Bol. Soc. Paran. Mat.
©SPM –ISSN-2175-1188 on line
SPM: www.spm.uem.br/bspm

(3s.) **v. 32** 2 (2014): 163–174.
ISSN-00378712 in press
doi:10.5269/bspm.v32i2.21378

Integrating FAHP and Fuzzy ARAS for evaluating financial performance

Abdolhamid Safaei Ghadikolaei and Saber Khalili Esbouei

ABSTRACT: Multi Criteria Decision Making (MCDM) is an advanced field of Operation Research; recently MCDM methods are efficient and common tools for performance evaluation in many areas such as finance and economy. The aim of this study is to show one of applications of mathematics in real word. This study with considering value based measures and accounting based measures simultaneously, provided a hybrid approach of MCDM methods in fuzzy environment for financial performance evaluation of automotive and parts manufacturing industry of Tehran stock exchange (TSE).for this purpose Fuzzy analytic hierarchy process (FAHP) is applied to determine the relative important of each criterion, then The companies are ranked according their financial performance by using fuzzy additive ratio assessment (Fuzzy ARAS) method. The finding of this study showed effective of this approach in evaluating financial performance.

Key Words: Financial performance evaluation, Multi Criteria Decision Making (MCDM), Fuzzy Analytic Hierarchy Process (FAHP), Fuzzy Additive Ratio Assessment (Fuzzy ARAS)

Contents

1. Introduction

Multi Criteria Decision Making (MCDM) is an advanced field of operation research (OR). It provides decision makers and analysts with a wide range of methodologies, which are overviewed and well–suited to the complexity of economical decision problems [1]. Most of the economical, industrial, financial or political decision problems are multi attribute. The application of multi–criteria decision making

2000 *Mathematics Subject Classification:* 62C86, 90B50, 03B52

methods significantly improves the robustness of financial analysis and business decisions in general [2].

In today's world economy, good financial situations provide company's competitive advantage; On the other hand financial ratios provide useful quantitative financial information about company performance [3]. In this context, this study puts forth a fuzzy hybrid approach for the financial performance evaluation of the listed companies in automotive and parts manufacturing that traded on TSE in 2002–2011. At first FAHP will be used to determine the weight of main criteria and sub criteria, then fuzzy ARAS will be applied for ranking the automotive group's companies traded on TSE in 2002–2011.

2. Literature review

Several studies on financial performance evaluation are focused on ranking the alternatives according to their financial performance measures included in their comparison environments. Secme et al (2009) used FAHP and TOPSIS for evaluating of five Turkish banks. Wang and Lee (2010) evaluated three major container shipping companies in their study by using Grey Relation Analysis (GRA). Balzentis et al (2012) based on financial ratios used FTOPSIS, FVIKOR and fuzzy ARAS methods for integrated assessment of Lithuanian economic in 2007–2010 periods. Ergul and Seyfullahogullari (2012) for ranking of retail companies trading on ISE applied ELECTRE III based on financial performance in 2008–2010. Lee et al (2012) in a comparative study on financial positions of shipping companies in Taiwan and Korea used entropy and grey relation analysis. At first, they applied entropy to find the relative weights of financial ratios of the four companies, and then they used grey relation analysis to rank the companies. Yalcin et al (2012) constructed a hierarchical structure of the financial performance model for ISE's manufacturing companies. They used FAHP, VIKOR and TOPSIS in their approach. Bayrakdaroglu and Yalcin (2012) for strategic financial performance evaluation of ISE used FAHP for determining the weight of criteria and used VIKOR for best company selection. Ignatus et al (2012) in their study survey financial performance of Iran's Automotive Sector based on PROMETHEE II. Khalili Esbouei and Safaei Ghadikolaei (2013) in their study to ranking ten parts manufacturer companies based on six value based measures an accounting measures, used FAHP to calculate the weights of criteria an used ARAS method to ranking alternatives. Safaei Ghadikolaei et al (2013) in their study about financial performance evaluation of companies with applying fuzzy MCDM methods used FAHP to determine the weights of criteria and fuzzy VIKOR, fuzzy ARAS and fuzzy COPRAS to select best alternative among six Iranian companies. Table 1 Summarized similar study in this subject.

3. Hierarchical model for financial performance evaluation

In this study based on two main criteria and eleven sub–criteria, presented a multi criteria new model consists of accounting measures and value based measures, also provided a combinative approach of MCDM methods in fuzzy environment for

Table 1: Comparison of the previous studies that have used MCDM methods for financial performance evaluation.

Study	Objectives	Methods used	Approach used MCDM methods
Secme et al. [4]	Evaluating of five Turkish banks	FAHP, TOPSIS	FAHP to determine criteria's weights and using TOPSIS for outranking five banks
Wang and Lee [5]	Financial performance evaluating of shipment companies	GRA	Evaluating the companies by using GRA
Balzentis et al. [2]	Integrated assessment of Lithuanian economic	FTOPSIS, FVIKOR, FUZZY ARAS	They used FTOPSIS, FVIKOR and FUZZY ARAS together for evaluation of economic sector
Ergul& Seyfullahogullari. [6]	Ranking of Retail Companies Trading in ISE applied	ELECTRE III	They applied ELECTRE III for ranking five retail company in Turkey
Yalcin et al. [3]	Financial performance evaluation of Turkish manufacturing companies	FAHP, VIKOR, TOPSIS	FAHP to determine the weight of criteria and VIKOR and TOPSIS were used to ranking the company comparatively
Bayrakdaroglu and Yalcin [7]	Strategic financial performance evaluation of ISE	FAHP, VIKOR	Used FAHP for calculate the relative important of measures and VIKOR was used to select the best company
Ignatus et al. [8]	Financial performance of Iran's Automotive Sector	PROMETHEE II	PROMETHEE II was used for select the best company
Lee et al. [9]	Study for survey financial positions of shipping companies in Taiwan and Korea	Entropy, Grey Relation Analysis (GRA)	They used Entropy for determine the weight of criteria and used GRA to rank the company
Khalili Esbouei and Safaei Ghadikolaei [10]	Ranking of 10 automotive parts manufacturers Trading in TSE	FAHP, ARAS	They used FAHP for determine the weights of criteria and used ARAS to rank the companies
Safaei Ghadikolaei et al. [11]	Financial performance evaluation of six Iranian companies	FAHP, Fuzzy VIKOR, Fuzzy ARAS, Fuzzy COPRAS	They used FAHP for determine the weights of criteria and used Fuzzy VIKOR, Fuzzy ARAS and Fuzzy COPRAS to rank the companies

financial performance evaluation of TSE's company. Yalcin et al (2012) constructed hierarchical structure for financial evaluation of ISE's manufacturing companies based on VFP[1] and AFP[2] as main criteria that each have four sub criteria, EVA[3], MVA[4], CFROI[5], CVA[6] and ROA[7], ROE[8], EPS[9], P/E[10] respectively. But this study's model is very different from Yalcin et al. model. The proposed model

[1] Value based financial performance evaluation
[2] Accounting based financial performance evaluation
[3] Economic Value Added
[4] Market Value Added
[5] Cash Flow Return on Investment
[6] Cash Value Added
[7] return on assets
[8] return on equity
[9] earning per share
[10] price/earnings ratio

is shown in Fig. 1. In this study, four accounting measures are determined as the sub–criteria by the finance and TSE expert. These measures are ROA, ROE, Operating Profit Growth (OPG) and P/E. Also, seven Value based measures are determined as the sub–criteria to evaluate by the experts. These measures are determined as EVA, MVA, Refined EVA (REVA), True Value Added (TVA), CVA, Created Shareholder Value (CSV) and Tobin's Q. Formulation of These sub–criteria measures are briefly explained in the table 2.

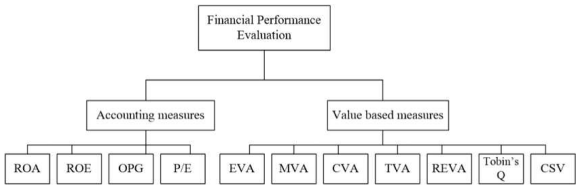

Figure 1: Hierarchical model for financial performance evaluation of TSE's company

Table 2: formulation of financial performance evaluation measures.

Financial performance measures	Formula	Study
Return On Assets (ROA)	$ROA = \frac{Net\ income\ available\ to\ common\ stockholders}{Total\ assets}$	Yalcin et al. [3]
Return On Equity (ROE)	$ROE = \frac{Net\ income\ available\ to\ common\ stockholders}{Stockholder's\ equity}$	Yalcin et al. [3]
Operating Profit Growth (OPG)	$OPG = \frac{(Operating\ profit)_t - (Operating\ profit)_{t-1}}{(Operating\ profit)_{t-1}}$	Ergul and Seyfullahogullari [6]
P/E	$P/E = \frac{Market\ price\ per\ share}{Earning\ per\ share}$	Yalcin et al. [3]
Economic Value Added (EVA)	$EVA_t = NOPAT_t - (WACC_t \times CE_{t-1})$	Yalcin et al. [3]
Market Value Added (MVA)	$MVA = Total\ market\ value - Total\ capital\ employed$	Bayrakdaroglu and Yalcin [7]
Cash Value Added (CVA)	$CVA = Gross\ cash\ flows - Economic\ depreciation - -Capital\ charge$	Yalcin et al. [3]
True Value Added (TVA)	$TVA = FCF + Capital Gains - (MV \times (1 + WACC))$	Bayrakdaroglu and Yalcin [7]
Refined Economic Value Added (REVA)	$REVA_t = NOPAT_t - WACC(Mcapital_{t-1})$	Hajiabbasi et al. [12]
Tobin's Q	$Tobin'sQ = \frac{Market\ Value + Book\ Value\ of\ Liabilities}{Book\ Value\ of\ Assets}$	Jones et al. [13]
Created Shareholder Value (CSV)	$CSV = Market Value of Equity \times (Shareholder\ Return - K_e)$	Largani et al. [14]

4. MCDM methods

MCDM is an advanced field of Operation Research; it provides decision makers and analysts with a wide range of methodologies, which are overviewed and well–suited to the complexity of economical decision problems [1]. In this study two fuzzy MCDM methods were used for evaluation of twenty four companies. At first FAHP was used to determine weight of main criteria and sub criteria then researcher used fuzzy ARAS to ranking the companies based on best financial performance.

To evaluate the importance of the main–criteria and sub–criteria and consist the fuzzy pare wise matrix, expert group (decision makers) utilized the membership function of linguistic scale that presented in Table 3.

Table 3: Membership functions of linguistic scale [15].

Linguistic scale	Positive triangular fuzzy numbers	Positive reciprocal triangular fuzzy numbers
Absolutely importance	(8, 9, 10)	(1/10, 1/9, 1/8)
Intermediate	(7, 8, 9)	(1/9, 1/8, 1/7)
Very strongly	(6, 7, 8)	(1/8, 1/7, 1/6)
Intermediate	(5, 6, 7)	(1/7, 1/6, 1/5)
Strong	(4, 5, 6)	(1/6, 1/5, 1/4)
Intermediate	(3, 4, 5)	(1/5,1/4,1/3)
Weakly	(2, 3, 4)	(1/4,1/3,1/2)
Intermediate	(1, 2, 3)	(1/3, 1/2, 1)
Equally importance	(1, 1, 1)	(1, 1, 1)

In this study for testing the consistency ratio (CR) of fuzzy pare wise matrix, Lin (2010) approach was used. If the CR is greater than 0.1, the result is not consistent, and the pair–wise comparison matrix must be revised by the evaluator. Let $\tilde{R} = [\tilde{r}_{ij}]$ be a fuzzy judgment matrix with triangular fuzzy number $\tilde{r}_{ij} = (l_{ij}, m_{ij}, u_{ij})$ and form $R = [m_{ij}]$. If R is consistent, then $\tilde{R}$ is consistent [16].

4.1. FAHP

In this study, the weights of the financial performance criteria are obtained by using extent FAHP method that is because of the computational easiness and efficiency [3]. Calculation of FAHP can be described as follow:

Assume that $O = \{o_1, o_2, o_3, ..., o_n\}$ is an object set, and $G = \{g_1, g_2, g_3, ..., g_m\}$ be a goal set. Each object is taken and extent analysis for each goal is performed, respectively. Therefore, m extent analysis values for each object can be obtained, with the following signs:

$$\tilde{Q}^1_{g_i}, ..., \tilde{Q}^2_{g_i}, ..., \tilde{Q}^m_{g_i}, i = 1, 2, ..., \alpha,$$

where all the $\tilde{Q}^m_{g_i}$ $(j = 1, 2, \dots , m)$ are triangular fuzzy numbers (TFNs).

The steps of extent FAHP can be given as in the following:

Step 1. The value of fuzzy synthetic extent with respect to the ith object is defined

as

$$\tilde{S}_i = \sum_{j=1}^{m} \tilde{Q}_{g_i}^j \otimes \left[\sum_{i=1}^{n} \sum_{j=1}^{m} \tilde{Q}_{g_i}^j \right]^{-1} \tag{4.1}$$

To obtain $\sum_{j=1}^{m} \tilde{Q}_{g_i}^j$, perform the fuzzy addition operation of β extent analysis values for a particular matrix such that:

$$\sum_{j=1}^{m} \tilde{Q}_{g_i}^j = \left(\sum_{j=1}^{m} l_j, \sum_{j=1}^{m} m_j, \sum_{j=1}^{m} u_j \right) \tag{4.2}$$

and to obtain $\left[\sum_{i=1}^{n} \sum_{j=1}^{m} \tilde{Q}_{g_i}^j \right]^{-1}$, perform the fuzzy addition operation of $\tilde{Q}_{g_i}^j$ $(j = 1, 2, \ldots, \beta)$ values such that

$$\sum_{i=1}^{\alpha} \sum_{j=1}^{\beta} \tilde{Q}_{g_i}^j = \left(\sum_{i=1}^{\alpha} l_i, \sum_{i=1}^{\alpha} m_i, \sum_{i=1}^{\alpha} u_i \right) \tag{4.3}$$

and then the inverse of the vector above is computed:

$$\left[\sum_{i=1}^{\alpha} \sum_{j=1}^{\beta} \tilde{Q}_{g_i}^j \right]^{-1} = \left(\frac{1}{\sum_{i=1}^{\alpha} u_i}, \frac{1}{\sum_{i=1}^{\alpha} m_i}, \frac{1}{\sum_{i=1}^{\alpha} l_i} \right) \tag{4.4}$$

Step 2. As $\tilde{Q}_1 = (l_1, m_1, u_1)$ and $\tilde{Q}_2 = (l_2, m_2, u_2)$are two triangular fuzzy numbers, the degree of possibility of $\tilde{Q}_2 \geq \tilde{Q}_1$ defined as:

$$V\left(\tilde{Q}_2 \geq \tilde{Q}_1\right) = \sup_{y \geq x} \left[\min \left(\mu_{\tilde{Q}_1}(x), \mu_{\tilde{Q}_2}(y) \right) \right] \tag{4.5}$$

and can be equivalently expressed as follows:

$$V\left(\tilde{Q}_2 \geq \tilde{Q}_1\right) = hgt\left(\tilde{Q}_1 \cap \tilde{Q}_2\right) = \mu_{\tilde{Q}_2}(d) = \begin{cases} 1, & if m_2 \geq m_1 \\ 0, & if l_1 \geq u_2 \\ \frac{l_1 - u_2}{(m_2 - u_2) - (m_1 - l_1)} & O.W \end{cases} \tag{4.6}$$

where d is the ordinate of the highest intersection point D between $\mu_{\tilde{Q}_1}$ and $\mu_{\tilde{Q}_2}$ (see Figure 2). To compare $\tilde{Q}_1$ and $\tilde{Q}_2$, we need both values of $V\left(\tilde{Q}_1 \geq \tilde{Q}_2\right)$ and $V\left(\tilde{Q}_2 \geq \tilde{Q}_1\right)$.

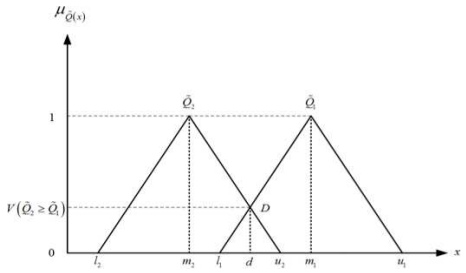

Figure 2: The intersection between$\tilde{Q}_1$and$\tilde{Q}_2$.

Step 3. The degree possibility for a convex fuzzy number to be greater than k convex fuzzy $\tilde{Q}_i$ $(i = 1, 2, \ldots, k)$ numbers can be defined by

$$V\left(\tilde{Q} \geq \tilde{Q}_1, \tilde{Q}_2, ..., \tilde{Q}_k\right) = V\left[\left(\tilde{Q} \geq \tilde{Q}_1\right) and \left(\tilde{Q} \geq \tilde{Q}_2\right) ...and \left(\tilde{Q} \geq \tilde{Q}_k\right)\right]$$
$$= \min V\left(\tilde{Q} \geq \tilde{Q}_1\right), \qquad i = 1, 2, 3, ..., k. \tag{4.7}$$

Assume that $d'(P_i) = \min V(S_i \geq S_k)$ for $k = 1, 2, ..., n;\ k \neq i$. Then the weight vector is given by

$$W' = \left(d'(P_1), d'(P_2), ..., d'(P_n)\right)^T \tag{4.8}$$

where $P_i\,(i = 1, 2, ..., n)$ are n elements.

Step 4. Via normalization, the normalized weight vectors are

$$W = \left(d(P_1), d(P_2), ..., d(P_n)\right)^T \tag{4.9}$$

where W is a non–fuzzy number.

4.2. Fuzzy ARAS

The fuzzy ARAS is based on comparing every alternative with the hypothetic ideal one [17]. Let us assume the fuzzy decision making matrix $\tilde{X} = \tilde{x}_{ij}$, where $i = 1, 2, ..., m$ and $j = 1, 2, ..., n$ represent the number of alternatives and criteria respectively. In this study, $m = 24$ and $n = 11$. The jth criterion of the ith alternative is represented by triangular fuzzy number: $\tilde{x}_{ij} = (x_{ij_1}, x_{ij_2}, x_{ij_3})$. Also each jth criterion is assigned with respective coefficient of significance$\tilde{w}_j$that it obtained by FAHP, in this study. Benefit criteria are members of benefit criteria set B while cost criteria are members of respective set C.

With above, calculation of fuzzy ARAS can be described as follow [2]:

With $\underset{ij}{\tilde{x}} = (x_{ij_1}, x_{ij2}, x_{ij3})$, the ideal alternative is described in the following way:

$$\underset{0j}{\tilde{x}} = \max_i x_{ij_3}, \forall j \in B \quad \underset{0j}{\tilde{x}} = \min_i \underset{ij_1}{x}, \forall j \in C \tag{4.10}$$

Subsequently, the normalized values $\tilde{\tilde{x}}_{ij}$ are obtained:

$$\tilde{\tilde{x}}_{ij} = \frac{\tilde{x}_{ij}}{\sum_{i=0}^{m} \tilde{x}_{ij}}, \ \forall j \in B \, \tilde{\tilde{x}}_{ij} = \frac{1/\tilde{x}_{ij}}{\sum_{i=0}^{m} 1/\tilde{x}_{ij}}, \ \forall j \in C \tag{4.11}$$

Each $\tilde{\tilde{x}}_{ij}$ is weighted by computing elements of the weighted–normalized matrix:

$$\tilde{\hat{x}}_{ij} = \tilde{\tilde{x}}_{ij} \times \tilde{w}_j, \ \forall j, i \tag{4.12}$$

where $\tilde{w}_j$ is coefficient of significance and $\tilde{\hat{x}}_{ij}$ is the weighted–normalized value of the jth criterion of the ith alternative. The overall utility$\tilde{S}_i$ of the ith alternative is computed in the following way:

$$\tilde{S}_i = \sum_{j=1}^{n} x_{ij}, \ \forall i \tag{4.13}$$

Since $\tilde{S}_i = (s_{i1}, s_{i2}, s_{i3})$, $i = 0, 1, ..., m$ is a fuzzy number, the COA method is applied for defuzzification:

$$S_i = \frac{s_{i1} + s_{i2} + s_{i3}}{3}, \forall i \tag{4.14}$$

Finally, the relative utility of the ith alternative K_i is found:

$$K_i = \frac{S_i}{S_0}, \forall i \tag{4.15}$$

where $K_i \in [0, 1]$. The best alternative is found by maximizing value of K_i.

5. Evaluation process

The aim of this study is to present a fuzzy approach to evaluate the financial performance of the companies in the Iran traded on TSE by using both accounting measures and value based measures together in a fuzzy environment. This approach was applied for evaluation companies of automotive and parts manufacturing industry of TSE in 2002–2011 (ten years). For this period of the research, annual financial statements of companies which pass away independent external auditing are considered. With respect to the TSE's Database and Rahavard Novin software, data were gathered. At the end twenty four were selected for this study. For convert crisp numbers of financial measure into fuzzy numbers following equation was used:

As for time series data, a fuzzy number can represent the dynamics of certain indicator during past *t=10* periods [4]:

$$\left(Minx_{ij}, \frac{\sum_{i=1}^{10} x_{ij}}{10}, Maxx_{ij} \right) \tag{5.1}$$

The weights of the criteria are first determined by using FAHP. The pair–wise comparison scores have been carried out by financial experts. Experts are asked to make pair–wise comparisons for all evaluation criteria based on table 2. After computing the result of each evaluator's assessment, Lin (2010) approach was used to obtain the consistency ratio of each expert's pare wise matrix. Consistency ratio values are less than the acceptable threshold value (i.e., CR < 0.1). The overall results are obtained by taking the geometric mean of individual evaluations. In Table 4 combined pare wise matrix of main criteria with their weights from FAHP are shown.

Table 4: The fuzzy evaluation matrix with respect to the goal.

	Accounting measures	Value based measures	Weights
Accounting measures	(1, 1, 1)	(0.3102, 0.4518, 0.8409)	0.2332
Value based measures	(1.1892, 2.2134, 3.2237)	(1, 1, 1)	0.7668

With respect to the results Value based measures are more important than Accounting measures in financial performance evaluation of TSE's companies. Table 5 shows the weights of the sub criteria were obtained by FAHP. CVA, TVA, REVA have highest weight among sub criteria, respectively, so TSE's companies should Pay special attention to this measures about their financial performance.

Table 5: Weights of sub criteria obtained from FAHP.

Sub criteria	Local Weights	Total Weights	Rank
ROA	0.2431	0.0567	10
ROE	0.2089	0.0487	11
OPG	0.2689	0.0627	9
P/E	0.2791	0.0651	8
EVA	0.1040	0.0797	6
MVA	0.1359	0.1042	4
CVA	0.1823	0.1398	1
TVA	0.1764	0.1353	2
REVA	0.1668	0.1279	3
Tobin's Q	0.1031	0.0791	7
CSV	0.1315	0.1008	5

Fuzzy ARAS has been used for ranking the companies based on financial performance. Table 6. Shows the results have been obtained from fuzzy ARAS. With respect to K values among the evaluated companies, RENA had best financial performance in 2002–2011.

Table 6: Ranking the companies.

Company	K	Rank
IKCO	0.4130	2
KAVR	0.2572	6
PKOD	0.2621	5
SIPA	0.3391	3
RENA	0.4354	1
BHMN	0.3316	4
ATIR	0.1124	22
KRIR	0.1246	12
RADI	0.1176	16
RTIR	0.1213	13
RINM	0.1099	24
ZMYD	0.1367	8
SZPO	0.1509	7
AZIN	0.1141	19
RIIR	0.1186	14
KFAN	0.1151	18
FNAR	0.1156	17
GHAT	0.1359	9
LENT	0.1281	10
TMKH	0.1103	23
MESI	0.1185	15
MHKM	0.1280	11
NMOH	0.1128	20
INDM	0.1126	21

6. Conclusion

This study showed one of interesting applications of mathematics in real world. MCDM is an advanced field of OR that very appropriate to performance evaluation problems. Many studies in the literature involving MCDM procedures use only the traditional financial ratios for financial performance. In this study Accounting measures and Value based measures have been used for financial performance evaluation, simultaneously. Results shown Value based measures are more important than Accounting measures for TSE's companies evaluation, also for show better performance evaluation, companies should pay more attention to value based measures such CVA, TVA , REVA.

Further study can include both qualitative and quantitative criteria for evaluating financial performance, In addition to the proposed methods in this study, some other MCDM methods such as PROMETHEE, ORESTE and MULTIMOORA can be used for financial performance evaluation.

References

1. E. K. Zavadskas and Z. Turskis, Multiple criteria decision making (MCDM) methods in economics, *Technological and Economic Development of Economy,* 17(2) (2011), 397–427.

2. A. Balzentis, T. Balzentis and A. Misiunas, An integrated assessment of lithuanian economic sectors based on financial ratios and fuzzy MCDM methods. *Technological and Economic Development of Economy* 18(1) (2012), 34–53.

3. N. Yalcin, A. Bayrakderaglu and C. Kahraman, Application of fuzzy multi–criteria decision making methods for financial performance evaluation of Turkish manufacturing industries, *Expert Systems With Applications,* 39(3) (2012), 350–364.

4. N. Y. Secme, A. Bayrakderaglu and C. Kahraman, Fuzzy performance evaluation in Turkish Banking Sector using Analytic Hierarchy Process and TOPSIS, *Expert Systems With Applications*, 36(2009), 11699–11709.

5. Y. J. Wang and H. S. Lee, Evaluating financial performance of Taiwan container shipping companies by strength and weakness indices, *International Journal of Computer Mathematics*, 87(1) (2010), 38–52.

6. N. Ergul, C. A and Seyfullahogullari, The Ranking of Retail Companies Trading in ISE. *European Journal of Scientific Research,* 70(1) (2012), 29–37.

7. A. Bayrakdaroglu and N. Yalcin, Strategic Financial Performance Evaluation of the Turkish Companies Traded on ISE. *EGE ACADEMIC REVIEW,* 12(4) (2012), 529–539.

8. J. Ignatius, M. Behzadian, H. S. Malekan and D. Lalitha, Financial Performance of Iran's Automotive Sector based on PROMETHEE II. *Proceeding of the 2012 IEEE ICMIT*, 35–38.

9. P. T. W. Lee, C. W. Lin and S. H. Shin, A comparative study on financial positions of shipping companies in Taiwan and Korea using entropy and grey relation analysis, *Expert Systems with Applications,* 39(5) (2012), 5649–5657.

10. S. K. Esbouei and A. S. Ghadikolaei, An integrated approach based on FAHP and ARAS methods for financial performance evaluation, *ARPN Journal of systems and software*, 3(4) (2013), 53–56.

11. A. S. Ghadikolaei, S. K. Esbouei and J. Antucheviciene, APPLYING FUZZY MCDM FOR FINANCIAL PERFORMANCE EVALUATION OF IRANIAN COMPANIES, *Technological and Economic Development of Economy*, (2013) in press.

12. M. Hajiabasi, M. Kaviani, M. Samadi Largani, M. Samadi Largani, H. Montazeri, Comparison of information content value creation measures(EVA, REVA, MVA, SVA, CSV and CVA) and accounting measures (ROA, ROE, EPS, CFO) in predicting the Shareholder Return (SR) Evidence from Iran Stock Exchange. *ARPN Journal of Science and Technology,* 2(5) (2012), 517–521.

13. J. S. Jones, S. A. Miller and T. J. Yeager, Charter value, Tobin's Q and bank risk during the subprime financial crisis. *Journal of Economics and Business*, 63(5) (2011), 372–391.

14. M. S. Largani, M. Kaviani and A. Abdollahpour, A review of the application of the concept of Shareholder Value Added (SVA) in financial decisions. *Procedia - Social and Behavioral Sciences,* 40 (2012), 490–497.

15. W. C. Chou and Y. P. Cheng, A hybrid fuzzy MCDM approach for evaluating website quality of professional accounting firms,. *Expert System with Applications,* 39(3) (2012), 2783–2793.

16. H. F. Lin, An application of Fuzzy AHP for evaluating course website quality. *Computers & Education* 54(4) (2010), 877–888.

17. Z. Turskis, E. K. Zavadskas, A new fuzzy additive ratio assessment method (ARAS-F), Case study the analysis of fuzzy multiple criteria in order to select the Logistic Center location, *Transport,* 25(4) (2010), 423–432.

Abdolhamid Safaei Ghadikolaei
Faculty of Economic and Administrative Sciences,
Mazandaran university,
P. O. Box 416, Babolsar, Mazandaran, Iran
E-mail address: ab.safaei@umz.ac.ir

and

Saber Khalili Esbouei
Faculty of Economic and Administrative Sciences,
Mazandaran university,
P. O. Box 416, Babolsar, Mazndaran, Iran
E-mail address: khalili.saber@ymail.com