	0.840	0.877	0.893
DMU27	0.847	0.885	0.909	0.943	0.971	0.990	0.962	0.980	1.010	1.075	1.099	1.136
DMU28	0.980	1.000	1.010	0.909	0.943	0.980	1.031	1.064	1.099	1.176	1.205	1.266

	DMU17			DMU18			DMU19			DMU20		
DMU1	1.130	1.180	1.210	1.200	1.220	1.230	1.000	1.000	1.000	1.030	1.040	1.070
DMU2	0.940	0.970	1.020	1.030	1.040	1.070	1.120	1.140	1.190	0.910	0.940	0.970
DMU3	1.080	1.090	1.100	0.760	0.780	0.790	0.780	0.790	0.820	0.780	0.790	0.820
DMU4	0.860	0.880	0.890	1.160	1.190	1.200	0.880	0.920	0.950	0.860	0.880	0.890
DMU5	0.940	0.970	1.020	0.990	1.020	1.050	0.980	1.100	1.170	1.080	1.090	1.100
DMU6	0.990	1.000	1.020	0.880	0.920	0.950	1.030	1.040	1.070	0.880	0.920	0.940
DMU7	1.010	1.040	1.060	0.990	1.020	1.040	1.010	1.030	1.060	0.790	0.830	0.850
DMU8	0.980	1.100	1.170	1.080	1.090	1.100	0.790	0.830	0.850	1.120	1.140	1.190
DMU9	1.030	1.040	1.070	1.010	1.040	1.060	0.990	1.010	1.030	1.010	1.040	1.060
DMU10	0.780	0.790	0.820	1.100	1.130	1.180	1.160	1.190	1.200	0.990	1.000	1.020
DMU11	1.100	1.130	1.180	0.980	1.100	1.170	0.990	1.020	1.040	0.880	0.920	0.950
DMU12	0.810	0.830	0.870	1.010	1.030	1.060	0.880	0.920	0.940	0.990	1.010	1.030
DMU13	0.760	0.780	0.790	0.880	0.920	0.950	0.940	0.970	1.020	1.120	1.140	1.190
DMU14	0.980	1.100	1.170	0.860	0.880	0.890	0.990	1.000	1.020	1.160	1.190	1.200
DMU15	1.160	1.190	1.200	1.030	1.040	1.070	1.010	1.030	1.060	0.990	1.020	1.050
DMU16	0.910	0.940	0.970	0.990	1.020	1.050	1.100	1.130	1.180	1.080	1.090	1.100
DMU17	1.000	1.000	1.000	1.120	1.140	1.190	0.760	0.780	0.790	0.990	1.020	1.040
DMU18	0.840	0.877	0.893	1.000	1.000	1.000	0.860	0.880	0.890	0.990	1.000	1.020
DMU19	1.266	1.282	1.316	1.124	1.136	1.163	1.000	1.000	1.000	0.940	0.970	1.020
DMU20	0.962	0.980	1.010	0.980	1.000	1.010	0.980	1.031	1.064	1.000	1.000	1.000
DMU21	0.971	0.990	1.010	1.064	1.087	1.136	0.833	0.840	0.862	0.909	0.917	0.926
DMU22	0.840	0.877	0.893	1.124	1.136	1.163	1.099	1.136	1.149	0.855	0.909	1.020
DMU23	0.847	0.885	0.909	0.909	0.943	0.980	0.833	0.840	0.862	0.909	0.917	0.926
DMU24	0.943	0.962	1.031	0.855	0.909	1.020	1.124	1.136	1.163	1.064	1.087	1.136
DMU25	0.962	0.980	1.010	0.971	1.020	1.064	0.833	0.840	0.862	0.980	1.031	1.064
DMU26	0.971	1.020	1.064	1.124	1.136	1.163	1.064	1.087	1.136	1.176	1.205	1.266
DMU27	1.099	1.111	1.163	0.847	0.885	0.909	1.075	1.099	1.136	1.220	1.266	1.282
DMU28	1.124	1.136	1.163	0.962	0.971	0.990	1.266	1.282	1.316	1.064	1.087	1.136

	DMU21			DMU22			DMU23			DMU24		
DMU1	0.910	0.940	0.930	0.990	1.000	1.020	1.010	1.020	1.030	0.870	0.910	0.930
DMU2	0.990	1.020	1.050	1.160	1.190	1.200	0.910	0.940	0.970	0.790	0.830	0.850
DMU3	1.160	1.190	1.200	1.010	1.040	1.060	1.100	1.130	1.180	1.120	1.140	1.190
DMU4	0.810	0.830	0.870	0.860	0.880	0.890	0.780	0.790	0.820	0.990	1.000	1.020
DMU5	0.780	0.790	0.820	0.790	0.830	0.850	1.160	1.190	1.200	0.880	0.920	0.950
DMU6	0.880	0.920	0.950	0.990	1.020	1.050	1.010	1.030	1.060	0.870	0.880	0.910
DMU7	1.010	1.030	1.060	0.980	1.100	1.170	0.940	0.970	1.020	1.100	1.130	1.180
DMU8	0.780	0.790	0.820	0.870	0.880	0.910	1.020	1.060	1.100	0.940	0.970	1.020
DMU9	1.160	1.190	1.200	0.880	0.920	0.940	0.860	0.880	0.890	0.990	1.010	1.030
DMU10	1.020	1.060	1.100	0.990	1.010	1.030	0.790	0.830	0.850	0.980	1.100	1.170
DMU11	1.080	1.090	1.100	0.760	0.780	0.790	0.990	1.000	1.020	1.030	1.040	1.070
DMU12	0.990	1.020	1.050	1.030	1.040	1.070	0.990	1.020	1.040	0.990	1.020	1.050
DMU13	1.010	1.040	1.060	0.910	0.940	0.970	0.970	1.040	1.060	0.910	0.940	0.970
DMU14	0.790	0.830	0.850	1.010	1.030	1.060	1.080	1.090	1.100	1.160	1.190	1.200
DMU15	0.990	1.000	1.020	0.880	0.910	0.930	0.870	0.880	0.910	1.020	1.060	1.100
DMU16	0.970	1.040	1.060	1.020	1.060	1.100	0.880	0.920	0.950	1.010	1.030	1.060
DMU17	0.990	1.010	1.030	1.120	1.140	1.190	1.100	1.130	1.180	0.970	1.040	1.060
DMU18	0.880	0.920	0.940	0.860	0.880	0.890	1.020	1.060	1.100	0.980	1.100	1.170
DMU19	1.160	1.190	1.200	0.870	0.880	0.910	1.160	1.190	1.200	0.860	0.880	0.890
DMU20	1.080	1.090	1.100	0.980	1.100	1.170	1.080	1.090	1.100	0.880	0.920	0.940
DMU21	1.000	1.000	1.000	0.990	1.020	1.050	0.940	0.970	1.020	1.100	1.130	1.180
DMU22	0.952	0.980	1.010	1.000	1.000	1.000	0.990	1.010	1.030	0.760	0.780	0.790
DMU23	0.980	1.031	1.064	0.971	0.990	1.010	1.000	1.000	1.000	0.880	0.920	0.950
DMU24	0.847	0.885	0.909	1.266	1.282	1.316	1.053	1.087	1.136	1.000	1.000	1.000
DMU25	0.980	1.000	1.010	1.099	1.111	1.163	1.031	1.064	1.099	1.075	1.099	1.136
DMU26	1.099	1.111	1.163	0.855	0.909	1.020	0.962	0.980	1.010	1.266	1.282	1.316
DMU27	0.833	0.840	0.862	0.943	0.971	0.990	1.149	1.205	1.235	0.847	0.885	0.909
DMU28	0.909	0.917	0.926	0.935	0.962	0.971	1.099	1.136	1.149	0.971	0.990	1.010

	DMU25			DMU26			DMU27			DMU28		
DMU1	1.010	1.030	1.060	0.880	0.890	0.910	0.910	0.930	0.960	0.970	0.980	0.990
DMU2	1.100	1.130	1.180	1.030	1.040	1.070	0.940	0.970	1.020	1.030	1.040	1.070
DMU3	0.990	1.020	1.040	0.880	0.920	0.950	0.860	0.900	0.910	0.760	0.780	0.790
DMU4	0.970	1.040	1.060	0.910	0.940	0.970	0.860	0.880	0.890	1.010	1.030	1.060
DMU5	0.860	0.880	0.890	0.790	0.830	0.850	1.010	1.030	1.040	0.880	0.920	0.940
DMU6	1.160	1.190	1.200	0.980	1.100	1.170	1.020	1.060	1.100	1.120	1.140	1.190
DMU7	0.990	1.010	1.030	0.970	1.040	1.060	0.880	0.920	0.940	1.080	1.090	1.100
DMU8	1.080	1.090	1.100	0.990	1.000	1.020	1.160	1.190	1.200	0.880	0.920	0.950
DMU9	0.910	0.940	0.970	0.870	0.880	0.910	0.990	1.000	1.020	0.940	0.980	1.030
DMU10	1.010	1.030	1.060	0.940	0.970	1.020	0.910	0.940	0.970	0.990	1.010	1.030
DMU11	0.880	0.920	0.940	0.760	0.780	0.790	0.990	1.010	1.030	0.980	1.100	1.170
DMU12	0.860	0.900	0.910	1.160	1.190	1.200	0.940	0.980	1.030	0.870	0.880	0.910
DMU13	1.080	1.090	1.100	0.880	0.910	0.930	1.100	1.130	1.180	0.990	1.000	1.020
DMU14	0.880	0.910	0.930	0.910	0.940	0.970	1.010	1.030	1.060	1.020	1.060	1.100
DMU15	0.970	1.040	1.060	1.020	1.060	1.100	0.990	1.020	1.040	0.910	0.940	0.970
DMU16	0.990	1.020	1.050	1.120	1.140	1.190	0.880	0.910	0.930	0.790	0.830	0.850
DMU17	0.990	1.020	1.040	0.940	0.980	1.030	0.860	0.900	0.910	0.860	0.880	0.890
DMU18	0.940	0.980	1.030	0.860	0.880	0.890	1.100	1.130	1.180	1.010	1.030	1.040
DMU19	1.160	1.190	1.200	0.880	0.920	0.940	0.880	0.910	0.930	0.760	0.780	0.790
DMU20	0.940	0.970	1.020	0.790	0.830	0.850	0.780	0.790	0.820	0.880	0.920	0.940
DMU21	0.990	1.000	1.020	0.860	0.900	0.910	1.160	1.190	1.200	1.080	1.090	1.100
DMU22	0.860	0.900	0.910	0.980	1.100	1.170	1.010	1.030	1.060	1.030	1.040	1.070
DMU23	0.910	0.940	0.970	0.990	1.020	1.040	0.810	0.830	0.870	0.870	0.880	0.910
DMU24	0.880	0.910	0.930	0.760	0.780	0.790	1.100	1.130	1.180	0.990	1.010	1.030
DMU25	1.000	1.000	1.000	0.870	0.880	0.910	0.880	0.910	0.930	1.020	1.060	1.100
DMU26	1.099	1.136	1.149	1.000	1.000	1.000	0.860	0.900	0.910	1.120	1.140	1.190
DMU27	1.075	1.099	1.136	1.099	1.111	1.163	1.000	1.000	1.000	0.880	0.910	0.930
DMU28	0.909	0.943	0.980	0.840	0.877	0.893	1.075	1.099	1.136	1.000	1.000	1.000

Appendix 2. Result of pairwise comparisons

$\tilde{r}_i$	lr_i	mr_i	ur_i	$\tilde{r}_i$	lr_i	mr_i	ur_i
$\tilde{r}_1$	0.990	1.011	1.029	$\tilde{r}_{15}$	0.984	1.010	1.042
$\tilde{r}_2$	0.958	0.986	1.013	$\tilde{r}_{16}$	0.965	0.996	1.027
$\tilde{r}_3$	0.959	0.986	1.013	$\tilde{r}_{17}$	0.972	1.003	1.034
$\tilde{r}_4$	0.943	0.971	0.997	$\tilde{r}_{18}$	0.949	0.977	1.005
$\tilde{r}_5$	0.955	0.990	1.016	$\tilde{r}_{19}$	0.979	1.006	1.031
$\tilde{r}_6$	0.985	1.014	1.043	$\tilde{r}_{20}$	0.962	0.990	1.015
$\tilde{r}_7$	0.970	1.004	1.030	$\tilde{r}_{21}$	0.994	1.015	1.042
$\tilde{r}_8$	0.958	0.989	1.019	$\tilde{r}_{22}$	0.981	1.011	1.043
$\tilde{r}_9$	0.986	1.016	1.043	$\tilde{r}_{23}$	0.955	0.980	1.007
$\tilde{r}_{10}$	0.965	0.994	1.023	$\tilde{r}_{24}$	0.970	0.999	1.035
$\tilde{r}_{11}$	0.968	0.991	1.016	$\tilde{r}_{25}$	0.970	0.992	1.022
$\tilde{r}_{12}$	0.956	0.985	1.016	$\tilde{r}_{26}$	1.018	1.047	1.085
$\tilde{r}_{13}$	0.957	0.984	1.013	$\tilde{r}_{27}$	0.990	1.016	1.044
$\tilde{r}_{14}$	0.988	1.017	1.046	$\tilde{r}_{28}$	1.000	1.026	1.054

Appendix 3. Result of decision units' weights

Units efficiency	lr_i	mr_i	ur_i	Units efficiency	lr_i	mr_i	ur_i
E1	0.034	0.036	0.038	E15	0.034	0.036	0.038
E2	0.033	0.035	0.037	E16	0.033	0.036	0.038
E3	0.033	0.035	0.037	E17	0.034	0.036	0.038
E4	0.033	0.035	0.037	E18	0.033	0.035	0.037
E5	0.033	0.035	0.037	E19	0.034	0.036	0.038
E6	0.034	0.036	0.038	E20	0.033	0.035	0.037
E7	0.034	0.036	0.038	E21	0.034	0.036	0.038
E8	0.033	0.035	0.037	E22	0.034	0.036	0.038
E9	0.034	0.036	0.038	E23	0.033	0.035	0.037
E10	0.033	0.036	0.038	E24	0.034	0.036	0.038
E11	0.034	0.035	0.037	E25	0.034	0.035	0.038
E12	0.033	0.035	0.037	E26	0.035	0.037	0.040
E13	0.033	0.035	0.037	E27	0.034	0.036	0.038
E14	0.034	0.036	0.038	E28	0.035	0.037	0.039