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Research on Financial Risk Evaluation and Classification of Listed Companies in China's New Energy Automobile Industry

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Abstract

In the context of Chinese-style modernization, the development of the new energy vehicle industry is of great significance for promoting green development and realizing the goal of becoming an automobile power. This study takes 23 financial indicators of 74 listed companies in China's new energy vehicle industry as the research object, uses the entropy weight TOPSIS method to score their financial risks, and classifies them according to the evaluation results. The research results reveal the significant differences in financial risk stability among different companies. Finally, according to the results of risk assessment, the corresponding financial risk control suggestions are put forward. This study objectively assesses the financial risks that listed companies in China's new energy automobile industry may face in the process of development, and the relevant conclusions can provide theoretical guidance for the financial risk management of the new energy automobile industry in the process of Chinese-style modernization.

Keywords

New Energy Vehicles; Financial Risk; Entropy Weight TOPSIS Method.

1. Introduction

In the context of Chinese-style modernization, the new energy automobile industry has become an important field of China's economic transformation and green development [1]. The General Office of the State Council issued the "New Energy Automobile Industry Development Plan (2021-2035)", which requires in-depth implementation of the national strategy for the development of new energy vehicles, promote the high-quality sustainable development of China's new energy automobile industry, and accelerate the construction of an automobile power. However, there are many uncertainties and risks in the development process of new energy vehicle companies, such as technical risks, market risks, policy risks, etc., the most important of which is financial risks. The existence of financial risks will have a certain impact on the company's operating conditions and profitability. Only by taking appropriate and effective measures in time can the company's managers reduce financial risks and improve earnings.

At present, the development of new energy vehicles in China is still in the exploratory stage, facing a series of problems such as shortage of funds, lack of talents and technical challenges. Under such a background, using modern statistical measurement methods with Chinese characteristics to accurately evaluate and classify the company's financial risk status is conducive to managers' comprehensive understanding of the company's financial risk characteristics. The existing risk types and changing trends are clearly identified, so as to better develop risk management strategies and preventive measures [2]. Therefore, this paper adopts the entropy weight TOPSIS method to conduct a comprehensive assessment and analysis of the financial risk of listed companies in the new energy automobile industry. The application of this research method enables us to have a deeper understanding of the financial risk status of the

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new energy automobile industry, and provides targeted financial risk control suggestions for the company.

2. Relevant Research

Under the background of "dual carbon", the development of new energy automobile industry has attracted much attention [3]. As an important part of this industry, the financial status of listed companies directly affects the trend of the whole industry. Over the past few years, scholars have conducted a large number of studies to explore the financial risks of listed companies in the new energy vehicle industry. In these studies, scholars usually start from the company's financial indicators and analyze the company's financial risk by establishing various models. With the extensive application of entropy weight TOPSIS method, more and more scholars have begun to adopt this method to quantify the financial risk of companies [4]. Among them, X.N. Yin et al. [5] (2017) adopted entropy weight TOPSIS method for the first time in their study to quantitatively rank the financial risks of companies. They select a batch of company's financial index data, calculate the weight of each index by entropy weight method, and then use TOPSIS model to comprehensively evaluate the company's financial risk. In this way, they are able to objectively compare the level of financial risk between companies, providing an important reference for decision makers. T. Zhao et al. [6] (2019) focused on the financial risk evaluation of China's liquor industry. They identified a set of key indicators using entropy weight TOPSIS method, and analyzed the relative importance of these indicators and the financial risk level of each company through weight calculation and TOPSIS model. The results show that the growth rate of total assets is one of the most noteworthy indicators in the financial risk evaluation of liquor industry. H.R. Zhao [7] (2020) focuses on the financial risk evaluation of high-tech companies in his research. He adopted the entropy weight TOPSIS method as the entry point, established an evaluation system containing multiple indicators, and carried out quantitative analysis of these indicators through data analysis and comprehensive evaluation methods. The research results provide a reference for the financial risk assessment of high-tech companies, and help to improve the accuracy and effectiveness of risk identification and management.

To sum up, entropy weight TOPSIS method has a wide application prospect in the study of corporate financial risk. This method can comprehensively evaluate the financial risk level of the company from the perspective of multiple indicators, and provide accurate and reliable risk analysis results and decision support for the company's managers and decision makers. With the continuous development and improvement of this method, it is believed that it will continue to make important contributions to the company's financial risk management in the context of Chinese modernization.

3. Data Source and Research Method

3.1. Data Selection

In order to better study the financial risk situation of listed companies in the new energy automobile industry, this paper selects the financial data of 80 listed companies in the "upper, middle and lower" of the new energy automobile industry chain as research samples, and removes 6 companies listed on the Hong Kong Stock Exchange, the New York Stock Exchange and Nasdaq, and finally retains 74 listed companies. In addition, referring to the existing literature [8] and the classification of the company's financial indicators by Choice database, this paper selects 23 relatively representative indicators from the five aspects of the company's basic ability, repayment ability, operating ability, profitability and development ability, with a time span from 2018 to 2022. For listed companies, the CSRC will disclose financial data every year, which is transparent and can be directly exported through software.

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3.2. Entropy Weight TOPSIS Method

The essence of entropy weight TOPSIS method is to improve the traditional TOPSIS evaluation method. The main steps are as follows: First, entropy weight method is used to calculate the weights of all evaluation indicators, and then TOPSIS method is used to sort evaluation objects by approximating ideal solutions [9]. This method can not only retain the scoring function of TOPSIS multi-attribute evaluation, but also ensure the objectivity of the evaluation method [10]. In this paper, entropy weight TOPSIS method is adopted to make the financial indicators more accurately reflect the financial risks and main influencing factors of listed companies in the new energy automobile industry in different years [11]. The specific steps are as follows:

Step 1: There are m financial indicators, n listed companies. $X_{ij}$is the i financial indicator data of the j company, and finally form A matrix of $A = M_{ab}$.

Step 2: Standardization of indicators. Distinguish positive indicators and negative indicators, normalize them respectively to eliminate the impact of dimension on results.

Standardization of positive indicators, such as current ratio:

$$A_{ij} = X_{max} - X_{ij}/X_{max} - X_{min} \tag{1}$$

Standardization of negative indicators, such as asset-liability ratio:

$$A_{ij} = X_{ij} - X_{min}/X_{max} - X_{min} \tag{2}$$

If the indicator is a moderation indicator, the optimal value is X_0, that is, the value is the best in a certain range:

$$A_{ij} = \begin{cases} X_{ij} - X_{min}/X_0 - X_{min}, X_{ij} < X_0 \\ X_{max} - X_{ij}/X_{max} - X_0, X_{ij} \geq X_0 \end{cases} \tag{3}$$

And i=1,2,⋯,m, j=1,2,⋯,n.

At the same time, some index values are still negative after non-dimensional processing. Therefore, in order to avoid the occurrence of this situation, all indicators must be non-negative processing to obtain a new matrix.

When there is $A_{ij} < 0$, translation coordinates:

$$A'_{ij} = A_{ij} + d, d = 0.0001 \tag{4}$$

Then the matrix is normalized:

$$P_{ij} = A'_{ij} / \sum_{i=1}^{n} y'_{ij} \tag{5}$$

Step 3: Determine the weight W_{ij}, entropy S_i and weight W_i of the i financial indicator of the j company to be evaluated respectively.

$$W_{ij} = P_{ij} / \sum_{j=1}^{n} P_{ij} \tag{6}$$

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$$S_i = \frac{-1}{ln} \sum_{j=1}^{n} W_{ij} \, ln \, W_{ij} \tag{7}$$

$$W_i = 1 - S_{ij} / \sum_{i=1}^{m} (1 - S_{ij}) \tag{8}$$

Step 4: Find the maximum and minimum values of each column vector in the matrix M_{ij}, and form a new optimal matrix transversal and the worst matrix transversal.

$$A^+ = (A_{max,1}, A_{max,2}, \cdots, A_{max,j}) \tag{9}$$

$$A^- = (A_{min,1}, A_{min,2}, \cdots, A_{min,j}) \tag{10}$$

Step 5: The distance D^+, D^- and comprehensive evaluation index C_i between the index to be evaluated and the positive ideal solution of the best scheme and the negative ideal solution of the worst scheme are solved.

$$D^+ = \sqrt{\sum_{j=1}^{b} (A^+ - A_{ij})^2} \tag{11}$$

$$D^- = \sqrt{\sum_{j=1}^{b} (A^- - A_{ij})^2} \tag{12}$$

$$C_i = \frac{D^-}{D^+ + D^-} \tag{13}$$

4. Empirical Analysis

4.1. Data Preprocessing

In order to reduce the interference of heterogeneity such as scale to this paper, this paper selected 23 financial indicators data of 74 listed companies in the new energy automobile industry from 2018 to 2022, and standardized all financial indicators. In this way, the financial indicators of different companies can be compared under the same standard, so as to better conduct multidimensional comprehensive consideration of listed companies.

For example, the average debt ratio varies from industry to industry, so it is difficult to accurately judge a company's financial position just by analyzing its asset-liability ratio, because high debt ratio may be due to industry characteristics rather than poor operations. Similarly, measures such as the tangible assets ratio and the current liabilities ratio reflect a company's asset adequacy and short-term liabilities, respectively. However, if these metrics are compared individually, it is difficult to determine which company is in better financial shape. Therefore, through the standardized treatment of financial indicators, we can better reflect the relative position of listed companies' financial conditions in the market, so that we can make accurate comparisons on the basis of comprehensive consideration.

4.2. Input Variable Correlation Comparison

Using MATLAB to take 23 financial variables as horizontal and vertical indicators, Pearson correlation coefficient thermal map was performed for correlation analysis. Figure 1 can be obtained:

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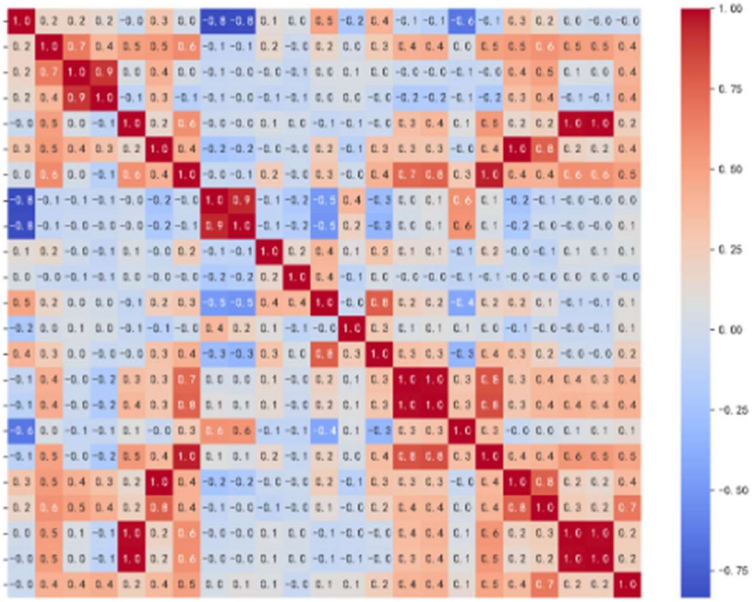

Figure 1. Pearson correlation coefficient thermal map of financial variables in 2022

It can be seen from Figure 1 that after standardization, the correlation coefficients among most financial variables are relatively low. This means that the linear correlation between these indicators is weak, and the probability of their mutual influence in cluster analysis is low, and it is not easy to have the situation that the weight of similar indicators is too large or interfered by other indicators. Therefore, the relationship between financial indicators can be identified and analyzed more accurately, which provides a reliable basis for the subsequent risk assessment.

In addition, although there are significant correlations between individual variables, on the whole, the correlation coefficients of most variables are low. This shows that in the new energy industry, the linear correlation between financial indicators is relatively weak, and each indicator has relatively independent characteristics. This kind of independence helps to comprehensively consider the influence of multiple indicators in risk analysis, reduce the redundant information among indicators, and improve the accuracy and interpretability of analysis.

4.3. Corporate Financial Risk Evaluation

Table 1. TOPSIS Evaluation for 2022

Company	D^+	D^-	C_i
Ningbo Shanshan Co., Ltd.	0.8459	0.2273	0.2739
Guangzhou Tinci Materials Technology Co., Ltd.	0.7723	0.4164	0.4530
Do-Fluoride New Materials Co., Ltd.	0.8029	0.3159	0.3651
EVE Energy Co., Ltd.	0.7830	0.3782	0.4211
Gotion High-tech Co., Ltd.	0.8163	0.3333	0.3749
Shanghai Putailai New Energy Technology Co., Ltd.	0.8250	0.3184	0.3601
BTR New Material Group Co., Ltd.	0.7822	0.4098	0.4446
Yunnan Yuntianhua Co., Ltd.	0.7857	0.4578	0.4761
Sinoma Science and Technology Co., Ltd.	0.8397	0.2406	0.2880
Shenzhen Senior Technology Material Co., Ltd.	0.7826	0.3859	0.4271

First of all, based on the original data, the evaluation indicators are processed by dimensionless, non-negative and normalized, and then the input data is scored by entropy weight TOPSIS

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comprehensive evaluation method: The data of 23 financial indicators of 74 listed companies in the new energy automobile industry were converted into $A = M_{74\times23}$ matrix, and the entropy weight method was used to obtain the entropy and weight of various financial indicators from 2018 to 2022 after data standardization. On this basis, TOPSIS method was used to obtain the distance D^+ and D^- between A_{ij} and the best ideal solution and the worst ideal solution of each listed company in the new energy automobile industry in the past five years, as well as the comprehensive evaluation score C_i. Specific results are given in Table 1. (Note: Due to space limitation, only some data results are listed).

The value range of the above C_i is [0,1]. The closer the value of C_i is to 1, the higher the index such as asset-liability ratio, which indicates that the more assets the company raises through debt, the greater the risk. On the contrary, the closer the C_i value is to 0, the smaller the financial risk is. For example, the C_i value of Shanshan shares is low in 2022, indicating that the company's overall financial position is healthy. The TOPSIS values of 74 listed companies in the new energy automobile industry from 2018 to 2022 are shown in Figure 2:

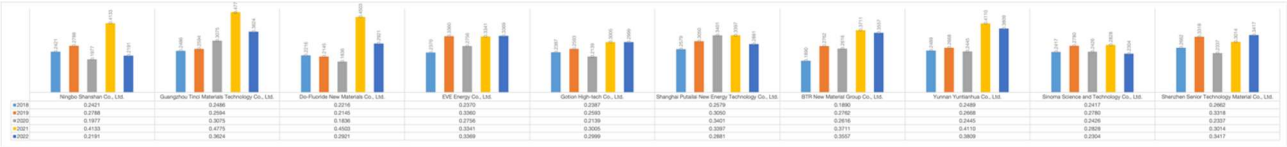

Figure 2. TOPSIS values of 74 listed companies in the new energy automobile industry from 2018 to 2022

As can be seen from Figure 2, there have been different volatility and stability trends among different companies over the past five years. This change in trend has important implications for investors and policymakers. But overall, these companies can be broadly divided into three categories:

a. TOPSIS declining companies: The TOPSIS value of some companies has been declining in the past five years. In the case of Organic Light Emitting Display, its TOPSIS value was at a high level in 2018, but gradually declined over 5 years. Because although Organic Light Emitting Display cut into the OLED field earlier, with the accelerated layout of industry giants such as BOE Technology Group Co., Ltd., TCL Technology Group Corporation and Tianma Microelectronics Co., Ltd., the competition in the market is becoming increasingly fierce, and the financial risks it faces are getting worse and worse.

b. TOPSIS stable companies: The TOPSIS value of some companies has been relatively stable in the past five years. Taking Zhejiang Sanhua Intelligent Controls Co., Ltd. as an example, the company has shown relatively stable financial performance in the past five years, and its TOPSIS value fluctuates little from year to year, indicating the continuity and reliability of its financial situation, which indicates that Zhejiang Sanhua Intelligent Controls Co., Ltd. has taken effective measures in financial risk management, combined with the international business layout, the company continues to accelerate production capacity construction. Have stable profitability and good financial stability.

c. TOPSIS rising companies: The TOPSIS value of some companies has been rising in the past five years. Take BTR New Material Group Co., Ltd. as an example, its TOPSIS value has shown a steady growth trend in the past five years, which indicates that the company has made remarkable progress in financial terms, with strong profitability and financial stability. BTR New Material Group Co., Ltd. is a company engaged in the research and development, production and operation of positive and negative materials for lithium-ion batteries. It fully grasped the market opportunity of the current strong demand for new energy lithium-ion batteries in the world, expanded production capacity, continued to explore the positive and

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negative materials market, increased market share, and achieved a substantial increase in production and sales.

To sum up, the changing trend of TOPSIS value of each company can provide an important reference for investors and decision makers. This not only helps to evaluate the financial risk and stability of each company, but also reflects the development trend of the new energy automobile industry under the Chinese-style modernization.

5. Conclusion

In this paper, the entropy weight TOPSIS method is used to evaluate the financial risk of 74 listed companies in the new energy automobile industry, and the trend classification is carried out according to the evaluation results. The results show the difference of financial risk stability among different companies, indicating that the measurement method adopted in this paper has high practicability and operability in the financial risk evaluation of listed companies in the new energy automobile industry.

In the future, under the guidance of the market, listed companies in the new energy automobile industry will continue to focus on the classification direction of new business, actively promote industrial transformation, prevent and resolve financial risks, take the road of high-quality development of manufacturing industry with Chinese characteristics, and contribute to Chinese-style modernization.

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