

# Empirical Analysis on Financial Distress Forecasting of Listed Companies in Jilin - Research based on Z-score Model

Shanshan Yu<sup>1</sup>, Lihua Zhao<sup>2</sup>

<sup>1</sup> School of Economics, Eastern Liaoning University, Dandong, China

<sup>2</sup> School of Management, Liaoning Provincial College of Communications, Shenyang

**Abstract** - This article discusses the early warning model of financial crisis, considering our business practice. According to financial distress prediction model of existing listed companies, it applies the Fisher discriminant method in multivariate statistical, analyzes and forecasts the financial crisis of 31 listed companies in Jilin Province, and puts forward relevant policy recommendations, which make reference to the investment decisions of investors.

**Index Terms** - financial crisis prediction model, Z-score ratings, Fisher discriminant, financial risk

## 1. Summarize Z-score Model

Z-score model was proposed by a well-known financial expert Edward Altman in 1968. Basic principles of Z-score model are: First, using statistical methods, analysis the company's past financial indicators statistical, select the most predictive or analytical value ratio index to reflect the Company's financial condition. Secondly, using the selected ratio indicators, design a mathematical model to maximum distinguish financial position. Finally, this model helps to assess and distinguish the company's financial condition, and put financial condition of the enterprise into two categories: bankruptcy normal and risk categories. The basic steps of establishing Z value scoring model: first, select a group financial ratios to reflect the Company's financial position, such as the liquidity ratio, return on assets, solvency indicators, etc. The second step, collect sample data of the Company, and divide the sample into two categories: one is the samples of normal financial conditions; the other is the samples of bankruptcy trends. The third step, according to the degree of influencing on the financial situation of Various ratios, select Fisher, Bayes discriminant analysis, etc, establish linear discriminant function determined by the above ratio index, determine the affect weight of each ratio, then get a Z value scoring model. The fourth step is analysis a series of Z values of selected sample, get bankruptcy threshold and the Z region, which can measure the value of the financial position. The fifth step, put the company's relevant financial data in the model can get a Z value. If the score is higher than a certain threshold or a pre-determined range, you can determine that the company's financial condition is good; if less than a values, indicate that the company has the possibility of bankruptcy.

Z-score models according five financial ratios which established by Altman:

$$Z = 0.012 X_1 + 0.014 X_2 + 0.033 X_3 + 0.006 X_4 + 0.999 X_5 \quad (1)$$

$X_1$  = working capital / total assets, reflecting the liquidity;  $X_2$  = retained earnings / total assets, the cumulative profitability;  $X_3$  = EBIT / total assets, reflecting the level of profitability of corporate assets;  $X_4$  = market value of equity / the book value of total liabilities, reflecting the degree of decline in the value of assets before its liabilities exceed its assets;  $X_5$  = sales / total assets, reflecting the capital turnover rate and sales capacity of the company. Altman calculated through statistical analysis and finalized borrowers default threshold  $Z_0 = 2.675$ , if the  $Z < 2.675$ , borrowers are included in Default group; Conversely, if  $Z \geq 2.675$ , then the borrowers are classified as non-default group. When  $1.81 < Z < 2.99$ , get larger misjudgment, the overlapping area is called "unknown zone" or "gray area."

According to financial indicators of eighty listed companies in 2012, this paper use Fisher discriminant analysis, build a model of financial distress which considering six aspects, including profitability, solvency, operation, capacity development, asset liquidity and the ability to receive cash, then test the model by choosing a random sample, finally applying this model analysis and forecast financial status of 31 listed companies in Jilin Province.

## 2. Model and Analysis

### A. Sample selection and data sources

ST and \* ST is an identification of financial crisis for listed company in the stock market of China. ST shares refers to the loss of domestic listed companies for two consecutive years by special treatment. \* ST shares of domestic listed companies refers to three consecutive losses. Domestic enterprises generally take whether ST as identification Standard of financial crisis in order to distinguish enterprise's financial situation. Considering changes of financial indicators and the timeliness of the selected data, the paper select the data of 2011 and 2012 for research.

This article divide the study sample data into three groups: ① take data of 80 listed companies (40 non-ST and 40 ST) in Shanghai and Shenzhen as samples of establishing the Financial Distress Prediction model. ② take data of 20 randomly selected listed companies (10 ST and 10 non-ST) as samples of testing the Financial Distress Prediction mode. ③ take data of 31 listed companies in Jilin Province as samples to be assessed.

**B. Selected financial indicators**

Each researcher select different indicators, there isn't uniform standard for selecting financial Indicator of Financial Distress Prediction now. The indicators can basically reflect the company's financial health. According to the relevant literature, this paper selects seven financial indicators. There are six aspects: the solvency, profitability, operations, capacity development, asset liquidity and the ability to receive cash, which comprehensive response to the financial health of the enterprise.

The selected seven financial indicators are: Quick Ratio  $X_1$ ; ROA  $X_2$ ; total asset turnover  $X_3$ ; net profit growth  $X_4$ ; working capital utilization  $X_5$ ; operating cash flow per share  $X_6$ ; cash current liabilities ratio  $X_7$ .

**C. Build financial risk prediction**

Take the selected seven indicators as model predictive variables, grouping category of the 40 non-ST listed companies is set to 0, grouping category of the 40 ST listed companies is set to 1, using SPSS 19.0 software and Fisher method, get Standardized canonical discriminant coefficient, Non-standardized discriminant coefficient and Classification function coefficients, Detailed in Table I, Table II, Table III:

TABLE I Standardized Canonical Discriminant Function Coefficients

y	$X_1$	$X_2$	$X_3$	...	$X_7$
1	0.108	0.290	0.538	...	0.577

Table I shows that, according to the standardized discriminant function coefficients, standardized Fisher discriminant function is:

$$Z=0.108X_1+0.290X_2+0.538X_3+0.087X_4+0.338X_5+0.166X_6+0.577X_7 \quad (2)$$

TABLE II Non-standardized Canonical Discriminant Function Coefficients

y	$X_1$	$X_2$	$X_3$	...	$X_7$	constant
1	0.073	1.531	1.236	...	1.597	-0.926

From Table II, discriminant function can be constructed as follows:

$$Z=0.073X_1+1.531X_2+1.236X_3+0.015X_4+0.235X_5+0.122X_6+1.597X_7-0.926 \quad (3)$$

TABLE III Classification Function Coefficients

y	$X_1$	$X_2$	$X_3$	...	$X_7$	constant
0	0.611	-2.04	4.788	...	2.753	-3.709
1	0.458	-5.25	2.195	...	-0.597	-1.767

Table III shows that, we can get Bayes discriminant function according to the classification function coefficients. ST group:

$$Z_1=0.458X_1-5.258X_2+2.195X_3-0.015X_4-0.035X_5+0.133X_6-0.597X_7-1.767 \quad (4)$$

TABLE IV Eigenvalues

Function	Eigenca-lues	The Percentage of Variance	The Percentage of Accumulation	Canonical correlatio-n
1	1.129	100.0	100.0	0.728

If you need to use Bayes discriminant function, enter values of the independent variables in two discriminant function. Determine the group by getting greater function value. Use a non-standardized discriminant function to calculate the discrimination value, input variables, then identify groups by comparing the Z-scores obtained and threshold. This article uses non-standardized discriminant function as criteria namely for convenience:

$$Z=0.073X_1+1.531X_2+1.236X_3+0.015X_4+0.235X_5+0.122X_6+1.597X_7-0.926 \quad (5)$$

$$Z_0=0.611X_1-2.046X_2+4.788X_3+0.015X_4-0.459X_5+0.389X_6-2.753X_7-3.709 \quad (6)$$

Then the mean of each financial indicators ,which belongs to two groups of sample data (non-ST group and ST group) ,were substituted into non-standardized discriminant function to obtain the mean center of gravity of non-ST and ST sample companies. Namely, non-ST group's center of gravity values  $Z_1 = 1.05$ ; ST group's center of gravity value  $Z_2 = -1.05$ . Determine best decision point according to completely symmetrical principle, namely:  $Z^* = (Z_1 + Z_2) = 0.00$ , when  $Z < Z^*$ , it is judged as ST company, otherwise, when  $Z > Z^*$ , it is judged as non-ST company.

**3. Empirical Analysis**

**A. Model validation**

Take the data samples of randomly selected 20 listed companies in Shanghai and Shenzhen (10 ST and 10 non-ST companies) into discriminant function, the text results showed that: judgment on 10 non-ST is correct, the correct rate is 100%; the judgment on 10 ST companies, 7 companies' is correst, the correct rate is 70%, false positive rate is 30%, the correct rate of the overall model is 85%, indicating that the model still have good judgement ability. So you can use the model for financial distress forecasting of listed companies.

**B. Jilin Province listed companies financial crisis early warning and assessment**

Based on selected data sample of 31 listed companies in Jilin Province (2011, 2012), using the established model of Financial Distress Prediction analyze and forecast financial situation of listed companies in Jilin Province, obtain Z - score

distribution of a listed company in Jilin Province by calculating as shown in Table V:

Table V shows that ,in 2011,the Z-Score of two listed companies is too low, the probability of financial crises is high , which accounted for 9.7%.Additionally,in 2011, there are four high Z-score of listed companies, while in 2012 there are eight. In general, the indicators of Financial Early Warning Model are generally positive indicators, so the higher Z-score, the more secure financial situation of enterprises. But too high Z-score may mean low resource utilization efficiency, which should attract attention.

TABLE V The Z-score Distribution Listed Companies in Jilin

Z-score range	Number of range		Proportion	
	2011	2012	2011	2012
Z<-1.05	2	3	6.5%	9.7%
[ -1.05,1.05 ]	25	20	80.7%	64.5%
Z>1.05	4	8	12.8%	25.8%
Total	31	31	100%	100%

Obtain changes in financial position of listed companies in Jilin by analysing the Z-score changes from 2011 to 2012, as shown in Table VI:

TABLE VI Changes in Financial Crisis Situation of Listed Companies in Jilin

Financial position	Number of companies	Proportion
Maintain normal	12	38.7%
In crisis	11	35.5%
Improve	5	16.1%
Deterioration	3	9.7%
Total	31	100%

As can be seen from Table VI, there are 12 company's financial position remained normal, accounting for 38.7%; there are 11 companies still exist hidden crisis, accounting for 35.7%; 5 company's financial situation has improved, accounting for 16.1 %; three of the company's financial condition deteriorated from the normal state to the financial crisis, accounting for 9.7%. On the whole, in 2011, the Z-score of 15 companies is higher than 0(financial position is expected to normal).Z-score of 16 companies less than 0(there exists the possibility of the financial crisis), Which has two less than -1.05, that is a high likelihood of financial crises. Z -score of 17 companies is higher than 0 in 2012, financial projections is normal. Z-score of 14 companies less than 0, there exists the possibility of financial crisis, 3 is less than -1.05, a high likelihood of financial distress.

Study enterprise financial crisis also should consider the Z-score fluctuations. If the Z-score of each company keep a certain value each year, only occurs small amplitude fluctuations, indicating that the company's financial situation is relatively stable, the possibility of financial crisis is relatively

small. If Z-score of the company has relatively large fluctuations each year, illustrate that there are more factors of instability in the company's production and management process, which will be the company's hidden financial crises. Table VII analyses Z-score changes of company each year:

Learn from Table VII, the magnitude of changes of 14 companies are less than 50% (The magnitude of changes within normal range account for 45.2%); Changes in amplitude of four companies are 50% to 100%, the change amplitude is slightly higher, accounting for 12.9%.The Z-score changes of 13 companies are more than 100%.The changes in amplitude are larger, which accounting for 41.9%, has a high potential of financial crisis. Greater volatility of Z value illustrates many unstable factors in business activities of the company. The factors make the company's financial position at risk. Probably some uncertain factors lead to financial crises of the company. Considering the fluctuations of Z-score is also very important for analysing the company's financial situation.

TABLE VII Z-scores change of Listed Companies in Jilin 2011-2012

Z -score variation width	Number of companies	Proportion
Changes in amplitude ≤ 50%	14	45.2%
50% <change rate of ≤ 100%	4	12.9%
Changes in amplitude> 100%	13	41.9%
Total	31	100%

#### 4. Conclusions and Policy Recommendations

##### A. Conclusions

The characteristics of Financial Distress Prediction and empirical analysis shows that there are indications for listed companies before the financial crisis occurred. Analysis the Z-score and its financial indicators you can make financial distress forecasting. Analysis financial position of the listed company in Jilin, we can draw the following conclusion:

##### 1) reasonable and effective for model building

First,select enough samples. The more adequate sample date, the better the model. Second, make adjustments over time to ensure the model accurate and effective. Moreover, univariate and multivariate models are combined, quantitative and qualitative analysis are combined, during the financial distress forecasting ,which can analyze the ture level of the company's financial condition more comprehensively.

##### 2) the overall financial situation of listed companies in Jilin Province is common

By analyzing the financial situation of the 31 listed companies in Jilin, half of the Z-scores is less than 0 from 2011 to 2012, has the probability of occurring financial crisis. The proportion in 2012 is 45%, slightly fewer than 2011, but is still higher ratio. While most of listed companies in Jilin Province in 2012 get profit, but listed companies have greatly increased size of debts, which constantly swallowing profits, and the main source of profit come from non-core business revenue, quality of the company's operations is poor, the risk

of financial crisis increase. Jilin Province has relatively backward economic and technological strength and located in the northeast old industrial base is the main reason. High-tech industries and services are still in a relatively early stage of development, we can see from Z-score of listed companies in Jilin that the overall financial situation is common.

### 3) *fluctuations of financial position of listed company in Jilin*

The listed companies in Jilin province, which Z-score fluctuations over 50%, reach 54.8% from 2011 to 2012, indicate that many of the company's financial situation is very unstable and greatly influenced by uncertain factors. High financial fluctuations greatly increase the risk of the company's financial risk. We can not ignore the Z-score fluctuations.

### B. *Policies and proposals*

Listed companies generally develop good in China, which is an important power source of economic growth. Through analysis, we can see that there are many financial crisis risks of listed companies in Jilin Province, which should cause the managers of companies great attention: take active measures, establish financial early warning mechanism and prevent financial risks.

Listed companies in Jilin should rational allocate resources, promote the adjustment of industrial structure, promote optimization and upgrading, adapt to market needs.

Jilin's industrial structure should be more rational layout, make full use of the advantages of the various regions, conduct a comprehensive and balanced industrial development. Pay more attention and support the development of emerging industries. Traditional industries should continue to become bigger and stronger.

Listed companies should pay attention to the importance of the main business, improving the efficiency of the company's management, enhance the company's competitiveness in the market. Always pay attention to changes of financial indicators, avoid the possibility of a financial crises.

### **References**

- [1] Man Wang, Kunrong Li, Empirical analysis on early warning model of financial crisis of Liaoning listed company-from perspective of Z-score model, Journal of Dalian Maritime University, 2009
- [2] JiLu Liu, build financial early warning model based on Fisher discriminant analysis-financial condition evaluation of listed company in Zhejiang. Accounting Monthly, 2011
- [3] Hui Xuan Gao, Applied Multivariate Statistical Analysis, Peking University Press, 2005
- [4] Shinong Wu, xian Yi Lu, A Study of Models for Predicting Financial Distress in China's Listed Companies. Economic Research Journal, 2001
- [5] Han Zheng, Corporate financial distress model Analysis Co-Operative Economy & Science, 2009