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A Performance Measurement Model for Automotive and Petrochemical Companies Using FAHP and CCR Method

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Abstract: Through Exchange, non-efficient savings and investments entered into industries and organizations and can be used in economy of country in order to getting benefit for the entire of a community. Hence, this study analyzes a barrier of developing Exchange named lack of information related to performance of organization. At first by the study of theoretical background and then by consulting with experts; financial ratios were selected as performance indicators. They contain five main indicators and the 16 sub-indicators in the period of 6-year (2006-2011). By using fuzzy hierarchical analysis, we have weighted indicators and sub-indicators. In the next step, 3920 financial ratios were calculated for these two industries; then by multiplying the value of these ratios to weight of the indexes, the five main indicators were calculated. Finally by using the method of constant returns to scale in the output mood, and using DEA MASTER Software, the efficient and non-efficient organizations were isolated. In the petrochemical industry, the companies of Jahrom, Maroon, and Persian Gulf petrochemical; and in the automotive industry, the companies of Saipa Diesel, Iran Khodro Parts, Nasir Khodro, and Fanarsazi khavar are considered as the efficient companies. Therefore, these companies can be introduced to other companies as patterns. And also investors can be advised to consider these companies.

Keywords: Performance, Financial Ratios, Fuzzy Logic, Data Envelopment Analysis.

1. Introduction

Today, economic development is one of the most important issues in developed and developing countries around the world. The development of capital market is an important aspect of economic development in each country. Indeed, capital market is a place for supply and demand of medium and long-term financing. This market, as a center of capital funding, will lead individuals' savings and liquidity to long-term investments by using financial intermediaries and brokers.

Obviously, investing in the stock exchange is an important part of economy and undoubtedly, the greatest amount of capital is traded through stock exchanges around the world; and national economy is strongly influenced by the stock market performance. Also, this market is an available investment tool both for professional investors and the general public. Stock exchanges are affected by a series of macro-economic and non-economic factors and many other variables. The multiplicity and anonymity of factors influencing on capital markets had cause to uncertainty about investment [1]. Stock market investors are always seeking higher profits. They buy and hold stocks which expected to be the best with most profit and return. Uncertainty is the most important features of the capital market. All investors seek to achieve the best possible choices considering all criteria effective on investment decisions and their personal preferences [2].

The issue that to what extent managers operate in line with the demands of shareholders and creating value and wealth for them, is determined by the performance evaluation system [3]. The performance evaluation system is a useful tool to enhance organization capabilities. Performance evaluation helps to remove the weaknesses and improve the strengths of the organization. The ability of performance evaluation system in measuring and understanding of what is important for organization, is very important. A good performance evaluation system in the organization ensures its success and excellence [4]. A company which can

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manage its capital in the best way; will benefit the shareholders with more profit. This requires information about actual performance of the company. Examining companies' performance is one of the most subjects of accounting information users; and its results is a basis for many decisions of inside and outside of the company. Actually, performance evaluation systems is a tool for monitoring and planning organization activities and should be specially considered. This tool is used to correcting and updating of all organization aspects and even to change organization objectives.

There is a famous sentence about performance measurement: "nothing is manageable, unless to be measured" [5]. At any time, specific criteria and tools which are designed for this purpose have not been perfect and has been criticized[6]. Over the years many studies have been conducted in universities and research centers in order to achieve better metrics to measure performance [7]. In today's changing commercial environment, business strategy is the key to maintain a competitive advantage. In this regard, performance evaluation issues are crucial to design and implement strategies. Milink, Stewart, and Swink believe that the standard measurements of performance received more attention in recent years, but according to Evans, we need better approaches to performance analysis in terms of competitive and comparison scales among the organizations. There is always disagreement about selection of financial and non-financial criteria for performance measures. However, it should be considered that financial measurements which are used in managers' decision-making, are more objective rather than subjective. On the other hand, non-financial measures are more associated with strategic factors. So, selecting evaluation criteria is a controversial issue[8]. Nowadays, due to the complexity and diversity of investments, the evaluation and ranking of companies is an important issue. Since there is no specific method to evaluate the performance of companies and to separate efficient companies from non-efficient in the Iranian capital market, it is necessary to promote a model for identifying efficient and superior firms; so that directors of companies attempt to deal with problems and at a higher level investors act in a more certain way. While entry of mathematics and operations research branches to the field of performance evaluation and efficiency of organization and to decision maker centers, have created a profound transformation in this area. Although traditional and simple methods such as ROA and ROE indicators are still used to assess performance, but modern methods such as BSC (Balanced Scorecard), FAHP (Fuzzy Analytic Hierarchy Process), DEA (Data Envelopment Analysis) and MCDEA (Multi Criteria Data Envelopment Analysis) are widely used for organization performance evaluation and ranking.

Performance evaluation: evaluation is important because it's a prerequisite for management. Chang SU believes that if something cannot be measured, it cannot be managed.

Performance evaluation is considered as a base for organizational improvement and change programs and has received much attention by experts in recent years. Recent developments have resulted in performance management systems which encompass a set of measures to establish a reasonable balance between objectives rather than focusing on profitability [9]. According to Akalu, performance evaluation is a managerial technique to evaluate the efficiency and effectiveness of system and project [10]. In general, performance evaluation is a process of assessment, measurement, and comparison of the quantity and the quality of achieving to the desired state[4]. Considering capital markets development, performance evaluation is one of the most important interests of shareholders, creditors, governments and administrators. Investors always tend to be aware of managers success level in using their capitals [3].

2. Financial Ratios

Accounting reports are important sources of information for managers, investors, and financial analysts. Financial ratios are common tools to extract these information that must remove the effect of size of organization from accounting variables; and emphasize on important and remarkable firm characteristics such as profitability and liquidity[11]. Financial statements which include reports of managerial performance (which is an evidence for success or failure of management and a warning about signs of problems) are drawing tools for the company's commercial status [12]. Financial ratios are the most useful indicators of firms' performance and financial status[13]. Financial ratios create useful financial quantitative information both for investors and analysts so that they can assess the company's operations and analyze its conditions. Also these ratios provide suitable quantitative data for basic statistical operations such as regression analysis [14].

Financial ratios are known as effective predictors of business failure that carefully distinguish between failed and non-failed companies [15]. A financial ratio is defined as a mathematical relationship between two quantities. Financial ratio analysis is important for several reasons:

1. As an important financial tool create knowledge and insight about financial condition of the company
2. Assessment and comparison of firms performance
3. Financial forecasts for strategic researches

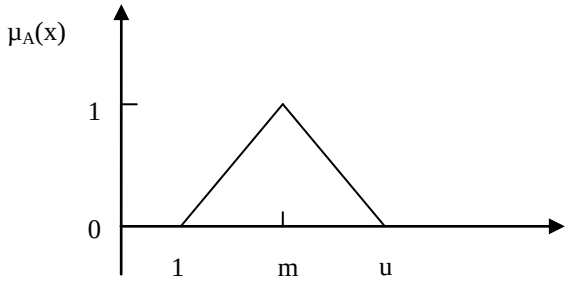
Fuzzy logic: Professor Lotfizadeh, UC Berkeley professor, presented fuzzy sets theory for the first time in 1965. On the basis of this theory and its relationships, human needs another kind of mathematics in order to modeling the uncertainty and imprecision of events. This model is different from probability theory[16]. Fuzzy theory is suitable for uncertainty conditions. It can converse many concepts, variables and systems that are vague and inexact, as it is real conditions, to mathematical types. And provides

opportunity for argument, inference, control and decision making in uncertainty circumstances[17]. Fuzzy numbers are a group of numbers that widely used in modern mathematics. Depending on situation, different fuzzy numbers can be used. Usually triangular and trapezoidal fuzzy numbers are used in practice. Because of their calculation easiness, triangular fuzzy numbers (T.F.N) is widely applied. Triangular fuzzy number is shown by three points (l, m, and u). Membership function of a triangular fuzzy number is as following equation:

$$\mu_M(X) = \begin{cases} \dfrac{x-1}{m-1}, 1 \le x \le m \\ \dfrac{u-x}{u-m}, m \le x \le u \\ 0, Otherwise \end{cases}$$

Mathematical operators on fuzzy numbers are as follows:

$M_1 = (l_1, m_1, u_1)$, $M_2 = (l_2, m_2, u_2)$, $M_1 + M_2 = (l_1 + l_2, m_1 + m_2, u_1 + u_2)$
$M_1 - M_2 = (l_1 - l_2, m_1 - m_2, u_1 - u_2)$, $M_1M_2 = (l_1l_2, m_1m_2, u_1u_2)$
$M_1 / M_2 = (l_1/u_2, m_1/m_2, u_1/l_2)$
And the membership function of a triangular fuzzy number is as follows:



3. Data Envelopment Analysis

Data envelopment analysis is one of the most popular methods that have been considered by many experts and analysts in recent years. DEA method is a new approach for evaluating a set of peer institutions and groups' performance (decision-making units such as universities, cities, courts, companies, countries and regions that convert multiple inputs to multiple outputs). This method is based on optimizing using linear programming. In this method, the efficient frontier curve which is formed by a series of points determined in turn by linear programming, according to relevant economic theories determine the organization efficiency using nonparametric method. For this reason, it has fewer constraints [18]. DEA estimate the production frontier. It's a method that examines and solves a set of fractional reverse planning to determine relative efficiency of multi-criteria systems in conversion of multiple inputs to multiple outputs. Since DEA doesn't induce analysts to know the complex relationships between multiple inputs and outputs, it outspread in wide application areas. DEA experimental trends and lack of previous assumptions, have led to its widespread use in studies [19]. The original DEA models divided into two categories including CCR and BBC. Each of these models can be examined with two approaches of input-oriented and output-oriented. CCR and BCC models differ in assumption of constant or variable returns to scale. The CCR model assumes constant returns to scale, and the BCC model assumes variable returns to scale. "Constant returns to scale" means that outputs change with the same ratio as inputs change. In the method of constant returns to scale (CCR) based on available data, efficiency of each decision maker unit individually as well as of each unit between all n-units (DMUJ), estimated and calculated.

4. Research Background

Khajavi et al (2005) examined the application of data envelopment analysis in determining a portfolio of most efficient companies of Tehran Stock Exchange. An input-oriented CCR model with covering form, was used in this study. The results showed that among 90 studied companies, 29 companies equal to 32 percent of the total number are efficient and the others are inefficient [20]. Moddel (2000) comprise relative performance of 24 MBA higher education programs using DEA[21]. Paradi and Schaffnit (2004) evaluate the performance of a major Canadian bank branches using DEA and presented two models based on. The first model named production model which consider sources in which there is most profits for the branch director and the other named strategic model consider financial sources that is more important for higher level directors[22]. Hall and Darke (2003) used nonparametric DEA method to assessment of Japan banks efficiency. Their results showed that loans related issues are the main factor affecting the performance of Japanese banks, especially in small regional banks[23]. Wu et al (2006) compared banks which use Fuzzy DEA and compared results with DEA [24] studied Brazil banks efficiency. They use DEA in this study. Results indicated that more than 30 percent of banks have a poor performance and are subject to bankruptcy, As well as more than 50% of the banks have an average efficiency and only 20 percent are efficient[25]. Cummins and Nini (2002) investigated that insurance companies how to use their capital. In fact they investigated that whether insurers optimize their capital maintenance and usage or not? They used data envelopment analysis technique for the assessment; and capital was considered as one of the input variables in their model. The results indicated optimized areas of insurers' investment. Approximately 65 percent of insurers invested optimize [26].

5. Research Method

This research intends to help understanding the various issues occur in companies and to perceive and develop the decision making models mentioned in companies ranking. Thus considering its results, this study could be developmental and on the other hand, due to its application in solving current problem in our country's stock exchange (ranking and separation of efficient from non-efficient companies and optimized investment) would be applicable. Accordingly, the present study is descriptive, and since the survey research is used to assess the characteristics of a statistical population, and the data in this study has been

obtained for a specified period of time (1385 - 1390), this is a cross-sectional survey study. One of the goal of this study is to provide a model for the performance assessment of accepted companies in Tehran Stock Exchange and calculating efficiency of them and separating successful and unsuccessful companies. This study examines financial ratios of firms as criteria and indicators of decision-making. Using average of observations for each company, the ratios calculated for companies in these two industries (automotive and Petrochemical) in the specified time interval, also the criteria weights are calculated using multi-criteria decision making techniques. So the indicators (financial ratios) of all years for each of the samples was determined and calculated in the information preparation phase. Since there are 28 companies in the automotive and automobile parts industry and 15 companies in the petrochemical industry and given 16 indicators and performance criterion, and because the cross-sectional method has been used in this study, the data is expressed based on "year – observation" means the number of observations in investigated years. Hence, a firm with 2 years presence in the exchange market, include 2 "years- observation" and one with 4 years history, has 4 "years- observation". So, there is 77 years- observation for the petrochemical firms and 168 year- observation for the automotive and automobile parts firms. Also, this study includes 1232 financial ratios for the petrochemical firms and 2688 ratios for the automotive and automobile parts firms. Generally, 245 years- observation and 3920 financial ratios were calculated for both industries. Then, the AHP questionnaire was distributed between decision-making experts (professors of finance, capital market investors) and the data on paired comparisons of financial ratios used to determine the indexes weights were collected. The time scale range (1- Non-preferred to 9- strongly preferred) is used in this questionnaire. First, the main criteria and then sub-criteria were compared with each other. In this questionnaire, six paired comparisons matrixes were developed. In the first matrix, five research's main criteria (liquidity, leverage, activity, profitability and growth) were compared by thirteen experts (professors of finance and capital market investors) and their weights were determined. In turn, weights of sub-criteria were determined by paired comparison matrix. Then, weights of sub-criteria were multiplied in calculated financial ratios and the main criteria of research were assigned. Given the main criteria and determining inputs and outputs by DEA solver software and using the Constant returns to scale method in an output oriented manner, efficient and inefficient companies for both industries were separated. This study has no statistical sample and all accepted companies in both automotive and petrochemical industries are examined.

5.1 Validity and reliability

Since FAHP method was used in this study to determine weights of indicators and sub-indicators, therefore the validity of the questionnaire is dependent on AHP which is assigned by the rate of compatibility in paired comparisons. Reliability (validity) of this questionnaire is measured by compatibility rate means that if the compatibility rate be more than 0.1, the questionnaire can be modified and re-distributed, so that this rate be lower than 0.1 for all paired comparisons[27]. Since the compatibility rate for this study is 0.1, so we can say that the present questionnaire is valid. It should be noted that the criteria and sub-criteria was determined after library studying and consulting with some experts. After preparing the questionnaire, it was distributed between financial professors of Tehran University and consequently some of sub- indicators were confirmed and some of them were removed, also some sub- indicators were added to the conceptual model. So the expert's advice increased the validity and reliability of the Questionnaire.

6. Data Analysis

6.1 Determining the weight of each indicators and sub-indicators based on Fuzzy AHP

After determining indexes by experts, the hierarchical analysis questionnaire was developed in order to determining priorities or weights of indicators and sub-indicators. Thirteen AHP questionnaires were distributed among experts (Tehran University financial professors) and stock investors in order to determining them through Group Fuzzy AHP. At first we compute group paired comparison matrix; group fuzzy paired comparisons matrix can be combined by following algorithm [28].

$$l_{ij} = \min(l_{ijk}), m_{ij} = \left(\prod_{k=1}^{k} m_{ijk}\right)^{\frac{1}{k}}, u_{ij} = \max(u_{ijk})$$

Where (L_{ijk}, M_{ijk}, U_{ijk}) are involved in fuzzy calculations and K answerers are existed. Anyway calculating the minimum and maximum of fuzzy numbers are not symmetric if the responses of the individual have a great distance from each other. In other words, ratings and calculations will be incongruent. In this case, we have to consider one or a few numbers of respondents. Because of the operations of multiplication and division of fuzzy numbers, group fuzzy weights which are obtained in this case are not reliable and dependable; and this is not desirable. Typically, geometric mean is used in the arithmetic operations of group AHP. So we decided to use geometric mean in calculating L_{ij} and U_{ij} in order to getting reliable and dependable weights (ibid, p.5).

$$l_{ij} = \left(\prod_{k=1}^{k} l_{ijk}\right)^{\frac{1}{k}}, m_{ij} = \left(\prod_{k=1}^{k} m_{ijk}\right)^{\frac{1}{k}}, u_{ij} = \left(\prod_{k=1}^{k} u_{ijk}\right)^{\frac{1}{k}}$$

So integrated fuzzy comparison matrices by experts (professors and investors) are as follow:

Now the adaptation rates of paired comparisons matrix should be calculated. These rates are shown in following which indicates the integrity of comparisons.

Now we calculate the weight of main index and sub-indexes by FAHP:

$Sk = \sum_{i=1}^{5} Ci$ = (19.3275 , 31.4322 , 48. 0885)

S_1 = (2.517/48.0885 , 3.429/31.4322 , 5.098/19.3275) , S_1 = (.0523,.109,.2638)
S_2 = (3.1199/48.0885,4.6732/31.4322,7.3445/19.3275) , S_2 = (.0649 ,.1486,.38)
S_3 = (2.943/48.0885,4.276/31.4322,6.436/19.3275) ,
S_3 = (.0612 ,.136 ,.333)
S_4 = (7.164/48.0885,13.342/31.4322,20.214/19.3275) , S_4 = (.149,.4245,1.0459)
S_5 = (3.5832/48.0885,5.711/31.4322,8.996/19.3275) , S_5 = (.074,.1817,.4654)

V $(S_1 \geq S_2) = \frac{.2638 - .0649}{(.2638 - .0649) + (.1486 - .109)}$ = 0**.834**, V $(S_1 \geq S_3) = \frac{.2638 - .0612}{(.2638 - .0612) + (.136 - .109)}$ = **0.8824**

V $(S_1 \geq S_4) = \frac{.2638 - .149}{(.2638 - .149) + (.4245 - .109)}$ = **0.2667**,V $(S_1 \geq S_5) = \frac{.2638 - .074}{(.2638 - .074) + (.1817 - .109)}$ = **0.723**

V $(S_3 \geq S_2) = \frac{.333 - .0649}{(.333 - .0649) + (.1468 - .136)}$ = 0**.9551,** V $(S_2 \geq S_4)$ = $\frac{.38 - .149}{(.38 - .149) + (.4245 - .1486)}$ = **0.4557**

V $(S_2 \geq S_5) = \frac{.38 - .074}{(.38 - .074) + (.1817 - .1476)}$ = 0**.8997**,V $(S_3 \geq S_4) = \frac{.333 - .149}{(.333 - .149) + (.4245 - .136)}$ = **0.3894**

V $(S_3 \geq S_5) = \frac{.333 - .074}{(.333 - .074) + (.1817 - .136)}$ =**0.85**,V $(S_5 \geq S_4) = \frac{.4654 - .149}{(.4654 - .149) + (.4245 - .1817)}$ = **0.5651**

V $(S_2 \geq S_1)$ = **1**, V $(S_3 \geq S_1)$ = **1,** V $(S_4 \geq S_1)$ = **1,** V $(S_5 \geq S_1)$ = **1,** V $(S_2 \geq S_3)$ = **1**,
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V $(S_1 \geq S_2 , S_3 , S_4 , S_5)$ = Min [.834 , .8824 , .2667 , .723] = **0.2667**

V $(S_2 \geq S_1 , S_3 , S_4 , S_5)$ = Min [1 , 1 , .4557 , .8997] = 0**.4557**

V $(S_3 \geq S_1 , S_2 , S_4 , S_5)$ = Min [1 , .9551 , .3894 , .85] = 0**.3894**

V $(S_4 \geq S_1 , S_2 , S_3 , S_4)$ = Min [1 , 1 , 1 , 1] = **1**

V $(S_5 \geq S_1 , S_2 , S_3 , S_4)$ = Min [1 , 1 , 1 , .5651] = 0**.5651**

$W_{liquidity} = \frac{.2667}{.2667 + .4557 + .3894 + 1 + .5651}$ = 0**.1**, $W_{leverage} = \frac{.4557}{2.6769}$ = 0**.17**

$W_{activity} = \frac{.3894}{2.6769}$ = 0**.15**, $W_{profitibility} = \frac{1}{2.6769}$ = **.37,** $W_{growth} = \frac{.5651}{2.6769}$ = 0**.21**

The weight of sub-indexes are calculated as the same:

follow:

Table 2. integrated fuzzy comparison matrices of main indexes

	C_1	C_2	C_3	C_4	C_5
C_1	(1 , 1 , 1)	(.4 , .63 , 1.084)	(0.55 , .89 , 1.49)	(0.202 ,0 .302 ,0 .582)	**(0.365 , 0.607 , 1.012)**
C_2	(0.916 , 1.575 , 2.497)	(1 , 1 , 1)	(0.5125, 0.8822, 1.485)	(0.2294, 0.376, 0.675)	**(0.4622 , 0.84 , 1.6875)**
C_3	(0.65 , 1.22 , 1.7)	(0.671 , 1.127, 1.95)	(1 , 1 , 1)	(0.231 , 0.307 , 0.6)	**(0.391 , 0.622 , 1.186)**
C_4	(1.71 , 3.11 , 4.93)	(1.475 , 2.64 , 4.34)	(1.5 , 3.22 , 4.51)	(1 , 1 , 1)	**(1.479 , 3.372, 5.434)**
C_5	(0.967 , 1.645 , 2.69)	(0.5926 , 1.17 , 2.1)	(0.84 , 1.6 , 2.537)	(0.184 , 0.296 , 0.669)	**(1 , 1 , 1)**

Table 3. integrated fuzzy comparison matrices of liquidity sub-indexes

	C_{11}	C_{12}	C_{13}
C_{11}	(1 , 1 , 1)	(0.1884 , 0.3128 , 0.6841)	**(0.166 , 0.228 , 0.379)**
C_{12}	(1.754 , 3.18 , 5.278)	(1 , 1 , 1)	**(0.3042 , 0.5318 , 1.0436)**
C_{13}	(2.32 , 4.088 , 5.719)	(1.08 , 2.003 , 3.2873)	**(1 , 1 , 1)**

Table 4. integrated fuzzy comparison matrices of leverage sub-indexes

	C_{21}	C_{22}	C_{23}
C_{21}	(1 , 1 , 1)	(1.288 , 2.763 , 3.154)	(2.005 , 3.19 , 5.001)
C_{22}	(0.3 , 0.37 , 0.763)	(1 , 1 , 1)	(1.088 , 2.008 , 3.19)
C_{23}	(0.2 , 0.298 , .496)	(0.31 , 0.496 , 0.917)	(1 , 1 ,)

Table 5. integrated fuzzy comparison matrices of activity sub-indexes

	C_{31}	C_{32}	C_{33}	C_{34}
C_{31}	(1 , 1 , 1)	(0.127 , 0.169 , 0.363)	(0.161 ,0 .252 , 0.628)	(0.244 , 0.419 , 1.1)
C_{32}	(3.77 , 5.85 , 7.76)	(1 , 1 , 1)	(1 , 2.036 , 3.85)	(1.512 , 3.607 , 5.54)
C_{33}	(1.884 , 3.825 , 6.155)	(0.2589 , 0.491 , 0.998)	(1 , 1 , 1)	(1.054 , 2.245 , 4.27)
C_{34}	(1.79 , 2.38 , 4.088)	(.18 , .323 , .66)	(0.232 , 0.445 , 0.948)	(1 , 1 , 1)

Table 6. integrated fuzzy comparison matrices of profitability sub-indexes

	C_{41}	C_{42}	C_{43}
C_{41}	(1 , 1 , 1)	(0.158 , 0.23 , 0.432)	(0.195 , 0.333 , 0.684)
C_{42}	(2.258 , 4.322 , 6.31)	(1 , 1 , 1)	(1 , 1.63 , 2.428)
C_{43}	(1.458 , 2.987 , 5.1)	(0.412 , 0.613 , 1)	(1 , 1 , 1)

Table 7. integrated fuzzy comparison matrices of growth sub-indexes

	C_{51}	C_{52}	C_{53}
C_{51}	(1 , 1 , 1)	(.152 , .219 , .394)	(0.19 , 0.298 , 0.706)
C_{52}	(2.538 , 4.566 , 6.578)	(1 , 1 , 1)	(0.883 , 1.579 , 2.702)
C_{53}	(1.415 , 3.355 , 5.263)	(0.37 , 0.631 , 1.132)	(1 , 1 , 1)

Table 8. adjustment rate of combined answers of experts

Main indexes	Sub-indexes				
	Liquidity (c1)	Leverage (c2)	Activity (c3)	Profitability (c4)	**Growth (c5)**
0.07408	0.0755	0.0543	0.01144	0.0741	**0.005**

Now we calculate the weight of main index and sub-indexes by FAHP:

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V $(S_2 \geq S_1, S_3, S_4, S_5)$ = Min [1 , 1 , .4557 , .8997] = 0**.4557**

V $(S_3 \geq S_1, S_2, S_4, S_5)$ = Min [1 , .9551 , .3894 , .85] = 0**.3894**

V $(S_4 \geq S_1, S_2, S_3, S_4)$ = Min [1 , 1 , 1 , 1] = **1**

V $(S_5 \geq S_1, S_2, S_3, S_4)$ = Min [1 , 1 , 1 , .5651] = 0**.5651**

$W_{liquidity} = \frac{.2667}{.2667 + .4557 + .3894 + 1 + .5651}$ = 0**.1**, $W_{leverage} = \frac{.4557}{2.6769}$ = 0**.17**

$W_{activity} = \frac{.3894}{2.6769}$ = 0**.15**, $W_{profitibility} = \frac{1}{2.6769}$ = **.37,** $W_{growth} = \frac{.5651}{2.6769}$ = 0**.21**

The weight of sub-indexes are calculated as the same:

Table 9.The weight of indexes

Main indexes	Weight	Sub-indexes	weight
Liquidity (c1)	**0.1**	Current ratio (c11)	**0.01**
		Quick Ratio (c12)	**0.432**
		Current liabilities by Current assets (c13)	**0.558**
Leverage (c2)	**0.17**	Liability ratio (c21)	**0.62**
		Liability by equity capital (c22)	**0.33**
		Fix assets by equity capital (c23)	**0.05**
Activity (c3)	**0.17**	Accounts Receivable turnover (c31)	**0.07**
		Current assets turnover (c32)	**0.43**
		Total assets turnover (c33)	**0.32**
		Inventory turnover (c34)	**0.18**
Profitability (c4)	**0.37**	Net profit margin (c41)	**0.03**
		Return on equity (c42)	**0.55**
		Return on assets (c43)	**0.42**
Growth (c5)	**0.21**	Operating profit growth (c51)	**0.03**
		Equity growth (c52)	**0.54**
		Assets growth (c53)	**0.43**

After calculating the weights of indicators and sub-indicators, the amount of main indicators must be prepared. They calculated by multiplying the weight by the amount of sub-indicators and summation of them. According to DEA MASTER Software and having the amount of main indicators, we will determine efficient and high-performance company.

In this study, indicators of liquidity, activity, profitability, and growth are considered as positive output indicators. Because liquidity index represents the strength of the company in repayment of debt; activity index represents the company's operating efficiency; profitability index represents the ability to make profit based on the sale, equity, and assets; growth index represents developing company's operations over the life of the company. The leveraged index is considered as negative input indicator because it's increasing shows higher debt ratio, fixed assets by equity, and liabilities by equity and reflect higher debt levels which cause to lower performance of company. (Debt ratio higher than 1 means to provide assets from liabilities, fixed assets by equity ratio above 1 to provide assets from liabilities, and on the other hand, liabilities by equity ratio higher than 1 means to provide liabilities from a source except equity) thus this index is a negative index and is a expense. Therefore, based on each main indexes of both industries' firms, the separation of efficient and inefficient firms have been done. The results are presented in table 10.

Table 10.The output of DEA Master of petrochemical industry (CCR)			
Export Data From DEA Bank			
Decision making unit	**Efficiency**	**Ranking**	**Rank**
Bistoon petrochemical	3.0524201398	3.0524201398	15
Jahrom petrochemical	100	925.76057404412	1
Persian Gulf petrochemical	100	137.762310956931	3
Kermanshah petrochemical	4.395174454094549	4.395174454094549	14
Shazand petrochemical	21.9584376727698	21.9584376727698	8
Abadan petrochemical	20.7720991445493	20.7720991445493	9
Isfahan petrochemical	17.74676383552	17.74676383552	11
Pardis petrochemical	12.9565004971245	12.9565004971245	12
Zagros petrochemical	41.73775567339	41.73775567339	6
Maroon petrochemical	100	22.03010122536	2
Shiraz petrochemical	23.12632946927	23.12632946927	7
Khark petrochemical	91.7466302503457	91.7466302503457	4
Farabi petrochemical	10.7576415939582	10.7576415939582	13
Iran petrochemical	49.8382630145912	49.8382630145912	5
Fanavaran petrochemical	18.4800618812442	18.4800618812442	10

Table 11. Tthe output of DEA Master of automotive industry (CCR)			
Export Data From DEA Bank			
Decision making unit	**Efficiency**	**Ranking**	**Rank**
Iran khodro	17.8373758068694	17.8373758068694	25
Iran khodro diesel	8.59190612930101	8.59190612930101	27
Pars khodro	49.0222320292667	49.0222320292667	12
Saipa	35.6278011333912	35.6278011333912	18
Zamyad	30.2937800628838	30.2937800628838	21
Saze pouyesh	55.1863212523775	55.1863212523775	10
Ring making of mashhad	54.3822889922068	54.3822889922068	11
Pars Mehrkam	42.0755578389396	42.0755578389396	14
Niro Mohareke	63.5853603433993	63.5853603433993	7
Nasir mashin	100	107.051616106787	4
Mehvarsazan	86.445894463588	86.445894463588	5
Mehvar khodro	24.4604916195881	24.4604916195881	23
Lent tormoz	76.4184451503267	76.4184451503267	6
Automobile parts	100	226.302792785937	2
Rikhtegari Iran	43.8665228940638	43.8665228940638	13
Fanarsazi khavar	100	111.292401876925	3
Fanarsazi zar	22.0025401872751	22.0025401872751	24
Saipa Azin	16.3043719446356	16.3043719446356	26
Rikhtegari Teraktor	4.44851151283191	4.44851151283191	28
Iran radiator	38.5227433770604	38.5227433770604	16
Charkheshgar	35.663080743466	35.663080743466	17
Irka part	39.9396999005135	39.9396999005135	15
Motor sazan teraktor	32.015316827114	32.015316827114	20
Saipa diesel	100	56245.80790753992	1
Bahman group	60.1160233844014	60.1160233844014	9
Ahangari teraktor	63.0625029605419	63.0625029605419	8

Shargh electric khodro	32.1388408294699	32.1388408294699	19
Endamin komakfanar	26.1484704995801	26.1484704995801	22

6.2 Separating efficient and inefficient petrochemical firms by output-based CCR method

The outputs of DEA Master calculated by output-based CCR for petrochemical indexes are shown in table 11.

Output-based CCR method provides ranking for efficient units in addition to demonstrating efficiency. As shown in the above table; Jahrom petrochemical, Maroon petrochemical, and Persian Gulf petrochemical are efficient. And other companies are inefficient, but among them Khark Petrochemical is close to the efficient units.

6.3 Separating efficient and inefficient automotive firms by output-based CCR method

The outputs of DEA Master calculated by output-based CCR for automotive industries are shown as follow: So Nasir Mashin, Iran Automobile parts, Saipa Diesel, and Fanarsazi Khavar are the efficient firms and other companies are classified in group of inefficient firms.

7. Conclusions and Recommendations

Exchange market like other markets is one in which some people offer their commodities and others buy them, but the merchandise in this market is stocks or corporate bonds that are issued by governments or credible corporations and institutions. Some strict regulations are applied in this market to prevent loss and to benefit both companies and people. Stock exchange is one of the most important channels in the world and the world's main commodity and stock exchanges are critical for all markets. Also, this market is a way to collection of people's small and large capitals to promote the country's economy and using in production and services. Furthermore, exchange market prepares the way for economic and industrial growth and development, and by promoting new jobs and engaging young people fight with unemployment. As a result, many of social pathologies of unemployment such as theft, crime, etc., will reduce. In order to fulfill this important task by capital market; it must supply both investors and corporate executives with clear information. Performance evaluation based on quantitative indicators help to achieve this important aim, so that investors can invest more certain and the companies' directors can maximize the shareholders wealth in the best way. This is not possible without information about the company's and its stock's situation. Accordingly, this study seeks to provide a mechanism to better investment and performance evaluation. Since the AHP is not able to consider the qualitative judgments, a combined approach of fuzzy AHP and DEA (method of constant returns to scale in an output-oriented manner) is used in this study. Five main criteria including liquidity, leverage, activity, profitability and growth and 16 sub-criteria were determined and refined in consultation with experts. A 6-year period (1385-1390) was appointed. Experts assigned maximum weight to profitability indicator (0.37) and minimum weight to liquidity indicator (0.1). Among liquidity sub-criteria, "current liabilities to total assets" and "quick" ratios have the most weights according to experts. In leverage sub-criteria, "debt ratio" received a high weight. In activity sub-criteria, "current asset turnover" and total asset turnover" supposed to be important. In profitability sub-criteria, "return on equity" and "return on investment" supposed to be more important than "net profit margin". Experts believe that "growth of equity" is more important than other growth sub-criteria. In petrochemical industry, "Jahrom", "maroon", and "Persian Gulf" companies are efficient, thus these companies have a better financial situation and may be offered to investors for investment and to other firms as good patterns. "Khark" Petrochemical Company also has a good status with a bit difference from efficient firms, therefore it can also be offered to investors. In the automotive and parts manufacturing, "Saipa Diesel" , "Iran auto parts" , "Fanarsazi Khavar" and "Nasir machines" are efficient and may be models for other companies in this industry. Furthermore, these are reliable for investors. Other companies in this industry lack efficiency, Therefore, it is recommended to inefficient companies' directors of this industry to take these efficient companies as performance patterns. Also, "Mehvarsazan" and "Lent Tormoz" firms can be offered to investors as secondary options for investment.

Suggestions for companies: in this DEA analysis for each inputs in the output mood; the following suggestions are offered in table 12.

However, some companies such as Farabi Petrochemical are too inefficient (10.7576415939582) therefore increasing output through DEA is unrealistic and unexpected. For example the cited company should increase liquidity ratio to 6.767, activity ratio to 32.507, and profitability ratio to 2/343 in order to achieving efficiency which is almost impossible. The situations of many other companies are the same. But these suggestions can be useful for the companies with average and high performance. Suggestions for automotive firms are in table 13

Table 12. Values and goals of petrochemical companies (CCR)										
Index values and target values for these indicators										
Index	Liquidity		Activity		Profitability		Growth		Leverage	
Organization	value	goal	value	goal	value	goal	value	goal	value	goal
Bistoon petrochemical	0.26	8.518	8.035	263.234	0.586	19.198	-4.852	158.956	21.71	21.71
Jahrom petrochemical	5.407	5.407	0	0	0.015	0.015	0.389	0.389	0.049	0.049
Persian Gulf petrochemical	4.744	4.744	0.064	0.064	0.061	0.061	4.32	4.32	0.398	0.398
Kermanshah petrochemical	0.376	8.555	1.268	28.85	0.156	3.549	0.305	6.939	2.637	2.637
Shazand petrochemical	0.526	2.395	2.532	11.531	0.258	1.175	0.127	0.578	0.951	0.951
Abadan petrochemical	0.568	2.734	2.841	13.667	0.298	1.435	0.08	0.385	1.128	1.128
Isfahan petrochemical	0.865	4.874	2.051	11.557	0.374	2.107	0.44	2.479	1.03	1.03
Pardis petrochemical	0.458	3.535	2.224	17.165	0.631	4.87	0.61	4.708	2.279	2.279
Zagros petrochemical	0.596	1.428	3.168	7.59	0.435	1.042	0.168	0.403	0.626	0.626
Maroon petrochemical	1.024	1.024	3.298	3.298	0.602	0.602	0.47	0.47	0.272	0.272
Shiraz petrochemical	1.353	5.85	1.077	4.657	0.074	0.32	0.123	0.532	0.424	0.424
Khark petrochemical	1.487	1.621	1.877	2.046	0.712	0.776	0.302	0.329	0.353	0.353
Farabi petrochemical	0.728	6.767	3.497	32.507	0.168	1.562	0.252	2.343	2.681	2.681
Iran petrochemical	0.72	1.445	2.677	5.371	0.347	0.696	0.229	0.459	0.443	0.443
Fanavaran petrochemical	0.63	3.409	1.993	10.785	0.31	1.677	-0.005	-0.027	0.89	0.89

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Table 13. Values and goals of petrochemical companies (CCR)										
Index values and target values for these indicators										
Index	Liquidity		Activity		Profitability		Growth		Leverage	
Organizations	value	goal	value	goal	value	Organization	value	goal	value	goal
Iran khodro	0.715	4.008	2.69	15.081	0.185	1.037	0.165	0.925	3.466	3.466
Iran khodro diesel	0.662	7.705	0.998	11.616	-0.012	0.14	0.115	1.338	3.371	3.371
Pars khodro	0.602	1.228	3.33	6.793	0.003	0.006	0.082	0.167	1.393	1.393
Saipa	0.608	1.707	2.667	7.486	0.165	0.463	0.106	0.298	1.6	1.6

Zamyad	0.668	2.205	1.318	4.351	0.184	0.607	0.148	0.489	1.246	1.246
Saze pouyesh	0.609	1.104	2.876	5.211	0.359	0.651	0.338	0.612	1.485	1.485
Ring making of mashhad	0.65	1.195	3.704	6.811	0.144	0.265	0.108	0.199	1.413	1.413
Pars Mehrkam	0.676	1.607	3.256	7.738	0.007	0.017	0.105	0.25	1.618	1.618
Niro Mohareke	0.621	0.977	2.884	4.473	0.147	0.231	0.225	0.354	1.084	1.084
Nasir mashin	0.711	0.711	2.862	2.862	0.165	0.165	0.12	0.12	0.613	0.613
Mehvarsazan	0.54	0.625	7.376	8.533	0.09	0.104	0.1	0.116	1.067	1.067
Mehvar khodro	0.6	2.453	1.07	4.374	0.09	0.368	0.06	0./245	1.067	1.067
Lent tormoz	0.682	0.892	1.915	2.506	0.18	0.236	0.083	0.109	0.561	0.561
Auto mobile parts	1.3	1.3	0.326	0.326	0.317	0.317	0.248	0.248	0.34	0.34
Rikhtegari Iran	0.753	1.717	1.352	3.082	-0.172	0.392	0.65	1.482	2.178	2.178
Fanarsazi khavar	0.732	0.732	1.5	1.5	0.13	0.13	0.18	0.18	0.41	0.41
Fanarsazi zar	0.744	3.381	1.364	6.199	0.052	0.236	-0.021	0.095	1.241	1.241
Saipa Azin	0.746	4.575	2.354	14.438	0.047	0.288	0.133	0.816	3.272	3.272
Rikhtegari Teraktor	0.657	14.769	1.488	33.449	-0.017	0.382	-0.451	10.138	1.084	1.084
Iran radiator	0.684	1.776	1.642	4.262	0.084	0.218	0.052	0.135	0.93	0.93
Charkheshgar	0.618	1.733	1.77	4.963	0.222	0.622	0.177	0.496	1.353	1.353
Irka part	0.669	1.675	1.974	4.942	0.187	0.468	0.126	0.315	1.175	1.175
Motor sazan teraktor	0.488	1.524	1.43	4.467	0.106	0.331	0.046	0.144	0.956	0.956
Saipa diesel	0.772	0.772	1.308	1.308	0.387	0.387	-0.475	-0.475	0.001	0.001
Bahman group	0.643	1.07	1.216	2.023	0.229	0.381	0.229	0.381	0.724	0.724
Ahangari teraktor	0.654	1.037	1.517	2.406	-0.271	0.43	1.253	1.987	2.724	2.724
Shargh electric khodro	0.691	2.15	1.846	5.744	0.115	0.358	0.073	0.227	1.265	1.265
Endamin komakfanar	0.62	2.371	2.636	10.081	-0.6	2.295	0.343	1.312	2.878	2.878

. 8. Suggestions for future research

1. Using combined approach of AHP and DEA models to provide performance measurement model.
2. Using a combined approach of fuzzy AHP and variable returns to scale to provide performance measurement model.
3. Using new econometric models in order to providing a useful model for separation of efficient and inefficient companies.
4. Using new method of multi-component DEA in order to provide performance measurement model.
5. Using other combination method such as balanced scorecard, DEA, hierarchical analysis, fuzzy hierarchical analysis, and TOPSIS
6. Since in this study financial indicators were used for evaluating performance of companies, we suggest that qualitative indicators also considered in evaluating performance of companies. The results can be compared.
7. Using new indexes according to the experts in providing performance appraisal model.

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