International Business and Management
Vol. **2**, No. **2**, **2011**, pp. 1-5
www.cscanada.net

ISSN 1923-841X [PRINT]
ISSN 1923-8428 [ONLINE]
www.cscanada.org

Multivariate Statistical Analysis on Competitiveness of Environmental Listed Companies in China

JIN Jian[1, 2]

SONG Liting[3]

Abstract: Taking 12 companies as an example, we evaluate the competitiveness of Environmental Listed Companies in China by multivariate statistical methods of AHP and Principal Component Analysis, on base of which these companies were ranked and classified by Cluster Analysis method, according to the advantages and disadvantages of each indicator. Investors may choose stocks which are more competitive, in order to reduce risk and make profits.

Key words: Environmental Listed Companies; Competitiveness; Multivariate statistical analysis

1. INTRODUCTION

Enterprise competitiveness is the comprehensive capabilities of a company to develop its own resources and ability, at the same time, obtain external resources, both of which are made multiple use, so as to create value for customers and to realize their own value in a competitive market conditions. It is an abstract concept, containing multiple levels, which includes competitiveness of the surface, of those to support the platform, as well as the core competitiveness. Each industry has his own key abilities, one shall conduct specific analysis aimed to specific questions. In addition, indicators for evaluating competitiveness are very complex, and so far, there is no uniform index system for it, researchers must establish one system directly towards different sectors of the economy.

With wind energy and solar energy put into use, the human race has stepped into an age of industrial civilization and agricultural civilization. However, more attention has been paid to environmental problems caused by usage of energy, which is the result of rapid development of global economy. Now people are advocating a so-called Low-Carbon Economy, and are cognizing environmental problems more deeply. With such a background, Environmental Listed Company is faced with opportunities and challenges at the same time. They shall try to improve their competitiveness, so as to meet challenges and seize opportunities, and stand out in the competitive market.

So it is of great necessary to investigate into the competitiveness of Environmental Listed Companies, not only can it provide references to make competitive strategy for companies, but also can it give advice for investors.

[1] Professor, mainly engaged in economic statistics, quantitative economics, national economic accounting. College of Economics, Hebei University, China.
E-mail: jinjian626@163.com
[2] Statistical Department, Tianjin University of Finance & Economics, China.
[3] College of Economics, Hebei University, China
*Received 22 March 2011; accepted 15 May 2011

2. COMPREHENSIVE EVALUATION OF ENVIRONMENTAL LISTED COMPANIES

2.1 Index System for Evaluation

Taking data availability and existing research into consideration, an indicator system for evaluation of environmental listed companies may be comprised of profitability, development ability, management ability, debt-paying capacity, and financing ability. Indicators reflecting a company's profitability includes profit margin (let it be X1), all capital earnings rate (X2). Those reflecting development ability may be growth rate of main business income (X3) and that of net asset (X4). And management ability, turnover of account receivable (X5), fixed asset turnover (X6), debt-paying ability, asset-liability ratio (X7) and number of times interest earned (X8), financing ability, gross profit (X9) and earnings per share (X10).

2.2 Choice of Weights

There exit many methods to weight indicators. In this paper, we employ AHP and the Principal Component Method.

2.2.1 Sort indexes according to importance

We extract four principal components on base of principal component analysis, and divide ten indicators into 4 grades by their degrees of importance, which are important, more important, very important, most important, respectively denoted as 1, 2, 3, 4. The result of Principal Component Analysis by SPSS15.0 show that the first principal component includes X6, X8, X10, the second principal component, X4, X7 and X9, and the third, X1, X2, the fourth, X3,X5, variance contribution rate progressively decreasing. This means that fixed asset turnover, number of times interest earned and earnings per share are the most important indicators, growth rate of net asset, asset-liability ratio and gross profit are very important indicators, profit margin and all capital earnings rate are more important indicators, and growth rate of main business income and turnover of account receivable, important indicators.

2.2.2 Establishing comparison matrix and calculating weights vector

On base of the result of rank above, we may establish the comparison matrix, normalize each column of the matrix, and add them by the line to get vector M. The normalized vector is the feature vector, which we denote with W. Then by the formula $\lambda_{\max} = \sum_{i=1}^{n} \frac{(AW)_i}{nW_i}$, we calculate the largest eigenvalue of comparison matrix, the data given in Table 1.

$$A = \begin{bmatrix} 1 & 1 & 2 & 2/3 & 2 & 1/2 & 2/3 & 1/2 & 2/3 & 1/2 \\ 1 & 1 & 2 & 2/3 & 2 & 1/2 & 2/3 & 1/2 & 2/3 & 1/2 \\ 1/2 & 1/2 & 1 & 1/3 & 1 & 1/4 & 1/3 & 1/4 & 1/3 & 1/4 \\ 3/2 & 3/2 & 3 & 1 & 3 & 3/4 & 1 & 3/4 & 1 & 3/4 \\ 1/2 & 1/2 & 1 & 1/3 & 1 & 1/4 & 1/3 & 1/4 & 1/3 & 1/4 \\ 2 & 2 & 4 & 4/3 & 4 & 1 & 4/3 & 1 & 4/3 & 1 \\ 3/2 & 3/2 & 3 & 1 & 3 & 3/4 & 1 & 3/4 & 1 & 3/4 \\ 2 & 2 & 4 & 4/3 & 4 & 1 & 4/3 & 1 & 4/3 & 1 \\ 3/2 & 3/2 & 3 & 1 & 3 & 3/4 & 1 & 3/4 & 1 & 3/4 \\ 2 & 2 & 4 & 4/3 & 4 & 1 & 4/3 & 1 & 4/3 & 1 \end{bmatrix} \quad (1)$$

Table 1-a: The Weights Vector for Evaluation Index System

indicators	eigenvector W	vector AW	AW / nW_i
X1	0.0741	0.7407	0.99965
X2	0.0741	0.7407	0.99965
X3	0.0370	0.3704	1.001001
X4	0.1111	1.1111	1.0001
X5	0.0370	0.3704	1.001001
X6	0.1481	1.4815	1.000325

Table 1-b: The Weights Vector for Evaluation Index System

indicators	eigenvector W	vector AW	AW / nW_i
X7	0.1111	1.1111	1.0001
X8	0.1481	1.4815	1.000325
X9	0.1111	1.1111	1.0001
X10	0.1481	1.4815	1.000325

2.2.3 The consistency test of judgement matrix

It can be concluded that $\lambda_{\max} = 10.00258$ on base of table 1. According to test coefficient formula, it is drawed that test coefficient is $CR = \frac{CI}{RI} = \frac{(\lambda_{\max} - n)/(n-1)}{RI} = 0.00019 < 1$, so the judgement matrix has satisfactory consistency. The comprehensive evaluation index weights of most important, very important, more important, important are 0.1481, 0.1111, 0.0741, and0.0370.

2.3 Comprehensive Evaluation of Competitiveness of Environmental Listed Companies

2.3.1 Non-dimensional treatment of the indexs

We uses the function method to treat dimensionless problem for index, the formula is as follows:

$$G_i = \frac{x_i - x_{di}}{x_{hi} - x_{di}} \times 40 + 60 \quad i = 1, 2 \cdots n \tag{2}$$

Where G_i is evaluation score for the ith item; x_i the actual value for the ith indicator; x_{hi} the highest level for the whole industry and x_{di} the lowest level; $\times 40 + 60$ is to make the results not equal to 0. The calculated results is shown in Table 2.

Table 2: Non-Dimensional Treatment of the Indexs

enterprise	profitability		development capacity		management capacity		solvency capacity		financing capacity	
Weights	X1	X2	X3	X4	X5	X6	X7	X8	X9	X10
	0.0741	0.0741	0.037	0.1111	0.037	0.1481	0.1111	0.1481	0.1111	0.1481
IWT	65.6123	72.7148	82.3432	60.38	80.0721	60	88.4586	97.5001	61.2373	60
FL	67.0069	76.2141	68.7506	60.0902	70.3933	63.4421	92.4199	86.8328	86.2841	85.7525
ZFEST	60.0000	60.0000	72.2779	60	72.3345	63.0848	100	96.4215	60	60.5661
TCEPG	84.2050	73.1823	75.007	60.1873	62.2636	60.1062	88.6423	96.9174	96.271	63.3797
ZYEP	88.8511	100.0000	75.9988	60.6035	61.2717	60.7055	72.9237	100	68.4848	65.5831
CXRG	100.0000	98.2570	73.0115	60.4355	94.9005	60.0219	79.9875	98.5932	86.6014	71.8542
TEDAIH	64.5369	65.1836	100.0000	60.0411	100	63.2632	97.4533	96.7125	100	60.9322
SER	81.4829	85.1386	80.9141	60.5881	60	67.8102	89.746	97.6313	80.6357	69.8203
BWBD	84.9527	78.4476	60.0000	100	60.9832	74.2493	64.1233	93.0804	64.7712	71.1763
XSEI	72.6108	88.7460	78.7543	76.7249	64.2558	61.2901	68.4826	88.7438	60.8922	70.1593
BOWT	87.7421	77.6617	93.1010	98.4323	66.9954	62.9633	60	89.145	68.081	74.5661
DENED	72.6024	90.5985	86.0230	83.1329	67.1433	100	71.9634	60	67.0973	100

2.3.2 Calculation of composite index

Here we try Weighted Average Method to calculate composite score, the calculating formula is:

$$\overline{G_i} = \frac{\sum G_i W_j}{\sum W_j} \tag{3}$$

Where $\overline{G_i}$ is the composite score of the indicators, W_j indexes' weights. According to the formula and relevant data, we get composite score of each enterprise and competitiveness rankings in Table 3.

Table 3: Competitiveness Score

enterprise	composite score	rank
Interchina Water Treatment	71.8106	11
Fujian Longking	77.24669	6
Zhejiang Feida Environmental Science & Technology	71.27738	12
Tianjin Capital Environmental Protection Group	76.61382	8
Zhong Yuan Environmental Protection	75.02975	9
Chengdu Xing Rong Group	80.2585	2
TEDA Investment Holding	78.33637	3
Sound Environmental Resources	78.06349	4
Beijing Water Business Doctor	77.33726	5
Xiamen Savings Enviromental Industrial	72.7562	10
Beijing Origin Water Technology	76.91609	7
Dalian East New Energy Development	80.95205	1

3. CLUSTER ANALYSIS OF ENVIRONMENTAL LISTED COMPANIES

3.1 What is Clustering Analysis?

Cluster analysis is a collection of statistical methods, which identifies groups of samples that behave similarly or show similar characteristics. It is a approach of studying "birds of a feather flock together", aimed at finding some statistics that can measure the similarity between different levels' sample or indicators (variables) being investigated and classify them into different types by these statistics. Generally, samples or indicators of more similarity are clustered together step by step, until each sample has a class which it attributed to.

3.2 Cluster Analysis of Companies

On based of Hierarchical Clustering Method and the result of rank for comprehensive competitiveness of 12 listed companies, we classify the 12 listed companies.

It shows that the 12 listed companies can be divided into three categories according to pedigree chart.

The first category includes Fujian Longking, Chengdu Xing Rong Group and Sound Environmental Resources. Their profitability, operating ability, development ability, financing ability and debt-paying ability develop in a more balanced way and top out. So these companies have quite doughty competitiveness and good momentum of development.

The second category includes Tianjin Capital Environmental Protection Group and TEDA Investment Holding. They have higher asset-liability ratio, number of times interest earned and gross profit, which indicates that they have better debt-paying ability and financing ability, as well as profitability. However, growth rate of these enterprises' net assets is lower, showing weaker development ability.

The third category includes Interchina Water Treatment, Xiamen Savings Environmental Industrial, Zhejiang Feida Environmental Science & Technology, Zhong Yuan Environmental Protection, Beijing Origin Water Technology, Dalian East New Energy Development and Beijing Water Business Doctor. They have better profitability, development ability and management ability, but bear weaker debt-paying ability and financial ability than other enterprises, showing smaller number of times interest earned and gross profit, which may lead to higher financial risk, so investors shall be cautious with them.

4. CONCLUSION

Involving a wide range of factors and indicators, comprehensive evaluation of competitiveness of the Listed Companies is a very complex process. This artile employs multivariate statistical methods such as AHP, Principal Component Analysis and Cluster Analysis to comprehensively evaluate competitiveness of Environmental Listed Companies, and classify them by their superiors and inferiors.

REFERENCES

HE Xiaoqun. (2004). *Multivariate Statistical Analysis*. China Renmin University Press.

XU Guoxiang. (1998). *Statistical Prediction and Decision-Making*. Shanghai University of Finance & Economics Press.