ISSN: 2688-8645

Analysis of the Performance of New Energy Vehicle Companies based on Entropy-Topsis

-- Take Company A as an Example

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Abstract

With the introduction of the "double carbon" goal, promoting the green and low-carbon transformation and development of the industry has become the main grasp to help the "double carbon" goal, and traditional car enterprises are shifting to new energy vehicle manufacturing with precision under the new development concept. This paper takes new energy vehicle enterprises as an example, selects their 2018-2021 financial data, constructs a comprehensive evaluation system using entropy-topsis model, evaluates their corporate performance, and makes corresponding suggestions.

Keywords

Entropy-topsis Model; New Energy Vehicle Companies; Corporate Performance.

1. Introduction

Based on the "double carbon" goal and the background of sustainable development, the new energy vehicle industry has attracted a period of rapid expansion, and many experts and scholars have explored and studied the development trend of the new energy industry.[1] Many experts and scholars have explored and researched the development trend of the new energy industry, and proposed insights on new energy supply reform, new energy development trend and development mechanism. The "double carbon" policy has brought development opportunities and challenges to the new sunrise industry, and new energy companies in transition still have a long way to go in terms of strategic change and market development and implementation. Research on the business performance of new energy enterprises is based on R&D investment[2] intellectual capital[3] tax incentives[4] and government subsidies[5] The research on the business performance of new energy enterprises is based on specific factors such as R&D investment, intellectual capital, tax incentives, government subsidies, etc., and uses descriptive statistics to establish correlations between variables and multiple regression analysis to draw conclusions. By establishing the weights of variables, the performance level of enterprises can be objectively evaluated. Therefore, this paper selects Company A, a representative of new energy vehicle enterprises, takes the financial data of the last four years, extracts the corresponding analysis factors, uses the entropy weight-TOPSIS model to build a comprehensive evaluation system, evaluates its financial performance in four aspects: solvency, operation, profitability and development, and proposes corresponding solutions based on the analysis results. Based on the analysis results, we propose corresponding solution.

2. Entropy-TOPSIS Model Construction

In this paper, the entropy-TOPSIS model is introduced into the financial performance analysis of the new energy vehicle manufacturing industry for the following reasons.

The TOPSIS model calculates the submitted progress by homogenizing and normalizing the sample while maximizing the use of raw data. the TOPSIS model eliminates the interference of

ISSN: 2688-8645

different measures by homogenizing and normalizing the sample while maximizing the use of raw data. These unique data processing methods improve the accuracy of financial performance analysis results[6] .

All financial data in this paper come from Company A's 2018-2021 annual report, the latest annual report data can reflect the company's recent financial situation in a timely manner, and all financial data are complete, which ensures the timeliness, comparability, accuracy and scientificity of the financial performance study.

2.1. Data Processing

2.1.1. Positivization Process

Among the 14 financial indicators selected in this paper, they are divided into positive and moderate indicators. Current ratio, quick ratio, cash ratio, gearing ratio, and equity ratio are moderate indicators, and all other indicators are positive indicators. We need to convert the moderate indicators into positive indicators through the positive treatment, and the formula of the positive treatment is.

$$Y_i = \frac{1}{1 + |k - x_i|}$$

where:X_i is the value of the indicator before treatment,Y_i is the index value after treatment, and k is the standard value of the index.

Table 1. k-value table

	Current Ratio	Quick Ratio	Cash Ratio	Gearing ratio	Equity ratio
k value	2	1	0.5	3	0.5

2.1.2. Standardized Processing

① Standardization of entropy method

The original matrix of indicators is constructed first, assuming that the number of performance indicators is denoted bym and the number of years is denoted byn is denoted byX_{ij} is the number of i of the evaluation indicator under the j year of the evaluation indicator (i = 1,2,3 ... m; j = 1,2,3 ... n) . Thus, the original decision matrix for evaluating the financial performance of several financial indicators of company a is obtainedX : The

$$X = \begin{pmatrix} x_{11} & \cdots & x_{1n} \\ \vdots & \ddots & \vdots \\ x_{m1} & \cdots & x_{mn} \end{pmatrix}$$

Because we have carried out the forwarding process, there is no negative indicator in the matrix, so we directly carry out the normalization process, and the normalization formula is as follows.

$$Y_{ij} = \frac{X_{ij} - \min\,(X_{i1} \ldots X_{in})}{\max(X_{i1} \ldots X_{in}) - \min\,(X_{in} \ldots X_{in})}$$

In addition, it is specified that when$Y_{ij} = 0$ time, the standardized result is taken as 0.0001.

② TOPSIS standardized processing

When there are multiple indicators in an evaluation system, there will inevitably be differences in order of magnitude, nature and magnitude. If the raw indicators are used for analysis when there is a large difference between each indicator, then it will lead to a large value indicator becoming the main factor in the comprehensive assessment, which will have an impact on the

ISSN: 2688-8645

smaller value indicators. To overcome these differences, the raw data are to be normalized under the TOPSIS method. The normalization method deals with the following formula.

$$X'_{ij} = X_{ij} / \sqrt{\sum_{j=1}^{n} X_{ij}^2}$$

2.1.3. Entropy Weighting Method to Determine Index Weights

2.1.3.1 Entropy Method Weight Calculation Steps

Calculate the proportion of the data in year j under the i evaluation index

$$P_{ij} = Y_{ij} / \sum_{j=1}^{n} Y_{ij}$$

Calculate the output entropy of the i-th indicator

$$E_{ij} = -\ln(n)^{-1} \sum_{j=1}^{n} (p_{ij} \ln(p_{ij}))$$

Calculate the degree of variation of the i-th indicator where i = 1, **2-m**

$$D_i = 1 - E_i$$
$$W_i = \frac{D_i}{\sum_{i=1}^{m} D_i}$$

2.1.3.2 Entropy Method Weight Calculation Results

The financial performance indicators of enterprise A are regarded as independent evaluation indicators, and the weights of four primary indicators and 15 secondary indicators are determined by using the entropy weighting method. The entropy weighting method is used to obtain the results shown in Table 2 Weighting results. The results are shown in the figure. The results show that the maximum value of the index weights is the gross operating margin (12.31%) and the minimum value is the gearing ratio (4.80%). The maximum weight of the four financial indicators is profitability (30.97%) and the minimum weight is development capacity (17.09%).

Table 2. Weighting results

Indicator Name		Capability Weights	Indicator Weights
Solvency	Current Ratio	29.43%	6.80%
	Quick Ratio		6.59%
	Cash Ratio		5.06%
	Gearing ratio		4.80%
	Equity ratio		6.18%
Operating Capacity	Accounts Receivable Turnover Ratio	22.51%	6.39%
	Current asset turnover ratio		8.44%
	Total assets turnover ratio		7.68%
Profitability	Return on Assets	30.97%	7.45%
	Gross operating margin		12.31%
	Net operating margin		5.30%
	Cost Margin		5.91%
Development capacity	Capital accumulation rate	17.09%	10.46%
	Total assets growth rate		6.63%

ISSN: 2688-8645

3. Financial Performance Evaluation under Entropy-TOPSIS Model

The raw data are normalized using the TOPSIS method. In order to avoid human factors affecting the accuracy of performance evaluation results, the decision matrix determined above is subjected to a weighting process. The final smaller evaluation score is obtained by calculating the positive and negative ideal distance.

$$C_j = \frac{D_j^-}{D_j^- + D_j^+}$$

3.1. Comprehensive Financial Performance Evaluation

Table 3. TOPSIS score results

Year	Positive ideal solution	Negative ideal solution	Overall Score Index	Sort by
2018	0.078738713	1.487938	0.960268	1
2019	0.735659302	0.636923	0.422464	2
2020	0.944364349	0.092334	0.074482	4
2021	0.918306101	0.498857	0.327894	3

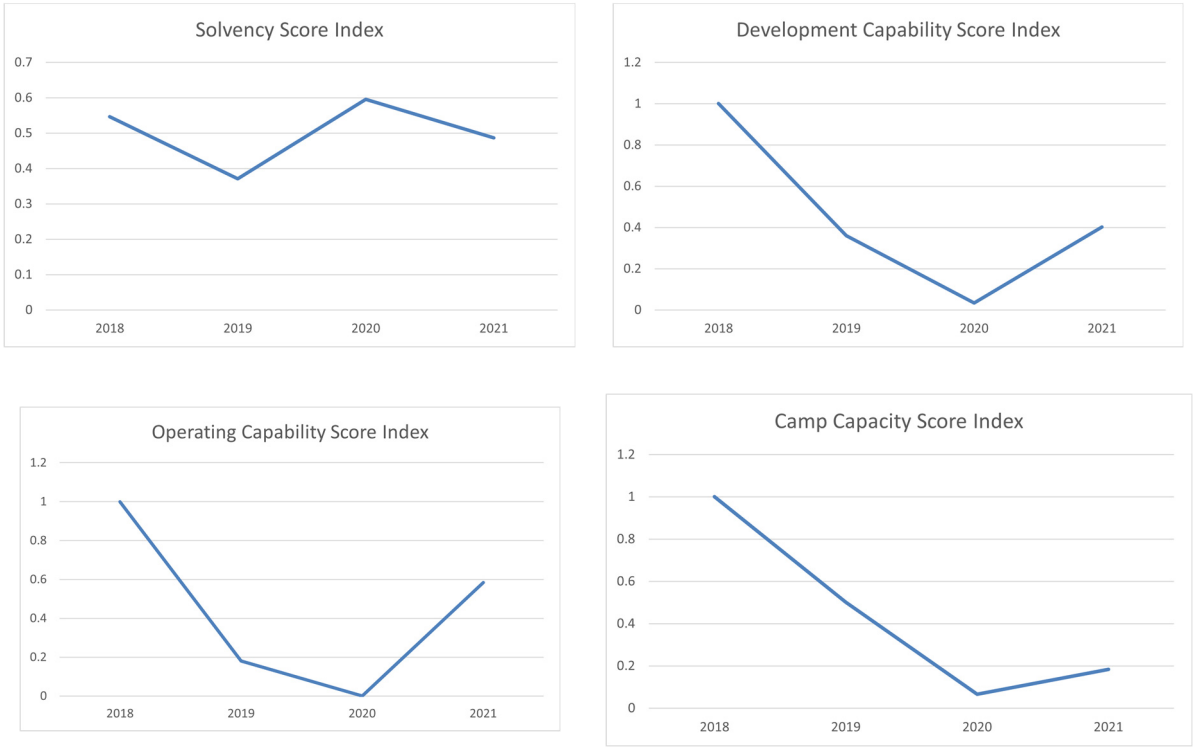

Figure 1. Evaluation results of each performance capability

4. The Problems of Corporate Financial Performance and its Countermeasures

4.1. Problems

The longitudinal analysis of the four indicators shows that the overall performance of the firm receives two main factors: the solvency of the firm and the profitability of the firm.

4.1.1. Weak Ability of Enterprises to Repay Long-Term Debt

A firm's gearing and equity ratio reflect the firm's ability to repay long-term debt. The standard gearing and equity ratio are both 50%, while Firm A's gearing rises 19% and equity ratio rises 71% from 2018 to 2021. The enterprise's ability to repay long-term debt has weakened. By

ISSN: 2688-8645

reviewing the financial statements of the enterprise for the last four years, the enterprise's long-term debt has increased year by year, mainly for financing leases, repayment of long-term bank loans, and projected liabilities due to reduced sales volume. The cumulative sales of new energy vehicles decreased by 4.69% year-on-year from 2018 to 2019, while the cumulative production of new energy vehicles decreased by 57.79% in the same year, but there is a phenomenon that the cumulative incremental vehicle production exceeds sales. Analogously, from 2019 to 2021, the production exceeds sales, and the sales volume of vehicles decreases year by year, and the production volume decreases, but the decreasing speed makes the sales volume of enterprises not optimistic. Due to the decreasing sales volume, the enterprise's revenue decreases, while on the other hand, the enterprise's cost decreases more than revenue decreases, making the enterprise's debt high.

4.1.2. Weak Profitability

Enterprises new energy companies operating gross margin in 2018 compared to 2017 increased by 0.25 percentage points, but from The operating gross margin started 2018 from 14.10% to down to -32.16%. In terms of operating revenues and operating costs.

See, in 2018 to 2020 the company's operating income has been greater than the operating cost. At the same time, the company's assets are increasing in size, and expenses and costs are increasing, but the corresponding revenues are not increasing, so the company's return on assets, operating margin, and cost/expense ratio are all at low levels.

4.2. Matching Suggestions

4.2.1. Improve Product Competitiveness

In 2019, with the significant decline in state subsidies for new energy vehicles, the development of the industry has taken a sharp turn for the worse, coupled with the impact of the new crown epidemic has made enterprises face a shrinking market for online vehicles and cabs, and a lack of competitiveness of products in the consumer market. This requires enterprises to do their own research and development, the introduction of the latest intelligent technology, to create new technologies, intelligent car industry, open up the high-end car market.

4.2.2. Increase Marketing Efforts

Strengthen the marketing system and enhance the marketing level. For a long time A enterprise's products are mainly sold in the net car and cab market, and in the consumer market, they are often labeled as low-end. To break the original lot image we have to improve the enterprise manufacturing system, cooperate with multiple brands and improve product awareness.

4.2.3. Do a Good Job of Monitoring Product Quality

Safe products are trusted by consumers, and companies should always put product quality first in the manufacturing process. Safe and intelligent products will win the trust of consumers. Establish a perfect, complete quality testing system, timely detection of product problems, improve product quality, good product control, to provide a boost to the product to the low-end.

Acknowledgments

Funded by: Anhui University of Finance and Economics Undergraduate Research Innovation Fund Project (XSKY22182).

ISSN: 2688-8645

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