

Financial Stress Evaluation of Listed Companies Based on Factor Analysis

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Abstract: Rom the perspective of profit pressure and payment pressure, combined with the theory of corporate stakeholders, 16 financial pressure indicators were proposed, and a set of comprehensive evaluation of corporate financial pressure measurement system was constructed by factor analysis. Further, comparative analysis was conducted on enterprises with different pressure levels, and it was found that the financial pressure of ST enterprises was significantly higher than that of normal operating enterprises. The future performance of enterprises with abnormal financial pressure is significantly lower than that of enterprises with moderate financial pressure. The conclusion shows that the debt repayment pressure still plays a dominant role in the financial pressure. Managers should be alert to the financial pressure that is too high and fall into financial difficulties. At the same time, they should also prevent the financial pressure from being too small and reduce the efficiency of resource use.

1 INTRODUCTION

Financial stress is formed by the external and internal environment of an enterprise acting on its financial activities. (Duan, 2014) Enterprises will face varying degrees of financial pressure in the course of operation. Moderate financial pressure is conducive to the enterprise to improve the utilization efficiency of resources, too much or too little financial pressure is not conducive to the development of the enterprise. (Gan, 2016) When the financial pressure is too high, an enterprise may go through the process of normal financial condition, deterioration and bankruptcy, and eventually evolve into financial risk. (Zheng, 2014) When the financial pressure is too small, such as the appearance of financial affluence and other phenomena, it will reduce the capital utilization efficiency of enterprises (Gan, 2020).

The existing literature mainly focuses on the study of the consequences of excessive financial stress and the prediction of financial risks. In the aspect of consequence research, the fraud triangle theory believes that three factors, pressure, opportunity and self-rationalization, act together to lead to the fraud behavior. Among them, financial pressure is the direct inducement that leads Chinese listed companies to take frauds, and financial

pressure can be subdivided into debt repayment pressure and backdoor financing pressure. (Wu, 2010) On the other hand, in the face of financial pressure, enterprises are more inclined to adopt such measures as whitewashing the report and earnings management to alleviate short-term pressure, which will also lead to further increase of financial pressure and lead to financial risks in the future. (Wang, 2019) Moreover, in the empirical research, the research focus is mostly on the sample of enterprises with excessive financial pressure. Domestic scholars often select enterprises marked as special treatment (ST) as samples of financial risks. Foreign scholars often choose bankrupt enterprises as the sample to study financial risks.

In terms of financial risk prediction, the main quantitative research methods include discriminant model, probabilistic model and non-parametric model. In the discriminant model, Beaver proposes to use debt guarantee ratio, return on assets (ROA), asset-liability ratio (ALR) and asset-safety ratio (ASR) to determine whether an enterprise fails. (Beaver, 1966) Altman proposed Zeta model, and judged enterprise failure by five financial indexes. (Altman, 1977) The comparison shows that the selected indicators are mainly financial indicators of solvency, shell protection pressure and enterprise liquidity. The probability model is based on Logistic

model and Probit model. The basic idea is to study the financial indicators of enterprises that have fallen into financial difficulties, and then propose a comprehensive measurement standard (Ohlson, 1980; Zmijewski, 1984). The non-parametric model is based on survival analysis, and the purpose of this method is to predict the bankruptcy time of enterprises. To sum up, existing studies, on the one hand, only focus on the study of excessive pressure, even if the starting point of the prediction model is the enterprise already in financial risk; on the other hand, the measured financial indicators are limited to three aspects: solvency, cash flow and profitability.

In real life, enterprises also face profit pressure from shareholders and pressure from external stakeholders, so it is necessary to expand the scope of measurement. In addition, little attention has been paid to the consequences of too little financial stress. In fact, the serious consequences caused by excessive financial pressure of enterprises are not caused by overnight financial decisions and business activities, but the inevitable trend caused by the gradual accumulation of risk factors within enterprises. Therefore, enterprises should take preventive measures in the operation process, pay due attention to the financial pressure faced by enterprises, and keep it at a reasonable level, so as to promote the better development of enterprises. Based on the existing literature, this paper adds other indicators related to the financial stress of enterprises, uses factor analysis method to build a measurement system of the financial stress of enterprises, and finally uses actual samples for

analysis.

2 INDEX SYSTEM CONSTRUCTION AND SAMPLE SELECTION

2.1 Construction of Indicator System

The goal of factor analysis is dimensionality reduction. Based on the correlation between various indexes, common factors can be extracted by linear combination, and most of the information of original indexes can be represented by a few factors. As mentioned above, financial ratio is the main index to measure financial stress in the previous literature, and there is coincidence and similarity among the indexes. Factor analysis method can retain most of the effective information, and eliminate the repeated information among the indexes. Therefore, this paper chooses factor analysis method to establish a corporate financial stress measurement system.

In order to cover as much as possible influence of enterprise financial pressure index, based on the Beaver (1966), Altman (1987), guo-ping wu (2010), and Wang Hong (2019) scholars such as the selection of measuring financial pressure, on the basis of facing the profit from the enterprise pressure and pay two financial pressure Angle, combining the theory of enterprise stakeholders added 10 indicators, received 16 indicators, as shown in table:

Table 1: Indicator description¹.

Target classification	Basic indicators	calculation	The serial number
Profit pressure	Operating margin	Gross profit/operating income	X1
	Operating net interest rate	Net profit/operating income	X2
	Equity incentive goal	Growth rate of net profit in 2018 relative to 2017	X3
	Analysts Focus on Stress	Analysts watched the numbers that year	X4
	Annual profit	0= the profit before the year is negative, 1= the profit before the year is positive	X5
	Enterprise growth	Revenue growth rate	X6
Pay pressure	Net cash flow from operating activities/current liabilities		X7
	Total net cash flow/liabilities from operating activities		X8
	Current ratio	Current assets/current liabilities	X9
	Asset-liability ratio	Total liabilities/total assets	X10
	Equity/Claims	Year-end share price * Number of shares issued/claims	X11

	Operating/Total assets	Current assets - Current liabilities/total assets	X12
	Dividend distribution rate	Dividends payable/net profit	X13
	Effective tax rate		X14
	Pay the pressure	Employee compensation/operating costs	X15
	R&d spending	R&d investment/revenue	X16

2.1.1 Indicators of Profit Pressure

The requirement of maintaining profitability runs through the whole process from listing to delisting. Therefore, enterprises will first face profit pressure, which comes from the difficulties in the operation process on the one hand, and from the capital market to evaluate the advantages and disadvantages of enterprises through earnings on the other hand.

Operating gross margin and operating net margin are commonly used as indicators to measure the profitability of enterprises. In terms of profit pressure indicators, this paper first considers adding these two indicators to measure the profitability pressure faced by enterprises in operation.

The shell-holding pressure is a dummy variable. The value of 0 represents the enterprise loss in the previous year, while 1 represents the enterprise profit in the previous year. The enterprise growth is used to measure the pressure of profit keeping, and the index is the growth rate of the enterprise's net profit in the current year compared with that of the previous year. When an enterprise has losses or other abnormal operating conditions for two consecutive years, it will be labeled as ST enterprise and face delisting risk, thus affecting the financing and enterprise value of listed enterprises. Therefore, the enterprise will try its best to maintain the profit state, and considering that the stock price will fluctuate with the profit situation, it will also try its best to increase the revenue growth rate of the enterprise. Therefore, these two indicators are used to measure the profit pressure of enterprises.

Secondly, the capital market can be scrutinized from the perspective of shareholders and other investors. The pressure of shareholders on the enterprise can be transmitted from the two paths of demanding profits and demanding dividends. The profit target put forward by shareholders is not disclosed publicly in the document. Considering the accessibility of data, this paper considers to select the profit target put forward by shareholders in the public document as a measurement index. The equity incentive plan is put forward by the enterprise to solve the agency problem, which conveys the profit level that the shareholders hope the enterprise can achieve in the future. Therefore, this paper

chooses equity incentive target to measure the profit expectation of shareholders.

Analysts focus on Pressure Measured by the number of analysts who followed the same year, financial analysts, as an external force, on the one hand, will exert pressure on companies to push management to meet analysts' profit forecasts, resulting in "short-sighted" behavior. (Dai, 2015) For example, the more analysts pay attention, the more likely management is to spend less on research and development to improve a company's short-term performance. (Jie, 2013) And as the attention of corporate analysts rises, so does the level of earnings management. (Xie, 2014) On the other hand, the higher the analysts' attention is, the more accurate the forecast will be, which can relieve the financing pressure of enterprises. (Fan, 2019) Therefore, this paper chooses analysts' attention to measure the pressure exerted on enterprises by other investors in the capital market.

2.1.2 Payment Pressure

The income of an enterprise will eventually flow to creditors, other stakeholders (government, employees, etc.) and equity holders in turn, and the final balance will be retained earnings. In the past, more attention was paid to the financial pressure brought by creditors. In fact, other beneficiaries would also bring financial pressure on enterprises.

First of all, from the perspective of the creditors, combining with the existing literature current ratio, asset-liability ratio, market capitalization/liabilities, working capital, liabilities, net business activities generated cash flow/current liabilities, net business activities generated cash flow/total liabilities six indicators to measure the enterprise's solvency and capital structure is reasonable.

Secondly, in practice, enterprises will respond to financial pressure by avoiding tax, cutting r&d expenditure and reducing employee compensation. (Wei, 2020) Therefore, in this paper, the effective tax rate, employee compensation and R&D expenditure of other profit distribution items are selected to measure the financial pressure brought by other stakeholders.

The effective tax rate is the ratio between the amount of taxes paid and the actual income of the enterprise. Different from the nominal interest rate, the effective tax rate can relate the tax burden to the enterprise's earnings. Therefore, the effective tax rate is selected to measure the financial pressure of the enterprise.

Employee compensation is often rigid. (Fehr, 1999) In other words, when the profit status of the enterprise is good, the salary of employees will rise or remain unchanged, but when the profit status of the enterprise is bad, the salary of employees will not necessarily decrease, bringing the payment pressure to the enterprise. Employee compensation is often regarded as labor cost. Therefore, the ratio of employee compensation to operating cost is used in this paper. The bigger the index is, the greater the financial pressure will be.

R&d spending is non-mandatory and tends to fluctuate with a company's financial position. There is a significant positive correlation between enterprise performance and R & D expenditure. (Sun, 2013) Therefore, the ratio of R & D expenditure to operating income is used in this paper. The larger the index is, the smaller the financial pressure is.

Finally, from the perspective of shareholders. As mentioned above, the pressure exerted by shareholders can be divided into the pressure of profit target and the pressure of demanding dividends. For enterprises, dividends will reduce their cash flow and affect their solvency and future business activities. Therefore, dividend payout ratio is selected to measure the payment pressure demanded by shareholders.

2.2 Data Selection and Preprocessing

The financial stress indicators of listed companies involved in this paper are all derived from CSMAR database, and the time span is from the first quarter of 2014 to the second quarter of 2020. Before the study, the data were preprocessed in this paper.

First of all, the target growth rate selected in this paper must meet the following conditions: (1) In order to prevent the time span is too large, and the target growth rate is too high or too low under the influence of uncontrollable factors, the selection of equity incentive plan should be proposed at least in the first three years of the study year. (2) It is found in the collection and arrangement that the incentive target measure caliber of most enterprises is the net profit growth rate. In order to make the target comparable, this paper excludes a small number of

enterprises that take the operating income growth rate, EVA added value and other indicators as the standard, and only keeps the enterprises that take the net profit growth rate as the measurement index. In order to eliminate the large difference between industries, the manufacturing industry was selected as the research object.

Secondly, in order to ensure the reliability of the results, this paper preprocesses the data according to the following standards: Eliminate enterprises with missing key indicators. (2) Continuous variables in 1% and 99% of the level of Winsorize processing, the software used for Stata16.0. Finally, 250 enterprises were collected and sorted in 2017, 297 enterprises in 2018, and 267 enterprises in 2019. A total of 814 enterprises.

Finally, before exploratory factor analysis, KMO and Bartlett sphericity tests were carried out for the 18 selected indicators. The results showed that KMO=0.767, the test result was greater than 0.5, and the Bartlett spherical test result was significant, indicating that the selected indicators were suitable for factor analysis.

Table 2: KMO and Bartlett tests².

Number of KMO sampling appropriateness.		0.767
Bartlett sphericity test	The approximate chi-square	3095.24
	Degrees of freedom	120
	significant	0.000

3 EMPIRICAL TEST

3.1 Exploratory Factor Analysis

Since factor analysis is applicable to sectional data analysis, this paper first uses SPSS26.0 to make exploratory factor analysis of the financial pressure indicators collected by enterprises in 2018, and uses principal component analysis to extract common factors. A total of 6 common factors with the characteristic value greater than 1 are retained. As shown in the table, the total interpretation rate of the six common factors reaches 76.548%, which can contain most of the information of the selected indicators. Secondly, in order to better explain the meaning of each common factor, this paper adopts the maximum variance method to carry out factor rotation and construct factor loading matrix. The rotation converges after the 14th iteration. The following table shows the load coefficient of each index on the common factor after rotation.

Table 3: Total variance interpretation³.

composition	Initial eigenvalue			Sum of squares of rotating loads		
	A total of	Percentage of variance	Cumulative %	total of	Percentage of variance	Cumulative %
1	5.368	33.548	33.548	3.926	24.535	24.535
2	1.981	12.384	45.932	2.435	15.220	39.755
3	1.621	10.134	56.066	1.577	9.855	49.609
4	1.208	7.551	63.617	1.466	9.164	58.774
5	1.067	6.671	70.288	1.429	8.934	67.708
6	1.002	6.260	76.548	1.414	8.841	76.548
7	0.776	4.848	81.396			
8	0.714	4.464	85.860			
9	0.642	4.014	89.875			
10	0.550	3.438	93.312			
11	0.306	1.915	95.227			
12	0.280	1.750	96.977			
13	0.217	1.355	98.332			
14	0.150	0.941	99.272			
15	0.097	0.606	99.878			
16	0.019	0.122	100.000			

Table 4: Component matrix after rotation⁴.

	composition					
	1	2	3	4	5	6
Total net cash flow/liabilities from operating activities	0.956	0.010	0.082	0.082	0.062	0.002
Net cash flow from operating activities/current liabilities	0.953	0.008	0.079	0.087	0.058	0.019
Equity/Claims	0.759	0.352	0.261	0.032	0.059	0.123
Current ratio	0.718	0.313	0.512	0.053	0.004	0.004
Asset-liability ratio	0.619	0.293	0.552	0.070	0.187	0.079
Pay the pressure	0.135	0.883	0.016	0.124	0.028	0.103
Operating margin	0.358	0.776	0.121	0.038	0.184	0.175
R&d spending	0.010	0.722	0.152	0.190	0.234	0.025
Analysts Focus on Stress	0.085	0.207	0.659	0.273	0.041	0.149
Operations/Liabilities	0.498	0.374	0.591	0.163	0.041	0.083
Equity incentive goal	0.112	0.045	0.156	0.826	0.075	0.053
Annual profit	0.099	0.027	0.075	0.572	0.373	0.516
Effective tax rate	0.045	0.040	0.109	0.136	0.844	0.026
Dividend distribution rate	0.041	0.003	0.239	0.364	0.570	0.091
Enterprise growth	0.048	0.051	0.078	0.098	0.138	0.864
Operating net interest rate	0.448	0.189	0.021	0.347	0.301	0.546

3.2 Common Factor Naming

Common factor F1 includes five indicators, including net cash flow generated from operating activities/total liabilities, net cash flow generated from operating activities/current liabilities, equity/creditor's rights, current ratio and asset-liability ratio, in order of factor load. The first two indicators reflect the correlation between cash flow and liabilities of an enterprise, while the last

three indicators reflect the capital structure of an enterprise. Therefore, the common factor F1 is named as the solvency pressure factor.

The common factor F2 is ranked according to the factor load, including salary pressure, operating gross margin, and R&D expenditure. It mainly reflects the operating income status of the enterprise and the pressure of other payment items, so it is named profit quality factor.

Common factor F3 is based on both analyst focus stress and working capital/total assets. Among them, analysts' attention is negatively correlated with corporate financing constraints, and corporate financing constraints are also negatively correlated with corporate debt capacity. (Li, 2011) At the same time, it is found that corporate liquidity ratio and asset-liability ratio are also highly correlated with the common factor F3, which mainly represents the ratio of corporate liabilities and assets. Therefore, the common factor F3 is named as the financing pressure factor.

The common factor F4 is composed of shareholder pressure and shell retaining pressure. Shareholders' expectation of earnings is proposed based on the earnings status over the years. Its essence is to expect the enterprise to maintain profits and improve its value. Therefore, the common factor F4 is named as the growth pressure factor

Common factor F5 is based on two items including effective tax rate and dividend payout ratio. These two items are the distribution items of corporate profits, and their size is related to the status of corporate profits. When an enterprise loses money, its tax rate and dividend payout ratio are generally 0, that is, it is not paid. Therefore, the common factor F5 is named as other payment pressure factors.

Common factor F6 represents the net profit quality of the enterprise in the current year according to two indicators including operating net interest rate and enterprise growth, so it is named as net profit quality factor.

4 FINANCIAL STRESS EVALUATION AND ANALYSIS OF DIFFERENT COMPANIES:

4.1 Enterprise Index Score

The formula of six common factors and total score is as follows:

$$F_j = \sum_{i=1}^n W_{ij}X_i \tag{1}$$

$$S_j = \sum_{i=1}^n W_{ij}X_i \tag{2}$$

Where, is the value of the ith index, is the load coefficient of this index on the JTH common factor, and n is the number of indexes. Where, is the value of the ith index, is the load coefficient of this index on the JTH common factor, and n is the number of indexes. According to the formula, the lower the score, the greater the stress, and vice versa.

Based on the above scoring formula, this paper calculates the scores of 814 listed companies from 2017 to 2019. The comparison is made in the following two situations : (1) for the enterprises that are specially treated in the current year or the year after that, the financial pressure of the enterprises that are normally operated is compared horizontally according to the year and scale of 1:1. (2) The samples were divided into two categories: enterprises with normal pressure and enterprises with abnormal pressure, and their earnings performance in the following year were compared respectively.

Through the analysis, it is found that the financial pressure of the specially treated enterprises in the current year or the year after is significantly higher than that of the paired normal operating enterprises. The profit performance of enterprises with abnormal pressure in the following year is significantly lower than that of enterprises with normal pressure;

4.2 Comparison Between ST Enterprises and Normal Operating Enterprises

In this paper, a total of 21 enterprises changed from normal operation to special treatment from 2017 to 2019 in the same year or the year after, and then 21 similar enterprises were matched according to year and enterprise size. The financial stress scores of the two types of enterprises in the current year were investigated respectively, and the mean test results were as follows:

Table 5: Mean test of pressure scores of ST and non-ST enterprises^{5,0}

	No. of ST	Mean	No. of Non-ST	Mean	MeanDiff	t-value
Score	21	0.56	21	0.068	0.492 ***	3.320 ***

Table 6: Mean test of abnormal pressure and normal pressure corporate earnings⁶.

	No. of Normal	Mean	No. of Abnormal	Mean	MeanDiff	t-value
Inc1	677	0.386	136	0.041	0.056 **	2.222 **
Inc2	675	0.178	137	0.033	0.019 *	1.894 *

It can be seen from the table that the financial pressure score of ST enterprises in that year is lower than that of normal operating enterprises, and the difference is significant at 1%. The results show that, on the one hand, excessive financial pressure will bring difficulties to the enterprise's future operation. On the other hand, it is a gradual development process for an enterprise to get into financial difficulties, so the management should pay attention to the financial indicator information of the enterprise and keep alert to the financial pressure of the enterprise.

4.3 Comparison between Enterprises with Moderate Pressure and Enterprises with Abnormal Pressure

According to section B, special processing enterprise financial pressure to the geometric average of 0.56, the pressure will score less than 0.56 and is greater than 0.56 respectively defined as financial stress and financial pressure too small enterprises, companies are collectively referred to as abnormal pressure, the rest of the enterprise is defined as the pressure moderate, respectively to investigate two kinds of enterprise after a year of profit growth.

It can be seen from the table that no matter what profit performance indicators are used, enterprises under normal pressure will perform better than those under abnormal pressure in the future, with growth rates 9.67% and 12.4% higher respectively, and the two mean tests are significant at the level of 10% and 5% respectively. The results show that moderate financial pressure can promote enterprises to achieve better earnings performance.

5 RESEARCH CONCLUSIONS AND SUGGESTIONS

Paying attention to the financial pressure of enterprises helps managers to make better financial decisions and maintain the healthy development of enterprises. This paper first takes listed manufacturing enterprises in 2018 as research samples and uses factor analysis to construct a set of measurement system to comprehensively evaluate the financial stress of enterprises. Secondly, the listed manufacturing enterprises from 2017 to 2019 are taken as research samples to analyze from two perspectives, namely, the comparison between special treatment enterprises and normal operating

enterprises, and the comparison between abnormal financial pressure and normal enterprises. The results showed that the financial pressure of the enterprises that were subjected to special treatment in the same year or the year after was significantly higher than that of the normal enterprises of the same size. The profits of enterprises under normal financial pressure in the next year are significantly better than those under abnormal financial pressure. It shows that moderate financial pressure is beneficial to the growth of enterprises, while too much or too little financial pressure will restrain the development of enterprises.

According to the research conclusions, the following suggestions are proposed for the financial pressure generally faced by enterprises: First, pay close attention to the pressure of debt repayment. In this paper, it is found that the interpretation rate of debt repayment pressure factor to the overall information reaches 24.545%, accounting for 32.052% of the retained information, indicating that debt repayment pressure is still the biggest pressure faced by enterprises. Different from the pressure exerted by shareholders, the repayment pressure has strict requirements on the repayment time, so it is more urgent. Enterprises should take on appropriate debts and choose a reasonable capital structure. Second, we should be alert to the situation of too little financial pressure. Article inspection found that financial pressure too small enterprise's performance is still under normal pressure in the future, there may be the reason: the pressure is too small too small businesses generally solvency, explain enterprise debt relative to its assets, cash flow situation is less, but relatively high pressure appropriate corporate debt, financial leverage effect, to choose better decision prompted managers to meet the requirements of creditors and equity. Therefore, enterprises should keep financial pressure at an appropriate level.

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