Evaluation of the Profitability of Power Listed Companies Based on Entropy Improved TOPSIS Method

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Abstract

TOPSIS evaluation method can quantitatively evaluate the merits of the different extent of the object being evaluated, and the evaluation result is objective and accurate. Based on entropy Improved TOPSIS method, which eliminates the lack of subjective weighting of indicators, can integrated evaluate the company's profitability and can provide a reference for companies to increase profitability.

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1. Introduction

Profitability of listed companies is the ability of corporate profits, also known as enterprise funds or capital value added, and usually presents how much the amount of corporate earnings and the level of in a period. Through the evaluation of the profitability of power listed companies can see the problems of business links, as well as the gap between competitors, so as to enhance the profitability of the business reference. Based on 2010 annual reports financial data of power industry listed companies, this article use the entropy improved TOPSISI method to evaluate the profitability of power listed companies.

2. Profitability Indicator System

the profitability index of power listed companies from the financial indicators to measure, mainly select from operating profitability, asset profitability, shareholder profitability and business development capabilities in four areas.

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the profitability index of power listed companies from the financial indicators to measure, mainly select from operating profitability, asset profitability, shareholder profitability and business development capabilities in four areas.

Operating profitability indicators: Net Profit Margin.
Assets profitability indicators: Total Assets Return, Net Assets Return.
Shareholder profitability indicators: Per Share Earnings and Net Assets of Per Share.
Business development capabilities indicators: Main Business Revenue Growth Rate, Total Assets Growth Rate and Net Profit Growth Rate.

3. Profitability Indicator System

The full name of TOPSIS is "Technique for Order Preference by Similarity to Ideal Solution". TOPSIS method is a analysis methods suitable for a number of indicators, and multiple program options to select. Central idea of the method is first to identify indicators of positive ideal value and negative ideal value, and then calculated the distance between the program and the positive ideal and negative ideal value, finally calculated Closeness degree as the standard of evaluation of the merits and the ranking criteria for the program. Entropy is introduced to determine the index weight, avoiding the subjective factors when using the traditional TOPSIS method of Delphi method and AHP to determine weights.

Modeling process is as follows:
Suppose there are \( n \) pending evaluation companies and \( p \) evaluation indexes, the \( j \) indicators of the \( i \) objects is \( x_{ij} \), the initial judging matrix is \( X = (x_{ij})_{n \times p} \).

1. A positive and dimensionless treatment on \( X \) matrix is \( Y \) matrix. \( Y = (y_{ij})_{n \times p} \).

\[
y_{ij} = \begin{cases} 
\frac{x_{ij} - \min_{i} x_{ij}}{\max_{i} x_{ij} - \min_{i} x_{ij}} & \text{if } j \text{ is positive indicator} \\
\frac{\max_{i} x_{ij} - x_{ij}}{\max_{i} x_{ij} - \min_{i} x_{ij}} & \text{if } j \text{ is negative indicator}
\end{cases}
\]

2. Calculate \( p_{ij} \), the proportion of the \( j \) indicators of the \( i \) objects.

\[
p_{ij} = \frac{y_{ij}}{\sum_{i=1}^{m} y_{ij}}
\]

3. Calculate the entropy value and the variation coefficient of the \( j \) indicators.
Entropy Value:

\[
h_{j} = \frac{1}{\ln(n)} \sum_{i=1}^{n} p_{ij} \ln p_{ij}, (j = 1, 2, \cdots, p)
\]

\(0 \leq h_{j} \leq 1\) when \( p_{ij} = 0 \) \( p_{ij} \ln p_{ij} = 0\)

Variation Coefficient:

\[
g_{j} = 1 - h_{j}
\]

4. Calculate the entropy. That the weight of the \( j \) indicators.
\[ w_j = \frac{g_j}{\sum_{j=1}^{n} g_j}, 0 \leq w_j \leq 1, \sum_{j=1}^{n} w_j = 1 \]

(5) Calculate the weighted judging matrix \( Z = (z_{ij})_{n \times p} \)
\[ z_{ij} = w_j \cdot y_{ij} \quad (i = 1, 2, \cdots, n; j = 1, 2, \cdots, p) \]

(6) Based on the weighted judging matrix for the positive and negative ideal value of the indicators.
the positive ideal value:
\[ Z^+ = (z_1^+, z_2^+, \cdots, z_j^+ \cdots z_p^+) \quad z_j^+ = \max (z_{ij}, z_{2j}, \cdots, z_{pj}) \]
the negative ideal value:
\[ Z^- = (z_1^-, z_2^-, \cdots, z_j^- \cdots z_p^-) \quad z_j^- = \min (z_{ij}, z_{2j}, \cdots, z_{pj}) \]

(7) Calculated the Euclidean distance between the target of the evaluation object and the ideal values.
\[ D_i^+ = \sqrt{\sum_{j=1}^{n} (z_{ij} - z_{ij}^+)^2}, \quad i = 1, 2 \cdots n; \]
\[ D_i^- = \sqrt{\sum_{j=1}^{n} (z_{ij} - z_{ij}^-)^2}, \quad i = 1, 2 \cdots n; \]

(8) calculate the relative closeness between the evaluation object and the ideal value.
\[ C_i = \frac{D_i^-}{D_i^+ + D_i^-}, 0 \leq C_i \leq 1 \]

(9) Sort the evaluation objects according to the size of the relative closeness and obtain the evaluation results.

4. Use the entropy improved TOPSIS evaluation model to evaluate the profitability of power listed companies.

Apply the model above to evaluate the profitability of 15 individual power listed companies in Shanghai and Shenzhen Stock Exchanges. Data from the 2010 Annual Report of the power listed companies. The specific indicators data of the 15 individual power listed companies are shown in Table 1.

| Company Names | Net Profit Margin | Total Assets Return | Net Assets Return | Per Share Earnings | Net Assets of Per Share | Main Business Revenue Growth Rate | Total Assets Growth Rate | Net Profit Growth Rate |
|---------------|-------------------|---------------------|------------------|-------------------|-------------------------|----------------------------------|------------------------|----------------------|
| Company 1     | 11.26             | 4.73                | 10.21            | 0.64              | 6.26                    | 9.44                             | -3.90                  | -29.91               |
| Company 2     | 0.19              | 0.09                | 0.36             | 0.01              | 3.16                    | 14.27                            | 20.37                  | -85.41               |
| Company 3     | 0.45              | 0.18                | 1.31             | 0.03              | 2.35                    | 23.96                            | 27.25                  | -81.93               |
| Company 4     | 8.42              | 4.56                | 8.11             | 0.36              | 4.47                    | 17.07                            | 12.21                  | 5.05                 |
| Company 5     | 8.76              | 3.12                | 6.61             | 0.27              | 3.64                    | 17.76                            | 32.58                  | 27.20                |
| Company 6     | 3.39              | 1.70                | 6.70             | 0.29              | 3.76                    | 30.80                            | 15.44                  | -30.24               |
After the positive and dimensionless treatment on the date of table 3-1, we can get the table 2.

Table 2 the date after the positive and dimensionless treatment

| Company Names | Net Profit Margin | Total Assets Return | Net Assets Return | Per Share Earnings | Net Assets of Per Share | Main Business Revenue Growth Rate | Total Assets Growth Rate | Net Profit Growth Rate |
|---------------|-------------------|---------------------|-------------------|--------------------|------------------------|-------------------------------|------------------------|-----------------------|
| Company 1     | 0.2960            | 0.9172              | 0.8159            | 1.0000             | 1.0000                 | 0.0000                        | 0.2709                 | 0.3259                |
| Company 2     | 0.0000            | 0.0000              | 0.0000            | 0.0000             | 0.3333                 | 0.0542                        | 0.7096                 | 0.0340                |
| Company 3     | 0.0070            | 0.0176              | 0.0783            | 0.0318             | 0.1591                 | 0.1628                        | 0.8339                 | 0.0523                |
| Company 4     | 0.2201            | 0.8831              | 0.6417            | 0.5588             | 0.6153                 | 0.0855                        | 0.5621                 | 0.5097                |
| Company 5     | 0.2291            | 0.5984              | 0.5179            | 0.4118             | 0.4366                 | 0.0933                        | 0.9302                 | 0.6262                |
| Company 6     | 0.0856            | 0.3169              | 0.5253            | 0.4436             | 0.4624                 | 0.2395                        | 0.6205                 | 0.3241                |
| Company 7     | 0.8265            | 0.6585              | 0.4809            | 0.5628             | 0.9269                 | 0.1341                        | 0.3569                 | 1.0000                |
| Company 8     | 0.2016            | 0.3851              | 0.5866            | 0.3323             | 0.2946                 | 0.0509                        | 0.6700                 | 0.8871                |
| Company 9     | 0.1872            | 0.7843              | 0.6119            | 0.7266             | 0.8615                 | 0.1615                        | 0.5823                 | 0.4079                |
| Company 10    | 0.2396            | 0.6288              | 0.9740            | 0.7774             | 0.5441                 | 0.2008                        | 0.0000                 | 0.7429                |
| Company 11    | 0.1521            | 0.3334              | 0.7731            | 0.3100             | 0.0000                 | 0.0000                        | 0.8003                 | 0.4631                |
| Company 12    | 0.0778            | 0.0848              | 0.4355            | 0.3766             | 0.6022                 | 0.2733                        | 0.6018                 | 0.4467                |
| Company 13    | 1.0000            | 1.0000              | 1.0000            | 0.7750             | 0.5161                 | 1.0000                        | 0.2924                 | 0.8941                |
| Company 14    | 0.1037            | 0.2306              | 0.6368            | 0.3054             | 0.1914                 | 0.1918                        | 0.6270                 | 0.8840                |
| Company 15    | 0.0091            | 0.0032              | 0.0170            | 0.0079             | 0.2640                 | 0.1369                        | 1.0000                 | 0.0000                |

The entropy value, the variation coefficient and the entropy of the indicators are shown in the Table 3.

Table 3 The entropy value, the variation coefficient and the entropy of the indicators

| Indicators          | Net Profit Margin | Total Assets Return | Net Assets Return | Per Share Earnings | Net Assets of Per Share | Main Business Revenue Growth Rate | Total Assets Growth Rate | Net Profit Growth Rate |
|---------------------|-------------------|---------------------|-------------------|--------------------|------------------------|-------------------------------|------------------------|-----------------------|
| The Entropy Value   | 0.79916           | 0.87143             | 0.91993           | 0.89917            | 0.92818                | 0.83380                       | 0.95236                | 0.90702               |
| The Variation       | 0.20084           | 0.12857             | 0.08007           | 0.10083            | 0.07182                | 0.16620                       | 0.04764                | 0.09298               |
Then calculate the weighted judging matrix, the positive and negative ideal value of the indicators and
the Euclidean distance between the target of the evaluation object and the ideal values. Calculate the
relative closeness between the evaluation object and the ideal value. Sort the evaluation objects according
to the size of the relative closeness and obtain the evaluation results. Shown in Table 4.

| Company Names | Relative Closeness | Sequence |
|---------------|--------------------|----------|
| Company 1     | 0.4587             | 3        |
| Company 2     | 0.1142             | 15       |
| Company 3     | 0.1361             | 14       |
| Company 4     | 0.4087             | 6        |
| Company 5     | 0.3597             | 7        |
| Company 6     | 0.2794             | 11       |
| Company 7     | 0.5776             | 2        |
| Company 8     | 0.3293             | 8        |
| Company 9     | 0.4145             | 5        |
| Company 10    | 0.4360             | 4        |
| Company 11    | 0.2853             | 10       |
| Company 12    | 0.2657             | 12       |
| Company 13    | 0.8566             | 1        |
| Company 14    | 0.3072             | 9        |
| Company 15    | 0.1481             | 13       |

From the above results we can learn that it is feasible that using the entropy improved TOPSIS method
to evaluate the profitability of power listed companies. This article reflects only the use of financial
indicators of profitability, without considering the other indicators reflecting the profitability of power
listed companies. Such as the total installed capacity of electric power companies and other such.

5. Conclusion

TOPSIS evaluation method can quantitatively evaluate the merits of the different extent of the object
being evaluated, and the evaluation result is objective and accurate. Based on entropy Improved TOPSIS
method, which eliminates the lack of subjective weighting of indicators, can integrated evaluate the
company's profitability and can provide a reference for companies to increase profitability.

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