Research on Financial Quality Evaluation of New Energy Listed Companies based on Factor Analysis and Cluster Analysis

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Abstract: This paper will study the financial conditions of 118 listed companies in the energy industry in 2020, extract four common factors reflecting four aspects of financial conditions from 12 indicators by factor analysis, and rank the companies by calculating the scores of each factor and the total scores. According to the four factors extracted, the clustering analysis is carried out on the companies, and the 118 companies are divided into three types by means of multiple comparison of the mean value, namely, strong companies, ordinary companies and problem companies, which provides certain basis for the managers to make business decisions and investors to make investment decisions. Finally, countermeasures and suggestions are put forward to improve the operating performance of listed companies in the energy industry, pointing out the direction for energy enterprises to improve their performance and better development.

1 INTRODUCTION

Since the 21st century, the rapid development of Tesla has stimulated the innovation of the new energy industry and the overall quality improvement of related industries, and the development is in the ascendant. Under a series of complex backgrounds such as global economic integration and sluggish world economy, China's new energy listed companies are facing a very severe situation and are under great pressure at home and abroad.

2 LITERATURE REVIEW

Since the 20th century, foreign scholars have studied many methods of financial quality evaluation, including enterprise credit ability index, DuPont financial analysis system, Balanced Scorecard, Z scoring model. Later, with the popularity and maturity of statistical software such as SAS, SPSS and STATA, multivariate statistical analysis method was also applied to various fields such as financial quality analysis, including factor analysis. Hornungova, Jana et al. (Jana, et al, 2016) used correlation analysis and factor analysis to eliminate information duplication, reduce dimensions, and reduce the 13 financial indicators originally concentrated in basic indicators into three categories. Meanwhile, Pearson chi-square test shows that the above indicators are correlated with the company size to a certain extent, and the largest and most significant indicator related to the company size is "operation indicator". Yulin GE and Jing Y used factor analysis method to study the financial quality of listed retail companies and know the development level of each company in the industry through comparison, which provides a direction for improving the financial quality of enterprises. Santosh Kumar Yadav, M. Dharani (2019) examined the financial quality of banks based on the financial ratio study, obtained the final ranking of banks by using the TOPSIS method from 2010 to obtain the standard value by using the entropy method.

After the reform and opening up, domestic scholars began to explore and study enterprise financial quality and established a perfect enterprise financial quality evaluation system from two research perspectives. First of all, on the macro understanding, such as professor Zhang Xinming (Zhang, 2013) believes the financial quality terms from the book to see the quality of the enterprise financial situation, have the profit is the main business of the company

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can rely on production of timely and efficient distribution of dividends, bonuses, etc., should at least include asset quality quality, quality of capital structure, profits and cash flow quality. Other scholars, starting from the micro aspect, evaluate the financial quality through a variety of analysis methods, the more common methods are factor analysis, EVA evaluation method, balanced scorecard method and entropy method. For example, Based on the financial data of 13 listed companies of Xinjiang Production and Construction Corps, Wang Haixia and Guo Jiaxi (Guo, 2016) found that the listed companies of Xinjiang Production and Construction Corps had a low level of proximity from the effectiveness analysis of DEA model, and Malquist index was used for dynamic analysis, suggesting that the relative performance from 2010 to 2014 declined instead of rising. Li Xiaoyan (Li, 2014) analyzed the index data of 16 commercial banks in 2011 with the entropy method of objective weighting, and obtained the ranking of 16 commercial banks through comprehensive evaluation. During the analysis, she found that profitability and growth play an important role in evaluating the financial quality of commercial banks.

3 SAMPLE SELECTION AND DATA SOURCES

All financial data in this paper are from the CSMAR database. According to the definition of the new energy industry, 118 a-share new energy listed companies in Shanghai and Shenzhen are selected in this paper, including Kaier New Materials, Yueng Holdings... Gigaweft lithium energy, etc. In order to comprehensively analyze the financial quality of the new energy industry, *ST company is retained and the following companies are excluded :(1) companies that have just been listed for less than two years, which are not conducive to empirical research; (2) companies with incomplete financial data and obvious errors in some information are excluded from the sample.

Based on the relevant theory of financial capacity, this paper selected twelve variable indicators, including current ratio, cash ratio, asset-liability ratio, growth rate of total assets and net profit growth rate, operating income growth, accounts receivable turnover, inventory turnover, total assets turnover ratio, total assets net profit margin, net interest rate of the return on net assets and business, this paper selects indicators in 2020.

4 THE RESEARCH PROCESS

4.1 Factor Analysis

4.1.1 KMO and Bartlett's Test

The closer KMO value is to 1, the stronger the correlation between variables is, and the more suitable the original variables are for factor analysis. Bartlett is used to test whether the correlation matrix is a unit matrix, that is, whether each variable is independent. In factor analysis, if the null hypothesis is rejected, factor analysis can be done; if the null hypothesis is not rejected, it means that these variables may provide some information independently and are not suitable for factor analysis (Wang 2018).

KMO and Bartlett sphericity tests were carried out on the data, and the results were shown in Table 4.1. The KMO value was 0.681, over 0.5 and close to 0.7, and the P value was 0.000<0.05. It can be seen that the original data is suitable for factor analysis.

Table 1: KMO and Bartlett's Test.

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		0.681
Bartlett's Test of Sphericity	Approx. Chi-Square	789.652
	df	66
	Sig.	0.000

4.1.2 Factor *Out*

As the selected indicators are different, the measurement units and orders of magnitude of data indicators are different, so the original data are standardized first. SPSS software was used for factor naming and rotation of standardized data, and the total variance of interpretation was shown in Table2. Four common factors are extracted from the ten factors, and the contribution rates of the four principal components are 28.185%, 19.117%, 10.023% and 9.322% respectively (as can be seen from the percentage of variance). The cumulative variance contribution rate of the four common factors is 66.647%, that is, the combined influence of all common factors on the dependent variable is 66.647%. It can accurately describe the financial quality of listed new energy companies.

Table 2: Total Variance Explained

Component	Initial Eigenvalues			Sum of squares of rotational loads		
	Total	% of Variance	Cumulative %	Total	Sum of squares of rotational loads	% of Variance
1	3.633	30.275	30.275	3.382	28.185	28.185
2	2.083	17.358	47.633	2.294	19.117	47.302
3	1.189	9.911	57.544	1.203	10.023	57.326
4	1.092	9.103	66.647	1.119	9.322	66.647
5	0.958	7.981	74.628			
6	0.876	7.304	81.932			
7	0.846	7.047	88.979			
8	0.558	4.653	93.632			
9	0.389	3.239	96.870			
10	0.217	1.807	98.677			
11	0.140	1.164	99.841			
12	0.019	0.159	100.000			

4.1.3 Define Factor Variable

Since the typical representative variables of each main factor in the unrotated load value are not very prominent, in order to more accurately describe the inherent economic significance of each factor and to better describe the obtained factor with realistic language, SPSS is used to rotate the factor load matrix and the rotation component matrix is obtained in Table3. It can be seen from the figure that net interest rate on total assets, return on net assets and net operating interest rate reflect the profitability of the enterprise, while liquidity ratio, cash ratio and asset-liability ratio reflect the solvency, receivables turnover, inventory turnover and total assets turnover reflect the operating capacity of the enterprise. The growth rate of total assets, net profit and operating income reflects the development ability of enterprises. These four factors just confirm the four representative indicators reflecting the financial ability of enterprises.

Table 3: Rotated Component Matrix

	Component			
	1	2	3	4
Zscore (current ratio)	-0.005	0.919	0.039	-0.115
Zscore (cash ratio)	0.085	0.826	0.060	0.136
Zscore (lev)	-0.183	-0.834	-0.034	-0.017
Zscore (growth rate of total assets)	0.449	-0.075	-0.012	-0.323
Zscore (net profit growth rate)	0.727	0.118	-0.018	0.070
Zscore (growth rate of revenue)	-0.037	-0.037	0.415	-0.521
Zscore (account receivable turnover)	0.025	-0.022	0.223	0.820
Zscore (inventory turnover)	0.057	0.006	-0.715	0.052
Zscore (total assets turnover)	0.114	0.134	0.670	0.168
Zscore(rate of return on total assets)	0.956	0.144	0.076	0.037
Zscore(return on equity)	0.958	0.075	0.075	0.030
Zscore(Net operating interest rate)	0.873	0.069	-0.050	0.006

4.1.4 Calculated Factor Score

Variables are coded for the factors, and expressions between 12 indicators and 4 factors are constructed. F_1 is defined as profitability factor, F_2 as debt paying ability factor, F_3 as operating ability factor and F_4 as development ability factor. The scoring coefficient matrix based on factor analysis is shown in Table 4.

Table 4: Component Score Coefficient Matrix

	Component		
	1	2	3
Zscore(current ratio)	-0.068	0.424	-0.022
Zscore(cash ratio)	-0.036	0.366	-0.009
Zscore(lev)	0.005	-0.368	0.029
Zscore(growth rate of total assets)	0.147	-0.057	-0.003

Zscore(net profit growth rate)	0.215	0.001	-0.039
Zscore(growth rate of revenue)	-0.012	-0.026	0.372
Zscore(account receivable turnover)	-0.001	-0.050	0.161
Zscore(inventory turnover)	0.030	0.043	-0.607
Zscore(total assets turnover)	0.011	0.006	0.550
Zscore(rate of return on total assets)	0.283	-0.010	0.036
Zscore(return on equity)	0.288	-0.041	0.040
Zscore(Net operating interest rate)	0.265	-0.029	-0.063

According to the component scoring coefficient matrix in Table 4, the factor scoring function can be obtained as follows:

F_1=-0.068X_1-0.036X_2+0.005X_3+0.147X_4+0.215X_5-0.012X_6-0.001X_7+0.030X_8+0.011X_9+0.283X_{10}+0.288X_{11}+0.265X_{12}

F_2=0.424X_1+0.366X_2-0.368X_3-0.057X_4+0.001X_5-0.026X_6-0.050X_7+0.043X_8+0.006X_9-0.010X_{10}-0.041X_{11}-0.029X_{12}

F_3=-0.022X_1-0.009X_2+0.029X_3-0.003X_4-0.039X_5+0.372X_6+0.161X_7-0.607X_8+0.550X_9+0.036X_{10}+0.040X_{11}-0.063X_{12}

F_4=-0.131X_1+0.096X_2+0.011X_3-0.291X_4+0.055X_5-0.481X_6+0.729X_7+0.071X_8+0.123X_9+0.019X_{10}+0.014X_{11}-0.002X_{12}

According to the calculation result of factor analysis, to new energy of the listed company profit ability factor, debt paying ability factor, development capacity factor and operation ability factor score values as independent variables, explanation as dependent variable, namely to Y represent new energy listed companies financial quality score, build multivariate linear regression model (Shen 2012), formula is:

Y=(0.30275F_1+0.17358F_2+0.09911F_3+0.09103F_4)/0.66647

4.1.5 Ranking

The score of factor analysis is summarized and the 118 enterprises are ranked according to the score. The paper only lists the top six and the bottom three listed new energy enterprises.

Table 5: New energy enterprise score and ranking

Company name	F_1	F_2	F_3	F_4	Y	Ranking
Star power	-0.005	1.150	0.969	6.051	1.27	1
Yuxing real stake	-0.222	4.240	-0.332	0.157	0.98	2
Suzhou solid technetium	-0.050	3.198	0.306	0.329	0.90	3
Wanli shares	-0.526	4.279	0.222	-0.365	0.86	4
Donghua energy	0.255	-0.437	2.376	2.343	0.68	5
Aoke shares	0.180	0.371	1.733	1.394	0.63	6
……	……	……	……	……	……	……
Jiaru co	-0.775	-1.027	0.506	-0.353	-0.59	113
Eicon Tec	-1.222	-0.613	-0.207	0.174	-0.72	114
Jia new can	0.5256	0.175	-7.478	0.397	-0.77	115
Million lida	-2.795	-0.549	0.581	-0.696	-1.42	116
*ST Huayi	-6.315	-0.505	-0.606	-0.179	-3.11	117
ST King Kong	-7.347	-0.487	-0.560	-0.211	-3.58	118

Comprehensive analysis: In terms of comprehensive scores, 64 companies, including Star Power, Yuxing, Suzhou Guzuo, Wanli, Donghua Energy and Oke, have positive comprehensive scores and their financial quality is higher than the average level. The remaining 54 companies scored negative, with only one company with a score greater than 1, and eight companies with a score greater than 0.5, indicating that some enterprises in China's energy industry have insufficient financial resources, and there is a large difference among enterprises, with the overall financial level being average. From the point of view of individual enterprises, star power, Yuxing shares and Suzhou Gootechnetium and other listed companies total score is high, the financial level is significant, while Yi Lida, *ST Huayi and ST King

Kong and other enterprises total score is significantly lower than the average. Sort by composite scores, the top five companies have good financial quality because of their four or most common factor score in a hierarchical levels, explain the company's financial quality not only see one aspect, such as low solvency is not a good use of financial leverage a performance, and to see whether the comprehensive factors.

4.2 Cluster Analysis and Results

Table 6: Cluster analysis.

category	company name
1(34)	Star Power, Yuxing Co., LTD., Suzhou Gootechnetium Co., LTD., Wanli Co., LTD., Donghua Energy Co., LTD., Oke Co., LTD., Chuantou Energy, Chengfei Integration, Zhongtian Technology, Yicheng Xinneng, Yingluohua, Kuanda Technology, Dangsheng Technology, Shengyang Shares, Cairn Co., LTD., Kesida Co., LTD., Longji Co., LTD., Beiba Media Co., LTD., Yunnan Energy Investment Co., LTD., Hengdian Dongci Co., LTD., Shougang Co., LTD., Igor, Longma Sanitation, Bowei Alloy, Camel Stock, Kaier New Material, Sheneng Stock, China Power, Daming city, New Zhou Bang, Yutong Bus, Baoxin Energy, Yiwei Lithium energy, Leading Intelligence
2(82)	Linyang Energy, Fosu Technology, Aerospace Rainbow, Dongcai Technology, Jiangsu Xineng, Jingsheng Electromechanical, Nanbo A, Zhuhai Port, Shenseg, Disen Shares, Putai Lai, Ganfeng Lithium, North International, Longstar Chemical, Hengtong Optoelectronics, Daijin Heavy Industry, Shangwei Shares, China Power Xingfa, Xinwangda, Jiangnan Chemical, Taisheng Wind Energy, Naura Chuang, Changjiang Power, Woer Nuclear Materials, Ganeng Shares, Chengzhi Shares, Zhonglai shares, Yinghe Technology, Nandu Power Supply, Fengyuan shares, Sunshine Power Supply, Tianshun Wind Energy, Jixin Technology, Sinomaterial Technology, Dunan environment, Dongfang Electric, Dongfang Risheng, Huawu Shares, Tianeng Heavy Industry, Gaolan Shares, Shanshan Shares, Yonker Environmental Protection, Shao Shares, dongshan precision, hubei energy, environmental protection, division of manufacturing, in the group, since the ranks, crystal photoelectric, investment power, byd, large groups, core technology, vibration, jiang in electric, electric, gansu hin tech center, its the big, huadian power international, Beijing can power, turbine in China, the amalekites, Beijing express, Shenzhen Energy, Yueng Holding, Guodian Electric Power, Tuori Xineng, Teride, Huaneng International, Ediqi Environment, Datang Power Generation, Baochange Electric, Shanghai Electric Power, Duofudo, Huayin Power, JDIAN Shares, King Kong Glass, Jia Yu Shares, Ikang Technology, Jia Ze Xineng, Yi Lida
3(2)	*ST Huayi, ST King Kong

In this paper, k-means clustering method is adopted to classify listed companies in the new energy industry based on financial quality (Zhao 2019), namely score Y, on the basis of factor analysis and factor and comprehensive score, in order to identify problems and draw conclusions more easily. The results are shown in Table6.

The first Gradient company has the best business performance, with 34 companies, accounting for nearly one-third, indicating that there are many high-quality companies in China's energy industry, and such companies have strong strength, and investors can get better returns if they invest in such companies. The second gradient company has the middle and lower business performance level, accounting for nearly three-quarters of the total sample. This kind of company is characterized by the overall performance is generally lower, has its own advantages, but also has certain problems, investors should hold a wait-and-see attitude to this kind of company. There are only two third gradient companies, poor business performance, factor score and comprehensive score are unsatisfactory, for *ST Huayi and ST King Kong managers, want to reverse the situation is very high pressure.

5 CONCLUSIONS

The new energy industry is in the stage of rapid growth, with the support of national policies, is an important part of the national strategy, and attracts the attention of a large number of investors. New energy listed companies are the "leader" of the new energy industry, so the conclusion based on new energy listed companies is more typical for the new energy industry. The main research and innovation of this paper are as follows:

With the method of factor analysis and cluster analysis of 118 new energy to evaluate the financial quality of listed companies and the company is

divided into three categories, the profitability as the main factor is obtained and the quality of new energy industry as a whole financial general conclusions, on the basis of other scholars to further verify the effectiveness of the factor analysis and cluster analysis.

In view of the large gap between enterprises, the lack of financial capacity of some enterprises and the weakness of some enterprises in a certain aspect, the government should allocate support resources reasonably and effectively according to the r&d and innovation capacity of enterprises in the new energy industry. For enterprise managers, we should find out the company's competitive advantages and disadvantages, always seek innovation and upgrading, encourage all staff to participate in enterprise cost management.

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