

## Research on M&As performance of iron and steel enterprises based on factor analysis

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**Abstract:** For a long time, market concentration of China's iron and steel industry is at a lower level, which affects the international competitiveness of iron and steel enterprises seriously and caused serious overcapacity. It is imperative to increase the M&As intensity of iron and steel enterprises and improve the market concentration. Analysis of the M&As performance has important guiding significance for guiding the merger behavior. Based on factor analysis, comprehensive evaluation model of the M&As performance for iron and steel enterprises is proposed in this paper. The results of the M&As performance verify the feasibility of evaluation model.

### Introduction

For a long time, the market concentration level of China's iron and steel industry is lower than that of other countries. On the one hand, it is not conducive for enterprises to increase investment in innovation, and low value-added products have caused serious waste of resources; On the other hand, low bargaining power and high operating risks are not conducive to develop overseas markets especially. Entering the new century, China's iron and steel industries have undergone a wave of mergers and acquisitions climax, and market concentration has improved. However, the effect of mergers and acquisitions of iron and steel companies is not satisfactory. The operating performance of part M&As enterprises even declines resulting in a great waste of resources. So, it has important practical significance to guide enterprises to conduct mergers and acquisitions and corporate internal integration by studying the performance changes after mergers and acquisitions of iron and steel enterprises.

A business performance model was built and the factors affecting on business performance were analyzed in literature [1]. Literature [2] studied the company's M&As performance from the sales, profits, return on investment, market share, technological innovation and customer, and it found that the effective integration of M&A business was a key factor to enhance performance. The performance level of 45 M&As enterprises was applied in literature [3]. The results showed that the synergies of scale economies, increased business sales, decreased administrative expenses were conducive to business performance in a certain size range. Literature [4] studied the performance of iron and steel industry market based on factor analysis, and it found that production scale was the key factor to affect performance. The author believed that increasing industry concentration was an important means to enhance performance.

Based on factor analysis, this paper integrated the main ingredient on the evaluating indicator of M &As performance. Based on the operating data of several iron and steel enterprises, this paper measured the performance of M&As and analyzed the reasons for performance change.

### The construction of restructuring performance evaluation of iron and steel enterprises

Considering the M&As strategic objectives and design principles of index system, performance evaluation will be divided into financial index, market power index, contribution index of industrial upgrading and scale economic index in this article. The performance evaluation index is shown in Tab.1.

**Tab.1 M&As performance evaluation index of iron and steel enterprise**

First grade index	Second grade index	Calculation method
Financial index	Asset-liability ratio (X1)	=debt/assets*100%
	Return on assets (X2)	=net profit/assets*100%
	Current ratio (X3)	=current assets/ current liabilities*100%
	Net profit growth rate (X4)	=(current term net profit-beginning term net profit)/beginning term net profit*100%
Market power index	Market share (X5)	=enterprise's production/industrial total yield*100%
	Bargaining ability (X6)	qualitative index, evaluated by professionals
Contribution index of industrial upgrading	Comprehensive energy efficiency of per ton steel (X7)	=consumption of standard coal/crude steel production
	Enhancing ability of product added value (X8)	qualitative index, evaluated by professionals
Scale economic index	Profit of per ton steel (X9)	=Total profit/crude steel production
	Elementary productivity (X10)	=crude steel production/elements input *100%
	Per-capita production value (X11)	=total income/ incumbency workers

### M&As performance evaluation model based on factor analysis

The M&As performance of iron and steel enterprise, represented as P, can be seen a function with several evaluation variables. Then P can be obtained as followed:

$$P = \sum_i^m a_i X_i + \sum_j^n b_j f_j(Y_j) \quad (1)$$

Where,

$X_i$ : quantitative index;  $a_i$ : weight of quantitative index;  $m$ : the number of quantitative index;  $Y_j$ : qualitative index;  $b_j$ : weight of qualitative index;  $n$ : the number of qualitative index;  $f_j(Y_j)$ : the corresponding membership function.

In this paper, by means of factor analysis, complex multiple indicators can be summed up into  $q$  comprehensive factors  $F_k$ , which can reflect the original information of performance function. The factor weight  $w_k$  is also calculated out. At this point, the performance function is simplified to:

$$P = \sum_{k=1}^q w_k F_k \quad (q < m + n) \quad (2)$$

In this paper, the factor analysis process of M&As performance of iron and steel enterprise is implemented with the aid of SPSS. However, we should pay attention to the following two points when we analyze the M&As performance based on factor analysis:

(1) Standardize the raw data to eliminate the differences in magnitude and dimension of variables. For negative index, such as comprehensive energy efficiency of per ton steel (X7), we will deal with it by taking reciprocal method, which is:

$$XX_i = \frac{100}{X_i} \quad (3)$$

For moderate indexes, such as asset-liability ratio (X1) and current ratio (X3), we build a function, and set the most reasonable value as  $X_{i,0}$ . Then, the positive function  $XX_i$  to moderate index  $X_i$  is:

$$XX_i = \frac{1}{0.5 + |X_{i,0} - X_i|} - 1 \quad (4)$$

(2) Convert qualitative index into quantitative index, mainly including the bargaining ability (X6) and enhancing ability of product added value (X8). According to the experts' satisfaction with the annual performance of the enterprises, five grades are classified as "very poor, poor, general, good, very good", which constitute the index score set  $V$ :

$$V = \{v_1, v_2, v_3, v_4, v_5\} = \{0.2, 0.4, 0.6, 0.8, 1\} \quad (5)$$

### Case analysis

This paper took Baosteel Group acquiring Bayi Iron and Steel, Guangzhou Iron and Steel (GIS), SGIS Songshan Steel as an example. Based on the operating data in 2005—2014, the M&As performance of iron and steel enterprises is analyzed. The analysis result of KMO and Bartlett's Test is shown in Fig.1. The KMO value is suitable for factor analysis.

Kaiser-Meyer-Olkin Measure of Sampling Adequacy	.705
Bartlett's Test of Sphericity	Approx Chi-Square
	426.484
	df
	55
	Sig.
	.000

**Fig.1 KMO and Bartlett's Test**

The total variance explained is shown in Fig.2. The cumulative variance of previous three factors is 81.818% and the eigenvalue is larger than one. So, we choose previous three factors as the main factors.

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	5.841	53.097	53.097	5.841	53.097	53.097	4.445	40.412	40.412
2	2.083	18.938	72.035	2.083	18.938	72.035	2.281	20.736	61.148
3	1.076	9.783	81.818	1.076	9.783	81.818	2.274	20.670	81.818
4	.806	7.324	89.142						
5	.451	4.099	93.241						
6	.317	2.881	96.122						
7	.236	2.149	98.271						
8	.095	.862	99.133						
9	.061	.558	99.691						
10	.023	.207	99.899						
11	.011	.101	100.000						

**Fig.2 Total Variance Explained**

As can be seen from Fig.3, based on factor analysis, we have extracted three key performance factors from the M&As performance analysis model of iron and steel enterprises. The first key performance factor (F1) has a higher load in market share, bargaining ability, comprehensive energy efficiency of per ton steel, enhancing ability of product added value, elementary productivity and per-capita production value. F1 is named as the scale economy factor, which reflects the scale economy of the M&As. The second key performance factor (F2) has a higher load in current ratio and asset-liability ratio. F2 is named as the financial health factor, which reflects the company's

financial health. The third key performance factor (F3) has a higher load in return on assets, net profit growth rate and profit of per ton steel. F3 is named as the value-added factor, which reflects the company's profitability.

Index	Component		
	1	2	3
Market share(X5)	.665	.619	.144
Bargaining ability (X6)	.962	.132	.194
Comprehensive energy efficiency of per ton steel(X7)	.329	-.630	.100
Enhancing ability of product added value (X8)	.884	-.050	.209
Elementary productivity(X10)	.942	-.037	.123
Per-capita production value(X11)	.927	.175	.150
Current ratio(X3)	.102	.807	.265
Asset-liability ratio(X1)	.356	.594	.402
Return on assets(X2)	.306	.356	.823
Net profit growth rate(X4)	.057	.009	.926
Profit of per ton steel(X9)	.454	.563	.599

**Fig.3 Rotated Component Matrix**

The component scores are shown in Fig.4.

Index	Component		
	1	2	3
Market share(X5)	.138	.297	-.179
Bargaining ability (X6)	.244	-.025	-.063
Comprehensive energy efficiency of per ton steel(X7)	.114	-.422	.183
Enhancing ability of product added value (X8)	.228	-.134	.009
Elementary productivity(X10)	.259	-.106	-.063
Per-capita production value(X11)	.238	.014	-.099
Current ratio(X3)	-.058	.408	-.052
Asset-liability ratio(X1)	.006	.229	.057
Return on assets(X2)	-.067	-.024	.418
Net profit growth rate(X4)	-.138	-.246	.623
Profit of per ton steel(X9)	.003	.152	.184

**Fig.4 Component Score Coefficient Matrix**

According to the scores of each variable in Fig.4, factor score function is built:

$$F_1 = 0.006X_1 - 0.067X_2 - 0.058X_3 - 0.138X_4 + 0.138X_5 + 0.244X_6 + 0.114X_7 + 0.228X_8 + 0.003X_9 + 0.259X_{10} + 0.238X_{11} \quad (6)$$

$$F_2 = 0.229X_1 - 0.024X_2 + 0.408X_3 - 0.246X_4 + 0.297X_5 - 0.025X_6 - 0.422X_7 - 0.134X_8 - 0.152X_9 - 0.106X_{10} + 0.014X_{11} \quad (7)$$

$$F_3 = 0.057X_1 + 0.418X_2 - 0.052X_3 + 0.623X_4 - 0.179X_5 - 0.063X_6 + 0.183X_7 + 0.009X_8 + 0.184X_9 - 0.063X_{10} - 0.099X_{11} \quad (8)$$

The M&As performance function of iron and steel enterprises is:

$$F = 53.097F_1 + 18.938F_2 + 9.783F_3 \quad (9)$$

Based on M&As performance function, we calculate the M&As performance of sample enterprises, conduct a comprehensive evaluation on the M&As performance. The results are shown in Tab.2.

Considering the acquisition time, M&As performance scores of Baosteel are better than those of other enterprises every year, showing the overall strength and more prominent M&As ability. After the acquisition, M&As performance of other acquired enterprises has improved. The result shows that Baosteel has achieved the desired M&As effect.

**Tab.2 Scores of iron and steel enterprise acquisition performance**

sequence	enterprise	years	performance score	sequence	enterprise	years	F
1	Baosteel	2012	8179.516	19	SGIS	2014	2803.577
2	Baosteel	2011	7813.518	20	GIS	2008	2401.405
3	Baosteel	2013	7561.805	21	SGIS	2011	2375.191
4	Baosteel	2014	7082.501	22	SGIS	2013	2327.992
5	Baosteel	2010	6926.126	23	GIS	2011	2279.074
6	Baosteel	2008	6379.861	24	SGIS	2008	2137.164
7	Baosteel	2007	6217.512	25	SGIS	2012	2116.924
8	Bayi Steel	2011	5751.331	26	Bayi Steel	2006	2032.545
9	Bayi Steel	2012	5468.659	27	GIS	2010	2014.92
10	Baosteel	2009	5072.554	28	SGIS	2010	1892.57
11	Baosteel	2006	4936.599	29	Bayi Steel	2005	1852.224
12	Bayi Steel	2013	4882.531	30	GIS	2009	1685.511
13	Bayi Steel	2010	4768.143	31	SGIS	2007	1486.476
14	Bayi Steel	2014	4381.416	32	SGIS	2009	1421.474
15	Bayi Steel	2008	4173.195	33	GIS	2007	1256.938
16	Baosteel	2005	3867.085	34	SGIS	2006	1233.2
17	Bayi Steel	2009	3300.978	35	GIS	2006	1135.114
18	Bayi Steel	2007	2993.029				

## Conclusions

In this paper, M&As performance evaluation method of iron and steel enterprises is studied. Based on the example of Baosteel Group acquiring Bayi Iron and Steel, Guangzhou Iron and Steel, SGIS Songshan Steel, we analyze the performance level before and after the merger. The result shows that due to the technical, financial and other advantages, the M&As performance of Baosteel Group which launches the merger is significantly better than the acquired enterprises. Then, the M&As performance of acquired enterprises is also better than before. Mergers and acquisitions among iron and steel enterprises will help to improve business efficiency and market competitiveness.

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