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Identification of Financial Risk Karma and High Correlation Indicators in ST Companies—Based on China's machinery manufacturing industry after the epidemic

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ABSTRACT
Based on 13 ST companies in the Chinese machinery manufacturing industry that were delisted in the first quarter of 2024, this paper combed the relevant key financial indicators, industry indicators, and economic and social indicators based on the data of the seven periods before they were delisted, selected 28 of them, and ranked the degree of influence of the characteristic indicators for financial risk through factor analysis, and then discussed the changes in the degree of influence of the characteristic indicators period by period. Finally a series of relevant conclusions are drawn.

KEYWORDS
Machinery Manufacturing in China; Financial Risk; Characterization Indicators; Factor Analysis

1 Introductory

In 2021, Nankai University published "Early Warning of Financial Crisis during 2020-2021", which analyzed and predicted the financial risk of listed companies in various industries in China in the context of the epidemic, and found that during the epidemic, 87% of the enterprises' financial risk has become larger than that of the pre-epidemic period, and it takes a long time for the enterprises to recover from the impacts brought by the epidemic. The epidemic has increased the risk of cash flow breaks to the extent that enterprises are unable to maintain normal production and sales; lowered the company's credit rating and investor confidence, which has brought more difficulties in financing; and the frequent occurrence of defaults and lawsuits, which has further increased the risk of corporate bankruptcy. The purpose of this paper is to help relevant enterprises to identify financial risks, play the role of early warning and decision support; optimize enterprise resource allocation, improve the transparency of corporate financial status to cope with regulatory needs, and at the same time, protect the stakeholders of listed companies in order to make rational investment choices and prepare for crisis response.

2 Literature review

The early warning analysis of corporate financial risk is characterized by complexity and foresight. Based on Altman's (1968) research, our scholar Chen Jing (1999) conducted a binary linear decision analysis and established a multivariate model. Zhou Shouhua (1996) modified the F-score model and introduced the concept of "cash flow" as a new independent variable indicator. Zhang Aimin

(2001) extracted a new early warning model using principal component analysis for eight financial indicators: total assets growth rate, return on net assets, current ratio, sales margin, capital accumulation ratio, total assets profitability, total assets turnover ratio, and shareholders' equity ratio.

The factors of non-financial indicators were considered in the subsequent study by Yin Yin (2004), and macroeconomic indirect effects such as new industry regulations were added to the model using Bayesian analysis. Jiang, Xiuhua, and Sun Zheng (2001) built a logistic regression model to select 13 raw financial indicators, and finally screened out four indicators - equity concentration coefficient, short-term borrowings/total assets, other receivables/total assets, and gross profit margin.

Li Xiaolan (2004) added economic value added indicator (EVA) to the independent variables as a new objectivity indicator that cannot be artificially manipulated but to be observed. Wu and Dai (2010) introduced corporate governance indicators to further improve the prediction of corporate financial risk based on the management level of the company.

In summary, the financial risk analysis method in the research from the static model and gradually enriched to the dynamic model, the selection of independent variables in the early warning model with the progress of the research and continue to improve, not only limited to the company's financial indicators, but also joined the corporate governance, market information, macroeconomics, the industry environment and other factors to be taken into account. Therefore, the purpose of this paper is to screen out more understandable factors for the measurement of financial risk, so that managers can be used in a comprehensive reference.

3 Research methodology

In order to get the comprehensive financial risk level of all ST samples in the industry and the matching description of the characteristic indicators, this paper chooses the factor analysis method to lower dimensionality. Factor analysis is to find out the few factors that can synthesize the original variables through the study of the relationship between the variables, so that the few factors can reflect most of the information of the original variables.

As a result, the research steps of this paper are as follows: (1) Measurement elimination; due to the different measures of different indicators, firstly, the inverse indicators are converted into positive indicators, and then the original indicators are standardized into dimensionless data. (2) Correlation test of data; KMO test and Bartlett sphericity test were performed using spss software. (3) The test of the strength of factor explanation; factor extraction and rotation were performed on the samples to obtain the factor loading matrix. (4) Interpretation of factor scores and rankings; according to the obtained factor loadings of the standardized variables, so as to get the comprehensive score ranking of each index through the weighted average method, and then analyze this.

4 Data analysis

4.1 Sample selection

The sample data in this paper is obtained from the CSMAR database, and we selected a total of 91 valid samples that were delisted in the first quarter of 2024 after the epidemic. We take June 2022-December 2023 as the study period, and each quarter quarter as the time point, screening a total of seven periods, each period of effective ST samples totaling 13.

4.2 Selection of characteristic indicators

Table 1 Financial Risk Identification Characterization Indicators

Direction Of Concern	Financial Indicators		Directional	Formula
Profitability	X1	Net Profit Margin On Total Assets	Positive	Net Profit / Total Assets
	X2	Return On Net Assets	Positive	Net Profit / Net Worth
	X3	Ratio Of Profits To Cost	Positive	Profit / Costs
	X4	Return On Investment (Roi)	Positive	Investment Income / Investment Cost
	X5	Earnings Per Share	Positive	Net Profit / Total Equity
Operating Ability	X6	Accounts Receivable Turnover Ratio	Positive	Operating Income / Average Accounts Receivable Balance
	X7	Inventory Turnover	Positive	Operating Costs / Average Inventory Balance
	X8	Total Asset Turnover	Positive	Operating Income / Total Assets
Solvency	X22	Quick Ratio	Positive	(Current Assets - Inventories) / Current Liabilities
	X23	Asset-Liability Ratio	Negative	Total Liabilities / Total Assets
Growth Capacity	X24	Total Asset Growth Rate	Positive	(Total Assets For The Current Period - Total Assets For The Previous Period) / Total Assets For The Previous Period
	X25	Revenue Growth Rate	Positive	(Current Period's Operating Income - Previous Period's Operating Income) / Previous Period's Operating Income
R&D Capability	X26	R&D Investment As a Percentage Of Operating Income	Positive	R&D Expenses / Revenue
Cash Flow Capacity	X27	Operating Cash Flows To Current Debt Ratio	Positive	Net Cash Flow / Debt To Maturity
Social Responsibility	X28	Amount Of Penalties	Negative	Sum Of Fines Imposed By The Sec On Companies And Persons Responsible For Disclosure Violations

Table 2 Financial Risk Identification Characterization Industry Indicators

The selection of indicators was not limited to company financial indicators, but took into account industry indicators, macroeconomic indicators and social responsibility indicators, resulting in a total of 28 indicators. The larger the indicator, the lower the financial risk of the enterprise as a positive indicator, then a total of 23 positive indicators, 5 reverse indicators. By the same token, the larger the reverse indicator, the higher the financial risk of the enterprise.

Table 1 Financial Risk Identification Characterization Indicators

In order to harmonize the evaluation criteria, the negative indicators were positively normalized by adopting the counting backward technique.

4.3 Factor analysis

Firstly, KMO and Bartlett's test in factor analysis method were performed on the data of the seven periods of variables before delisting of the sub-sample respectively. The Bartlett's test of sphericity statistic for each period is large enough and the corresponding Sig. value is close to 0. Therefore, the variables are not independent from each other and there is a strong correlation between the variables, which is suitable for factor analysis. And the KMO statistics are all greater than 0.5, indicating that the results of factor analysis are relatively good.

Table 1 Financial Risk Identification Characterization Indicators

In addition, this article also take the industry factors in consider to measure how the industry average level affect the financial risk.

Direction Of Concern	Financial Indicators		Directional	Formula
Industry Factors	X9	Industry Operating Margins	Positive	Industry Operating Profit / Industry Total Operating Revenue
	X10	Industry Operating Index	Positive	Industry Operating Profit / Industry Total Assets
	X11	Industry Cash Flow Risk	Positive	Net Cash Flow / Total Liabilities
	X12	Industry Concentration	Negative	Sum Of Squares Of Market Shares
	X13	Business Leverage	Positive	Ebit / Ebit - Fixed Costs
	X14	Industry Net Profit Growth Rate	Positive	(Net Profit For The Current Period - Net Profit For The Previous Period) / Net Profit For The Previous Period
	X15	Industry Gross Operating Income Growth Rate	Positive	(Current Period's Total Operating Income - Previous Period's Total Operating Income) / Previous Period's Total Operating Income
	X16	Growth Rate Of Total Industry Operating Costs	Negative	(Total Operating Costs For The Current Period - Total Operating Costs For The Previous Period) / Total Operating Costs For The Previous Period
	X17	Industry Quick Ratio	Positive	(Current Assets - Inventories) / Current Liabilities
	X18	Industry Interest Coverage Multiples	Positive	Ebit / Interest Expense
	X19	Industry Asset-Liability Ratio	Negative	Total Liabilities / Total Assets
	X20	Industry Equity Multipliers	Positive	Total Assets / Shareholders' Equity
	X21	Year-On-Year Growth Rate	Positive	(Industry Value For The Current Period - Industry Value For The Same Period Last Year) / Industry Value For The Same Period Last Year

Table 2 Results Of Kmo And Bartlett's Test For Top Three Period

Kmo And Bartlett's Test Results (Results For Top Three Period)				
		2022/6/30	2022/9/30	2022/12/31
Phase		1	2	3
Kaiser-Meyer-Olkin Metrics		0.559	0.588	0.524
Bartlett's Spherical Test	Approximate Chi-Square (Math.)	978.261	928.047	820.384
	Df	78	78	78
	Sig.	0	0	0

The seven-period cumulative variance explanations of the 13 sample variables are all higher than 85%, so the extracted main factors can summarize the information of the original data very well.

Table 3 Total Variance Explained by Period

Total Variance Explained In The First Period			
Ingredient	Initial Eigenvalue	Extract The Sum Of Squares	The Sum Of Squares Of a Rotation (Math.)

Table 3 Total Variance Explained by Period(Continued).

Total Variance Explained In The First Period									
	(Grand) Total	Vari-ance %	Cumula-tive %	(Grand) Total	Vari-ance %	Cumula-tive %	(Grand) Total	Vari-ance %	Cumula-tive %
1	9.578	73.679	73.679	9.578	73.679	73.679	7.82	60.155	60.155
2	1.569	12.071	85.75	1.569	12.071	85.75	3.327	25.595	85.75
3	0.981	7.547	93.297						
4	0.458	3.521	96.818						
5	0.246	1.895	98.713						
6	0.08	0.616	99.33						
7	0.05	0.384	99.714						
8	0.024	0.183	99.897						
9	0.008	0.064	99.961						
10	0.004	0.03	99.992						
11	0.001	0.007	99.998						
12	0	0.001	100						
13	4.83E-05	0	100						

Table 3 Results Of Kmo And Bartlett's Test For Last Four Period

Kmo And Bartlett's Test Results (Results For Last Four Period)					
		2023/3/31	2023/6/30	2023/9/30	2023/12/31
Phase		4	5	6	7
Kaiser-Meyer-Olkin Metrics		0.604	0.788	0.795	0.74
Bartlett's Spherical Test	Approximate Chi-Square (Math.)	2683.486	2369.223	2259.794	1892.062
	Df	78	78	78	78
	Sig.	0	0	0.795	0

Total Variance Explained In The Second Period									
Ingredi-ent	Initial Eigenvalue			Extract The Sum Of Squares			The Sum Of Squares Of a Rota-tion (Math.)		
	(Grand) Total	Vari-ance %	Cumula-tive %	(Grand) Total	Vari-ance %	Cumula-tive %	(Grand) Total	Vari-ance %	Cumula-tive %
1	8.566	65.89	65.89	8.566	65.89	65.89	5.813	44.713	44.713
2	2.311	17.774	83.665	2.311	17.774	83.665	4.061	31.239	75.953
3	1.384	10.644	94.308	1.384	10.644	94.308	2.386	18.356	94.308
4	0.374	2.875	97.184						
5	0.212	1.627	98.811						
6	0.074	0.567	99.378						
7	0.045	0.346	99.724						
8	0.021	0.162	99.886						
9	0.01	0.074	99.96						
10	0.003	0.023	99.983						
11	0.002	0.012	99.995						
12	0.001	0.004	99.999						
13	9.70E-05	0.001	100						

Total Variance Explained In The Third Period									
	Initial Eigenvalue			Extract The Sum Of Squares			The Sum Of Squares Of a Rota-tion (Math.)		
	(Grand) Total	Vari-ance %	Cumula-tive %	(Grand) Total	Vari-ance %	Cumula-tive %	(Grand) Total	Vari-ance %	Cumula-tive %
1	7.937	61.052	61.052	7.937	61.052	61.052	5.373	41.33	41.33
2	2.322	17.861	78.912	2.322	17.861	78.912	4.884	37.569	78.898
3	1.551	11.928	90.84	1.551	11.928	90.84	1.552	11.942	90.84

(Continued).

Total Variance Explained In The Second Period			
4	0.534	4.112	94.952
5	0.35	2.696	97.647
6	0.158	1.218	98.865
7	0.093	0.714	99.58
8	0.035	0.27	99.85
9	0.011	0.086	99.936
10	0.005	0.041	99.977
11	0.002	0.014	99.991
12	0.001	0.008	99.999

In the last four periods, only one factor is extracted, and the explanation rate is above 97%, which indicates that as the delisting is approaching, the homogeneity between the samples being counted is getting stronger and stronger, and gradually reaches the state of "delisting".

Total Variance Explained In The Forth Period						
Ingredient	Initial Eigenvalue			The Sum Of Squares Of a Rotation (Math.)		
	(Grand) Total	Variance %	Cumulative %	(Grand) Total	Variance %	Cumulative %
1	12.985	99.887	99.887	12.985	99.887	99.887
2	0.011	0.087	99.973			
3	0.002	0.015	99.988			
4	0.001	0.005	99.993			
5	0.001	0.005	99.998			
6	0	0.001	99.999			
7	8.25E-05	0.001	100			
8	3.32E-05	0	100			
9	1.14E-05	8.80E-05	100			
10	4.11E-06	3.16E-05	100			
11	6.23E-07	4.79E-06	100			
12	2.72E-07	2.09E-06	100			
13	1.05E-08	8.05E-08	100			

Total Variance Explained In The Firth Period						
Ingredient	Initial Eigenvalue			The Sum Of Squares Of a Rotation (Math.)		
	(Grand) Total	Variance %	Cumulative %	(Grand) Total	Variance %	Cumulative %
1	12.976	99.817	99.817	12.976	99.817	99.817
2	0.016	0.123	99.939			
3	0.004	0.032	99.972			
4	0.002	0.013	99.985			
5	0.001	0.007	99.991			
6	0.001	0.006	99.997			
7	0	0.002	99.999			
8	8.60E-05	0.001	100			
9	3.43E-05	0	100			
10	6.77E-06	5.21E-05	100			
11	3.14E-06	2.41E-05	100			
12	1.43E-06	1.10E-05	100			
13	3.96E-07	3.05E-06	100			

In each period, the variance contribution of each principal factor has been determined, and the composite financial risk score of each characteristic indicator in each period has been obtained using the variance contribution of each factor as weights, the matrix of score coefficients as variables, and the weighted average method as the calculation method.

Total Variance Explained In The Sixth Period						
Ingredient	Initial Eigenvalue			The Sum Of Squares Of a Rotation (Math.)		
	(Grand) Total	Variance %	Cumulative %	(Grand) Total	Variance %	Cumulative %
1	12.976	99.818	99.818	12.976	99.818	99.818
2	0.015	0.112	99.93			
3	0.004	0.033	99.963			
4	0.002	0.015	99.978			
5	0.001	0.01	99.987			
6	0.001	0.008	99.995			
7	0	0.002	99.997			
8	0	0.002	99.999			
9	0	0.001	100			
10	2.37E-05	0	100			
11	5.41E-06	4.16E-05	100			
12	1.50E-06	1.16E-05	100			
13	4.35E-07	3.35E-06	100			

Total Variance Explained In The Seventh Period						
Ingredient	Initial Eigenvalue			The Sum Of Squares Of a Rotation (Math.)		
	(Grand) Total	Variance %	Cumulative %	(Grand) Total	Variance %	Cumulative %
1	12.637	97.207	97.207	12.637	97.207	97.207
2	0.319	2.451	99.658			
3	0.023	0.174	99.833			
4	0.011	0.083	99.916			
5	0.008	0.058	99.974			
6	0.002	0.013	99.987			
7	0.001	0.007	99.993			
8	0.001	0.005	99.998			
9	0	0.001	99.999			
10	3.43E-05	0	100			
11	2.02E-05	0	100			
12	9.33E-06	7.17E-05	100			
13	2.88E-06	2.22E-05	100			

As a result, it is possible to obtain a ranking of the relevance of the characteristic indicators. From the results of the analysis, it can be seen that the Operating Cash Flow Debt Cover To Maturity Multiple (X27), which is the indicator that can improve the financial risk of the enterprise in most of the periods, is the financial indicator of the enterprise that should be focused on. The next most important indicators are Ratio Of Profits To Cost(X3), Return On Net Assets (X2), Total Net Asset Margin (X1), Earnings Per Share (X5), and the Amount Of Penalties Imposed By The Securities And Exchange Commission (X28). Once again there is a series of related industry indicators, with relative emphasis on Industry Cash Flow Risk (X11), Industry Operating Margin (X9), Industry Gross Operating Income Growth Rate (X15), and Industry Net Profit Growth Rate (X14).

Based on the data of these seven periods, we make a line graph, the horizontal axis is the time, and the vertical axis is the influence of the characteristic indicators on the financial risk, because the indicators have been treated positively in the counting backward technique, so the higher the vertical axis here, the lower the financial risk caused by the indicator. We can see that, except for the industry interest coverage multiple, an indicator of significant growth, the rest of the indicators with the delisting time approaching gradually converge to a lower absolute value of a stable value. This indicates that companies in the machinery manufacturing industry as a whole are becoming more and more capable of paying interest and repaying capital. The reason for the latter is worth exploring further, and follows what was said in the previous section, that the homogeneity of the

Table V Ranking of the relevance of characteristic indicators to financial risk

Ranking	Characteristic Indicators	Score
1	Operating Cash Flows To Current Debt Ratio	(2.96)
2	Earnings Per Share	(2.66)
3	Ratio Of Profits To Cost	(2.74)
4	Return On Net Assets	(2.72)
5	Net Profit Margin On Total Assets	(2.65)
6	Total Asset Growth Rate	(2.59)
7	Amount Of Penalties	(2.62)
8	Revenue Growth Rate	(2.46)
9	Industry Net Profit Growth Rate	(1.92)
10	Industry Operating Margins	(2.45)
11	Industry Gross Operating Income Growth Rate	(2.15)
12	Industry Cash Flow Risk	(2.40)
13	Total Asset Turnover	(2.22)
14	Industry Operating Index	(1.06)
15	Industry Quick Ratio	(0.72)
16	Business Leverage	(0.25)
17	Quick Ratio	(1.17)
18	Industry Asset-Liability Ratio	(0.05)
19	Asset-Liability Ratio	(0.03)
20	Industry Equity Multipliers	0.57
21	Accounts Receivable Turnover Ratio	0.32
22	Year-On-Year Growth Rate	2.53
23	Inventory Turnover	2.23
24	R&D Investment As a Percentage Of Operating Income	2.91
25	Return On Investment (Roi)	(2.21)
26	Industry Concentration	5.75
27	Growth Rate Of Total Industry Operating Costs	2.17
28	Industry Interest Coverage Multiples	21.54

samples being counted is getting stronger and stronger, and is gradually harmonizing to reach the so-called "delisting" status.

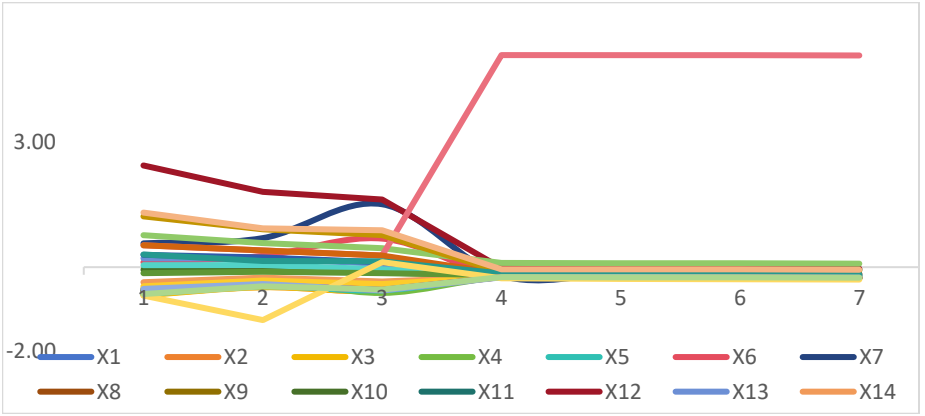

Figure 1 Trends in indicator correlation

5 Conclusion

This paper takes the machinery manufacturing ST companies delisted in the first quarter of 2024

as the research object, in order to screen out the characteristic indexes with high correlation to the enterprise financial risk, adopts the factor analysis method, cleans the data of the company before delisting period by period, and empirically compares and analyzes the indexes with high correlation to the financial risk in different periods. The test results show that.

The Operating Cash Flow Debt Security Multiple Of Maturity is the most salvageable indicator of financial risk for ST companies, according to which the company's managers can make corresponding improvements, Cost And Expense Margins, Net Asset Margins and other indicators also strongly reflect the profitability of the company in the financial risk, in addition to the high Amount Of Penalties imposed by the SEC also has a worthwhile impact on the financial risk of the company ;

The closer a company approaches delisting, the greater the homogeneity between the samples, and the weaker the impact of changes in characteristic indicators on financial risk compared to the previous period. In other words, for ST firms that eventually reach the delisting outcome, the extent of the impact of the characteristic indicators on the firm's financial risk diminishes over time.

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