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## Research on corporate financial early warning and control system based on industry environment risk

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### ABSTRACT

Industry environment risks have enormous impact on corporate development. Environment risks refer to the instabilities in corporate development, which are in many cases the major causes of corporate financial crisis. Therefore, the construction process of effective financial warning and control system is of special importance, which makes it possible to scientifically estimate and effectively control the risks in corporate development. This paper focuses on researches on such subjects, during which process related mathematical models for the corporate financial early warning and control system are established, to make sure such system is established in scientific manner.

### KEYWORDS

Environment risks; Financial warning; Model building.



## INTRODUCTION

From perspective of corporate development, industry environment may produce positive or negative influence on the corporate development, and such negative influence is mainly due to the risks in the industry. Effective controls will be essential to create satisfactory environment for corporate development<sup>[1]</sup>. Corporate financial risks control system is the most important essence to void these risks, because it can guarantee the financial management process and also provide strong supports to stability in commercial intercourse of the enterprise.

This paper carries out modeling on basis of the selection of system specimen. During this process, through scientific selection of system data, the author takes the selection of system indicators as the basic elements, in order to provide the modeling process with scientific grounds. Besides, this paper launches systematic discussion on the modeling process throughout the modeling and analysis process. Additionally, this paper carries out specific analysis on the data collected, in order to make the research process more clearly targeted and practical.

## SELECTION OF SYSTEM SPECIMEN

In comparison with small and medium sized enterprises, large enterprises usually have relatively complete financial management systems and operating mechanism, therefore, their financial data tend to be more transparent and standardized. However, large enterprises are the main targets of the enterprise reformation in China, in order to promote their development, as such, for investors of such enterprises, more demanding requirements are proposed to enhance their awareness of financial risks<sup>[2]</sup>. For such reasons, the calculation of risks in investment environment and the establishment of financial crisis context control system become the key to such reformation. They are also the objects studied in this paper, in order to fully embody the necessity and urgency in the establishment of effective financial risk early warning system.

In the researches in this paper, enterprises exposed to financial risks are defined as financially risky enterprise, while those enterprises without financial risks are defined as healthy enterprises. The corresponding data are used as initial specimen. In this process, financially risky enterprises are chosen and another 20 enterprises without financial risks are chosen for comparison purposes. The specimen enterprises are as given TABLE 1.

**TABLE 1 : Specimen studied**

ST enterprises (Yr 2007)	Non-ST enterprises
000004ST Guonong	600689Shanghai Sanmao
000005ST Xingyuan	600180180Jiufa Gufen
000007ST Dasheng	600836Jielong Shiye
000018ST Zhongguan A	600522Fangxing Keji
000020ST Huafa A	600680Shanghai Putian
000035ST Kejian	600652Aishi Gufen
000408ST Yuyuan	600622Jiabao Jituan
000409ST Taige	600785Xinhua Baihuo
000557ST Yinguangxia	600693Dongbai Jituan
000613ST Donghai A	600300Weiwei Gufen
000003ST Dongbeigao	600139Mianyang Gaoxin
600076ST Huaguang	600520Sanwei Keji
600136ST Daobo	600326Xizang Tianlu
600137ST Langsha	600712Nanning Baihuo
600209ST Luodun	600063Wanwei Gaoxin
600213ST Yaxing	600201Jinyu Jituan
600234ST Tianlong	600680Shanghai Putian
600313ST Zhongnong	600831Guangdian Wangluo
600338ST Zhufeng	600288Dahengkeji
600419ST Hualong	600354Dunhuang Zhongye

In the modeling process, verification is made to the precision of such models. The data used in this paper are chosen in accordance with the random principle, for which purpose 20 enterprises with financial risks and another 20 healthy enterprises without financial risks are selected for related verifications, so as to demonstrate the precision in the modeling process<sup>[3]</sup>.

## SELECTION OF SYSTEM DATA

There are some similarities and difference between the researches in this paper and those in the past. The related financial data of the T1 specimen enterprises are not used in the researches in this paper. Instead, the related financial data of T3 specimen enterprises are used, that is to say, the researches are based on the specific financial data of those enterprises in 2004. The reason why T1 financial data are used lies in that the specimen enterprise is suffering from continuous loss from 2005 to 2006, resulting in

larger possibilities of errors in the researches, so that they may affect the precision of judgments made. Then, predictions can be made on this company on basis of its financial data in 2006 and a conclusion can be made that this enterprise will not be listed as a financially risky enterprise in the year of 2007. However, it is of little practical significance to carry out analysis on information and data of the company in 2006 for purposes of forecasting if the company will be suffering from financial problems in the year of 2007. However, the financial information and data of the company in T2 are not adopted in this paper. This mainly because the company was profitable in 2005, then it will not be classified as a financially risky company, even though some financial problems may occur to the company in 2006<sup>[3]</sup>. We assume that if the company suffered from financial loss in 2005, then effective predication on the financial risks in 2007 can be made on basis of these data, and such prediction will be changed to the question whether or not the company is going to suffer from financial loss or see economic gains in 2006. These predictions usually end up in vain. But if the data in 2004 is used, then such question will not exist and besides, from the research process, researchers can find that in T4 there is no obvious difference between the financial indicators of financially risky enterprises and those of normal enterprises. This means the prediction period basically starts with the year of T3. In the researches and arguments in this paper, the data are mainly taken from specialized security trading websites and annual financial statements of related enterprises.

## SELECTION OF SYSTEM INDICATORS

### Classification of model indicators

During the financial early warning modeling process, the effective establishment of independent variables in the early warning model is the basis of modeling. In this paper, the author has specifically studied and understood, from related data in China and in other countries, the actual financial conditions of Chinese enterprises, and therefore the mobility in enterprise trading market are fully presented. The author also carries out further studies on corporate financial structures and basic efficiency and profitability, so that the long-term performance can be more clearly identified and understood. On basis of the research process as described above, the author establishes 21 early warning indicators for Chinese enterprises, which are as shown in TABLE 2 below:

**TABLE 2 : Chinese enterprise financial early warning indicators and the definitions**

Group	Indicator	Symbol	Formula
Current	Current ratio	$X_1$	Current assets/Current liability
	Quick ratio	$X_2$	Quick assets/current liability
	Liability-asset ratio	$X_3$	Total liability/total asset
	Current liability ratio	$X_4$	Current liability/total liability
Structure	Primary business ratio	$X_5$	Primary business cost/total costs
	Operating cost ratio	$X_6$	Operating cost/total cost
	Management cost ratio	$X_7$	Management cost/total cost
	Financial cost ratio	$X_8$	Financial cost/total cost
Efficiency	Receivables turnover	$X_9$	Primary business income/mean receivables
	Inventory turnover	$X_{10}$	Primary business cost/mean inventory
	Total asset turnover	$X_{11}$	Primary business income/mean total assets
Profitability	Net asset income rate	$X_{12}$	Net profit/total assets
	Net asset profit rate of assets	$X_{13}$	Net profit/total assets
	Net profit rate from sales	$X_{14}$	Net profit/primary business income
	Gross sales profit	$X_{15}$	Primary business profit/primary business income
Growth	Primary business income growth	$X_{16}$	(current period primary business income – previous period primary business income)/previous period primary business income
	Primary business profit growth	$X_{17}$	(current period primary business profit – previous period primary business profit)/previous period primary business profit
	Pre-tax profit growth	$X_{18}$	(current period pre-tax profit – previous period pre-tax profit)/previous period pre-tax profit
	Net profit growth	$X_{19}$	(current period net profit – previous period net profit)/previous period net profit
	Total assets growth	$X_{20}$	(current period total assets – previous period total assets)/previous period total assets
	Shareholder interest growth	$X_{21}$	(current period shareholders' interest – previous period shareholders' interest)/previous period shareholders' interest

## **Principles for Selection of Model Indicators**

During the modeling of corporate financial risk system, the indicators should be selected in accordance with the following principles:

### **1 Principle of measurability**

During the construction processing of financial early warning system, the main purpose of such system should be further clarified. Careful considerations should be taken of the indicators on basis of financial management needs of enterprises, in order to improve the operability of the system, which is the ultimate goal of the corporate financial early warning system. On another hand, it can also effectively ensure that the determination process of evaluation indicators is simple and the screening process is clear and reasonable.

### **2 Principle of predictability**

Predictability is the key to selection of modeling indicators, and it is required that such modeling indicators are capable of effectively predicting financial risks, therefore the importance of such indicators should also be fully embodied.

### **3 Principle of Comprehensiveness**

Effective analysis should be made in association with all related information during the modeling process, in order to take full considerations of the possible financial risks<sup>[4]</sup>. Through effective comparison of corresponding data and information, effective supplementation can be realized between the indicators, so that the risk evaluation structure is systematic and it can effectively reflect the financial conditions and create convenience for selection of indicators. This is also the fundamental target of the model evaluation indicators.

### **4 Principle of comparability**

During the selection process of model evaluation indicators, effective researches should be made on the selection process of indicators and the methods adopted, so that the indicators are within a reasonable range. Effective calculation and deduction is required during this process, in order to make effective horizontal and longitudinal comparison between these indicators and to identify the specific difference during the evaluation process. As such the indicators determined can be comparable.

### **5 Principle of scientificity**

This principle has practical and positive influences on the modeling process, together with the case-specific analysis on causes on basis of the financial risk theories, they can ensure that the modeling process is reasonably designed and effective description can be made to the factors in financial risks. In such way, the ultimate purpose of the modeling can be realized.

### **6 Principles of coordination**

During the establishment of model indicators, active researches should be made on the evaluability of indicators and the early warning approaches should be coordinated, in order to effectively exclude the factors having influences on one another and to eliminate the interference between such evaluation indicators. The indicator selection process will be scientific and effective in true sense under such conditions, so that strong supports can be provided to the modeling process.

## **Determination of basic model indicators**

The discussions in this paper mainly include 17 basic indicators, which are essential to effective selection of indicators. This is because no effective conclusion can be drawn simply on basis of the financial conditions of enterprises, and there is great difference between the financial risk indicators and healthy indicators. However, in order to determine which indicator can effectively reflect the financial risks of an enterprise, we can only make effective data statistics and analysis by using corresponding statistics software and should also take considerations of the T test results for purposes of effective judgment and determination<sup>[5]</sup>. Please refer to TABLE 3 for details.

In view of the financial early warning indicators of normal enterprises, the difference between these indicators are not very obvious and it can be found from the inspection findings that the inspection is made on basis of a confidence ratio of 95% or higher. However, in view of the inspection findings as given above, several inspection results are selected for alternative variables for the financial early warning model. These indicators include debt-to-equity ratio, current debt ratio, management cost ratio, financial cost ratio, inventory turnover ratio, total assets turnover, net assets yield, net interest rates and primary business input growth rate.

**TABLE 3 : Analysis on differences between financially risky enterprise and normal enterprise in financial risk early warning**

Warning variables	Value T	Warning variables	Value T
X <sub>1</sub> Current ratio	-0.466	X <sub>12</sub> Net asset income ratio	-1.798
X <sub>2</sub> Quick ratio	-0.175	X <sub>13</sub> Total asset income ratio	-2.452
X <sub>3</sub> Liability-asset ratio	1.682	X <sub>14</sub> Net sales profit rate	-0.530
X <sub>4</sub> Current liability ratio	2.187	X <sub>15</sub> Gross sales profit rate	0.361
X <sub>5</sub> Primary business cost ratio	-0.361	X <sub>16</sub> Primary business income growth	-1.996
X <sub>6</sub> Operating cost ratio	0.251	X <sub>17</sub> Primary business profit growth	0.888
X <sub>7</sub> Management cost ratio	1.483	X <sub>18</sub> Pre-tax profit growth	1.223
X <sub>8</sub> Financial cost ratio	2.969	X <sub>19</sub> Net profit growth	-0.97
X <sub>9</sub> Receivables turnover	-1.298	X <sub>20</sub> Total assets growth	-1.1217
X <sub>10</sub> Inventory turnover	-2.952	X <sub>21</sub> Shareholders' interest growth	-1.537
X <sub>11</sub> Total asset turnover	-3.416		

Note: Test value t is two-sample test value of heteroscedasticity. Original assumption: financial risk warning indicators and of ST enterprises.....

### MODELING AND ANALYSIS

#### Model selection

In considerations of the specific situations of Chinese enterprises, this paper selects the multivariate logic regression model as the basic model in the analysis process, which is mainly because of three reasons. Firstly, this model do not establish specific requirements on independent probability variables and therefore its application scope should not be restricted<sup>[6]</sup>. Secondly, the approaches applied are simple and can effectively ensure the effects. Finally, the research is based on solid grounds and has been positively recognized by scholars.

#### Model interpretation

During the modeling process, solutions are proposed on the 0-1 regression. The modeling process can effectively ensure that these issues can be solved. In this process, assumptions have been made on the  $i$  variable in financial risk warning, so that regression relation is established between the probabilities of financial risks and the variables, as shown below:

$$p_i = \exp(Y_i) / [1 + \exp(Y_i)], Y_i = a + \sum b_i X_i \quad (1)$$

In the formula given above,  $Y_i$  can fully reflect the quantity characters of the  $i$ # item in comprehensive financial conditions of an enterprise, while  $b_i$  represents a weight, namely the importance of related independent variable in  $X_i$ .  $X_i$  is closely related to the financial risk early warning ratio and is also one of the disturbance terms.

However, in this model, the curve shows an S pattern. While the maximum value approximate 1, the minimum value gets close to 0. In this paper, the middle point is adopted as the separating point, because after the logic regression calculations, if the financial risk probability is great, the enterprise can be classified as a financially risky enterprise, and if the probability is small, then the enterprise is naturally classified as a normal enterprise.

#### Model establishment

This paper adopts related specialized data and realizes effective statistics in the model data. Besides, in accordance with the logic regression analysis by Forward Conditional on 40 enterprises.

Obviously, the inspection has worked out a model on three financial indicators including debt-to-assets ratio ( $X_3$ ), net assets income rate ( $X_{12}$ ) and total assets growth rate ( $X_{20}$ ). According to the formula:

$$Y_i = b_1 X_1 + b_2 X_2 + b_3 X_3 + \dots + b_i X_i + a = a + \sum b_i X_i \quad (2)$$

When the calculation results in Step 3 in TABLE 5 are put into the formula, the financial risk model of the following listed enterprises can be obtained.

$$Y_i = -0.0699 + 0.037 X_3 - 0.84 X_{12} - 0.455 X_{20} \quad (3)$$

Put them into formula  $P_i = \exp(Y_i) / [1 + \exp(Y_i)]$ , and the financial risk model of the following listed enterprises can be obtained:

$$P_i = \frac{\exp(-0.0699 + 0.037 X_3 - 0.84 X_{12} - 0.455 X_{20})}{1 + \exp(-0.0699 + 0.037 X_3 - 0.84 X_{12} - 0.455 X_{20})} \tag{4}$$

Model application and result analysis

When the critical determination values of the above-mentioned mode is set as 0.5, which means the value of a listed enterprise is greater than 0.5, the such enterprise can be classified as a ST enterprise with financial risks, while if the financial risk probability P1 is smaller than 0.5, the listed enterprise should be treated as a normal enterprise. The Logistic model so established has been applied to predictions on 40 specimen enterprises.

**TABLE 4 : Logistic regression model based predictions**

	Original Result	Prediction		Total	Error Rate
		Risky	Healthy		
Enterprises	Risky, 20	14	6	20	22.5%
	Healthy, 20	3	17	20	
Percentage	Risky, 100%	70%	30%	100%	
	Healthy, 100%	15%	85%	100%	

From the application analysis of the above-mentioned models (as shown in TABLE 4), misjudgment is found with 6 out of the enterprises with financial risks, and the rate of misjudgments greater than 30%. However, misjudgment is also found with 3 out of 20 financially healthy enterprises and the rate is also as high as 15%. In general consideration, the rate of misjudgment is about 22.5% which means that the correct misjudgment rate is 77.5%. From these data, it can be found that the model has relatively high successful prediction rate on enterprises with financial issues in the first two years.

The predictions by using this model can be understand from two aspects: on one hand, it means that the model is of certain scientific sense, effectiveness and sensitivity and can be used as an effective tool by listed enterprises to quantize its financial risks and to further improve its control measures on such financial risks. But problems still exist, for instance, when the specimen enterprises are determined, this paper takes Special Treatment (ST) enterprises with abnormal financial risks and takes all other enterprises as financially healthy enterprises. It is still a question if such definition is reasonable<sup>[7]</sup>. In view of the existing researches in China on corporate financial risk early warning, most documents defined ST enterprises as financially risky enterprises. Before a better standard for determination of the financial risks, this method is currently the best method to define financial risks and this also affected the early warning effect of the model to a certain extent.

**CONCLUSION**

The research process on industry environment risks and corporate financial risk early warning and control system is as described above. Careful considerations should be taken of the indicators on basis of financial management needs of enterprises, in order to improve the operability of the system, which is the ultimate goal of the corporate financial early warning system. On another hand, it can also effectively ensure that the determination process of evaluation indicators is simple and the screening process is clear and reasonable. At the same time, we hope that the researches and discussions in this paper provide solid theoretical and data ground for future researches.

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