Performance Evaluation of Listed Coal Chemical companies in China:a Study Based on Factor Analysis

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Abstract

In recent years, under the background of low domestic coal price, high international oil price, high attention to coal pollution and good expectation of coal instead of oil market, China's coal chemical industry. To make rapid progress. Coal chemical industry chain is an important industry chain for the development of coal enterprises in China. It is of great practical significance to analyze the operating performance of coal chemical listed companies and to study how to improve the operating performance of coal chemical listed enterprises. In this paper, 23 coal chemical listed companies in China are used as research samples, and 13 main financial indexes of these listed companies are analyzed by using SPSS software, and 4 of them have certain meanings. To evaluate the profitability, business ability, growth ability and solvency of the company. The results of the study show that these 23 listed companies have a large gap in operating performance, and the development of these four capabilities is uneven. In view of this problem, this paper puts forward some suggestions for the management of listed companies according to the results of the analysis. The decision provides a certain reference.

Keywords

Factor molecule, coal chemical industry, performance evaluation.

1. Introduction

China is rich in coal resources, oil and gas resources are relatively scarce, so in China's energy structure, coal is the main energy pillar. Since the 21st century, China's annual coal output has been enormous. From 2001 to 2016, raw coal production accounted for a lot of the total energy production in China. At the same time, coal accounted for a huge proportion of China's energy consumption. The average annual share is 69 percent. The details are shown in figure 1.

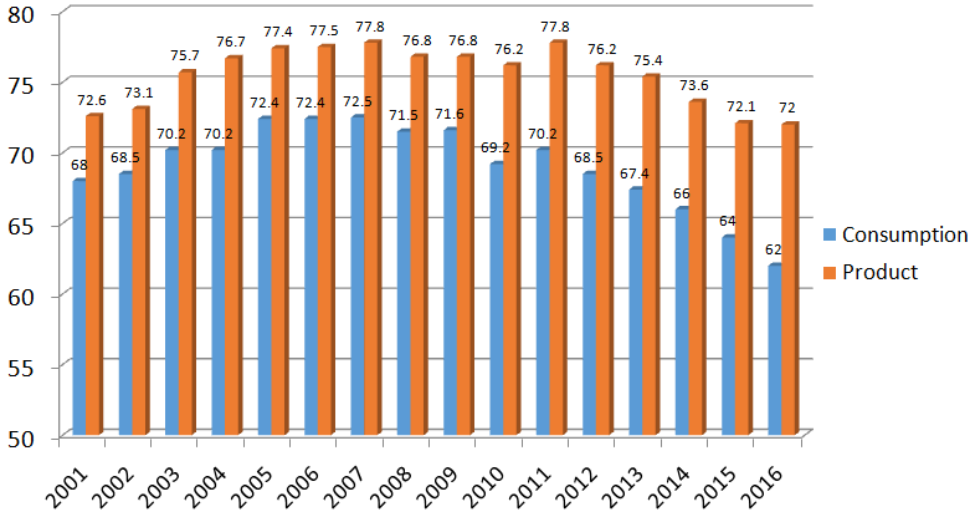

Fig 1. The proportion of raw coal production and consumption in energy in the 21st century

Considering the development of China's coal industry, we can find that the coal industry has changed from the traditional single development model to the diversified development model today. In the past, the traditional coal industry focused on the exploitation, transportation and sale of raw coal. Nowadays, the coal industry focuses on the clean and efficient use of coal, extending many coal-based industrial chains. Because the development of diversified industries is the fundamental approach to the sustainable development of the contemporary coal industry. In the years of development, the industrial chain formed by China's coal industry is shown in figure 2.

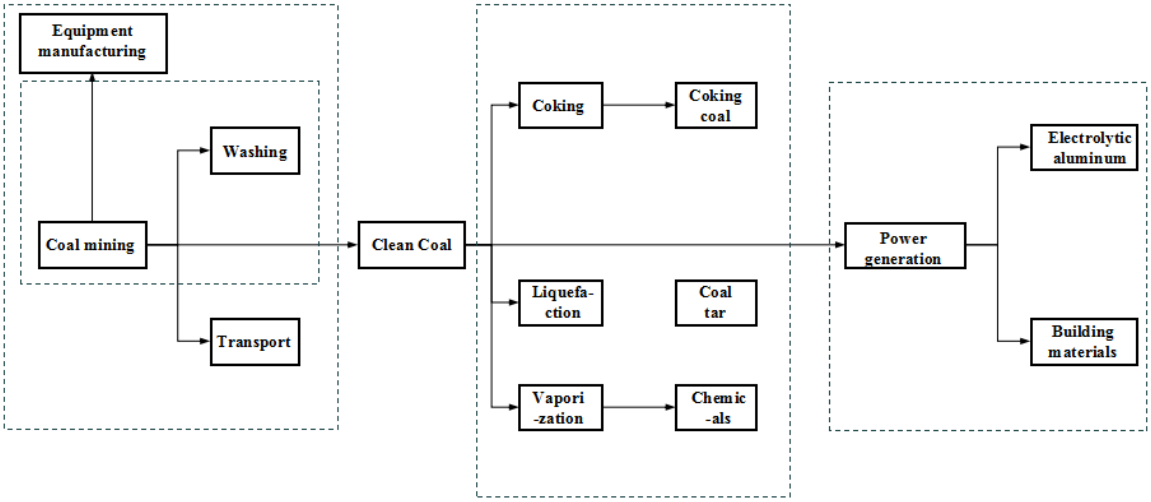

Fig 2. Coal industry chain schematic

As can be seen from figure 2, the coal chemical industry plays an important role in the development of China's coal industry, and the coal chemical industry has become one of the indispensable industries of coal enterprises. Therefore, it is of great practical significance to clarify the present operating performance of coal chemical enterprises in order to improve the operating performance of listed coal chemical enterprises.

2. Present Situation of Coal Chemical Industry Development in China

In recent years, under the background of low domestic coal prices, high international oil prices, the society attaches great importance to coal-burning pollution, and the market with coal instead of oil, the coal chemical industry in China has been developing rapidly.

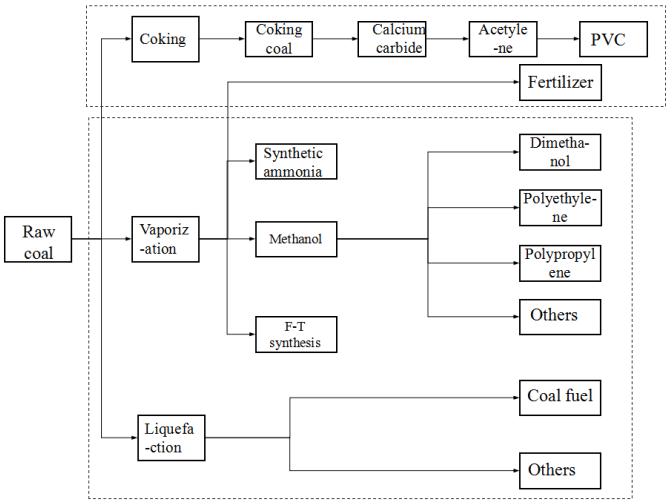

Fig 3. Coal chemical technology chart

On the one hand, the development of coal chemical technology is to make full use of coal in China optimizing the energy structure; On the other hand, coal chemical industry provides us with cleaner energy, reducing the pollution caused by energy in the process of use. In China, coal chemical

industry generally includes coal coking, coal gasification and coal liquefaction. The details are shown in the figure 3.

As can be seen from the picture above, when China's coal chemical enterprises are working, which technology is complex, and many products are producted.

The traditional coal chemical industry is mainly coal coking, while the new coal chemical technology is mainly coal liquefaction and gasification. Coal coking produces a large amount of coke, fertilizer, calcium carbide and other products. This process has the characteristics of low technical threshold, mature technology, and small investment scale, which may lead to the risk of excess capacity. The new coal chemical industry will directly gasify and liquefy coal. This process will produce coal oil, olefins, natural gas, and ethylene glycol compounds. These products have a large demand in China, and the gap is also large, so the product price is high, therefore they have a great market development space.

3. Research Design

3.1 Research Methods

The purpose of this paper is to look for factors that affect the operating conditions of such companies on the basis of evaluating the operating conditions of coal chemical related companies. To achieve this goal, we can use factor analysis. The basic purpose of factor analysis is to use a small number of factors to describe the relationships between many indicators or factors. That is, several variables that are closely related are grouped together in the same category. Each type of variable becomes a factor, with a smaller number. The factors reflect most of the information in the original data, so that the key factors are clearly presented to the observer.

In the specific operation process of this article, factor analysis is mainly conducted on the relevant data of coal chemical listed companies. The listed companies of coal chemical industry in China are currently considered as the overall study, and 23 sample companies are excluded from the ST listed companies. The selected data are the relevant financial indicators of the research companies in 2017, all of which are from CSMAR. When performing specific operations, follow the following steps: Firstly, use the Z-score standardization method to normalize the original data, and remove the influence caused by the differences in the unit and the numerical data between the statistical data. Secondly, find the correlation coefficient between the original variables and determine whether factor analysis can be used. Thirdly, calculate the eigenvalues and cumulative variance contribution of the factors. Fourthly, get the factor load matrix before and after the rotation from the software and determine how the factor represents the original variable. Fifthly, calculate each factor score and overall performance score.

3.2 Selection of indicators

In order to fully reflect the operating condition of the sample company, the indexes selected in this paper include the relative indexes of profitability, management ability, solvency and development ability, which are 13, such as Table 1.

4. Analytical Process

1. In order to eliminate the influence of the data dimension, the original data is standardized using formula (1). After the standardization process, the KMO and Bartlett sphericity tests are conducted. The KMO and Bartlett sphericity tests are used to judge the applicability of the factor analysis. The KMO test whether the bias between the variables is smaller. The test results are shown in Table 2.

$$z = \frac{x - \mu}{\sigma} \tag{1}$$

In the formula(1): z represents the standardized value of each index; x represents the original value of each indicator; μ represents the average of the indicators; σ is the standard deviation of the indices.

Table 1. Indicator selection

Indicator Code	Indicator Name	Indicator Code	Indicator Name
x_1	Earnings per share	x_8	Total asset turnover
x_2	Net profit rate	x_9	Account receivable turnover rate
x_3	Roe	x_{10}	Revenue growth rate
x_4	Current ratio	x_{11}	Net profit growth rate
x_5	Quick ratio	x_{12}	Total asset growth rate
x_6	Assets and liabilities rate	x_{13}	Shareholder's equity ratio
x_7	Inventory turnover rate		

In general, the closer the KMO value is to 1, the more suitable it is for factor analysis. From Table 2, it can be seen that the KMO value is 0.607, which is suitable for factor analysis. In addition, the Bartlett's sphericity test statistic is 485.216, the sig value is 0.000, which is less than the significance level of 0.05, indicating that the correlation coefficient matrix is not an array and is also suitable for factor analysis.

Table 2. KMO and Bartlett's test

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		0.607
Bartlett's Test of Sphericity	Approx.Chi-Square	485.216
	Do	78
	Sig	0.000

2. Extract the common factor. Using SPSS software to analyze the data, using the principal component analysis to determine the common factor, calculate the eigenvalue, variance contribution rate and cumulative variance contribution rate, as shown in Table 3:

Table 3. Toil variance explained

Total Variance Explained									
	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
Component	total	% of Variance	Cumulative %	total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	5.664	43.567	43.567	5.664	43.567	43.567	3.297	25.359	25.359
2	2.331	17.778	61.345	2.331	17.778	61.345	3.134	24.109	49.468
3	1.438	11.058	72.403	1.483	11.058	72.403	2.327	17.896	67.364
4	1.248	9.597	82.000	1.248	9.597	82.000	1.903	14.636	82.000
5	0.868	6.674	88.674						
6	0.462	3.557	92.231						
7	0.379	2.915	95.146						
8	0.321	2.470	97.616						
9	0.166	1.278	98.894						
10	0.114	0.881	99.775						
11	0.018	0.141	99.915						
12	0.011	0.085	100.00						
13	6.826E-8	5.327E-7	100.00						

As shown in Table 3, the common factors are selected according to the criteria whose eigenvalue is greater than 1, and a total of four common factors are selected. The cumulative contribution rate of

the sample variance is 82%, and the sample information can be effectively extracted. Therefore, we extracted four common factors, represented by S_1, S_2, S_3 and S_4 respectively. Their contribution rates were 43.356%, 17.778%, 11.058%, and 9.597%, respectively.

3. Rotation factor matrix. Since the unrotated factor matrix does not give ideal results, the factors are rotated and the resulting factor load matrix can more clearly reflect the sample information. The factor load matrix obtained after the rotation is shown in Table 4:

Table 4. Rotated component matrix

Rotated Component Matrixa				
	Component			
	1	2	3	4
Current ratio	0.849	0.093	0.351	0.213
Quick ratio	0.834	0.037	0.342	-0.179
Revenue growth rate	0.754	0.257	-0.086	0.094
Total asset growth rate	0.744	0.244	0.167	-0.241
Roe	0.273	0.913	0.255	0.043
Net profit growth rate	-0.013	0.909	0.029	-0.005
Earnings per share	0.355	0.747	0.285	0.224
Net profit rate	0.209	0.736	0.417	-0.143
Assets and liabilities rate	0.190	0.261	0.926	0.048
Shareholder's equity ratio	-0.190	-0.261	-0.926	-0.048
Account receivable turnover rate	-0.241	0.147	0.085	0.846
Inventory turnover rate	-0.358	-0.234	-0.074	0.722
Total asset turnover	0.504	0.162	0.061	0.667

From Table 4, it can be seen that the first common factor S1 has a larger load on X4, X5, X10, and X12, and it is named profitability factor; the second common factor S2 is on X3, X12, X1, and X2. There is a large load, and it is named as the development capability factor; the third common factor S3 has a larger load on X6, X13, and it is named as a solvency factor; the fourth common factor S4 is on X9, X7, X8 There is a large load on it, and it is named operational capacity factor.

4. Factor score. Using the factor score coefficient matrix (Table 5), a regression method was used to obtain the scores for each common factor.

We can obtain the quantitative relationship between S_1, S_2, S_3, S_4 and each influencing factor from Table 5, as shown in formula (2), (3), (4), (5).

$$S_1 = 0.042x_1 - 0.086x_2 + ... - 0.100x_{13} \quad (2)$$

$$S_2 = 0.231x_1 + 0.240x_2 + ... - 0.095x_{13} \quad (3)$$

$$S_3 = -0.036x_1 + 0.085x_2 + ... + 0.509x_{13} \quad (4)$$

$$S_4 = 0.113x_1 - 0.112x_2 + ... + 0.012x_{13} \quad (5)$$

5. Calculate comprehensive economic performance. The score of the factor can be used to quantitatively see the operating performance level of the coal chemical listed companies, and can use the factor score to make horizontal comparisons among the companies. When the overall operating performance score is denoted as Y, the calculation formula of Y is as shown in formula (6):

$$Y = 25.359\%S_1 + 24.109\%S_2 + 17.896\%S_3 + 14.636\%S_4 \quad (6)$$

Table 5. Component score coefficient matrix

Component Score Coefficient Matrix				
	Component			
	1	2	3	4
Earnings per share	0.042	0.231	-0.036	0.113
Net profit rate	-0.086	0.240	0.085	-0.112
Roe	-0.030	0.336	-0.071	-0.008
Current ratio	0.276	-0.119	0.068	-0.033
Quick ratio	0.282	-0.144	0.076	-0.012
Assets and liabilities rate	0.100	0.095	-0.509	-0.012
Inventory turnover rate	-0.031	-0.096	0.045	0.378
Total asset turnover	0.269	-0.042	-0.095	0421
Account receivable turnover rate	-0.039	0.026	0.047	0.433
Revenue growth rate	0.324	0.039	-0.238	0.127
Net profit growth rate	-0.123	0.419	-0.166	-0.063
Total asset growth rate	0.239	0.003	-0.063	-0.067
Shareholder's equity ratio	-0.100	-0.095	0.509	0..012

The final calculated composite scores are ranked by size in Table 6:

Table 6. Final score and ranking

Ranking	Score goal	Stock code	Ranking	Score goal	Stock code
1	0.79	300435	13	-0.19	002109
2	0.67	600426	14	-0.2	600123
3	0.66	300208	15	-0.23	600844
4	0.54	300055	16	-0.25	600997
5	0.38	002542	17	-0.25	600691
6	0.24	300263	18	-0.26	601015
7	0.22	601117	19	-0.36	601898
8	0.18	600499	20	-0.37	600408
9	0.16	000803	21	-0.39	601991
10	0.08	000627	22	-0.47	600256
11	-0.02	601101	23	-0.89	600740
12	-0.05	000683			

5. Conclusion and Analysis

5.1 Overall Analysis

Descriptive statistical analysis of the composite scores. The results are shown in Table 7.

Table 7. Results of descriptive statistics

Descriptive statistics						
	Number of samples	Min	Max	average value	Standard deviation	variance
Value	23	-0.89	0.79	0.08745	0.41938	0.176

According to Table 7, among the 23 listed companies in coal chemical industry, 10 listed companies have a positive composite score, such as 300435, 600426, 300208, while the overall score of 13 listed companies is negative, such as 601991, 600256, 600740 etc. In general, companies with positive composite scores have better performance, on the contrary, companies with negative overall

scores have poor performance. This shows that of the 23 listed companies, 10 companies such as 300435 Stock have good operating performance, and 13 companies such as 600740 have poor operating performance. The Y value of 300435 Stock ranked first is close to 1, while the Y value of 600740 ranked last is close to -1. The average score of the industry is 0, and the variance is 0.176. It can be seen that the performance of the listed companies in the coal chemical industry is mixed, and the differentiation between the pros and cons is serious.

5.2 Classification Analysis

The four factors that reflect the company's operating performance are the reference quantities and K-means clustering is performed. After K-means clustering, the 23 companies were divided into 4 categories. The results are shown in Table 8:

Table 8. K-means clustering results

The first category	The second category	The third category	The fourth category
601117, 000803, 000683, 600691, 600408, 601991, 600256	600426	300435, 002109,. 600123, 600844, 300208, 300055, 600997, 002542, 300263, 601015, 601898, 600499, 000627, 601101,	600740

Based on the different performance of these four types of companies in their four financial capabilities, the ranking of each financial factor in the statistics is as follows:

Table 9. The ranking of various companies on four financial factors

	The first category	The second category	The third category	The fourth category
S_1	1	3	4	2
S_2	2	3	1	4
S_3	4	1	2	3
S_4	2	4	1	3

From Table 9, we can see that the first type of companies represented by China Chemicals and Luxi Chemicals have very good profitability, but lack of solvency; the second type of company is only Hua Lu Hengsheng. The company, the result shows that the company Hua Lu Hengsheng has good debt repayment ability, but its operating ability is very poor; the third type of companies represented by Sino-Thai Stock, Hengshun Zhongsheng, etc., have very good operating capabilities. However, the profitability is very poor; 9 the fourth type of company is only the Shanxi Coking Company. This company has poor development ability and is also relatively poor in terms of solvency and operating capacity. The reason why the third type of companies can develop well is mainly because they have strong development capabilities and operating capabilities. This shows that the operating capabilities and development capabilities are very important to the company. For poorly performing companies, they can improve their own performance by controlling debt and controlling costs.

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