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The Ranking of Financial Efficiency of Companies Accepted in Stock Exchange of Tehran between 2013 to 2016 through Financial Ratio Approach and Using DEA

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Abstract

Financial ratios provide an image of financial status, the efficiency and future opportunities of trade units. In so far as in traditional methods and approaches, the effect of financial ratios on efficiency were individually studied they did not provide a comprehensive view; thus; a technique was chosen, through which the observation of the effect of financial ratios beside each other becomes possible. Using the data envelopment analysis technique, the financial ratios are aggregated and it becomes possible to observe their effects together; thus, the obtained efficiency through this method would be reliable. In this study, input-based BCC mathematical model of data envelopment analysis has been used and the relative efficiency of 470 companies accepted in Tehran Stock Exchange in 2013 to 2016 which were classified in nine heterogeneous groups were calculated and then the companies were ranked based on the efficiency; efficient and inefficient companies were specified. Moreover, the analysis and forecasts were performed to areas of financial distress and bankruptcy based on industry average obtained from each group concerning the future financial situation of companies where the group of construction materials with industry average of 0.89 was at the highest rank and the group of investment companies with industry average of 0.67 was at the lowest rank among these nine groups.

Keywords: Financial efficiency; Financial ratio; Stock Exchange; Data envelopment analysis (DEA).

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1. introduction

The evaluation of organizational performance is critical and vital for making efficient and effective organizational decisions. In so far as the financial situation of organizations is always one of the key set of indices for evaluation of organizational performance, the evaluation of financial situation in organizations has always been considered and used by top managers and organizational stakeholders [20]. One of the indices used for investigation of financial performance of each organization is financial ratio. When two or several ratio shows opposite signs, the main problem of the ratio analysis of financial statements is that each of financial ratios evaluates one dimension of financial performance of organization, such that some of them measure the ability to liquidate current debt payments, a group Determine the size and extent of financial resources available from the outside of the company; furthermore, they measure the efficiency of the management of the institution in the use of its resources; another part measures the institution's overall activity through profit from sales and investments. Finally, the last group evaluates the way the organization operates[14]. The present study proposes data envelopment analysis for removing this problem. This method allocates a unit score, called efficiency to each investigated item by aggregation of ratios. In fact, by entering the ratio as the input and output of the model, this technique converts them to a unit criterion with the capability of performance evaluation and comparison.

In sum, it could be claimed that this study intends to dealt with the measurement of the financial efficiency of companies accepted in Exchange Office of Tehran in 2013 to 2016 using two approaches of financial ratio and data envelopment analysis based on balanced and accumulated attitude toward analysis of financial ration. Based on this, the main research question is that which of the companies accepted in Tehran Exchange Office in mentioned years benefit from financial efficiency and which one is inefficient and how is the ranking of these companies in terms of financial efficiency? So that based on this, it becomes possible to use them in macro and micro level planning for efficient companies and companies with financial depreciation.

2. Theoretical foundations and review of related literature

2.1. Theoretical foundations

●Efficiency and its estimation methods

According to the approval of operational accounting committee of auditing organization, efficiency is the ratio of results obtained from operation (output) to the consumed resources (input) in comparison with a certain standard [7]. The efficient operation is the operation which using optimum methods supplies maximum efficiency (output) with using minimum resources (input) [10]. The manner of calculating efficiency is expressed in equation 2-1.

$$Efficiency = \frac{\frac{Real\ output}{Real\ input}}{\frac{Expected\ output}{Real\ input}} = \frac{Real\ output}{Expected\ output} \quad (1)$$

Different types of efficiency are scale efficiency, technical efficiency, expert efficiency, structural and financial efficiency; all of which are for maximizing production with certain cost or minimizing cost with certain production level and their result is maximization of the profit of decision making unit [16].In this study, in so far as the effect of financial ratio on efficiency is investigated, the concept of financial efficiency has been used.

Financial efficiency means the ratio of financial outputs due to performance and activities of institute to data related to various applied factors in performing different activities of institute [15].

In overall, traditional and scientific approaches could be proposed for measuring efficiency of economic units. The scientific methods are divided into parametric and non-parametric branches. Parametric approach which makes use of statistical methods has mostly applications in analysis of economic issues. The trend of parametric approach is such that using observed data, it is possible to estimate the parameters of a certain production function and then based on it, the efficiency of units under evaluation will be specified. The main hypothesis of this approach is the clear relation between input and output [15]. The Non-parametric methods usually examines the performance of one enterprise or deicison making unit with the best actualized performance of enterprises inside that industry. In this research, a nonparametric approach has been used.

- **Data envelopment analysis**

DEA is one of the nonparametric approaches based on mathematical programming which makes the evaluation of the efficiency of similar decision making units with multiple input and output possible. In this method, using an optimization series based on linear programming, efficient borderline will be created. Then after determination of efficient borderline, it will be specified that whether the investigated units are located on efficient borderline or not and in this way the efficient and non-efficient units will be distinguished from each other which will be possible only through specifying the coefficient of inputs and outputs for each decision making unit. In fact, data envelopment analysis specification in determination of input and output coefficients is through using mathematical linear programming.[6]

As previously mentioned, the efficiency of one unit requires the comparison of the inputs and outputs of that unit. In the simplest state where there is only one input and one output, the efficiency could be obtained by dividing output by input.

If decision making unit has multiple input and output and the value (coefficient) of each input and output is known, it is possible to calculate the efficiency by dividing the sum of outputs value multiply by coefficients (price or value) by sum of inputs value multiply by related coefficient.

Efficiency= Total weighted outputs/ total weighted inputs (2)

However, in most cases the coefficients (price or value) of inputs and outputs are not clear or inputs and outputs have different scales. In these cases, it is possible to use DEA. In this method, the coefficients of inputs and outputs for each operational unit which is called a decision making unit (DMU) is determined such that the efficiency of that unit maximizes in respect to other units.

- **DEA models**

The main models of DEA are divided into two main categories of BCC[2] and CCR[3]. Two main features for using DEA is the identity of pattern and output to pattern scale which will be explained.

1. The identity of the used model: the identity (approach) of the used pattern is divided into two categories of input and output of axis which are examined as follow:

a. The input identity

If in evaluation process, it is intended to minimize the inputs by keeping the output

1. A model of data envelopment analysis from the beginning of the name of Banker, Charnes and Cooper.

2. A model of data envelopment analysis from the beginning of the names of Charnes, Cooper and *Rhodes*

level fixed, the identity of the used pattern is input.

b. The output identity

If in evaluation process, it is intended to increase the level of output by keeping the level of inputs fixed, the identity of the used pattern is output.

2. The output to used pattern scale: The output to scale indicates the link between the variations of inputs and outputs of a system.

a. The output to fixed scale

The output to fixed scale means any coefficient of the inputs produces the same coefficient of outputs. In CCR pattern, the output to unit scales is assumed to be fixed; thus, the small and big units are compared.

b. The output to varied scale

The output to varied scale means any coefficient of inputs could produces the same coefficient of outputs or less or more in the outputs. In BCC pattern, the output to scale is assumed as varying.

- **CCR model**

Farrell (1957) was the first individual who proposed nonparametric method using linear programming [12]. Using an innovative method, Farell began measuring the performance of a production unit. The model which he investigated considered just one input and one output and he was not able to expand his model with multiple inputs and outputs[2]. In 178, Charnes, Cooper and Rhodes generalized Farrel method for the state with multiple inputs and multiple outputs which due to the first letters of the name of presents it becomes known as CCR method. In CCR model, the efficiency is defined the same as parametric methods as the ratio of output to input. The unit with the higher ratio is called efficient unit.

The variables of problem are underweights and the answer of the problem provides the most appropriate and desirable values for the weights of decision making unit or zero unit and evaluates its efficiency. Its mathematical model is as follow:

$$\text{Max } Z_0 = \frac{\sum_{r=1}^{s} u_r y_{r0}}{\sum_{i=1}^{m} v_i x_{i0}}$$

st: for each unit (j= 1, 2, ….., n)

$$\frac{\sum_{r=1}^{s} u_r y_{rj}}{\sum_{i=1}^{m} v_i x_{ij}} \leq 1 \qquad \text{(3): CCR model}$$

$$u_r, v_i \geq 0 \qquad [5]$$

x_{ij}= The value of i^{th} input for j^{th} unit (i = 1, 2, …., m)

y_{rj}= The value of r^{th} outpt for j^{th} unit (r= 1, 2, ….., s)

u_r= The weight given to r^{th} output (cost of r^{th} output)

V_i= The weight given to i^{th} input (cost of i^{th} input)

- **BCC Model**

One of the features of DEA is output to scale structure. As previously mentioned, output to scale could be fixed or varying. CCR models are among the models with fixed output to scale models. The fixed output to scale model is appropriate when all units acts in optimum scale. In evaluation of the efficiency of units, when the condition of incomplete competition imposes constrains in investment, it leads to failure in unit activity in scale.

In 1984, Banker, Charnes and Cooper presented a new model by changing CCR that concerning the first letters of their names, it was known as BCC model. BCC model is a model of DEA models that deals with evaluation of relative efficiency of units with variable output in respect to scale.

BCC model is as follow for evaluation of efficiency of unit under investigation (zero):

$$\text{Max } Z_0 = \frac{\sum_{r=1}^{s} u_r y_{r0} + \omega}{\sum_{i=1}^{m} v_i x_{i0}}$$

St: BCC model: (4)

$$\frac{\sum_{r=1}^{s} u_r y_{rj} + \omega}{\sum_{i=1}^{m} v_i x_{ij}} \leq 1 \qquad (j=1,2,\ldots..,n)$$

$$u_r, v_i \geq 0$$

ω free in terms of signs

As observed, the difference of this model with CCR model is in free variable in ω sign. In BCC model, the sign of ω could specify the output to scale for each unit.
In order to turn this model to input-oriented model, we add one free variable in sign to model. The model will be a multiple of input-oriented BCC as follow:

$\text{Max } Z_0 = \sum_{r=1}^{s} u_r y_{r0} + \omega$

(5): (The initial model of Input-oriented BCC)

st:

$$\sum_{i=1}^{m} v_i x_{i0} = 1$$

$\sum_{r=1}^{s} u_r y_{rj} - \sum_{i=1}^{m} v_i x_{ij} + \omega \leq 0$

(j=1,2,….,n)

$u_r, v_i \geq 0$ ω free in terms of sign

However, in order to convert BCC fractional model to a linear programming model, it is possible to use another method. In this method, by applying another constrain, the BCC fractional model to following linear programming model which indicate an output- oriented BCC model.

$\text{Min} Z_0 = \sum_{i=1}^{m} v_i x_{i0} + \omega$

(6): (Initial model of output-oriented BCC model)

st:

$$\sum_{r=1}^{s} u_r y_{r0} = 1$$

$\sum_{i=1}^{m} v_i x_{ij} - \sum_{r=1}^{s} u_r y_{rj} + \omega \leq 0$

(j=1,2,….,n) [5]

$u_r, v_i \geq 0$

The BCC model is the same as the CCR model. However, in the initial form of this model, the constraint $\{1\overline{\lambda}=1\}$ is added to the other constraints of the CCR model, and therefore in its secondary form, the variables corresponding to that restriction are added to the objective function. This issue is based on the relationship between the initial problems and The secondary is achieved in linear programming.

In the formulation of the CCR model, it is assumed that the relationship between inputs and outputs follows the assumption of return to a constant scale; that is, if the inputs are doubled, outputs are also doubled, in which outputs are incremental more than twice or less than twice, in order of their returns assumed to be incremental or decreasing. In many organizations, the assumption of returns to a constant scale is not established. This problem is corrected by adding the above mentioned restrictions in the BCC model.
Therefore, in view of the main theme for constructing data envelopment analysis models, the set of the possibility of production BCC is defined as formula 6, which is represented by (pps):

$\text{pps}=\{(X,Y)\mathbb{I}X \geq X\lambda, Y \leq X\lambda, 1\overline{\lambda} = 1, \lambda \geq 0\}$ (6)

where in:

$\{X=(x_j) \subset R^{m\times n}\}$,

$\{Y=(y_j) \subset R^{S\times N}\}$ (7)

Is a set of data and $(\lambda \subset R^n)$.so $(\underset{i}{\rightarrow})$ is a vector with all its elements equal to one. Therefore, the difference between the BCC model and the CCR model is only in $1\lambda = \sum_{j=1}^{n} \lambda_j = 1$

Condition. This condition analyzes a constraint situation due to the $(\lambda_j \geq 0)$ constraint for combining DMUs.[5]
In so far as the investigated model calculates the efficiency with determination of input and output weights, it is called weighted or CCR model.
In DEA, CCR form usually yield envelopment form. Envelopment form calculates the efficiency based on estimation of production function and comparison of the unit under evaluation with efficiency borderline. The result of efficiency of both forms is the same; however, different side results will be yielded.

- **Financial ratios**

Financial ratios create mathematical and logical relation between the items in financial reports that is used for qualitative evaluation of quantitative data and classification and prediction of future status of companies. These ratios are divided into four general categories including :

1. liquidity ratios
2. activity ratios
3. leverage ratios
4. Profitability ratios

1. Liquidity ratios: These ratios show the abilities of a company in respect to payment of short-term liabilities and payment of current debts by the current assets. The ratios of this group include: current ratio, future ratio, capital in net circulation.
2. Leverage ratios: This measure measures the extent to which a firm finances a company through a loan or borrowing from outside the institution. Among the ratios of this group are the ratio of debt, the ratio of the ability to pay interest and the ratio of covering fixed costs[14].
3. Activity ratios: This group measures the ratios of the degree to which an institution's management efficiency is measured in the use of its resources. Among the ratios of this group are: inventory turnover, average earnings period, inventory age, operating cycle, fixed assets turnover and total assets turnover.
4. Profitability ratios: This group of ratios measures the overall management of the firm through profit from sales and investments (the profitability of the company in a given period), and the ability to study profit and return on investment, a measure for financial health And effective management of the company. Among the ratios of this group are: net profit to sales (profit margin ratio), total return on investment and return on equity [14].

Independent variables in this study are financial ratios which are used in two input and output groups. The inputs and outputs have been selected concerning the past researches, survey of experts and available resources.

2.2. Literature review

Abedi Dehkordi (2017) [1] investigated the relative financial efficiency of active companies in ceramic industry in Tehran Stock Exchange with DEA model and its relation with stock return. In this paper, first the relative efficiency of active companies in ceramic industry during 2010 to 2014 using DEA has been investigated (BCC and CCR) and then the relation between efficiency and rate of return in these companies has been tested. The statistical population of this study is the companies accepted in Tehran Exchange Office and the statistical sample includes active companies in ceramic industry. In this study, library data collection method, regression analysis, meaningful test of Pearson correlation coefficient has been used. The results of this study indicate meaningful relation between relative efficiency of companies from output-oriented approach and stock rate of return.

Matinfard and Taqhadosi (2017) [8] in their study investigated "The Evaluation of efficiency of financial and non-financial variables in prediction of bankruptcy of companies accepted in Tehran exchange office". There are various variables for prediction of bankruptcy; however, the aim of this study is determination of the pattern including financial variables (balance sheet, profit and loss statement and the ratio of financial statements of cash flows) and non-financial variables which beside each other have better quality and power for prediction of bankruptcy. In this study, financial information of 88 companies accepted in Tehran exchange

office in 2010 to 215 has been studied. In this study descriptive and inferential statistics have been used for explanation and meaningful test of hypotheses. Moreover, regression model for each company is individually estimated. The results of test showed that all hypotheses were confirmed and among some financial and non-financial variables, there is direct and meaningful relation with probability of bankruptcy and for some other variables, this equation is not established.

Shokrollah Khajavi et al (2011) [6] in their study examined "DEA technique as complementary for traditional analysis of financial ratios". In this study, the financial statements of 267 companies accepted in Tehran stock exchange for fiscal year 2009 has been analyzed. The financial ratios and data, 4 inputs and 7 outputs of input-oriented constituted BCC envelopment model. The implementation of mentioned model showed that among 267 investigated company, 32 companies have relative efficiency and 235 companies are inefficient.

Faraqnia and Shaker Mahmoud Kiani (2014) [4] studied the evaluation of financial efficiency of pharmaceutics companies accepted in Tehran Stock Exchange using superefficient models of DEA and investigation of its relation with financial ratios. The aim of present study is evaluation of financial performance of 72 pharmaceutics companies accepted in Tehran stock exchange in 2010 to 2012 relying on mathematical planning technique of DEA with "Envelopment form of superefficient mode under output to fixed scale ratio of input identity" and its relation with the activity ratio of financial ratios. The average score of efficiency of pharmaceutics companies in 2010 to 2012 has been respectively 0.85, 0.77 and 0.69 and Iran Injection Processes Company and Zahravi Company were considered as the most efficient units. The normal data distribution was confirmed with Kolmogorov- Smirnov test and the research hypotheses were investigated with Pearson correlation test. The results showed that there is positive and meaningful relation between the efficiency of DEA and the ratios of activities and its dimensions include the circulation of total assets, the ratio of goods inventory and the ratio of receivable accounts.

Bozorgi Khanqa et al (2012)[3] in their study investigated the performance and efficiency level of Agricultural Cooperative Companies with emphasis on financial indices through DEA (case study of Agricultural Cooperatives of Yazd Province). In this sectional- analytical study, the efficiency of Agricultural Cooperative Companies of Yazd Province (24 companies) using DEA in 2011 was investigated. To this end, output-oriented model of DEA was used with the assumption of variable efficiency compared to scale and three inputs, i.e. rate of capital, receivable facilities, number of members and five outputs, i.e. the ratio of special value, the ratio of total circulation of assets, the per capita revenue of member, the sale volume to member and its growth were used for investigation.

Khan et al (2017) [7] in this study investigated "The efficiency of banks in south Asia: Indonesia, Malaysia, Philippine and Thailand". The aim of this study is the use of DEA concept for comparison of the technical efficiency of banks in selected countries of South Asia in 1998- 2012. The analysis shows that even in the trend of performed financial revisions in the selected countries, there are some similarities and the observed output levels of banks in market is completely different.

Permachandra et al. (2007)[13] in their study dealt with "DEA as an instrument for evaluation and bankruptcy: preliminary study with Logistics regression technique". The results of study indicate that the patterns based on logistic analysis

in educational samples have higher precision than the patterns based on DEA while in test samples, the patterns based on DEA act better.

Tyrone et al (2009) [18] performed a study for evaluation of technical efficiency of 117 branches of a certain bank in Taiwan and used CCR model of DEA for evaluation of the efficiency of branches. In this study, the average score of efficiency between banks is 54% and 9 branches were recognized as efficient.

Vezakin & Dozakin (2007) [19] in a study dealt with the evaluation of performance of various industrial sectors of Turkey. In this study, 3 components of net assets, number of employees and gross added value as the input and two components of profit before tax deduction and export revenue of each sector were used as output for evaluation model of data envelopment analysis in general level of companies and also companies in each industry. The results indicate that during 2007, only 9 companies in general level and 65 companies at the level of each industry acted efficiently and companies were recognized as most inefficient companies which were acting below average level of total companies level and level of industries.

3. Research methodology

This study dealt with evaluation of the efficiency of Tehran Stock Exchange Company using data envelopment analysis. Concerning the fact that this study is sectional and its objective is the evaluation of the efficiency of companies in Tehran stock exchange, the required information on the performance of companies were selected through balance sheet and profit and loss statement for four fiscal years from 2013 to 2016. In order to determine the efficiency and ranking of companies through DEA model, usually all companies were grouped in one group and analyzed. Concerning the identity of DEA where all members of set (DMUs) should have the same identity, this subject is one of the weaknesses of the previous studies. To this end, in this study, all companies accepted in Tehran stock exchange who were selected as the statistical population were classified in nine heterogeneous groups including: 1. Pharmaceutical companies, 2. Food industries, 3. Chemical and oil products, 4. Automobile and transportation, 5. Constructional materials, 6. Metal industries, 7. Technology, 8. Investment companies and financial intermediaries, 9. Credit institutions and banks which leads to increased precision of analysis and higher generalizability. The basis for this classification is the type of production system and similar risks which is for each category. For example, the construction industries and ceramic companies which are placed in a category have both continuous production system and in terms of storage of initial materials and distribution and transportation of products are similar and thus have similar financial and non-financial risks.

3.1. Research variables

Financial ratios create mathematical and logical relation between the items in the financial reports that are used for qualitative evaluation of quantitative information and classification and prediction of future status of companies (decision making units). The independent variables in this study are financial ratios that have been used in two input and output groups. Concerning previous studies, inputs and outputs have been selected through poling from experts and accessible resources.

Input: The factor whose increase with maintenance of other factors leads to efficiency decrease and whose decrease with maintenance of other factors leads to efficiency increase.

Output: The factor whose increase with maintenance of other factors leads to efficiency increase and whose decrease

with maintenance of other factors leads to efficiency decrease.

The factors that should be taken into account in selection of data factors (input) and output are:

1. There is a conceptual relation between inputs and outputs.
2. A value relation between inputs and outputs are inferred in practice.
3. The relation between inputs and outputs is direct.
4. The inputs and outputs are not negative and each DMU has at least one positive input and output.
5. {(input+ output) * 2 or ((input+ output) * MAX 3} ≤ the number of DMU [17].

The interesting issue in DEA method is that if the number of DMUs has not significant difference in comparison with the number of inputs and outputs, after solving the problem we will see that most DMUs will be efficient. What is achieved experimentally is that the number of DMUs under investigations should follow the above relation with total number of inputs and outputs [9] which is respected in grouping in this study. (Table1)

In so far as DEA pattern cannot take negative data, for adjustment of negative numbers, the smallest negative number of each input and output should be specified and by adding the positive number to related numbers, data set (variables) will be prepared for implementation of DEA pattern by software.

In order to access required financial information, annual financial statements of companies are required which have been collected through website f development research management and Islamic studies of Tehran stock exchange and library of Tehran stock exchange; Codal site and Rahavard Novin software.

3.2. DEA model used

The type of DEA model which is used in this study is input- oriented BCC with envelopment form; the reason is that the change in inputs doesn't lead to change in outputs of the same ratio and the investigated companies don't act optimally. The output to scale is varied; thus BCC model is more appropriate model. The reason for selection of this approach for the pattern is that in this study, the managements of companies have not that much control on the output (profit); however, they could decrease their input and thus increase the efficiency. In these cases, the value of inputs is as decision variable; thus, the input approach is used.

Table 1. Research variables

Name of variable	Symbol	Variable	Method of calculation
Debt ratio	TLTA	Input	Total assets/ total debts (without stakeholders' right)
Debt to special value ratio	TDE	Input	Stakeholders' rights/ total debts
Return on assets	ROA	Output	Assets/ net profit after tax deduction
Return on stakeholders' right	ROE	Output	Stakeholders' right/ net profit after tax deduction
Fixed assets circulation	CATA	Output	Fixed net assets/ total revenues (sale)
Total assets circulation	NSTA	Output	Total assets/ total revenues (sale)
Profit margin	PM	Output	Sale/ net profit after tax deduction

3.3. Data analysis method

First research variables that include the rate of debt, debt to special value ratio as the input and return on asset, output of stakeholders' right, fixed asset circulation, total assets circulation and profit margin are as output achieved through financial statements of companies for four fiscal years from 2013 to 2016. In follow, using input- oriented BCC model, the input and

output variables whose values were obtained through financial statements of companies are entered for each group of industry and each year individually into MATLAB and the results of efficiency for each year and each category will be calculated and then the efficiency numbers are ranked in Excel and based on the efficiency of companies for them, the curve has been drawn for each year such that the ranking of companies is better observable, understandable and distinguishable. In follow, using the average of the achieved efficiencies in four years, a new ranking of companies will be presented which is explained in next section. In follow, using the definition of industry average and achieved efficiency values, analysis of the future status of companies will be performed.

4. Research findings

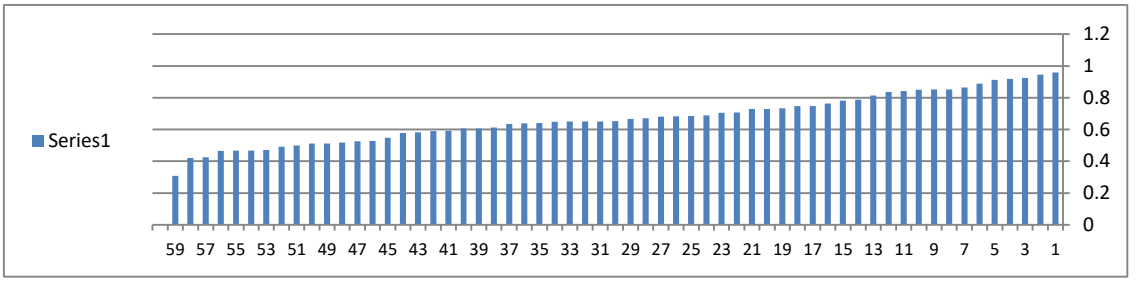
The ranking of efficiency and determination of efficient and inefficient companies and the efficiency curves of each group for each year have been individually calculated and for each group, the general ranking of companies has been explained in tables and curves based on average efficiency in 2013 to 2016. Due to high volume of information and space constraint, the tables and curves of one group of industry is presented as example. The results related to mean efficiency and ranking of investment companies group in 2013 to 2016 have been presented in table 2.

Table2. The general ranking of Investment Companies Group

Rank	Name of company	Efficiency	Efficient/ inefficient
1	International building of Namavaran Mohandesi	0.9582	Inefficient
2	Abadgaran Iran Kish	0.945475	Inefficient
3	Shahed	0.92535	Inefficient
4	Iran product stock	0.917975	Inefficient
5	Maskan Tehran	0.912075	Inefficient
6	Reconstruction and building of Tehran	0.88815	Inefficient
7	Arzesh Afarinan	0.8639	Inefficient
8	Tosee Goharan Omid	0.852975	Inefficient
9	Ta'min Maskan Javanan	0.851225	Inefficient
10	Atiye Damavand	0.85115	Inefficient
11	Iran industrial development	0.843025	Inefficient
12	Northeast Housing	0.836125	Inefficient
13	Iran Engineering System Building	0.813575	Inefficient
14	Kouhe Noor	0.7875	Inefficient
15	Bahman	0.7811	Inefficient
16	Pars Ariyan	0.764025	Inefficient
17	Tadbirgaran Fars and Khouzestan	0.7471	Inefficient
18	Deposit and funds settlement	0.74675	Inefficient
19	Omid financing	0.73345	Inefficient
20	Zayanderoud housing	0.7299	Inefficient
21	Iran OTC	0.7299	Inefficient
22	Etelae Alborz	0.706625	Inefficient
23	National Development	0.704725	Inefficient
24	Shahed Construction and Development	0.6887	Inefficient

25	North Development	0.6857	Inefficient
26	Buali	0.683875	Inefficient
27	Insurance industry	0.68005	Inefficient
28	Sakht Ajand	0.6675	Inefficient
29	Fars Construction and Development	0.6528	Inefficient
30	Pardis	0.650875	Inefficient
31	Housing	0.650025	Inefficient
32	Kharazmi	0659825	Inefficient
33	National Development Group	0.648025	Inefficient
34	A.S.P	0.64135	Inefficient
35	SAIPA	0.6384	Inefficient
36	Etemad Gostar Construction	0.65355	Inefficient
37	Noor Kowsar Iranian	0.613067	Inefficient
38	Saman Gostar Isfahan	0.606625	Inefficient
39	Baqmisheh Utbanization and Construction	0.605975	Inefficient
40	Mellat	0.591575	Inefficient
41	Sepah	0.5893	Inefficient
42	Cultural heritage and tourism	0.5826	Inefficient
43	Pardis Housing	0.577375	Inefficient
44	Abadgaran	0.54805	Inefficient
45	Kargozaran Pars	0.52795	Inefficient
46	Iran Building	0.52495	Inefficient
47	Falat Iranian	0.517375	Inefficient
48	Tous Gostar	0.511025	Inefficient
49	Ariyan Economic Development	0.5107	Inefficient
50	Northwest Housing	0.4987	Inefficient
51	Industries and Mines	0.49185	Inefficient
52	Iranian Investment Development	0.4715	Inefficient
53	Construction of Qazvin province	0.4681	Inefficient
54	Construction of Kerman province	0.467825	Inefficient
55	Building development	0.464825	Inefficient
56	Zagros Construction and Development	0.425825	Inefficient
57	Khouzestan Development	0.42125	Inefficient

Figure 1: Mean efficiency of Investment Companies Group



In Table 2, the overall ranking of the group of investment companies is based on their mean efficiency in the years 2013 to 2016. There were 57 companies in this group, none of which were effective in all years.
Given that the results of the mean efficiency of a group of investment companies in the years 2013 to 2016 are shown in this table and a company has been efficient in some years and in some inefficiencies, so the average of none of the companies 1 Not yet.
According to the results of Table 2, it can be said that In the investment companies group, although some companies have been effective in some of the years under review, none of them have been fully operational in all years. In other word the companies from one industry which are inefficient in all years are not recognized as appropriate for investment. In other words, it could be said that the probability of financial exhaustion of these companies concerning the undesired trend of the activity of these companies is high.

4.1. Prediction of financial exhaustion

Despite the common methods of performance evaluation, DEA method is a futurist method based on which it is possible to perform prediction on the future performance of companies. This method could predict to some extent the companies with the probability of financial exhaustion (which is one stage left to bankruptcy) in future by calculation of the efficiency of models (however, this method is based on the fact that the general trend of policies of the companies do not changed significantly in future years). To this end, each year is considered as a decision making unit and the industry efficiency in that year has been calculated and the mean efficiency in this time period (2013 to 2016) has been achieved as the industry average and the efficiency of each company will be compared with the average of its own industry. The results obtained from calculation of industry average are shown in table 3.

Table 3. The average ranking of industry

Rank	Name of group	Industry average
1	Construction materials	0.895606
2	Metal industries	0.845067
3	Automobile and transportation	0.808605
4	Chemical and oil products	0.790548
5	Financial institutes	0.787667
6	Food industries	0.762995
7	Pharmaceutical industries	0.703206
8	Technology companies	0.698784
9	Investment Companies	0.673243

5. Conclusion and Discussion

After ranking of companies for each fiscal year, DEA classifies the investigated units into efficient and inefficient units. The efficient units are those whose efficiency equals to 1 and non-efficient units are those whose efficiency is less than one. For example, in investment companies in 2013 (10 companies are efficient and 47 companies are inefficient), in 2014 (9 companies are efficient and 46 companies are inefficient), in 2015 (9 companies are efficient and 46 companies are inefficient) and in 2016 (9 companies are efficient and 46 companies are inefficient).

The companies where all years are efficient are recognized as being appropriate for investment and it could be said that the probability of bankruptcy of these companies concerning the desired trend of the activities of these companies is so low because they have not entered financial exhaustion. In other words, these companies could be introduced as the model and reference companies for other companies. In the investment companies group, although some companies have been effective in some of the years under review, none of them have been fully operational in all years. In other word the companies from one industry which are inefficient in all years are not recognized as appropriate for investment. In other words, it could be said that the probability of financial exhaustion of these companies concerning the undesired trend of the activity of these companies is high. Table (4) shows the companies that have been fully operational in all relevant years in the industry category.

Concerning the companies which are recognized as being efficient in some years and inefficient in some years, the investors are recommended to have more precision in selection of these companies for investment. In other words, it could be said that the probability of bankruptcy of these companies compared to efficient companies is more and compared to inefficient companies is less.

One of the main advantages of DEA is that in this method, for each inefficient decision making unit, one set of efficient units is recognized that could be used as model for improvement of efficiency. The constituting decision making unit of this combination is proposed as the model groups for inefficient decision making units. Moreover, this method could specify the required improvement in each input and output of inefficient unit (using the given weights to variables).

Table 4: Completely efficient companies in each industry group

Number of group	Name of group	Industry average
1	Construction materials	Bushehr sarooj
2	Metal industries	-
3	Automobile and transportation	Iran pump
4	Chemical and oil products	Fanavaran Petrochemicals
5	Financial institutes	-
6	Food industries	Behshahr Industries Development
7	Pharmaceutical industries	Alborz pakhsh-Daroo pakhsh-Shirin daroo
8	Technology companies	Yazd steel technical services-Taban hoor energy managment
9	Investment Companies	-

For example, the higher is the circulation of fixed asset, total assets circulation and margin profit, the company has more chance to be classified as the efficient unit and the higher is the debt ratio, the ratio of debt to special value, the higher will be this probability that the company to be classified as inefficient company where the required variations in the values of inputs and outputs could be measured for converting inefficient to efficient unit using the weights given to them.

For example, in the investment companies group, the International investment company of Namavaran Mohandesi with the highest efficiency is selected for other companies as pattern and in fact the other companies of this group should consider the policies and input and output weights of this company as the basis for their performance in their financial path.

Concerning the prediction of future financial status of companies, it could be said that:

The companies whose efficiency is more than industry average are recognized as appropriate for investment and the investors are proposed to invest in these companies.

The companies with lower efficiency than the industry average are not recognized as being appropriate for investment. In other words, it could be said that the probability of the financial exhaustion of these companies concerning the undesired trend of the activity of these companies is higher.

For example, concerning table 3, the industry average in investment companies of is 0.67 and Mellat, Sepah and Pardis investment companies whose efficiencies are respectively 0.59, 0.58 and 0.57 will suffer from financial exhaustion more than other companies if not changing their policies in future years.

The other application of the industry average is that it is possible to consider a fiscal year as the pattern; for example, the investment companies group in 2016 benefits from higher financial efficiency compared to other years and this could be introduced as the reference unit or pattern. To this end, the production policies that are used in this year could be used to increase efficiency in this industry in future.

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