



# Financial Evaluation and Prioritization of Base Metals Industries listed in Tehran Stock Exchange based on Analytic Hierarchy Process (AHP)

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## Abstract

*Today, the need for quick and accurate decision making in the face of environmental changes imposes special conditions on decision makers. Due to multiplicity and complexity of the relationships between the factors affecting stock selection decision, buyers and sellers in capital market are confused. Hence, it seems necessary to use a correct and logical way to make the best stock selection decision.*

*The present research aimed to provide a financial evaluation and prioritization of base metal companies listed in Tehran Stock Exchange in a 5 year period from 2005 to 2009. For this purpose, 20 financial ratios including liquidity, operation, leverage and profitability ratios obtained from the financial statements of the listed companies were analyzed as the variables of this research through analytic hierarchy process (AHP) using Expert Choice Software. Based on AHP, 8 financial ratios were selected as the main variables of the research. The results showed that National Iranian Copper Industries Co. and Iranian Lead and Zinc Co. held the first and last place in the base metal industry, respectively.*

**Keywords:** *financial ratios, analytic hierarchy process (AHP), base metal industries*

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## 1- Introduction

Given variation of stock price in the capital market, it is necessary to enable the stock buyers to make the best choice using novel scientific methods, providing a desired level of assurance for stock exchange investors by giving them unbiased advice. Thus, use of AHP can be effective when decision involves multiple competing options and several quantitative and qualitative criteria.

Traditional decision models were based on the assumption that organizations only pursued one objective, which was shareholder wealth maximization. However, under the complex conditions today, organizations interact with many beneficiaries in addition to their



shareholders. Thus, the goal of such organizations is to maximize wealth of the beneficiaries considering certain issues and objectives including risk reduction, corporate liquidity, social responsibility, environmental support, improving personnel welfare, *etc.*; therefore, it is necessary to use multifactor decision approaches and models in financial decisions and issues. Consequently, it is very important to focus on the primary principles of investment and attracting investors in the capital market. This method enable investors to make the best choice when purchasing the stock of metal base companies listed in the stock exchange.

Base metals industry with 23 members is one of the most influential group in the Tehran Stock Exchange. The group's turnover in recent years has been the third highest after automobile parts and banks groups. The purpose of this research was to identify important evaluation and ranking criteria of listed base metals companies. The present study is organized in five sections. The second section provides the theoretical background, the third section covers empirical background, and the fourth presents the methodology and results of the AHP model. Finally, Section 5 provides conclusions and policy recommendations from driven the research results.

## 2- Theoretical Background

The truth is that today's financial situation is very variable and competition is very close. In such a competitive and ever changing environment, firms have to focus on data from financial reports to select the best company to invest in.

To achieve the objectives of the analysis of financial statements, very diverse information on enterprises should be collected, which involves the preparation and presentation of multiple financial statements. In other words, the purposes of the analysis of financial statements requires a complete set of several distinct, yet related, financial statements are provided. [2]

Accounting information is useful and can help users in decisions when it have such features. While the provision of each qualitative feature alone is favorable, and seems to be non-problematic, considering all of them together in preparation and presentation of all accounting information is practically hard and sometime impossible due to contradictions between such features. For example, there is an inverse relation between feature of relevance and feature of reliability of financial information, in the sense efforts to provide more relevant information reduce reliability of the information. However, in order to reduce or remove such conflicts, priority must be given to features that are more necessary for fulfillment of research's objective, and even some features must be overlooked in the interest of other features. Financial ratios used in this research are as follows:

1. **Liquidity ratios**, indicating the company's ability to meet its short-term obligations.
2. **Financial leverage ratios**, indicating a company's ability to repay short-term and long-term debt.
3. **Activity ratios**, indicating how efficiently assets are used.
4. **Profitability Ratios**, representing net return on sales and asset.



Studied in this research as indices of financial evaluation were 20 financial ratios including operation, profitability, liquidity and leverage ratios, which are as follows.

Table 1- Indices used in this research

Remarks	Indices
Gross profit to sales ratio = $\frac{\text{Gross profit}}{\text{sales}}$	Gross profit to sales ratio
Operating profit to sales ratio = $\frac{\text{Operating profit}}{\text{sales}}$	Operating profit to sales ratio
Net income to sales ratio = $\frac{\text{Net profit}}{\text{Sales}}$	Net income to sales ratio
Return on total assets ratio = $\frac{\text{Net profit}}{\text{Sales}}$	Return on total assets ratio
Return on equity ratio = $\frac{\text{Net profit}}{\text{Sales}}$	Return on equity ratio
Return on investment ratio = $\frac{\text{Net profit}}{\text{Sales}}$	Return on investment ratio
Inventory turnover ratio = $\frac{\text{Net profit}}{\text{Sales}}$	Inventory turnover ratio
Asset turnover ratio = $\frac{\text{Net profit}}{\text{Sales}}$	Asset turnover ratio
Asset turnover ratio = $\frac{\text{Net profit}}{\text{Sales}}$	Asset turnover ratio
Fixed asset turnover ratio = $\frac{\text{Net profit}}{\text{Sales}}$	Fixed asset turnover ratio
Debt to equity ratio = $\frac{\text{Equity}}{\text{Debt}}$	Debt to equity ratio
Current capital turnover ratio = $\frac{\text{Equity}}{\text{Debt}}$	Current capital turnover ratio
Equity to assets ratio = $\frac{\text{Equity}}{\text{Assets}}$	Equity to assets ratio
Total debt to total assets ratio = $\frac{\text{Total assets}}{\text{Total debts}}$	Total debt to total assets ratio
Current ratio = $\frac{\text{Total assets}}{\text{Total debts}}$	Current ratio
$\frac{p}{E}$ ratio = $\frac{\text{Total assets}}{\text{Total debts}}$	P / E ratio
Quick ratio = $\frac{\text{Total assets}}{\text{Total debts}}$	Quick ratio
Return on capital employed ratio = $\frac{\text{Equity}}{\text{Assets}}$	Return on capital employed ratio



$\text{Sales to capital ratio} = \frac{\text{Sales}}{\text{Capital}}$	Sales to capital ratio
$\text{Profit quality ratio} = \frac{\text{Equity}}{\text{Assets}}$	Profit quality ratio

### 3- Literature

Dehqanpoor (2008) conducted a research titled “Performance evaluation of base metals companies listed in Tehran Stock Exchange using the EVA model and exploration of its relationship with criteria of accounting profit”. [14]

The research hypothesis test was conducted using Pearson's correlation coefficient. Test of hypothesis showed that there was no significant relationship between economic value added and accounting criteria. Having conducted standardization on the economic value added for each company, it was identified that Calcimine Company had the strongest and Khuzestan Steel Company had the weakest performance in the study period.

Ahmadi (2008) designed multiple criteria decision making to determine the optimum combination of exported goods in terms of category of goods. [20] In this study, the criteria were as follows:

- 1) Contribution to foreign exchange outflow ratio;
- 2) Actual contribution to foreign exchange inflow contribution rate;
- 3) Potential contribution to foreign exchange inflow;
- 4) Actual contribution to job opportunities created;
- 5) Potential contribution to create job opportunities;
- 6) Contribution to domestic currency added value; and,
- 7) Other costs.

Competing options (non-oil exports) include:

A1: Agricultural commodities group; A2: Light industries goods group; A3: Heavy industry group products; A4: Minerals and mineral products group; A5: Traditional commodities group; A6: Services group

In this study, the hypothesis that multiple criteria decision making model to determine the optimum combination of non-oil goods is an AHP model was confirmed.

Abbasnejad (2001) conducted a research on financial assessment of motorized transportation companies listed in Tehran Stock Exchange using analytic hierarchy process. [17]

In this study, 33 financial ratios was used to assess motor transportation companies in 2001, which was conducted using analytic hierarchy process to prioritize 19 listed companies.

Of these 33 criteria (financial ratios), 6 were selected factor analysis technique and after collecting expert’s opinion on the importance of each index, the relative weight of indices was determined. Then, using analytic hierarchy process was used for ranking companies based on criteria, and Saipa Diesel Company held the highest level and Iran Carburetor held the last place in the ranking.

### 4- Methodology and Model

This was an applied research, conducted by descriptive-survey method. Base metals group companies under studied included: National Copper Industries, Alumorad, Mobarakeh Steel,



Calcimine, Ferrosilicon, Iran pipe and machine making, Materials processing, Amirkabir steel, Kavian steel, Khuzestan Steel, Khorasan Steel, Alumtek, Sepahan, Rolled Steel, SADID tube, Sepanta, Bahonar Copper, Iralco, SADID, Aluminum Rolling, and Ferromolybdenum.

To select the most influential and important ratios that provided a good estimate of the all financial ratios, factor analysis technique was used. This technique causes certain variables from the collection of variables are chosen, to enable better responsiveness by financial experts as well as ensuring that the most important financial ratios are chosen.

Analytical hierarchical process (AHP) is one of MADM approaches, which is applied for decision making and making a choice from among several options, according to the criteria set by decision maker determines. [8] One of the most efficient techniques for weighting multiple objective functions is analytic hierarchy process, which has also been recognized by scholars. [6]

AHP is one of the most comprehensive systems designed for multi-criteria decision making. While solving major problems in such decisions, this technique have a strong theoretical basis, built on axioms. [20]

AHP reflect normal behavior and human thought. This technique analyzes complex issues based on their interactions, converting them to simple forms and solving them. Applying this method involves four major steps as follows: [9]

**Step 1. Modeling:** In this step, the objective of hierarchical decision making is extracted from interrelated decision elements. Decision elements include "criteria of decision making" and "decision options".

**Step 2. Preferential Judgment:** Making comparisons between different options based on each index, and paired comparison for importance of decision criterion. Step 3. **Step 3.**

**Calculation of relative weights:** Weight and importance of "decision elements" with respect to each other through a set of numerical calculations.

**Step 4. Integrating relative weights:** This step is done in order to rank the decision options Decision-making process ends when the decision-maker has already evaluated the decision in terms of its success in achieving the desired goals and solving initial problems. [13]

Analytical Hierarchy Process (AHP) involves breaking a multifactor problem into a hierarchy of levels. The first level represents the main objectives of the decision process. The second level represents a major and fundamental indices (which may be further broken down into sub-indices and more specific levels). Note that there is no limit to division of the criteria into smaller sub-criteria. The third level provides decision options. [4]

#### 4-1 Model

The statistical population consisted of 150 financial experts of stock exchange including stock brokers, dealers and financial advisors of stock exchange in the country. The sample size was determined using the Cochran's formula as follows:



$$n = \frac{Nt^2 pq}{Nd^2 + t^2 pq} = \frac{150 * (1.96)^2 * 0.5 * 0.5}{150 * (0.075)^2 + (1.96)^2 * 0.5 * 0.5} = 80$$

In this equation, n denotes the sample size, N the number of financial experts (150), t number of standard errors required to achieve a given confidence interval, with 95% confidence interval considered in this study. Thus, t will be equal to 1.96. d denotes probable accuracy and was equal to 0.075 percent. p and q are equal to 0.5, in which case the maximum variance reaches 0.25. Substituting the above figures in Cochran’s formula, sample size of 80 was obtained. Then, using the AHP, the results of ranking financial ratios from view of financial experts of stock exchange was obtained using Friedman test as summarized in Table 2.

**Table 2 – Ranking of financial ratios from view of financial experts of Stock Exchange based on Friedman test**

Average rank	Priority	Criterion	No.
3/14	3	Average gross profit to sale ratio	1
2/18	2	Average operating profit to sale ratio	2
1/41	1	Average net profit to sale ratio	3
5/32	5	Average equity to assets ratio	4
3/73	4	Average equity to debt ratio	5
7/95	8	Average asset to debt ratio	6
6/86	7	Average current ratio	7
5/41	6	Average quick ratio	8

Source: research’s calculations

**Table 3 – Results from Friedman test**

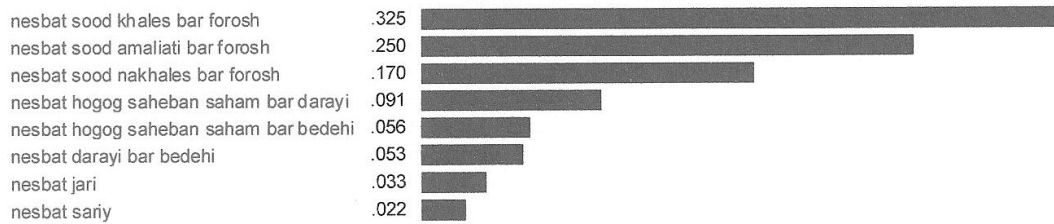
Significance level	Degree of freedom	Chi2 statistic	Size
0/000	7	133/47	22

Source: research’s calculations

Results from Friedman test showed that there was a strong and significant relation between prioritization of financial ratios from view of experts of stock exchange. From perspective of these experts, the first financial ratio was average net profit to sales ratio, second was average operating profit to sales ratio, third average gross profit to sales ratio, fourth average equity to assets ratio, sixth quick ratio, seventh average current ratio, and the last average assets to debts ratio. Next, consistency rate was calculated using Expert Choice software, results of which are listed below. The condition of consistency is that overall inconsistency must not be greater than 1.0.

Diagram 1 – Inconsistency rate of ratios studied in this research





In addition to specifying the priority of indices, this software determine consistency of indices. The steps of analysis of financial data in the present study are as follows:

**a) Calculation of financial ratios derived from the financial statements**

Using the financial statements of base metal companies, 20 financial ratios, including liquidity, profitability, activity, and leverage ratios were selected to be evaluated, which calculations including the 5-year period, and 5-year average was calculated for each company.

**b) Selecting a number of ratios from among different ratios**

Relationships between 20 provided ratios for 22 companies from base metals industry caused certain variables to be chosen from the set of variables. For this purpose, factor analysis technique was used. The results of calculations showed that each studied variable was obtained by calculating projection of each vector on x-axis and y-axis. The final estimates show the contribution of each variable to selected factors. The linear combination of each of the 8 factors is presented in the component matrix. According to the final estimates, the following indices had a privileged position and were used in the AHP model:

- |  |  |
|--|--|
| M <sub>1</sub> : Average gross profit to sales ratio | M <sub>2</sub> : Average operating profit to sales ratio |
| M <sub>3</sub> : Average net profit to sales ratio   | M <sub>11</sub> : Average equity to debt ratio           |
| M <sub>13</sub> : Average equity to assets ratio     | M <sub>17</sub> : Average assets to liabilities ratio    |
| M <sub>15</sub> : Average current Ratio              | M <sub>17</sub> : Average quick Ratio                    |

**C) Calculate of relative weight of ratios**

Selected decision-making criteria cannot be quantified. In this research, questionnaire was administered to financial experts to determine relative weight of ratios (criteria). The questionnaire was administered to 80 financial experts from Tehran Stock Exchange, Tabriz Stock Exchange and Urmia Stock Exchange.

**e) Prioritization of companies with respect to each selected ratio**

Given the values of the selected financial ratios were available, first paired comparisons was made between the criteria. This process starts with dividing selected financial ratio by one of the criteria, and the same procedure is repeated for other criteria. The, by calculating normal matrix of criteria, obtained by dividing financial ratios by their sum, priorities of each company with respect to one criterion (financial ratio) was determined. Base metals companies were processed as decision options and financial ratios as criteria. The high position of companies with respect to each of the financial ratios is as shown below.

Table 4 – High ranked companies based on one criterion



Quick ratio	Current ratio	Asset to debt ratio	Equity to assets ratio	Equity to debt ratio	Net profit to sales ratio	Operating profit to sales ratio	Gross profit to sales ratio
Alumorad	Alumorad	Alumorad	Alumorad	Alumorad	National copper industries	National copper industries	National copper industries

Source: research's calculations

#### f) Ranking of base metal companies

To obtain final matrix that specifies ranking of companies, matrix multiplication must be used, in which entries of normal matrix represent selected ratios. Indices are multiplied by entries of normal matrix, and then the products are added up, and product of normal values and priority of each ratio will give the priority of each company. Normal matrix of indices applies a specific weight to the criteria, and as seen, there was a relation between ranking of base metal companies and financial ratios, with degree of importance of indices affecting such prioritization. Evidently, if indices or importance varies, ranking will also change.

Table 5 – Ranking of companies using selected ratios using AHP

Rank of company	Name of company	Score
1	National Copper Industries	0/125836
2	Alumorad	0/120403
3	Mobarakeh Steel	0/101871
4	Calcimine	0/09671
5	Ferrosilicon	0/078706
6	Iran pipe and machine making	0/054348
7	Materials processing	0/05365
8	Amirkabir steel	0/046596
9	Kavian steel	0/043242
10	Khuzestan Steel	0/043197
11	Khorasan Steel	0/041631
12	Alumtek	0/035657
13	Sepahan	0/031026
14	Rolled Steel	0/029458
15	SADID tube	0/026755
16	Sepanta	0/026507
17	Bahonar Copper	0/025876
18	Iralco	0/018404
19	SADID	0/014295
20	Aluminum Rolling	0/010528





21	<b>Ferromolybdenum</b>	- 0/01446
22	<b>Iran lead and zinc</b>	- 0/01893

Source: research's calculations

## 5- Conclusion

In this research, the AHP method, which is one of the modern decision making techniques, was used for ranking base metals industry in the Tehran Stock Exchange. Given calculated weight of each selected financial ratio, and weight of indices of base metal industry companies obtained using normalization of pairwise comparison matrices, it was finally determined following calculated of the product of normalized matrices of selected ratios and indices of final matrices representing rank of each company that National Copper Industry Company earning the highest scores held the first place and Iran Zinc and Lead Company earning the lowest score held the last place in the ranking. Accordingly, the following suggestions are offered:

Ranking of stock exchange groups increases efficiency and improve transparency in the Stock Exchange. Besides, use of such modern techniques in financial affairs can be a new method to analyze financial status of the listed companies, paving the way for new similar methods. It is also suggested several criteria be used to rank companies in order to better assess the financial situation of the companies. Also it is necessary for the companies ranked lower to take appropriate measures to resolve the problems of their company. It is also suggested that such researches be performed once every few years to analyze structural failures resulting from capital market volatility.

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