Investigating the effect of financial indices on cement companies performance using Fuzzy Mcdm

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Abstract

Proper evaluation of company performance, not only for investors, shareholders and lenders is an important issue, but for companies that are active in the same sector is also important. Today, with the increased use of cement in infrastructure development, including the construction and development of building operation, construction activities and projects, and financial resources required for reconstruction and investments of cement industry, cement industry is become one of the most important and influential industrial infrastructure in Iran. In order to importance of cement industry and investment in, in this study financial indices that influence in evaluation of cement companies at Tehran Stock Exchange are considered. For these indices hierarchical structure is proposed and prioritized by 12 experts in this field. Results based on Fuzzy Analytical Hierarchical Process (fuzzy AHP) are shown profitability ratio and net profit margin ration are the most important financial index and sub-index in evaluation of cement companies.

Keywords: Cement Companies, Fuzzy Analytical Hierarchical Process (fuzzy AHP), Financial Indices, Tehran Stock Exchange

1. Introduction

According to international journal of Iran Investment (2010), Historical Background of Starting date of cement industry in Iran back to the year of 1933. This report with regard to the significant growth of the cement industry in over the past 10 years said that since the 1960s Iran's cement industry hadn't the real and importance role in construction industry. The per capita consumption of cement was 30 kg in 1961 and had been increased to 300 kg in 1984. In fact, the real growth of production and consumption of cement has been happened over the past decade. So, until March 2010 cement production capacity was reached to more than 62 million tons. Currently in Iran, there are 57 active units in the production of cement. Now, According to the report, 27 cement companies are listed on Tehran Stock Exchange. Today, the cement industry with an annual turnover of about more than 1milliard $ is one of the largest industries in Iran (Azar et al., 2008). Various studies show that cement production is highly advantageous in Iran and with consideration of comparing the cost of cement production in the world, the cement production in Iran is affordable. Hence, appropriate investment in the industry will be leaded to the development and promotion of position of this industry. For appropriate investment in this industry, companies that are active in this filed must be evaluated and for each evaluation, having proper indices is necessary. So, the purposes of this paper are identification, categorization, and prioritization of indices affecting the evaluation of cement companies for investment at Tehran Stock Exchange. For attaining list of financial indices of cement companies at Tehran Stock Exchange and determining importance of them, the organization of the paper is as follows. In section 2 and section 3 respectively Methodology for extracting financial indices and proposed hierarchical structure for evaluating these indices are given. Methodology for prioritization of induces and analyzing results are presented in sections 4 and 5. Also, conclusion and future are discussed in section 6.

2. Methodology for extracting financial indices of cement companies

Issue discussed in this study has been considered with various topics in literature such as stock evaluation, performance evaluation, stock selection, portfolio selection, stock forecasting and so on. At the first step, the indices considered in the evaluation of companies are studied with regarding to literature. Kimiagari and Amini (2007), in their study, examine the profitability of a wide range of stock selection strategies in Tehran Stock Exchange during the period of 1991-2004. Their indices were Capital markets - comparison of earnings per share / stock price - in cash per share / stock price - book value / share price - sales / shares - dividend per share / earnings per share - dividends per share / stock price - the growth rate of EPS - earnings growth rate - Refinancing Rates - net income and so on. Lee et al. (2009) consider indices of industry vision, earnings, operating cash flow, the dividend payments, the beta coefficient, the risk-free interest rate, income growth rate, the growth rate of dividends paid for their evaluation. ROI - Beta Factor - market power - P / E - dividend yield - the rate of return on assets - Return on equity - asset turnover - Inventory turnover - the ratio

of assets to liabilities - debt to equity ratio regard as indices in Xidonas's et al. (2009) research. Kasımbeyli et al. (2010), Modanlo Joibary and Nagaraja (2012), Yan and Ling (2007), Scinto and Hardin (2009), Islam et al. (2010), Quah (2008), Atsalakis and Valavanis (2009), Maslov and Rytchkov (2010), Becker and O'Reilly (2009) and so on applied some indices for evaluation of companies in their research.

In this research, for cement companies listed at the Tehran Stock Exchange, indices based on financial ratios in four group of: liquidity ratios, financial leverage ratios, profitability ratios, growth ratios are categorized and evaluated. Each of the main indices (financial ratios) contains some sub-indices. These main indices and sub-indices attain based on literature and confirm at person Meetings or contact via email by top executives of companies Stock Exchange Broker. In table 1 effective indices and sub-indices for evaluating cement companies at Tehran Stock Exchange is shown.

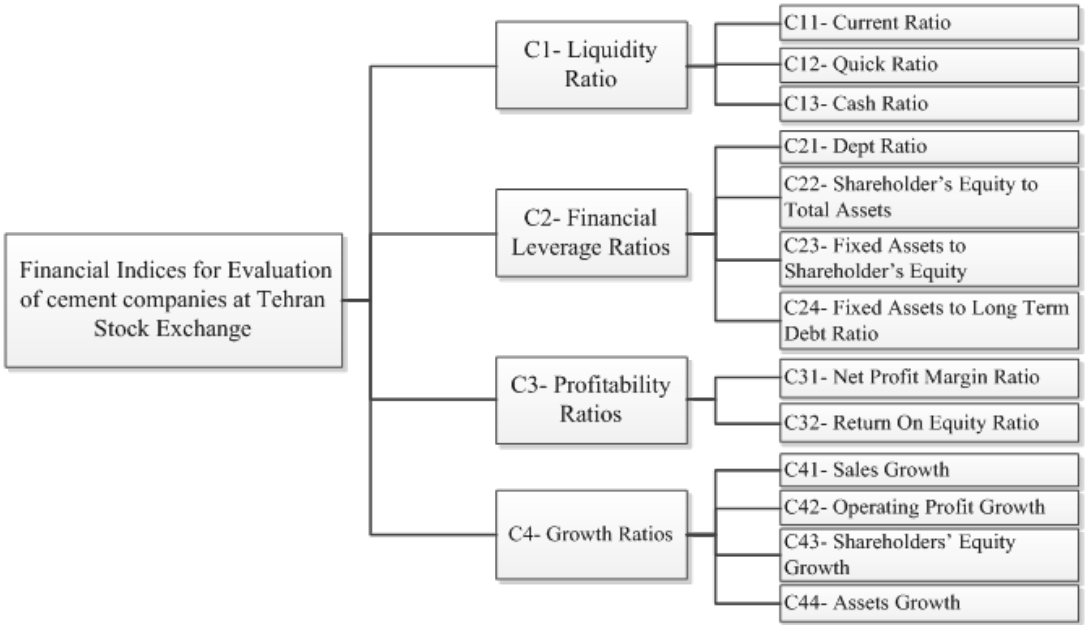
Table 1: *effective indices and sub-indices for evaluating Cement Company at Tehran Stock Exchange*

No.	Type of Ratio	Ratio	Symbol
1	Liquidity	Current Ratio	CRR
2		Quick Ratio	QR
3		Cash Ratio	CAR
4	Financial leverage	Dept Ratio	DR
5		Shareholder's Equity to Total Assets	SETAR
6		Fixed Assets to Shareholder's Equity	FASER
7		Fixed Assets to Long Term Debt Ratio	FALTDR
8	Profitability	Net Profit Margin Ratio	NPMR
9		Return On Equity Ratio	ROE
10	Growth	Sales Growth	SG
11		Operating Profit Growth	OPG
12		Shareholders' Equity Growth	SEG
13		Assets Growth	AG

3. The proposed hierarchical structure for evaluating financial indices in cement companies

After financial indices and sub-indices affected on evaluation of cement companies were extracted from literature and were confirmed by experts at meeting, the output of the meetings resulted in a hierarchical structure to evaluate the cement companies at the Tehran Stock Exchange. The hierarchical structure is shown in Figure 1.

Figure 1: *hierarchical structure for evaluation of cement companies based on financial indices*



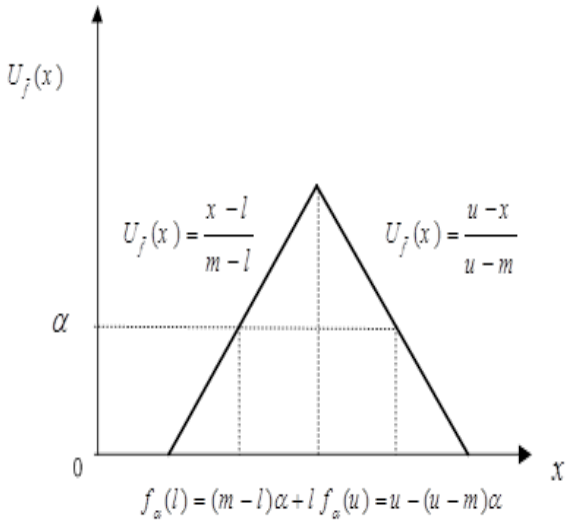
4. wMethodology for prioritization of financial indices in cement companies

Analytical Hierarchy Process (AHP) method has been used successfully on a variety of issues. This process was first developed by Saaty (1980). Fuzzy analytic hierarchy process (fuzzy AHP) when ambiguity of human thought involve the study of multi-criteria decision-making problems is widely used to help attaining better results. Zadeh (1996) first introduced the fuzzy set theory, which can effectively describe imprecise knowledge or human subjective judgment by linguistic terms. With regarding to hierarchical structure of indices and sub-indices, fuzzy AHP based on experts' judgment for evaluation of these indices is proposed by this research.

Triangular fuzzy numbers are used as membership functions in this research. The membership function of a triangular fuzzy number can be found in Equation (1) and is usually notated by the triplet (l, m, u). (Also see figure 2)

Figure 2*: A triangular fuzzy number*

$$U(x) = \begin{cases} \dfrac{x-l}{m-l} & 1 \le x \le m \\ \dfrac{u-x}{u-m} & m \le x \le u \\ 0 & \text{Otherwise} \end{cases}$$



For the first time, AHP process used in this paper was proposed by saaty (1980) contain pair wise comprising as shown in Equation (2). a_{ij} shows relative importance of c_i to c_j based on saaty (1980) scale. Fuzzy hierarchical structure change pair wise comparison matrix a_{ij} with w fuzzy triangular numbers. Equation (3) shows the fuzzy matrix of experts' opinion. is triangular fuzzy number for relative importance of two criteria of and. There are several ways for defuzzificatin and in this research, Liou and Wang (1992) method is applied. As Equations (4) and (5) shows, it clearly states the fuzzy concepts.

In Equation (4), indicates left value of forand indicates right value of for.

Because this method can clearly show the decision maker preferences (α) and risk tolerances (β), decision makers could understand risks that they face in different circumstances. α could be considered as stable or unstable condition. Pair wise comparisons matrix that are defuzzied is shown in Equation (6).

After converting the fuzzy pair wise comparisons matrix to definite pair wise comparisons matrix, consistency of experts' responses are evaluated. To obtain Consistency Index (CI), the eigen values $\lambda_{\max}$ need to determine. eigen values $\lambda_{\max}$ for paired comparison $g_{\alpha,\beta}(\tilde{A})$ is defined as:

$g_{\alpha,\beta}(\tilde{A})\,W = \lambda_{\max}.W$	(7)
$[g_{\alpha,\beta}(\tilde{A}) - \lambda_{\max}]\,W = 0$	(8)

In Equations (7) and (8), *W* indicates eigen values of $g_{\alpha,\beta}(\tilde{A})$. Then CI and Consistency Rate (CR) are essential to confirm consistency of pair wise comparison and defined as following Equations

Random Index (RI) is a value that depends on "n" and is shown in table 2.

Table 2*: Random Index (RI) Used to calculate the Consistency Ratio (CR)*

n	1	2	3	4	5	6	7	8	9	10
R.I.	0	0	0.52	0.89	1.11	1.25	1.35	1.4	1.45	1.49

Table 3: *Aggregation of experts' opinion matrix for the second level of the hierarchical structure*

	C1			C2			C3			C4		
C1	1	1	1	0.914	1.158	1.466	0.735	0.957	1.187	1.452	1.876	2.355
C2	-	-	-	1	1	1	0.263	0.341	0.535	0.734	0.933	1.124
C3	-	-	-	-	-	-	1	1	1	1.872	2.568	3.211
C4	-	-	-	-	-	-	-	-	-	1	1	1

Table 4*: Second level hierarchical structure with associated deterministic weights*

	C1	C2	C3	C4	weight
C1	1	1.1738	0.9586	1.8899	0.2845
C2	0.8519	1	0.3701	0.931	0.1737
C3	1.0432	2.702	1	2.5547	0.3828
C4	0.5291	1.0741	0.3914	1	0.159

Table 5: *Final and local weight of indices and sub-indices for evaluating the performance and ranking of cement companies*

Index	Weight	Sub-index	Weight	
			Local	Final
C1	0.2845	C11	0.2622	0.0746
		C12	0.2216	0.0630
		C13	0.5162	0.1469
C2	0.1737	C21	0.1523	0.0265
		C22	0.3296	0.0573
		C23	0.4101	0.0712
		C24	0.108	0.0188
C3	0.3828	C31	0.6429	0.2461
		C32	0.3571	0.1367
C4	0.159	C41	0.1708	0.0272
		C42	0.2264	0.0360
		C43	0.3288	0.0523
		C44	0.274	0.0436

If CR<0.1, the matrix is consistent, so the final ranking is done and decisions are taken, otherwise, we need to gather the experts' opinion again. After considering the consistency of experts' opinion, aggregation of it must be done. In this study, the following Equation to obtain the aggregation of experts' opinion and thus acquire the final tables of paired comparisons was used.

5. Analyzing results

For gathering the experts' opinions, a questionnaire including 22 pair comparisons in a 9-piece scale that applied linguistic variables can reflect different aspects of human judgments, based on Tesfamariam and Sadiq (2006) was used. Structure of questionnaire is similar to Tueysuz and Kahraman's (2006) paper. This questionnaire was distributed among 12 experts with different perspectives and financial advisory shareholder stock. Based on the description of the fuzzy AHP, after considering consistency for each expert's opinion, it turns to aggregation of experts' opinion. In table 3 aggregation of experts' opinion matrix using equation 11 is given to 3 decimal places. To calculate the weight of each index, equation 8 on fuzzy paired comparison matrices that are being defuzzy are applied. Also, these steps are repeated for each sub-index and the final weight of Indices and sub- Indices are shown in Table 5.

6. Conclusion and future research

Objectives of this paper were extraction of financial indices and categorizing them in order to create a novel hierarchical structure, also then prioritizing these indices for evaluation of cement companies in Tehran Stock Exchange. To achieve these objectives, based on literature, 13 financial indices were extracted. Lack of comprehensive lists in this field and unavailability of some journals to review key papers were one of the problems that doing this research. To evaluate and prioritize these indices, hierarchical structure including three levels: goal, main indices, and sub-indices were proposed. According to experts' judgment these indices were prioritized. The results of this research led to the creation of a proper understanding of indices that affected on evaluation of cement companies listed in Tehran Stock Exchange and help investors to purchase Shares of top cement companies with the aim of reducing investment risk. Using methods other than fuzzy AHP for prioritizing these indices and comparison of achieved results from those methods with the results of fuzzy AHP and also applying result of this research for evaluating of cement companies are proposed for future research.

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