

Research on Financial Risk Early Warning of Listed Companies on the Science and Technology Innovation Board Based on the Life Cycle Perspective

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ABSTRACT

This paper selects the 2017 to 2019 science and technology innovation board listed companies and ST companies as samples, from finance, corporate governance and life cycle three categories to construct and optimize the financial risk early warning index system. Factor analysis method and binary logistic regression method are used to construct the financial early warning models of listed companies in the science and technology innovation board in the growth and maturity periods, and then tested. It is found that the accuracy of the early-warning model in the growth stage can reach 90%, and the accuracy of the early-warning model in the growth stage can reach 95%.

Keywords: Financial early warning, Logistic regression analysis, Financial risk management, Listed company on science and technology innovation board

1. INTRODUCTION

With the in-depth implementation of the registration system of science and technology innovation board in China, due to the low barriers to market entry, the types and number of listed companies are also rising sharply. As of December 31, 2020, 214 listed companies have been officially registered on the science and technology innovation board in just two years. In such a market environment, some companies cannot balance the relationship between development and financial results, the root cause is that many production and operation activities are dragged down by the backward level of financial management. If we want to remain invincible in the fierce market competition and complex business environment, we must improve the level of financial management and fully implement the work of financial risk early warning.

According to the enterprise life cycle theory, the life cycle of an enterprise generally includes four stages: the introduction period, the growth period, the maturity period and the decline period, and the causes and manifestations of financial risks in each stage are different[1]. Most of the listed companies in the science and technology innovation board are in the early stage of starting their own business, and their risks include

research and development failure, capital chain rupture and other problems. After entering the growth period, the company begins to make profits, the capital chain tends to be stable, and the company has a certain social network. The risks are manifested as diversified "traps" such as complex business. After entering the mature period where the growth rate slows down but the profit rate increases rapidly, the risk manifests itself in difficulties such as insufficient innovation ability or improper transformation. The most significant risk performance in the recession is the lack of capital chain. If the enterprise can accurately position itself, it may "regain new life".

This paper constructs and optimizes the financial risk early warning index system from the three categories of finance, corporate governance and life cycle, constructs the financial early warning model of the listed companies in the science and technology innovation board in the growth and maturity stages by using factor analysis method and binary logistic regression method, and tests it to provide ideas for the financial early warning.

2. MODEL DESIGN AND INDEX SYSTEM CONSTRUCTION

2.1. Model design

In this paper, the binary Logistic regression method is used to establish the financial crisis early warning model. As a nonlinear model, the Logistic model is a forecasting method in which the most commonly used predictive explanatory variables are dichotomous variables[2]. In this paper, Y value of sample enterprises with financial crisis is set as 1, and Y value of normal enterprises is set as 0. In other words, the closer the Y value is to 1, the more likely the enterprise is to have financial crisis; the closer the Y value is to 0, the healthier the enterprise is. Logistic hypothesis shows the following relationship between the occurrence probability of the dependent variable and the independent variable that affects its occurrence:

$$P_i = F(K_i) = 1 / (1 + e^{-K_i}) \quad (1)$$

$$K_i = a_0 + a_1X_1 + a_2X_2 + \dots + a_nX_n \quad (2)$$

P_i —Even some probability;

K_i —interaction of the selected factors;

X_i —independent variables.

The linear regression model is: . . .

$$\ln\left(\frac{p'}{1-p'}\right) = a_0X_0 + a_1X_1 + a_2X_2 + \dots + a_nX_n \quad (3)$$

The selection ratio between the ST/*ST sample and the healthy sample in this paper is 3:1, so the cut value

selected according to the existing papers is 0.75, $\ln(p/(1-p))=Y_i$. When the Y_i value of the analyzed object is greater than 0.75, it will be considered as having financial crisis, while when the Y_i value is less than 0.75, it will be considered that the possibility of financial crisis is low or no financial crisis.

2.2. Construction of financial early warning index system

For those listed companies on the science and technology innovation board that have reduced listing requirements, the hidden trouble is prominent. The reduction of profitability requirements on the science and innovation board may make some enterprises manipulate profits to meet the listing standards. The science and technology innovation board enterprises and the main board enterprises will face the same problems of corporate governance, improper corporate governance system will also accelerate the delisting of enterprises. In addition, each life cycle has different characteristics of financial management and financial risk..

Based on this, appropriate indicators are designed from three dimensions of finance, corporate governance and life cycle to form a "three-dimensional" risk indicator framework of science and technology innovation board. It mainly includes (1) financial risks. Mainly including solvency, profitability, operating capacity and growth capacity; (2) Corporate governance risks. (3) Lifecycle characteristics. See table 1.

Table 1. Initial indicators

Indicator dimension		The index name	variable	Variable meaning
Financial risk solvency	Debt paying ability	Current ratio	X1	Current assets/current liabilities
		Quick ratio	X2	(current assets - inventory)/ current liabilities
		Cash ratio	X3	Monetary funds/current liabilities
		Asset-liability ratio	X4	Total liabilities/total assets
		Cash to maturity debt ratio	X5	Total net cash flow from operations/total liabilities
		Working capital ratio	X6	(undistributed profit+surplus reserves)/ total assets
	profitability	Return on equity	X7	Net Income/Average Net Assets
		Rate of return on total assets	X8	(total profit + finance expense)/average total assets
		Net interest rate on total assets	X9	Net interest rate on total assets = net profit/average balance of total assets
		Sales margin	X10	Operating profit/revenue
	Operational ability	Accounts receivable turnover	X11	Main business revenue/average accounts receivable
		Inventory turnover	X12	The main operating cost/average inventory balance

		Current asset turnover	X13	Main business income/average total current assets
		Fixed asset turnover	X14	Main business income/average total fixed assets
		Total asset turnover	X15	Main business income/average total assets
	Growth ability	Growth rate of revenue	X16	The increment of current business income/the previous period's main business income
		Growth rate of net profit	X17	(Net profit of current period - Net profit of previous period)/Net profit of previous period
		Growth rate of total assets	X18	(total assets of the current period - total assets of the previous period)/total assets of the previous period
		Growth rate of net assets	X19	(Total net assets of the current period - Total net assets of the previous period)/Total net assets of the previous period
Corporate Governance Risks	The shareholding ratio of the largest shareholder	X20	Shareholding ratio of the largest shareholder	
	The shareholding ratio of the top 10 shareholders	X21	The proportion of the top ten shareholders	
	Board Size	X22	The number of board members	
Life cycle trait	The proportion of R&D spending	X23	Total R&D expenditure/revenue	
	The top three salaries for directors, supervisors and executives	X24	Total compensation of the top three directors, supervisors and executives	
	Proportion of independent directors	X25	The proportion of the number of independent directors in the total number of directors	

3. RESEARCH DESIGN

3.1. Sample selection and data source

The data studied in this paper follow the principle of data availability. The end point of the observation period was set on December 31, 2019, and the observation years were 2017-2019. Three years of data were selected for the study. The empirical data in this paper are collected from the CSMAR China Financial and Economic Database, Wind financial terminal and part of manual collection. Select company nearly three years of financial indicators, to expand the sample vertical depth, select three years sample build model is helpful to find the potential risk as soon as possible, thus for managers in time and control time[3].

3.2. Financial crisis standard setting

Crisis group for sample selection: the listed company was noted "ST" is due to there was a problem in enterprise financial situation by special processing, rather

than the other non-financial reasons, because the financial situation is special processing refers to: according to the relevant accounting evaluation audit identified the special processing and nearly a year to less than shareholders registered capital.

3.3. Enterprise lifecycle demarcation

In this paper, the cash flow method of Dickinson[4] is adopted to conduct preliminary screening of listed companies on the science and technology innovation board. Finally, 10 ST and *ST companies in the data growth period and 30 health companies in the science and technology innovation board were selected, and a total of 120 samples were collected in three years. In the mature stage, there are 7 ST and *ST companies and 21 health companies on the science and technology innovation board, with a total of 84 samples in three years. There were too few samples in the recession period for regression analysis, so they were eliminated.

3.4. Key risk indicator screening

Since not every basic indicator has a good degree of differentiation, this paper first conducted normality test and significance test through the K-S test method of

SPSS software and the early warning indicators in Table 1 of Mann-Whitney U test, eliminated the evaluation indicators without significant distinguishing ability, and selected the key risk indicators in the two periods[5].

Table 2. Screening of key risk indicators of listed companies in the growth and maturity stages

dimensionality	Growth period	mature period
Financial risk	X1, X2, X3, X4, X5, X6, X7, X8, X9, X10, X14, X15, X16, X17, X18, X19	X1, X2, X3, X4, X6, X7, X8, X9, X10, X11, X13, X14, X15, X16, X17, X18, X19
Corporate Governance Risks	X20, X21	X21, X22
Life cycle trait	X23	X25

3.5. Key risk index extraction

Since multicollinearity will seriously affect the prediction ability of survival analysis model, this paper chose principal component analysis to further optimize the index system (see Table 3).

Table 3. Key index of scientific risk in growth and maturity period

	Growth period	mature period
Key risk index extraction	F1 Short-term solvency	F1 Debt paying ability
	F2 profitability	F2 profitability
	F3 Growth ability	F3 Growth ability
	F4 Debt paying ability	F4 Corporate governance
	F5 Operation ability	F5 Growth ability
	F6 Degree of ownership concentration	F6 Operation ability
	F7 Cash flow solvency	

4.THE EMPIRICAL ANALYSIS

4.1. The construction of financial risk model in growth period

A total of 120 samples were collected from 10 ST enterprises and 30 healthy enterprises on the science and technology innovation board identified in the previous paper. Regressive analysis was conducted on the 7 principal components extracted in Table 3 to build a Logistic early warning model in the growth period. See Table 4 for details.

Table 4. Assessment results of growth period model of listed companies on science and technology innovation board

		B	S.E.	Wals	df	Sig.	Exp (B)
Step 1	F1	-0.306	0.368	0.694	1	0.405	0.736

	F2	1.429	0.697	4.210	1	0.040	4.176
	F3	-0.652	0.262	6.197	1	0.013	0.521
	F4	-2.541	0.591	18.489	1	0.000	0.079
	F5	-0.875	0.383	5.231	1	0.022	0.417
	F6	1.439	0.408	12.467	1	0.000	4.218
	F7	0.043	0.557	0.006	1	0.938	1.044
	Constant	-2.034	0.408	24.784	1	0.000	0.131

From Table 4, we can get the financial crisis early warning model of listed companies in the growth period of science and technology innovation board(4):

$$Logit(Y) = -2.034 - 0.306F_1 + 1.429F_2 - 0.652F_3 - 2.541F_4 - 0.875F_5 + 1.439F_6 + 0.043F_7 \quad (4)$$

4.2. The construction of financial risk model in mature period

The 7 ST enterprises identified in the previous paper and the 21 healthy enterprises on the science and technology innovation board that are paired with them are 84 samples in three years. Regressive analysis is conducted on the 6 principal components extracted in Table 3 to construct the Logistic early warning model in the mature stage. See Table 5 below for details

Table 5. Assessment results of the mature stage model of listed companies on the Science and Technology Innovation Board

		B	S.E,	Wals	df	Sig.	Exp (B)
Step 1	F1	-1.939	0.686	7.984	1	0.005	0.144
	F2	-3.062	1.026	8.902	1	0.003	0.047
	F3	-3.610	1.386	6.789	1	0.009	0.027
	F4	2.832	1.017	7.755	1	0.005	16.979
	F5	-1.545	1.368	1.276	1	0.259	0.213
	F6	-8.233	3.093	7.083	1	0.008	0.000
	Constant	-6.088	1.932	9.934	1	0.002	0.002

According to Table 5, the financial crisis early warning model of listed companies in the mature period

of science and technology innovation board can be obtained (5):

$$Logit(Y) = -6.088 - 1.939F_1 - 3.062F_2 - 3.610F_3 + 2.832F_4 - 1.545F_5 - 8.233F_6 \quad (5)$$

It can be seen from Model 5 that F1, F2, F3, F5 and F6 are negatively correlated with the occurrence of financial crisis, that is, the stronger the profitability, debt paying ability, operation and growth ability of the listed company, the less likely it is to have financial crisis. F4 is positively correlated with the occurrence of financial crisis, that is, the better the corporate governance is, the more likely financial crisis is to occur.

4.3. Results of inspection

In addition to the research samples of the Science and Technology Innovation Board in 2019, 15 healthy companies in the growth stage and mature stage, and 5 companies in crisis stage were selected as the test group samples and substituted into the model. The results are shown in Table 6.

Table 6. The early warning model results of the test group in the growth and maturity stages

	Observed		Growth period			mature period		
			Whether the ST		Percentage Correct	Whether the ST		Percentage Correct
			0	1		0	1	
Step 1	Whether the ST	0	13	2	86.67	15	0	100.00
		1	0	5	100.00	1	4	80.00
	Overall Percentage				90.00			95.00

When the P value is greater than 0.75, it is identified as an enterprise in financial crisis; otherwise, when the P value is less than or equal to 0.75, it is identified as a financially healthy enterprise. As can be seen from Table 6, 13 healthy companies in the growth stage have accurate predictions, with an accuracy rate of 86.67%. Five of the crisis companies had accurate predictions, with an accuracy rate of 100% and an overall accuracy rate of 90%. The prediction accuracy of healthy companies in mature period is 100%, the accuracy of crisis companies is 80%, and the overall accuracy of the model is 95%, which proves that the accuracy test of the model is good.

5. CONCLUSION

This paper selects listed companies in the growth and maturity stages of science and technology innovation board as research samples, designs a "three-dimensional" risk index system from three categories of finance, corporate governance and life cycle, and makes a regression by combining the life cycle theory with Logistic model to construct and test different financial early warning models in the growth and maturity stages. It is concluded that the accuracy of the model in the growth period is up to 90%, and that in the mature period is up to 95%.

For the prevention and control of financial risks in different life cycles of the science and technology innovation board, not only the internal financial management of the company should play a main role, but also the impact of corporate governance and life cycle should be paid attention to. Specifically, for listed companies in the growth period of the science and technology innovation board, the dominant share should be avoided and the equity should be dispersed. The maximum shareholding ratio of individual stock shareholders can be set, and the debt paying ability and profitability should be paid more attention. For listed companies in the mature stage of science and technology innovation board, we should pay attention to innovation and development, avoid transformation failure, sit idle and pay more attention to profitability, growth ability and corporate governance factors.

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