

# Financial risk evaluation of listed companies in software and information technology service industry in China-Take M Company as an example

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## ABSTRACT

Software and information technology service industry are technology-intensive industries, and the great uncertainty of technological innovation, market investment and organization makes it possible for a large amount of capital invested by enterprises to suffer losses. Therefore, taking M company as an example, this paper uses TOPSIS method of multi-attribute decision-making to evaluate the financial risk of M company. The results show that the financial risk of M company tends to increase, among which profitability and development ability are the main factors affecting the financial risk. Software and information technology service enterprises must improve the level of financial risk prevention by improving the management level of accounts receivable, paying attention to cost control and enhancing the awareness of risk control.

## KEYWORDS

Software and information technology service industry; Entropy weight TOPSIS; Financial risk evaluation.

## 1. INTRODUCTION

Digital industry has been developed as a strategic emerging industry in China, and its important position has been clearly put forward in national strategic documents such as "Made in China 2025" and "National Big Data Strategy", and it is proposed to develop digital industries such as digital manufacturing, digital services and digital agriculture to create a new ecology for digital industry development. As one of the core parts of the digital industry, the software and information technology service industry plays a vital role in promoting new technologies, new production, new industries and new models. However, as a technology-intensive industry, technology research and development needs a lot of financial support, but the great uncertainty of technological innovation, market investment and organization makes it possible for a large amount of capital invested by enterprises to suffer economic losses in financing, investment and production and operation. On the one hand, it faces the problems of high R&D cost, large capital demand and complex technology update; on the other hand, the intensified market competition increases the uncertainty for the development of enterprises, which makes the software and information technology service industry face greater financial risks than traditional industries. Financial risk usually reflects the overall situation of the enterprise, and the difficulty of capital turnover caused by financial risk may directly affect the necessary production and business activities of the enterprise and bring survival crisis to the enterprise. Therefore, it is necessary for software and information technology service enterprises to manage and control financial risks.

In financial risk assessment, Fitzpatrick (1931), a foreign scholar, first used the univariate model to predict the financial risk of enterprises, but it can not fully reflect the financial situation of enterprises [1]. Altman (1968) selected five financial indicator ratios to establish a Z-Score five-variable multivariable model to predict financial risk according to the z-value. The results show that the accuracy of multivariate discrimination is much higher than that of the Univariate Predictive Model [2]. Since 1970, scholars have opened up the era of pluralistic logic returning to the mainstream. Ohlson (1980) further applied Logitci logistic regression to the evaluation of enterprise financial risk [3]. Odom and Sharda (1990) innovatively used neural network method to construct financial early-warning model. The results show that the accuracy of artificial neural network for financial risk identification is higher than that of multivariate discriminant model [4]. Most of the theories and models of financial risk in our country are based on the western research results. According to the actual situation and the characteristics of the enterprises in our country, the models of financial risk evaluation and prediction are perfected and enriched. Zhou Shouhua and Yang Jihua (1996) reformed the z-score model, established the f-score model, and divided the f-score value into three regional co-management decision-maker analysis and decision-making [5]. WUTIEMEI (2010) established a financial crisis early-warning model by factor analysis and Logistic regression after adding non-financial information to audit opinion variables [6]. Yin Xiaonan (2017) constructs the high-tech enterprise financial risk index system from five dimensions, and establishes the TOPSIS method to evaluate it based on the objective weight of entropy method [7]. Wang Chao (2018) uses a fuzzy hierarchy approach that combines Quantitative analysis and qualitative judgment to hierarchize and quantify financial risk assessment system indicators [8]. Li Cai (2022) uses factor analysis method to extract six factor indexes, and uses BP neural network model training and testing to early-warning the financial risk of feed listed companies [9].

To sum up, in order to overcome the one-sidedness of the evaluation result of the single-variable model, the research of financial risk mainly adopts the multivariable model to give the weight to the multidimensional index. The combination of entropy weight method and Topsis method can objectively give the index weight, and can effectively avoid the subjective randomness brought by the subjective weight method such as analytic hierarchy process, Therefore, this paper uses entropy weight method and TOPSIS method to evaluate.

## 2. THE PRINCIPLE AND STEPS OF ENTROPY WEIGHT TOPSIS METHOD

### 2.1. Weighting by entropy weight method

Entropy weight method uses information entropy to calculate the discrete degree of indexes. The higher the data discrete degree, the more information it contains, the lower the entropy value, the higher the weight, and the lower the weight. The objective index weight can be obtained by modifying the entropy weight.

The first step is to standardize the constructed evaluation matrix, and the standardized index is  $X_{ij}^*$ .

$$X_{ij}^* = \frac{x_{ij} - \min(x_{ij})}{\max(x_{ij}) - \min(x_{ij})} \quad (\text{Positive index}) \quad (1)$$

$$X_{ij}^* = \frac{\max(x_{ij}) - x_{ij}}{\max(x_{ij}) - \min(x_{ij})} \quad (\text{Negative index}) \quad (2)$$

$$X_{ij}^* = \frac{|x_{ij} - d_{\text{best}}|}{\max |x_{ij} - d_{\text{best}}|} \quad (\text{Moderate index}) \quad (3)$$

The second step is to calculate the information entropy of each index  $e_j$ .

$$e_j = -1 / \ln n \sum_{i=1}^n p_{ij} \ln(p_{ij}) \quad (4)$$

Among them,  $p_{ij} = \frac{X_{ij}^*}{\sum_{i=1}^n X_{ij}^*}$

The third step, determine the weight of each indicator  $w_j$ .

$$w_j = \frac{1-e_j}{\sum_{i=1}^n (1-e_j)} \quad (5)$$

## 2.2. Topsis method for multi-attribute decision making

Topsis method calculates the distance between the evaluation object and the positive and negative ideal solution of each index, and sorts the risk evaluation value according to the distance between the evaluation object and the positive and negative ideal solution, and obtains the evaluation result, it is an effective method in multi-objective decision making. The steps are as follows:

First, the weighted normalized matrix is constructed. The index weight  $w_j$  determined by entropy weight method is multiplied by the normalized matrix.

$$r_{ij} = w_j * X_{ij} \quad (6)$$

The second step is to determine the positive and negative ideal solutions  $R^+$  and  $R^-$ . The maximum value of the same index constitutes a positive ideal solution and the minimum value of the same index constitutes a negative ideal solution.

$$R^+ = (r_1^+, r_2^+, \dots, r_n^+), \quad r_j^+ = \max r_{ij} \quad (7)$$

$$R^- = (r_1^-, r_2^-, \dots, r_n^-), \quad r_j^- = \min r_{ij} \quad (8)$$

Third, the Euclidean distances  $d^+$  and  $d^-$  between the weighted and normalized sample data and the positive and negative ideal solutions are calculated. The formula is as follows:

$$d_i^+ = \sqrt{\sum_{j=1}^n (r_{ij} - r_j^+)^2}, \quad d_i^- = \sqrt{\sum_{j=1}^n (r_{ij} - r_j^-)^2}, \quad i = (1, 2, \dots, m) \quad (9)$$

The fourth step is to calculate the approximation degree  $C_i$  from the sample to the positive and negative ideal solutions. The formula is as follows:

$$C_i = \frac{d_i^-}{d_i^+ + d_i^-} \quad (10)$$

The fifth step is to sort the samples according to the size of  $C_i$  value. The bigger the  $C_i$  value is, the better the samples are.

## 3. OVERVIEW OF M COMPANY AND IDENTIFICATION OF FINANCIAL RISKS

### 3.1. Company profile

M company was established in 1995 and listed on the main board of Shanghai Stock Exchange in 2003. It is a key software enterprise in the national planning layout. The company mainly provides financial software products and network services for financial institutions and individual investors such as securities and futures. The company's main sources of income are sales of software products and other value-added services such as various platform services, application services, operation services, information and data services.

## **3.2. M company financial risk identification**

### **3.2.1. Financing risk identification**

M company is in a high-speed development stage, and the company continues to make mergers and acquisitions and invest to improve its business system, and maintains technological upgrading in core products and constantly explores new technical fields. A large amount of capital investment requires enterprises to carry out financing, and the fixed interest on debt has financial leverage. In addition, R&D risks are high. If R&D fails or the market is not promoted successfully, enterprises may not be able to repay the principal and interest, and the capital pressure is great.

### **3.2.2. Profit risk identification**

The profitability of an enterprise is affected by both income and cost, which is embodied in its cost control ability, product competitiveness and return on investment. In order to prevent the market competition risk, M Company increases the personnel salary and R&D. The rising cost affects the profit space of the enterprise. In addition, M Company keeps investing in M&A, which is influenced by investment direction, investment opportunity, investment amount and other factors, resulting in uncertainty and affecting the investment income of enterprises.

### **3.2.3. Development risk identification**

The company's business mainly serves the financial industry. Changes in financial regulatory policies have an impact on customers' business development, which in turn affects the company's business needs and investment in technology products. In recent years, the traditional financial institutions in the industry have increased investment to set up financial technology companies and the continuous influx of new subjects of Internet financial technology companies has intensified competition in the industry, and the competition for technical talents in the market has increased, which has adversely affected the company's market share and human resources.

### **3.2.4. Operational risk identification**

M company uses certain credit sales methods to attract customers, but the capital occupation caused by credit sales will make the enterprise lose some other investment opportunities, and even fail to put into production and operation in time or repay debts. In addition, not all the money can be recovered in time and in full, and some bad debt losses are also generated.

### **3.2.5. Risk identification of R&D innovation**

In terms of R&D and innovation, the speed of technology upgrading in the industry is relatively fast. If enterprises can't update technology in time or keep a leading position in the technical field, their competitiveness will decline. The investment of capital and manpower involved in the decision-making of product research and development and the transformation of project research and development process and results is uncertain, which may lead enterprises to face the risks of high cost, falling profits and difficult capital turnover.

## **4. FINANCIAL RISK ASSESSMENT**

### **4.1. Financial risk evaluation index system**

Combined with the previous research on financial risk evaluation index and the characteristics of software and information technology service industry, this paper constructs an evaluation index system from five aspects: solvency, profitability, operation, development and innovation. And use the formula to calculate the weight of each financial risk evaluation index, so as to screen out the strength of the role of each index in financial risk evaluation and reveal the areas that financial workers need to pay attention to in practical work. The results are shown in Table 1.

**Table 1.** Financial risk evaluation index system and entropy weight calculation results

Nature	Index	Index property	Entropy value	Entropy weight	Weight	Sort
Debt paying ability	liquidity ratio $X_1$	Moderate	0.7481	0.0590	0.1678	4
	quick ratio $X_2$	Moderate	0.8524	0.0404		
	Asset-liability ratio $X_3$	Negative	0.7499	0.0684		
profit competence	return on total assets $X_4$	Positive	0.7873	0.0582	0.2378	1
	Return on net assets $X_5$	Positive	0.7614	0.0652		
	Operating profit rate $X_6$	Positive	0.7733	0.0620		
	earnings per share $X_7$	Positive	0.8084	0.0524		
Develop ability	total assets growth rate $X_8$	Positive	0.7009	0.0818	0.2367	2
	net profit growth rate $X_9$	Positive	0.7308	0.0736		
	Operating profit growth rate $X_{10}$	Positive	0.7025	0.0813		
operating capacity	receivable turnover ratio $X_{11}$	Positive	0.6778	0.0881	0.2207	3
	Inventory turnover $X_{12}$	Positive	0.6718	0.0897		
	turnover of total assets $X_{13}$	Positive	0.8433	0.0429		
Innovation capacity	Proportion of R&D personnel $X_{14}$	Positive	0.8139	0.0509	0.1370	5
	R&D investment ratio $X_{15}$	Positive	0.6850	0.0861		

According to the weight displayed by entropy weight method, the order of financial risks affecting M company is: profitability > development ability > operation ability > solvency > innovation ability. From the specific indicators, inventory turnover rate, accounts receivable turnover rate, total assets growth rate and net profit growth rate have great influence on financial risks.

#### 4.2. Calculation of relative distance and pasting progress

Through TOPSIS calculation formula, the closeness of positive and negative ideal solutions of the evaluation object is obtained, that is, the size of financial risks faced by enterprises, and the higher the evaluation value, the smaller the financial risks faced by enterprises. The original evaluation results of the enterprise are shown in Table 2.

**Table 2.** Financial Risk Assessment Results of M Company from 2018 to 2022

Year	$d_j^+$	$d_j^-$	$C_j$	Sort
2018	0.1651	0.1565	0.4866	2
2019	0.0510	0.2472	0.8289	1
2020	0.1785	0.1231	0.4081	3
2021	0.1862	0.0945	0.3366	4
2022	0.2349	0.0800	0.2541	5

According to the relative closeness of each year, we can understand the financial risk changes of M company in recent five years. In 2019, M Company's financial situation performed best in five years, but after 2019, the relative progress continued to decline, and the financial risks faced by the company increased.

### 4.3. Modelling verification

In order to verify the accuracy of the model results in this paper, the main financial indicators of M company in recent 5 years are selected as the basis for analysis, and the specific financial indicators are shown in Table 3.

**Table 3.** Financial Risk Assessment Results of M Company from 2018 to 2022

Finance indicators	2018	2019	2020	2021	2022
liquidity ratio	1.0803	1.430	1.0949	0.9172	1.1350
Return on net assets	0.1983	0.3716	0.3157	0.3011	0.1736
net profit growth rate	0.5656	1.0865	-0.0369	0.0931	-0.2559
receivable turnover ratio	18.0685	19.7851	10.9379	8.5471	7.7160
R&D expenditure investment ratio	0.4305	0.4029	0.3585	0.3892	0.3608

As can be seen from the table, the current ratio, return on net assets, net profit growth rate and accounts receivable turnover rate of Company M are the largest in 2019, indicating that Company M has a high level of profitability, rapid business growth and efficient operation during 2019, ensuring the security of its financial situation. However, after 2019, the return on net assets of M Company decreased every year, the growth rate slowed down, and the company's ability to make profits declined; The company's accounts receivable turnover rate is smaller, which means that the speed of recovering accounts is slower. These indicate that the financial situation of enterprises will deteriorate and the financial risks of enterprises will increase in 2019-2020. To sum up, it can be verified that the entropy weight TOPSIS method can accurately evaluate the financial risk of enterprises.

## 5. FINANCIAL RISK CONTROL MEASURES BASED ON M COMPANY

### 5.1. Strengthen customer receivables management

In view of the situation that the turnover rate of M company's accounts receivable decreases, M company needs to balance the relationship between accounts receivable and sales performance, and maintain appropriate credit conditions. Do a good job of customer credit investigation before the formation of accounts receivable, and strengthen the control and supervision of contracts. In the later stage, it is necessary to formulate a reasonable collection strategy and strengthen the collection of accounts receivable with long age.

### 5.2. Focus on cost control

Although M company has a high market share in the domestic market, there is still a lot of room for development in its profit rate level. While maintaining business growth, enterprises need to pay attention to the growth of costs and expenses, establish detailed budgets, regularly review the differences between actual expenditures and budgets, and make timely adjustments. In terms of R&D expenses, enterprises can consider outsourcing part of R&D work to professional service providers, establish cooperative relations, and share R&D costs and risks. In talent management, enterprises should rationalize the salary level, optimize the team structure, establish a flexible employment model, and invest in employee training and development. Improve the incentive of salary through market salary research and performance evaluation system.

### **5.3. Strengthen control of market investment risks**

In recent years, M Company has actively laid out its industrial lines through investment and mergers and acquisitions, and adopted cooperation with external capital to expand the upstream and downstream of the industrial chain, which involves certain integration risks. Enterprises should fully conduct due diligence before M&A, establish detailed integration plans including technology, business process and cultural integration, and fully consider financing channels to carry out diversified financing to maintain capital structure; Actively implement the operational efficiency improvement plan after the merger, and attach importance to business integration and process optimization.

### **5.4. Conduct market demand monitoring and adaptation**

As the financial industry is a strongly regulated industry, fintech regulatory planning affects market demand and path. Companies need to pay close attention to market trends and flexibly adjust financing plans and technology needs to meet customer needs. With the continuous advancement of digital transformation and upgrading, many emerging demands and new industries have emerged in the market. Enterprises need to adopt more flexible market strategies, seize opportunities, and open up new areas of the market. At the same time, strengthen the awareness of risk management and ensure sufficient cash reserves to enhance the resilience of enterprises.

## **6. CONCLUSION**

Due to the uncertainty of technology innovation, market and decision-making, the listed companies in the software and information technology service industry face financial risks in financing, profit, development, operation, R&D and innovation. In this paper, the entropy weight TOPSIS method is adopted to evaluate the financial risk of M company as the research object, and then the financial risk prevention measures are proposed. The results show that the most important factors affecting M company's financial risk are its profitability index and development ability index, among which the entropy weight of inventory turnover, accounts receivable turnover and total assets growth rate is larger. The financial situation of M company is the best in 2019, and the financial risk is increased from 2020 to 2022, because of the decline in profitability, the slow development speed, and the slow payment speed of accounts receivable. Based on the above conclusions, software and information technology service enterprises should strengthen the improvement of profitability, control costs, maintain R&D investment, optimize product structure; Maintain good asset turnover, strengthen accounts receivable management to reduce the risk of capital occupation and bad debt losses; Strengthen the risk control of investment projects and maintain a good debt structure, consider diversified financing; Pay close attention to market trends and seize market opportunities.

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