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## The application of the utility theory based TOPSIS method in the evaluation of corporations' financial performance

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### ABSTRACT

with the increasing reform and transformation of economical system, the rules and regulations in each corporation vary. As the listed corporations with typical stock system play an essential role in national economy and major forces in market. Besides, they have promoted the economical development in China significantly. By taking 80 listed corporations in China as research objectives, a Technique for Order Preference by Similarity to an Ideal Solution (TOPSIS) method is used to carry out the financial performance evaluation of each corporation. Meanwhile, the developments state of each corporation in 2007 to 2012 is evaluated. The research provides some suggestions which may be helpful for the further researches on the evaluations of financial performance for the listed corporation.

### KEYWORDS

TOPSIS; Financial performance evaluation; Listed corporations.



### INTRODUCTION

Since the reform, China has witnessed tremendous achievements in financial market, enterprise transformation and economical system transition. The listed corporations with stock system have played a leading role in economical development. With the improvements of market economy, the performance evolution has aroused great attentions in economic field in the market directed stage.

Financial evaluation refers to the comprehensive assessment is conducted based on the requirements of the corresponding departments in governments. Lots of existing studies have made remarkable achievements on performance evaluation. For instance, Li Xin from Party school of the Guangdong Provincial Committee of CPC pointed out that financial performance evaluation should be analyzed base on the relevant principles and indexes systems of evaluating structural revenue and expenditure benefits ; While Wang Jingshan proposed the important measures of adjusting financial functions in his comparative research into evaluation and approval of financial evaluation. The measure is to coordinate and promote the construction of public performance-oriented finance.

Based on those researches, this study conducts the financial performance evaluations by using TOPSIS in utility theory. The results are proved to be reasonable. Besides, this research also provides some helpful sustentions, which are expected to promote the comprehensive strengths of the listed corporations.

### THE PERFORMANCE EVALUATION MODEL BASED ON TOPSIS IN UTILITY THEORY

In this research, the comprehensive evaluation for the financial performances of the listed corporations is conducted using utility theory and TOPSIS. Therefore, the performances of each corporation on the finance are analyzed objectively and effectively. Assuming there are  $n$  indexes, and  $m$  research objects, each evaluating index is  $x_{ij} (i = 1, 2, \dots, m, j = 1, 2, \dots, n)$ .

Since each index present various types, dimensions of each index need to be processed separately: dimensionless treatment. Pervious researches have proposed many dimensionless methods. In this research, the differential method is used. By conducting dimensionless treatment on  $X_{ij}$  at the interval  $[0, 1]$ ,  $Y_{ij}$  is obtained. The better the effects, the greater  $y_{ij}$  corresponding to each index is.

The negative exponent is

$$y'_{ij} = \frac{\max(X_{1i, \dots, X_{mj})} - X_{ij}}{\max(X_{1j, \dots, X_{mj})} - \min(X_{1j, \dots, X_{mj})} \tag{1}$$

For negative exponent, we get

$$y'_{ij} = \frac{X_{ij} - \min(X_{1i, \dots, X_{mj})}}{\max(X_{1j, \dots, X_{mj})} - \min(X_{1j, \dots, X_{mj})} \tag{2}$$

By taking optimum interval  $[a_{1j}, a_{2j}]$  as an appropriate interval, the corresponding dimensionless treatment is illustrated as

$$y'_{ij} = \begin{cases} 1 - \frac{a_{1j} - x_{ij}}{\max[a_{1j} - \min(x_{1j, \dots, x_{mj})}, \max(x_{1j, \dots, x_{mj}) - a_{aj}]} X_{ij} < a_{1j} \\ 1 - \frac{x_{ij} - a_{2j}}{\max[a_{1j} - \min(x_{1j, \dots, x_{mj})}, \max(x_{1j, \dots, x_{mj}) - a_{2j}]} X_{ij} > a_{2j} \\ 1 \text{ others} \end{cases} \tag{3}$$

The  $y'_{ij}$  values are performed translation treatment using standard method to obtain  $y_{ij}$ , the standardized matrix Y is constituted. The corresponding equation is

$$y_{ij} = y'_{ij} + 1 \tag{4}$$

Then, the weights of indexes are calculated. If  $p_{ij}$  is the proportion that enterprise  $i$  accounts in total index, the nano equation is

$$P_{ij} = \frac{y_{ij}}{\sum_{i=1}^m y_{ij}} \tag{5}$$

If  $e_j$  is the entropy of the index  $j$ , the smaller it is, the more important the index. The contribution degree of corresponding financial performance is more prominent as

$$e_j = -\frac{1}{\ln m} \sum_{i=1}^m p_{ij} \ln p_{ij} \tag{6}$$

If  $w_j$  denotes the entropy for the index  $j$ , its weight is  $W$ , the greater it is, the greater influences it exerts on the financial performance of enterprises as

$$w_j = \frac{1 - e_j}{n - \sum_{j=1}^n e_j} \tag{7}$$

Weighted matrix is  $R$ , we obtain

$$R = (r_{ij})_{m \times n} = (y_{ij} w_j)_{m \times n} \tag{8}$$

The ideal positive and positive vector solutions are

$$r_j^- = \min(r_{1j}, r_{2j}, \dots, r_{mj}) \tag{9}$$

$$r_j^+ = \max(r_{1j}, r_{2j}, \dots, r_{mj}) \tag{10}$$

Assuming the positive distance between the ideal and real index vectors is  $D_i^+$ , the negative distance is  $D_i^-$ , the equations are

$$D_i^+ = \sqrt{\sum_{j=1}^n (r_{ij} - r_j^+)^2} \tag{11}$$

$$D_i^- = \sqrt{\sum_{j=1}^n (r_{ij} - r_j^-)^2} \tag{12}$$

Let financial evaluation values to be  $C_i$ , the larger it is, the more favorable the financial performance as

$$C_j = 100 \times \frac{D_i^-}{D_i^+ + D_i^-} \tag{13}$$

### THE FINANCIAL PERFORMANCE EVALUATION OF THE LISTED CORPORATIONS BASED ON TOPSIS IN UTILITY THEORY

#### Selection of the samples

To validate the reasonability of this model, the various listed corporations in China are selected as research objects. Then, the quantitative analysis is made on the financial performance evaluation for the data collected from the listed

corporations in 2007 to 2012. Except for the corporations with the unreasonable data, the numbers and ratios for the rest of listed corporations are shown in TABLE 1.

**TABLE 1 : The industrial distribution of listed corporations**

Industries	Industry Item	The number of listed corporations	Ratio
A1	Manufacturing	4	
A2	Biological products	4	
A3	Food	12	
A4	Chemistry	9	
A5	-Metal/Nonmetal	13	
A6	Equipments	11	68.34%
A7	Textile	4	
A8	Electronics	2	
B	Propagation and Cultural industry	2	2.54%
C	Financial insurance	3	8.85%
D	Construction	3	2.53%
E	Real estate	8	2.54%
F	Farming, Forestry, Animal Husbandry and Fishery	6	6.33%
G	Mining	2	1.29%
H	Tourism	3	1.27%
I	wholesale and retail trade	2	1.28%
J	Information technology	2	1.28%
K	Utilities production and supply	4	3.9%

#### Determination of evaluation indexes

The evaluation indexes are determined by referring the financial performance operation regulations for enterprises issued by the state planning commission, Labor and Social Security bureau, and the central committee for the enterprises operations and the existing experiences. In this research, those indexes are determined based on five aspects, which are further subdivided into 24 indexes. The allocating and calculating processes are as follows:

For the financial management of the enterprises, we obtain

$$X_1 \text{ Shareholding proportion of the controlling shareholder} = \frac{\text{number of shares of the first shareholder}}{\text{total number of shares}} \cdot 100\%$$

$$X_2 \text{ Independent director proportion} = \frac{\text{the number of independent directors}}{\text{the total number of directors}}$$

$$X_3 \text{ Shareholding proportion of management level} = \frac{\text{the number of the number of shares of directors, supervisors and senior management personnel at the end of the year}}{\text{the total number of shares at the end}}$$

$X_4$ , denotes as the types of the audit opinions, the standard is set to 1, while others are zero.

Considering the cash ability for the enterprises,

$$X_5 \text{ Cash flow debt ratio} = \frac{\text{the net cash flow from operating activities}}{\text{current liabilities}}$$

$$X_6 \text{ Gross assets of cash recovery} = \frac{\text{the net cash flow from operating activities}}{\text{total assets}}$$

$$X_7 \text{ Cash profitability ratio} = \frac{\text{the net cash flow from operating activities}}{\text{net margin}}$$

$$X_8 \text{ Compulsory cash payment ratio} = \frac{\text{total cash inflow}}{\text{operating cash flows} + \text{the cash to repay the debt principal and interest}}$$

To improve the financial capabilities, we obtain

$$X_9 \text{ Growth rate of turnover} = \frac{\text{revenue of current term} - \text{revenue of last term}}{\text{revenue of current term}}$$

$$X_{10} \text{ Growth rate of gross assets} = \frac{\text{the final total assets} - \text{the beginning total assets}}{\text{the beginning total net assets}}$$

$$X_{11} \text{ Growth rate of net profits} = \frac{\text{net profits of current period} - \text{net profits of last period}}{\text{net profits of last period}}$$

$$X_{12} \text{ Capital accumulating rate} = \frac{\text{the final total net assets} - \text{the beginning total net assets}}{\text{the beginning total net assets}}$$

For the debt paying ability of the enterprises, it is found

$$X_{13} \text{ flow ratio} = \frac{\text{current assets}}{\text{current liabilities}}, \text{ appropriate interval } [2,3]$$

$$X_{14} \text{ Quick ratio} = \frac{\text{quick assets}}{\text{current liabilities}}, \text{ appropriate interval } [1,2]$$

$$X_{15} \text{ Asset-liability Ratio} = \frac{\text{total liabilities}}{\text{total assets}} \cdot 100\%, \text{ appropriate interval } [40\%, 60\%]$$

$$X_{16} \text{ interest rate safeguard multiplier} = \frac{\text{total profits} + \text{financial charges}}{\text{financial charges}}$$

For the capabilities of operating assets, we obtain

$$X_{17} \text{ Total assets turnover ratio} = \frac{\text{operating income}}{\text{the average total assets}}$$

$$X_{18} \text{ Accounts receivable turnover} = \frac{\text{operating income}}{\text{the average balance of accounts receivable}}$$

$$X_{19} \text{ Inventory turnover} = \frac{\text{operating income}}{\text{average inventory}}$$

$$X_{20} \text{ turnover of fixed assets} = \frac{\text{operating income}}{\text{average net of fixed asset}}$$

Regarding the financial profit capability in the enterprises, we obtain

$$X_{21} \text{ Profit rate of net assets} = \frac{\text{net profit}}{\text{average net asset}} \cdot 100\%$$

$$X_{22} \text{ gross assets profit rate} = \frac{\text{total profits}}{\text{total average asset}}$$

$$X_{23} \text{ Business profit ratio} = \frac{\text{operating profit}}{\text{operating income}} \cdot 100\%$$

$$X_{24} \text{ Cost profit ratio} = \frac{\text{operating profit}}{\text{operating cost} + \text{sales charges} + \text{management charges} + \text{financial charges}}$$

### THE PROCESS AND RESULTS OF THE FINANCIAL PERFORMANCE EVALUATION FOR THE LISTED CORPORATIONS BASED ON TOPSIS

The data from many listed corporations in China are selected and calculated in 2012. By analysis, the 24 non-financial and financial performance evaluation indexes are obtained. The evaluation model in TOPSIS is used to process the data. The evaluation indexes are calculated as TABLE 2. TABLE 2 The calculating results of evaluation indexes of the sample corporation

<b>Index</b>	$X_1$	$X_2$	$X_3$	$X_4$	$X_5$	$X_6$	$X_7$	$X_8$
Entropy	0.9974	0.9984	0.9974	0.9985	0.9981	0.9982	0.9993	0.9941
Weight	0.0772	0.0312	0.0742	0.0247	0.0242	0.0361	0.0251	0.0659
<b>Index</b>	$X_9$	$X_{10}$	$X_{11}$	$X_{12}$	$X_{13}$	$X_{14}$	$X_{15}$	$X_{16}$
Entropy	0.9992	0.9991	0.9995	0.9989	0.9991	0.9985	0.9995	0.9998
Weight	0.0306	0.0255	0.0135	0.0404	0.0266	0.0471	0.0205	0.0265
<b>Index</b>	$X_{17}$	$X_{18}$	$X_{19}$	$X_{20}$	$X_{21}$	$X_{22}$	$X_{23}$	$X_{24}$
Entropy	0.9978	0.9990	0.9977	0.9994	0.9994	0.9988	0.9991	0.9982
Weight	0.0898	0.0558	0.0715	0.0424	0.0373	0.0639	0.0202	0.0292

Based on the table, it is found that the weights of cash, capital operation, profits, development, debt paying ability and manage capability which denote as  $X_5$ ,  $X_{12}$ ,  $X_{14}$ ,  $X_{18}$  and  $X_{21}$  are relatively larger. Those six indexed prove that the financial performance values for the listed corporations exhibit a great influence on the corporations. While the indexes which have the greater contributions to the financial performance value in the listed corporations are  $X_5$ ,  $X_7$ ,  $X_8$ ,  $X_{18}$ ,  $X_{21}$ ,  $X_{22}$  and  $X_{23}$ . Based on the analysis results, it is obtained that the capabilities in cash, capital operation, and management have a great effects on the financial performance of the listed corporations.

To distinctly illustrate the financial performances ranks of each corporation, those corporations are classified four levels (A, B, C and D). The final performances are ranked in a decreasing order with corresponding standards as the table.

**TABLE 3 : Financial performance ranks**

Corporation classification	Ran interval	Financial performance
A	21%(No.1-16)	Good
B	22%~51%(No.17-40)	Average
C	52%~81%(No.41-No. 64)	Poor
D	82%~100%(No. 65-No.80)	Worst

The corporations which have higher ranks are Yilite Wine, Bayi Steel Co., Ltd, Xinhua Department Store, Jingyuan Coal Power and Jiuganghongxing, as the TABLE 4.

TABLE 4 : The corporations with better performances within 6 years

Samples	Jingyuan Coal Power	Yilitte	Jiuganghongxing	Bayi Steel Co., Ltd	Xinhua Department Store
Industry type	K	A3	A5	A5	E
2007 Performance ranks	7	20	1	5	15
Type	A	B	A	A	A
2008 Performance ranks	47	2	18	31	25
Type	C	A	B	B	B
2009 Performance ranks	10	5	1	17	30
Type	A	A	A	B	B
2010 Performance ranks	2	16	6	22	1
Type	A	B	A	B	A
2011 Performance ranks	1	16	10	8	2
Type	A	B	A	A	A
2012 Performance ranks	6	15	3	5	1
Type	A	A	A	A	A

The corporations with greater progress and high ranks are Youhao Group, Xiancheng Mining Co., Ltd, Sanjin Pharmacy, Kaiyuan Investement and Yanchanghuaajian respectively as shown in TABLE 5.

TABLE 5 : The ranks for the corporations with greater process within 6 years

Sample	Xiancheng Mining	Sanjin Pharmacy	Kaiyuan Investment	Yanchanghuaajian	Youhao Group
Industry type	K	A2	E	H	E
2007 Performance ranks	19	58	26	66	68
Type	B	C	B	D	D
2008 Performance ranks	49	38	23	64	55
Type	C	B	B	D	C
2009 Performance ranks	77	61	40	3	58
Type	D	C	C	A	C
2010 Performance ranks	50	68	4	3	21
Type	C	D	A	A	B
2011 Performance ranks	6	5	9	4	18
Type	A	A	A	A	B
2012 Performance ranks	14	4	7	2	11
Type	A	A	A	A	A

D-HPG, IRICO Display Device Co., Ltd, TYPICAL and QHYHGF show poorer financial performance. The results are shown in TABLE 6.

TABLE 6 : The corporations with a sharp decreasing ranks within 6 years

Sample	TYPICAL	D-HPG	QHYHGF	IRICO Display Device Co., Ltd
Industry type	A6	A4	A4	A8
2007 Performance ranks	2	16	11	6
2007 Type	A	B	A	A
2008 Performance ranks	3	22	1	7
2008 Type	A	B	A	A
2009 Performance ranks	16	9	7	13
2009 Type	B	A	A	A
2010 Performance ranks	45	77	17	62
2010 Type	C	D	B	C
2011 Performance ranks	28	75	26	22
2011 Type	B	B	B	B
2012 Performance ranks	45	78	51	72
2012 Type	C	D	C	D

The corporations which showed continually decreasing ranks in 2007 to 2012 are ST Zhongji, TOPSUN SCIENCE AND TECHNOLOGY CO.,LTD., \*ST Meili, ST Huangtai, ST Botong, \*ST Southwestern Bearing and \*ST Xinnong respectively, as shown in TABLE 7.

TABLE 7 : The ST corporations with poorer financial performances

Sample	ST TOPSUN	*ST Meili	ST Botong	*ST Southwestern Bearing	*ST Zhongji	ST Huangtai	*ST Xinnong
Industry type	A2	A1	B	A6	A3	A3	F
2007 Performance ranks	62	67	32	60	77	46	8
2007 Type	C	D	A	C	D	C	A
2008 Performance ranks	66	68	46	21	67	65	26
2008 Type	A	D	D	A	D	D	A
2009 Performance ranks	75	666	73	21	72	54	25
2009 Type	D	D	D	A	D	C	A
2010 Performance ranks	79	67	75	64	78	71	9
2010 Type	D	D	D	D	D	D	A
2011 Performance ranks	77	72	67	69	79	78	42
2011 Type	D	D	D	D	D	D	C
2012 Performance ranks	76	70	56	59	79	74	61
2012 Type	D	D	C	C	D	D	C

## CONCLUSION

The financial performance evaluation analysis of the 80 listed corporations in different areas in China were selected is conducted. The analysis results show the variation trend of the financial performances of each corporation. The financial performance in most industries perform well, this is because they are closely influenced by the strategic planning of each corporation. To create a preferable developing environment, the authors suggest the listed corporation should introduce more talents, enhance talents communication, and improve the index system and financing environment. In addition to be listed on growth enterprises market, more efforts shall be made to be listed in abroad, promote the financing portfolio, grasp the developing opportunities, construct reasonable talent structural system and improve the operation management level.



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