An Empirical Research on Financial Crisis Early Warning System from the Inventory Perspective

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Abstract　In allusion to the insufficient research on financial crisis early warning of listed companies in China, this paper makes an empirical research on the correlation between the companies' inventory risk and financial crisis with the design of two indicators like inventory turnover ratio and inventory scale through logistic regression analysis. The results showed that: 1) The inventory turnover ratio is negatively related to financial crises, in other words, the lower the inventory turnover ratio is, the more it likely to have financial crises; 2) The inventory scale is in direct proportion to financial crises, in other words, the smaller the inventory volume is, the less it likely to have financial crises.
Key words　Inventory risk; Inventory turnover ratio; Inventory scale; Logistic regression model

1 Introduction

As the financial crises of enterprises in China keep on increasing at present, the market of warning information as to financial crises assumes a booming spectacle. However, a brief look at research results on financial crises early warning in theoretical circles in China will enable us to see that most of them establish models by selecting some traditional financial ratio indicators from experience to carry out early warning of financial crises. Few ones make research on financial crises from the perspective of "Inventory". Therefore, this paper establishes a financial crises early warning system that is distinct from others by focusing on the inventory, selecting various inventory indicators to reveal financial crises and using Logistic regression model.

The single variable prediction carried out by (Fitzpartrick 1932) is a pioneer research on early warning of financial crises. Beaver used samples from 79 companies to study their warning ability 1-5 years before bankruptcy by testing respectively 30 variables of six groups, which indicate the companies' different financial characteristics. He found out that the closer the insolvency date is, the lower the error rate would be. Altman took the lead in studying the companies' financial crises by using multivariate linear discriminant model in 1968.

Professor Yu Lian from Wuhan University of Technology conducted "Enterprises Adverse Management - Component Analysis of Error Management and Countermeasures for Business Slide" and published *Corporate Warning Management Serie* (Hebei Science and Technology Press, 1999). Representative achievements in establishing financial crises early warning model suited to conditions of China include: ① *Financial Failure Prediction of Listed Companies Empirical Study* ("Systems Engineering and Electronics", No.1,2001,10) of Huang Yan and Li Yuanxu from Fudan University. ② Research on financial distress of listed companies in China conducted by Professor Chen Xiao from Tsinghua University and others ③ Accounting Department of Xiamen University, Fujian, Chen Yu's *Firm Prediction on China's Securities Market ST Empirical Rese*arch.

2 Financial Crises Early Warning Model of Listed Companies from the Inventory Perspective

2.1 Model design
2.1.1 Variable definition and model design
1) Variable definition

Table 1　Variable Name

Name	Code	Formula
Inventory turnover ratio	X1	Operating costs / Average inventory costs
Inventory scale	X2	Ending inventory costs / Total assets

Note 1: Average inventory costs = (Opening inventory costs + Ending inventory costs) / 2

The inventory turnover ratio indicates the number of inventory turnover during a certain period, which can be used to determine the rate of corporate inventory liquidity, measure the sales ability and inventories. It also reflects the company's marketing efficiency and inventory efficiency.

The inventory scale indicates that if the actual average inventory exceeds the normal level during a certain period, it will give rise to the opportunity and warehouse cost of unreasonable occupation of funds. It is the ration between the inventory and total assets at the end of the year.

2) Modeling Design

Logistic regression model and general linear regression model have a common feature: the relationship between a function of the mean response variable and the independent variables can be considered linear. In the binary response model, the response Y represents an individual or an experimental unit, assuming that x is a vector of independent variables, then $p = p\ (Y = 1\ /\ x)$ is the response probability of establish a model, linear Logistic model has the following form: Logistic $(p) = \ln [p\ /\ (1-p)] = a + b'x$.

2.1.2 Sample selection

Start from 31 December 2009, this paper randomly selected 30 ST companies with A shares listed in Shanghai and Shenzhen as research subjects. During the study, I selected financial data of 2008 as a research data, which was analyzed by the international authoritative SPSSl7.0 statistical analysis software.

2.2 Research hypotheses

2.2.1 Make hypotheses

Based on the company's measure of financial crisis and combined with social backgrounds and study issues, I make out the following hypotheses:

Hypothesis 1: The inventory turnover ratio is negatively related to financial crises.

In normal circumstances, if the business goes well, the higher the inventory turnover rate is, the faster the inventory turnover would be, the stronger the business sales capacity, the less the money occupied by inventories. Conversely, if the inventory turnover ratio is low, inventory turnover would move slowly and thus there will be more money occupied by inventories, resulting in financial crises. It is assumed that: the lower the inventory turnover ratio is, the more it likely to have financial crises.

Hypothesis 2: The inventory scale is in direct proportion to financial crises.

The greater the proportion of inventory scale is, the worse the company's overall asset would be, giving rise to payment difficulties and greater possibility of financial crises. It is assumed that: the larger the inventory scale is, the more it likely to have financial crises.

2.2.2 Test hypotheses

It can be seen from Table 2, which shows the descriptive statistics of 2008 data and t-test of mean value, that:

1) In terms of inventory turnover ratio (X1) indicator: mean values of ST companies are relatively lower than those of non-ST companies, and t-tests on mean values of such two types of companies based on this indicator are statistically significant in the 1% level. This shows that such two types of companies were significantly different from each other in "inventory turnover ratio" in 2008.

Table 2   Descriptive Statistics and T-test of Mean Value

Variable	Mean Value		Standard Deviation		t-Test	
	ST	non-ST	ST	non-ST	t value	P value
X1	5.8576	7.7835	7.5762	12.3496	3.452	0.000**
X2	0.2658	0.2117	0.2096	0.2060	5.631	0.000*

Note:* and ** showed statistical significance in the 5% and 1% level respectively [Sig. (2-tailed)]

Table 3   Estimation on Regression Model Parameters

	Variable	Parameter Estimation	S.E.	Wald Card Variance	pr	Remarks
Step	Intercept (b_0)	1.678	0.742	5.121	0.024	Parameters below the 5% level
1(a)	X1	-1.9094	0.327	11.206	0.001	Significant non-zero
Step	Intercept (b_0)	-4.191	1.025	16.278	0.001	Parameters below the 1% level
2(a)	X2	14.990	4.767	10.278	0.000	Significant non-zero

2) In terms of inventory scale (X2) indicator: mean values of ST companies are relatively lower than those of non-ST companies, and t-tests on mean values of such two types of companies based on

this indicator are statistically significant in the 1% level. This shows that such two types of companies were significantly different from each other in "inventory scale" in 2008, supporting the phenomenon described in Hypothesis 2.

It can be seen from Table 3 that:

1) In the variable X1, both the intercept b_0 and regression parameters are statistically significant in the 5% level, and the return of the variable parameters is negative, indicating that the inventory turnover ratio is in direct proportion to the financial crisis.

2) In the variable X2, the intercept b_0 and regression parameters are statistically significant in the 1% level, and the return of the variable parameters is positive, indicating that the inventory scale is in direct proportion to the financial crisis.

2.2.3 Conclusion

According to the abovementioned Logistic regression analysis and results of discussion, we can make the following judgments:

Table 4　Summary of Hypothesis Testing

Hypothesis	Empirical Results
Hypothesis 1: The inventory turnover ration is negatively related to financial crisis	Set up
Hypothesis 2: The inventory scale is in proportion to financial crisis	Set up

2.3 Logistic regression result and model construction

We establish the following regression model on the basis of abovementioned variable definitions and relevant conclusion:

$$W = b_0 + b_1 X1 + b_2 X2 + \varepsilon$$

Where, W is the logical dependent variable (ST companies W = 1; non-ST companies W = 0), b_i (i = 0,1,2) is the regression parameters, ε is the regression residuals. Refer to Table 5 for 2008 model regression results:

Table 5　Estimation on 2008 Regression Model Parameters

	Variable	Parameter Estimation	S.E.	Wald Card Variance	pr	Remarks
	X1	-0.035	0.032	1.209	0.043	Parameters below the 5% level Significant non-zero
Step 1(a)	X2	1.776	1.449	1.503	0.024	Parameters below the 5% level Significant non-zero
	Intercept (b_0)	0.568	0.477	1.415	0.234	Indistinctive

According to Table 5, we construct the model as follows:

$$In[p / (1-p)] = 0.568 - 0.035X1 + 1.776X2 + \varepsilon$$

2.4 Validity check on earlywarning model

According to the construction principles of two Logistic regression models and the abovementioned regression results, the company's probability of financial crisis is $P = e^z / (1 + e^z)$, in particular, Z = -1.704 - 0.561X1 + 5.949 X2 + ε. When calculating the probability, first, calculate relevant parameter value of the company, second, figure out the prediction probability of the company being predicted, finally, make judgments according to prediction probability. This paper takes 0.5 as the best decision point. The company shall be deeded as having financial crises if the probability is larger than 0.5.

Based on the above principle, we selected 20 ST companies and 20 non-ST companies with A shares listed in Shanghai and Shenzhen Stock Exchange as test samples and tested the validity of models by using the 2009 raw data.

2.4.1 Test ST companies by early warning model in 2009

1) Test results

To test the predictive validity of the early warning model, we first carried out tests on ST companies with A shares listed in Shanghai and Shenzhen in 2009, the results are shown in Table 6.

Table 6   Results of Tests on Early Warning Model for ST Companies In 2009

Number	Code	Companies	Inventory Turnover Ratio	Inventory Scale	Prediction Probability	Results
1	600381	ST Xian Cheng	23.9509	0.0033	0.4208	N
2	600419	ST Tian Hong	2.9918	0.2244	0.9729	Y
3	600462	ST Shi Yan	4.1718	0.0926	0.9646	Y
4	600604	ST Er Fang	2.2377	0.0906	0.9667	Y
5	600608	ST Hu Ke	3.1966	0.1069	0.9666	Y
6	000408	*ST Yu Yuan	4.0834	0.0682	0.9632	Y
7	000505	ST Zhu Jiang	0.4353	0.2650	0.9768	Y
8	000557	ST Yin Guangxia	0.0903	0.0428	0.3664	N
9	000576	ST Gan Hua	4.5544	0.0873	0.9638	Y
10	000586	ST Hui Yuan	4.2338	0.1356	0.9670	Y
11	000598	*ST Qing Xi	7.2231	0.1249	0.9629	Y
12	000605	ST Si Huan	2.6261	0.0847	0.9659	Y
13	000613	ST Dong Hai A	8.6545	0.0044	0.4522	N
14	000633	ST He Jin	5.0110	0.0558	0.9612	Y
15	000673	*ST Da Shui	0.8036	0.0172	0.9640	Y
16	000736	ST Zhong Shi	0.0256	0.5653	0.9865	Y
17	000738	ST Yu Hang	2.0687	0.1511	0.9702	Y
18	000856	ST Tang Tao	0.6557	0.4114	0.9819	Y
19	000921	ST Ke Long	13.0214	0.1522	0.9569	Y
20	002002	ST Qiong Hua	8.0623	0.0434	0.9561	Y

Note: Y indicates that the prediction is correct, while N indicates that the prediction is wrong.

2) Test results

It can be seen from Table 6 that among tests on early warning model for ST companies in 2009: predictions for 17 companies are correct, while for 3 ones are wrong, with the accuracy rate reaching 85%. The test on early warning model for ST companies' data in 2009 shows that our financial crisis early warning systems from the inventory perspective is effective, in other words, financial crises are largely related to inventories.

2.4.2 Tests on early warning model for non-ST companies in 2009

1)Test results

After testing the validity of early warning model for ST companies, it is necessary to carry out the same for non-ST companies so as to examine the prediction accuracy rate and obtain many results. We selected 20 samples, with the test results shown in Table 7.

2) Test results show

It can be seen from Table 7 that among tests on early warning model for non-ST companies in 2009: predictions for 16 companies are correct, while for 3 ones are wrong, with the accuracy rate reaching 85%. The test on early warning model for non-ST companies' data in 2009 shows that our financial crisis early warning systems from the inventory perspective is effective, in other words, financial crises are largely related to inventories.

Table 7 Results of Tests on Early Warning Model for Non-ST Companies In 2009

Number	Code	Companies	Inventory Turnover Ratio	Inventory Scale	Prediction Probability	Results
1	600004	Baiyun airport	68.7577	0.0023	0.7652	N
2	600006	Dongfeng Automobile	5.0257	0.1688	0.0668	Y
3	600011	Huaneng Power	13.9692	0.0211	0.0263	Y
4	600019	Shanghai Baosteel	4.1265	0.1465	0.2761	Y
5	600021	Shanghai Electric	21.2420	0.0150	0.3769	Y
6	600028	Sinopec	8.7193	0.1634	0.2614	Y
7	600031	Sany Corporation	3.7503	0.1856	0.1915	Y
8	600072	O/zgm	3.0937	0.1660	0.1693	Y
9	600086	Dfjy	1.3650	0.5372	0.4532	Y
10	600100	Tongfang Co. Ltd	3.0221	0.2002	0.1901	Y
11	600111	Baotou Steel Rare Earth	1.7667	0.2249	0.2850	Y
12	600127	Jinjian CIC	2.0951	0.3203	0.2659	Y
13	600151	SAAE	3.5357	0.0456	0.2986	Y
14	600166	Futian Automobile	10.4127	0.2772	0.1932	Y
15	600185	Griffith real estate	0.1789	0.6231	0.2045	Y
16	000502	Ljdc	0.7320	0.7389	0.6961	N
17	000506	Zhongrun Investment	0.2287	0.6901	0.8141	N
18	000537	Guangyu Development	0.2845	0.7453	0.5914	N
19	000541	Osram Foshan Lighting Company	4.7431	0.0782	0.2661	Y
20	000567	Heidelberger Druckmaschinen AG	0.3721	0.3079	0.2911	Y

Note: Y indicates that the prediction is corrent, while N indicates that the prediction is wrong.

3 Conclusion

This paper focuses on financial crises early warning system from the inventory perspective and selects two indicators manifesting characteristics of inventories: inventory turnover ration and inventory scale. It also makes an empirical research on the correlation between the companies' inventory risk and financial crisis and the following conclusion was reached:

1) The inventory turnover ration is negatively related to financial crisis, in other words, the lower the inventory turnover ration is, the more it likely to have financial crises.

2) The inventory scale is in direct proportion to financial crises, in other words, the greater the inventory scale is, the more likely it to have financial crises.

Based on the abovementioned conclusions, this paper constructs a financial crises early warning model from the inventory perspective, takes 30 ST companies and non-ST companies with A shares listed in Shanghai and Shenzhen in 2008 as test samples, and carries out tests on validity of early warning model for their financial data in 2009. Tests results show that the prediction accuracy rate for 20 ST companies in 2009 is 85%, while that for non-ST companies in 2009 is 80%. The test on early warning model shows that the prediction accuracy rate of financial crisis early warning system constructed in this paper is not only high but also effective, which further illustrating the theory and realistic meaning of the problem of financial crisis early warning system from the inventory perspective.

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