Keywords—Listed Steel Companies, Financial Quality, DEA

Abstract

At present, the main evaluation methods for enterprise financial quality belong to the category of variable scale efficiency. The company's production scale has not reached its optimal state. Also, according to the empirical results, the steel industry is the pillar industry of the national economy. It has a great influence on related industries such as machinery manufacturing, real estate, automobile, energy, home appliances, construction, real estate, automobile, etc. It plays an irreplaceable role in the industrial development of the country and the development of the national economy. An important indicator of a country's comprehensive development strength. In recent years, China's steel market has been sluggish and overcapacity has occurred even losses. Facing the severe market condition of multi-input and multi-output, the financial quality of enterprises is taken as the research object to measure the quality of enterprise assets and earnings, risk and improvement efficiency.

I. INTRODUCTION

Steel companies are the main enterprises in the steel market. Their financial quality belongs to the category of variable scale efficiency. Therefore, it is feasible to use DEA method for research. Since the evaluation of financial activities, which essentially reflects the relationship between input and output. Therefore, the evaluation of scale efficiency can be recorded as 𝑋 = (𝑋₁, 𝑋₂, ⋯ , 𝑋ₙ). The output variable, which can be recorded as 𝑌 = (𝑌₁, 𝑌₂, ⋯ , 𝑌ₙ). The input and output variables can be recorded as 𝑌 = (𝑌₁, 𝑌₂, ⋯ , 𝑌ₙ). The output variable, which can be recorded as 𝑌 = (𝑌₁, 𝑌₂, ⋯ , 𝑌ₙ). The output variable, which can be recorded as 𝑌 = (𝑌₁, 𝑌₂, ⋯ , 𝑌ₙ). The output variable, which can be recorded as 𝑌 = (𝑌₁, 𝑌₂, ⋯ , 𝑌ₙ). The output variable, which can be recorded as 𝑌 = (𝑌₁, 𝑌₂, ⋯ , 𝑌ₙ).

II. LITERATURE REVIEW


III. THE SELECTION OF DEA MODEL

The research on financial quality of iron and steel industry mainly focuses on financial risk, performance evaluation and corporate management and external investors.

Data envelopment analysis (DEA) is an evaluation method to comprehensively evaluate the financial quality of listed companies. Tao Wei used a factor analysis method to study the financial quality of 23 listed steel companies in China. The research on financial quality of iron and steel industry mainly focuses on financial risk, performance evaluation and corporate management and external investors. In this paper, the DEA method is used to construct a model to comprehensively evaluate the technical efficiency, technical efficiency, and scale efficiency of listed steel companies. The research on financial quality of iron and steel industry mainly focuses on financial risk, performance evaluation and corporate management and external investors. In this paper, the DEA method is used to construct a model to comprehensively evaluate the technical efficiency, technical efficiency, and scale efficiency of listed steel companies.

IV. THE SELECTION OF DEA MODEL

Studies on Financial Quality Evaluation of Listed Steel Companies Based on DEA in China

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introduces the slack variable \( S^- \) and the residual variable \( S^+ \), and obtain the CCR model and the BBC model of DEA as follows: (and the output variable can be recorded as ... Meanwhile, the slack variable \( S^- \) and the residual variable \( S^+ \) introduced to obtain the CCR model and the BBC model of DEA as follows:)

The CCR model:
\[
\min \theta = [\theta - \varepsilon (\ell^T S^- + \ell^T S^+)] \\
\text{s.t.} \sum_{j=1}^{n} x_j \lambda_j + S^- = \theta x_0 \\
\sum_{j=1}^{n} y_j \lambda_j - S^+ = y_0 \\
\lambda_j \geq 0; j = 1, 2, \ldots, n; S^+ = 0; S^- = 0; \theta \in E^1 \\
\]

Where, \( \varepsilon \) is the non-archimedes infinite small quantity, \( \theta \) is the coefficient of the linear combination of decision-making units, \( \theta \) is the effective value, and \( S^-, S^+ \) respectively represents the relaxation variables of input and output. 

When \( \theta = 1, S^- = S^+ = 0 \), then DMU is strongly effective; When \( \theta = 1, S^+ \neq 0 \) and \( S^- = 0 \), there is insufficient output, indicating that the output of some products can be increased under the condition of keeping the same input. When \( \theta = 1, S^+ = 0, S^- = 0 \), there is a waste of resources, so part of the input can be reduced and the original output keeps unchanged; When \( \theta < 1 \), the decision-making units are completely ineffective.

IV. DATA AND VARIABLES

A. Index Selection

According to the principles of scientific, comparability, representativeness, systematic, operability and other indicators system construction, combined with the characteristics of the steel industry, the total assets \( (X_1) \), operating cost \( (X_2) \), sales cost \( (X_3) \), management cost \( (X_4) \) and financial cost \( (X_5) \) are selected as input variables, and operating income \( (Y) \) as the output variable.

In the input indicator, the total assets refer to all the assets that a company owns or can control to bring economic benefits; the operating cost is the input of operating income, which is considered from the internal management financial efficiency of the company; period costs including sales expenses, management fees and financial expenses are also important indicators that affect the financial quality of enterprises. The reason why the output indicator selects operating income is mainly because a listed company with great development potential must have a clear main business as the pillar. The statistical description of input-output variables is shown in TABLE I.

**TABLE I. INPUT-OUTPUT VARIABLE STATISTICAL DESCRIPTION (UNIT: 100 MILLION YUAN)**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Min</th>
<th>Max</th>
<th>Mean</th>
<th>Standard deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>X1</td>
<td>43.44</td>
<td>3351.41</td>
<td>711.96</td>
<td>754.79</td>
</tr>
<tr>
<td>X2</td>
<td>40.77</td>
<td>2590.85</td>
<td>517.85</td>
<td>52.02</td>
</tr>
<tr>
<td>X3</td>
<td>0.45</td>
<td>34.93</td>
<td>10.03</td>
<td>9.62</td>
</tr>
<tr>
<td>X4</td>
<td>1.63</td>
<td>129.57</td>
<td>18.78</td>
<td>26.94</td>
</tr>
<tr>
<td>X5</td>
<td>0.17</td>
<td>44.22</td>
<td>11.64</td>
<td>12.27</td>
</tr>
<tr>
<td>Output</td>
<td>Y1</td>
<td>47.94</td>
<td>3047.80</td>
<td>610.83</td>
</tr>
</tbody>
</table>

B. Data Sources output variable.

The data in this paper is from the Guotaian Economic and Financial Research Database. According to the 2012 industry classification criteria of the CSRC, the data sample is the financial statement data published by the 2018 annual reports of Shanghai and Shenzhen listed steel companies. After the secondary screening, ST companies and incomplete data are excluded, and all input and output indexes cannot be negative as the DEA method requires. Also, experimental studies have shown that the negative treatment will affect the DEA results, making its distortion, and it will make the results of the analysis false in the process of mapping data. Therefore, samples with negative data such as Daye special steel, Shagang steel, Hangzhou steel, Fangda special steel and Wujin stainless steel are excluded in this paper. Finally, 23 listed steel companies were selected as research samples. The number of samples (23) is more than twice that of the product of input-output indexes (10), so it is considered that DEA evaluation results have an effective degree of differentiation.

V. EMPIRICAL RESULTS AND ANALYSIS

A. Calculation Process and Result Analysis

By combining sample data with DEA's BCC evaluation model and using DEAP2.1 software for analysis, the financial quality evaluation results of 23 listed steel companies in 2018 can be obtained, as shown in TABLE II.

**TABLE II. FINANCIAL QUALITY AND EFFICIENCY OF LISTED STEEL COMPANIES IN 2018**

<table>
<thead>
<tr>
<th>Stock Name</th>
<th>Comprehensive Efficiency</th>
<th>Technical Efficiency</th>
<th>Scale Efficiency</th>
<th>Scale returns</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hegang steel shares</td>
<td>1.000</td>
<td>1.000</td>
<td>1.000</td>
<td>-</td>
</tr>
<tr>
<td>Songshan steel</td>
<td>0.532</td>
<td>0.546</td>
<td>0.973</td>
<td>irs</td>
</tr>
<tr>
<td>Bao steel</td>
<td>0.691</td>
<td>0.715</td>
<td>0.966</td>
<td>irs</td>
</tr>
<tr>
<td>Taigang stainless</td>
<td>0.698</td>
<td>0.707</td>
<td>0.988</td>
<td>drs</td>
</tr>
<tr>
<td>Angang steel</td>
<td>0.717</td>
<td>0.720</td>
<td>0.986</td>
<td>drs</td>
</tr>
<tr>
<td>Valin iron and steel</td>
<td>0.565</td>
<td>0.570</td>
<td>0.990</td>
<td>drs</td>
</tr>
<tr>
<td>Shougang shares</td>
<td>1.000</td>
<td>1.000</td>
<td>1.000</td>
<td>-</td>
</tr>
<tr>
<td>Three steel fujian</td>
<td>1.000</td>
<td>1.000</td>
<td>1.000</td>
<td>-</td>
</tr>
<tr>
<td>Yongxing special steel</td>
<td>1.000</td>
<td>1.000</td>
<td>1.000</td>
<td>-</td>
</tr>
<tr>
<td>Baotou steel corporation</td>
<td>1.000</td>
<td>1.000</td>
<td>1.000</td>
<td>-</td>
</tr>
<tr>
<td>Bao steel</td>
<td>0.788</td>
<td>1.000</td>
<td>0.788</td>
<td>drs</td>
</tr>
<tr>
<td>Shandong iron and steel</td>
<td>1.000</td>
<td>1.000</td>
<td>1.000</td>
<td>-</td>
</tr>
</tbody>
</table>
Based on the above analysis, it can be found that the number of listed steel companies with effective technical efficiency in 2018 is 13. In 2018, the number of companies with an efficient scale is 11. The number of listed steel companies with efficient technology is generally higher than that of companies with efficient scale. In 2018, the average comprehensive efficiency, technical efficiency and scale efficiency of China's listed steel companies are 0.852, 0.873 and 0.977 respectively. The average scale efficiency is higher than the average technical efficiency, indicating that the financial quality of listed steel companies is more affected by scale efficiency than technical efficiency. Therefore, the main reason for the poor financial quality level of listed steel companies is the low scale efficiency. In addition, the input-output unreasonable resource allocation caused by technical efficiency is also an important factor affecting the company's financial quality.

### VI. CONCLUSIONS AND SUGGESTIONS

The article uses the DEA method to evaluate the financial quality of 23 listed steel companies, and the conclusion shows that the overall financial quality level of 11 listed companies, namely the Hegang steel shares, Shougang shares, Three steel fujian light, Yongxing special steel, Baotou steel corporation, Shandong iron and steel, Xining special steel, Bayi iron and steel, New steel shares, Liugang, and Chongqing iron & steel group co., is higher, and these companies have reached the DEA optimal state; The other 12 listed steel companies are DEA invalid. Among them, Bao steel and Lingang are invalid mainly because of scale reward, and the other 10 invalid enterprises are caused by the combination of scale reward and technical efficiency.

For listed steel and iron companies with effective comprehensive efficiency, their technical efficiency and scale return are in an ideal state. In order to ensure the existing financial input structure, we should continue to steadily increase financial input and promote the continuous, stable and efficient development of the company's financial operation.

For the listed steel companies of invalid type, there is redundancy in investment. The reasons for redundancy should be further analyzed and countermeasures should be found out. With the full use of existing technology and equipment, the input-output ratio and the quality of output need to be improved, the investment in research and development should be increased and the innovation ability ought to be enhanced, in order to achieve sustained and rapid development momentum, achieve economies of scale, improve the labor productivity and economic effect, raise profitability, and enhance the quality of the company's financial level.

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