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Empirical Studies on the Warning of Financial Crisis Based on Factor Analysis

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Abstract: This paper discusses the method of setting up the financial early warning model of listed companies based on the researches before. With the data from the public financial information report of listed companies we choose the appropriate financial indicators. Then Based on the data of 29 ST listing companies and 128 similar normal ones, we give our factor analysis model and discriminant analysis model for the financial early warning. And then get the result of the analysis.

Keywords: factor analysis, listed company, Financial early warning

1. INTRODUCTION

With the continuous deepening of economic system reform and rapid development of capital markets in China, The listed companies are faced with more opportunities and challenges. The companies with poor operation enough may fall into the financial crisis and have a bad influence on the investors, loaners, other companies and even on the country. In fact, the financial crisis is a slow process which can be predicted. So

It is important to set up a model for the financial early warning which can be used by the company to take steps and improve the company's financial state and finally reduce the investment losses. On the other hand, the early warning model is essential for the securities regulatory authorities to monitor the listed companies and reduce the risk of stock market.

The financial crisis is also called financial distress; Bankruptcy is the most serious one. In china, if a listed companies fall into a bad financial situation due to poor operation, it will be faced with a special treatment, which is an example of financial crisis. The financial early-warning model can be used to identify the financial situation based on financial indicators and other non-financial indicators of the company. The research method is as follows, first we choose a set of companies which have fallen into financial crisis. then we determine a set of companies which have not yet met the crisis based on certain standards. We use the statistics method to analysis the data of the two types of companies, and find which financial ratio is significant. Finally we use the significant indicators and ratios to construct our early-warning model.

2. LITERATURE REVIEW OF FINANCIAL WARNING

2.1 International researches on financial early warning

The international research on financial early warning has been developed for a long time. In 1932 Fitzpatrick proposed invariance bankruptcy prediction model, which is the first research on early-warning. Fitzpatrick chose the data from 19 companies as the sample and divide it into two groups according to the financial ratio, the bankruptcy one and the non-bankruptcy one respectively. The result shows that clear profit/stockholder's equity ratio and stockholder's equity/debts ratio have the most significant discriminant effect. During the three years before the financial crisis these ratios increased a lot.

In 1968, the famous economist, Edward Altman of Stern School of Business, proposed the 'z-score' model, which is the first multivariable analysis method used to predict the financial crisis. Altman choose 22 possible

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financial ratios. The ratios can be divided into five categories: liquidity, profitability, leverage, repayment ability and activity. According to industry and asset size, Altman chose 33 bankrupt companies and 33 non-bankrupt companies as the data sample, and find the relationship between the variables. According to the significance of the variables and the minimum error rate principle, 5 variables are chosen into the model. The result of the model is accurate and thus promoted the development of financial early warning

In 1980, Ohlson use the Logistic Regression model for early-warning. He gave (the probability distribution of interval and the relationship between the sample distribution company in bankruptcy probability interval as well as two types of discrimination error and split point. Logistic Regression model is not depending on the variable's distribution and probability is considered in the model which has a good affect.

In 1993, Coats and Fant set up a neural network model. The model uses the 5 financial ratios as the input. Although the 'z-score' model works well on determining the crisis, it has poor performance on predicting the crisis, the network model can solve the problem which has a good predicting performance.

In 1998, McGurr&DeVaney used a hybrid model, the result shows it has an outstanding accuracy compared with the traditional ones. The hybrid model is also a trend for further research.

2.2 Researches on financial early warning in china

China's research on early financial warning started late, we mainly borrowed the abroad experience. But we also combined our actual situation and used a variety of combinations. Of all these methods, we mainly use quantitative analysis but little qualitative analysis.

In 1996, Shouhua Zhou and Jichang Yang added the Cash flow ratio into Altman's z-score model and gave the F score model, But the Data sample is not from China's securities market.

In 2001, Shinong Wu and Xianyi Lu had a research on the listed companies in China; the research shows two years before the crisis, the Profit growth index, Turnover ratio, debt ratio, and ratio of total assets are significant.

In 2005, Lianghua Chen used Logit regression to analysis the data from Stock market of Shanghai, he found that the Governance structure variables such as the proportion of independent directors, The proportion of the first shareholder, Cash flow rights and voting right deviation has a correlation with the Financial crisis. Defang Cao use principal component analysis method, the variables for the financial index and the equity structure were considered. The result showed The proportion of corporate shares, the proportion of tradable shares, holding model and the top 10 shareholders of the square are significant.

In 2005, Huihao Shu pointed out that the existing financial warning system didn't consider the Industry factors, which reduced the model accuracy. Hu added the Industry difference to the model.

In 2007, Yanwen Liu combined the rough set with the neural network method; the method is better than the traditional BP neural network.

In 2008, Zhining Wang chose 6 financial indicators from the data of newly formed listed company during 2003 to 2007. Through a comprehensive pretreatment on the driving factors of each model; Wang got the main indicators for the early-warning model.

In 2009, Lijian Zhou and Wenfeng Pang chose 57 ST companies of the year 2008, and then compared them with other 57 companies of the same industry and equal total assets. The 'z-score' method was also used.

In 2009, Lijun Zhang, Ying Wang run the Discriminant process using the software SPSS to do Bayes discriminant analysis, and found that the Bayes model had a high predicting accuracy. Furthermore, they analyze the financial report of listed companies. Current ratio and Asset-liability ratio was considered.

In 2010, Yaoyun Guo analyzed 20 financial indicators using statistical method. Factor analysis and Logistic regression were used. The result shows the model has a high accuracy rate of discrimination, providing a criterion for Investors, creditors and managers.

From the researches above, we can see that the research on financial early-warning in china started later, most of them are based on the international works. The data sample for analysis is mostly from the listed companies in China. To set up a model, several indicators were considered. And the method is usually a combination of different model which is also the trend for the research of this area.

3. DATA SAMPLE AND FINANCIAL INDICATORS SELECTION

3.1 Data sample selection

We choose two groups of data, one is for the financial crisis, and the other is for the normal ones. In the crisis group, 20 ST listed companies which have fallen into financial crisis were selected. And in the normal group, 128 companies of the same industry, similar scale and same time were selected.

3.2 Financial indicator selection

Although there are some difference between the early-warning method and the point of evaluation, In general, the indicators reflect the companies' Industry profitability, solvency, operation ability and growth ability. So the paper chooses 16 indicators to reflect the company's financial state. They are: X1: Return on assets operating profit、X2: Rate of return on assets、X3: Net profit margin、X4: the growth rate of total assets、X5: operating profit growth rate、X6: liquidity ratio、X7: The quick ratio、X8: Inventory current liabilities ratio、X9: Cash flow to assets ratio、X10: Capital adequacy ratio、X11: Debt capital ratio、X12: Debt equity ratio、X13: Inventory turnover ratio、X14: Accounts receivable turnover rate、X15: Asset turnover ratio、X16: Fixed asset turnover ratio

4. FACTOR ANALYSIS

Factor analysis can reduce variables with Perplexing relationship to fewer factors in order to reveal the relationship between the original variable and the factors and different factors can also divide the variables into different groups. The basic idea is to change a number of indicators to a few common factors by dimension reduction without losing much information. It is a method of Multivariate statistical method. There are two steps: first, reduce the data of higher dimensional space into a lower space using Principal component analysis, by applying linear transformation and abandoning the small part of information, the original data was replaced by fewer Principal components. Then rotate the component to get common factors which can be explained.

The goal of factor analysis is not only to find the common factor, but also to know what each common factor stands for. Factor rotation can be used to simplify the factor loading matrix which makes results easy to explain. In our work, the 16 selected factors was reduced to 7 common factors, The 7 factors were got using Varimax orthogonal rotation method.

The discriminant model was established on the basis of factor score, the main idea of discriminant analysis method is to determine the group of samples according to the distance, and usually a linear decision function was used to divide the sample into different groups. The data sample must be normal distributed and have equal covariance matrix between two groups. In practical, we need give each indicator a score and get a discriminant. Then form the decision interval according to the normal financial enterprises' scores and financial distress enterprises. To judge if a company has fallen into financial distress, we just calculate the company's score.

5. THE SETTING OF FINANCIAL EARLY-WARNING MODEL

Now we analyze the sample data, we use software spss13.0 to calculate the financial indicator's value and extract the common factors from the indicators. Then we set up the discriminant model according to the factor analysis. Finally get the warning score of company.

Table 1 is the result of KMO and Spherical Bartlett test. KMO is indicator for comparing correlation

coefficient of Observation and partial correlation coefficient, its value ranges from 0 to 1. When its value gets closer to 1, the explanatory effect of factor analysis is stronger and when its value gets closer to 0, the model may work not so well. Spherical Bartlett test can be used to judge whether Correlation matrix is a unit matrix. When the KMO value is below 0.5 it is not suitable to use factor analysis. From the result of Spherical Bartlett test we should reject the null hypothesis which means the variables has a strong association. In table the KMO value is 0.677 which is above the 0.7 level, so it is reasonable to use the factor analysis.

From the Total variance explained of table 2, we get 7 common factors from 16 indicators. The eigenvalues of the first 7 component are all above 1. The accumulative rate is 82.034%, that's to say if we only use 7 factors, we still get 82.034% information of the sample covariance matrix. The result meets the demand of factor analysis. The amount of information loss is relatively small when the number of indicators was greatly reduced. So we can use fewer indicators to analysis the data.

Table 1. KMO and Bartlett's test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.677
Bartlett's Test of Sphericity	Approx. c hi-Square	1888.900
	df	120
	Sig.	.000

Table 2. Explanations of variance

Component	Initial Eigenvalues			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	4.722	29.510	29.510	3.632	22.697	22.697
2	2.329	14.555	44.065	3.225	20.157	42.854
3	1.743	10.896	54.961	1.647	10.295	53.149
4	1.222	7.638	62.599	1.250	7.812	60.961
5	1.084	6.774	69.373	1.160	7.249	68.210
6	1.017	6.359	75.732	1.111	6.941	75.151
7	1.008	6.302	82.034	1.101	6.883	82.034

The linear discriminant function is as follows, we use 7 common factors to establish discriminant model.

$$Y = -0.854F_1 + 0.825F_2 + 0.191F_3 + 0.332F_4 - 0.081F_5 + 0.082F_6 + 0.489F_7$$

Where $F_1 \sim F_7$ is the value for 7 common factors

Table 3 is the Wilks' Lambda test for the model, the result shows the model has a significantly discriminant effect between two groups. Table 4 shows Eigenvalue test. The result shows there is a strong association between the predict variable and the explain variable.

Table 3. Wilks' Lambda test

Test of Function(s)	Wilks' Lambda	Chi-square	df	Sig.
1	.447	122.101	7	.000

Table 4. Eigenvalue test

Function	Eigenvalue	% of Variance	Cumulative %	Canonical Correlation
1	1.239a	100.0	100.0	.744

We calculate two groups of data in the model and determined the group according to the function. The

model has an accuracy of 95.5% for the total, and 99.2% for the normal group and 79.3% for the distress group. The result is satisfactory.

6. CONCLUSIONS

In the paper, we choose a number of indicators which is universally acknowledged important. After calculation we found that the indicators have a strong association, this meets the demand of factor analysis. Based on the factor analysis, we establish discriminant analysis model, the result shows the model has a good discriminant effect. Our future work is to compare the data of distress with the one two or three years before the distress, and choose more data samples and more appropriate indicators.

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REFERENCES

- [1] Zheng Xinghui. Financial Distress Model Research [J]. CHINA BUSINESS (JINGJI LILUN YANJIU) , 2010 (17).
- [2] Wu Shinong Chinese stock market risk studies [the Chinese People's University Press, 2003.
- [3] Lin Chen. Basic factor model on financial risks. Era of financial (mid-May), 2011 (2)
- [4] Liu Jing Pan Yi days. Based on multiple discriminant analysis Financial Early Warning System [J] Chinese management of information technology, 2010.2
- [5] Shao Xijuan, Zeng Hai spend. Warning model of financial distress of listed companies in China [J]. Economics and Management, 2009.9
- [6] Zhang Yi, Zhang Peng, Lu Xiaofei. Listed companies' financial early warning model Research Review [J]. Securities Futures of China 2012 (10)
- [7] Gao Hui Xuan application of multivariate statistical analysis [M]. Peking University Press, 2005.1.
- [8] Shin, K.-S.; Lee, T.S.; Kim, H.-J. An application of support vector machines in bankruptcy prediction model 2005(01)
- [9] Altman, E.I. Financial Ratios, Discriminant Analysis and the Prediction of Corporate Bankruptcy 1968
- [10] Lau, H L. A Five—State Financial Distress Prediction Model. Journal of Accounting Research. 1987(25)
- [11] Edward I. Altman Max LHeine, Ling Zhang, Jerome Yen Corporate Financial Distress Diagnosis in China New York University Salomon Center Working Paper, 2007(9)
- [12] Chiung—Ying Lee. Applying “Financial Reference Data—base” in an Enterprise Financial Distress Warning System International Research Journal of Finance and Economics, Euro Journals Publishing, Inc, 2010
- [13] Odom M. D and Sharda R. A Neural Network Model for Bankruptcy Prediction. In Proceedings of the Interactional Joint Conference on Neural Network Tool [J]. Financial Management, 1990, 2(6).