Financial Risk Causes of Financial Risk Early Warning Model -- Based on Multiple Case Studies of Listed Pharmaceutical Companies

Xinyi Cao

School of Economics and Management, East China Jiaotong University, Nanchang, China

2020071005000201@ecjtu.edu.cn

Abstract. Currently, the pharmaceutical industry is facing development bottlenecks, primarily due to the overall economic environment and various pharmaceutical policies, including R&D pressure, cash flow pressure, and regulatory pressure. Therefore, the financial risk prevention and control of pharmaceutical companies is particularly important. This paper analyzes the risk level of the case company by selecting the financial risk early warning model proposed by previous scholars and testing its accuracy. Through a comparative study of three companies in the industry and an analysis of indicators item by item, the risk factors causing problems for pharmaceutical companies are identified. The study finds that the risk causes of pharmaceutical companies are low gross profit margin, unclear R&D conversion efficiency, high short-term borrowings, low inventory turnover, high operating costs, low accounts receivable turnover, low accounts payable turnover, and a high proportion of long-term borrowings in total liabilities. In response to these issues, corresponding improvement suggestions are proposed. At the product level, pharmaceutical companies should focus on R&D investment targets, equity transfer, production management systems, and government policies; At the turnover level, their attention should be paid to asset-backed notes, product customers, sales market and other aspects; At the financing level, their attention should be paid to the object of equity sale, patent pledge and debt-equity swap. This paper aims to make up for the gap in the field of multi-model and industry internal comparative research, and provide some reference and suggestions for subsequent researchers in this field on the early warning, prevention, and control of financial risks of pharmaceutical companies.

Keywords: Financial risk early warning model; risk causes; R&D conversion efficiency; capital pressure; pharmaceutical companies.

1. Introduction

In recent years, with macroeconomic fluctuations, the overall national economic growth has begun to slow down. With the further introduction of the medical insurance fee control policy, pharmaceutical companies are generally in a dilemma of development, and all kinds of financial crisis news are frequently exposed. In 2025, Yifang Biotech was questioned by regulators for failing to disclose the arrears owed by its partner Peking University Pharmaceutical, and its stock price plummeted as a result; Jiankangyuan has invested in several R&D varieties of respiratory drugs, but most of them are still in the first phase of clinical trials, with high capital pressure; In a short period of six months, several senior executives of Huaxi bio left, and the total number of employees was significantly reduced; Huadong pharmaceutical also suffered from the impact of consumption degradation and intensified competition, and its income declined periodically; Puli pharmaceutical was punished by regulatory authorities for falsely increasing its income. Many events have attracted extensive attention from investors and the public. At present, the systemic risk of the pharmaceutical industry is more prominent. Therefore, it is particularly important to predict the financial risk of pharmaceutical companies and find out their causes.

At present, there are many research results at home and abroad. Professor Altman proposed the Z-score financial risk early warning model in 1968 [1]. Later, Professor Zhoushouhua developed a new financial risk early warning model [2]. Zhang Ling, a subsequent scholar, found a four-variable financial risk early warning model [3]. At present, the domestic pharmaceutical industry is generally faced with the problems of a shortage of raw materials and overstock of inventory. A key factor contributing to financial crises in the industry is the poor liquidity of the capital chain [4]. By using ratio analysis and DuPont analysis to study the specific financial indicators, the study find the risk causes of pharmaceutical companies [5]. The R&D investment and profit of pharmaceutical companies are not necessarily positively correlated, and sometimes negatively correlated. The scale and ownership structure of pharmaceutical companies may affect this correlation [6]. Although the centralized purchase policy of medical insurance can expand sales, it might intensify the competition among pharmaceutical companies and increase the financial pressure on them. Therefore, only by making efforts to develop high-quality and innovative drugs can pharmaceutical companies enhance their core competitiveness [7].

It can be seen that many scholars often only select a single financial risk early warning model for research, lacking multi-model combination analysis. At the same time, the previous literature often only selects a single company for analysis, lacking internal comparison in the industry. This paper aims to fill the blank in this field. At the same time, this paper selects several financial risk early warning models, and through comparative research, finding that the risk causes of pharmaceutical companies include low gross profit margin, unclear R&D conversion efficiency, high short-term borrowings, low inventory turnover, high operating costs, low accounts receivable turnover, low accounts payable turnover, and high proportion of long-term borrowings in total liabilities. Finally, it suggests that in terms of products, their attention should be paid to the object of R&D investment, equity sale, production management system and government policies; In terms of turnover, their attention should be paid to asset-backed bills, customers and markets; In terms of financing, they should pay attention to the object of equity sale, patent pledge and debt-equity swap. In the theoretical sense, it can provide some references for the follow-up researchers; In the practical sense, it can provide certain reference value for the managers of pharmaceutical companies.

2. Research Process

2.1. Accuracy Test of the Financial Risk Early Warning Model

The financial risk early warning models selected in this paper include the Z-score financial risk early warning model proposed by Professor Altman, the F1 financial risk early warning model proposed by Zhang Ling, and the F2 financial risk early warning model proposed by Professor Zhou Shouhua. The meanings of model formulas and variables are shown in Table 1. In order to verify the accuracy of the above three financial risk early warning models, after eliminating missing values and abnormal values, this paper selects 104 A-share listed pharmaceutical companies as samples and divides them into the marked ST group and the unmarked ST group. Subsequently, the collected variable data were input into the three financial risk early warning models to assess the risk levels of the sample companies.

Table 1. Model formula and key variables

Model name	Formula	Variable
Z model	Z= 1.2X1+ 1.4X2+ 3.3X3+ 0.6X4+ 1.0X5	X1=working capital/total assets, X2=retained earnings/total assets, X3=EBIT/average total assets, X4=total market value of stocks/total liabilities, X5=sales revenue/average total assets.
F1 model	F1=0.517- 0.46X1- 0.388X2+ 9.32X3+ 1.158X4	X1=total liabilities/total assets, X2=working capital/total assets, X3=net profit/average total assets, X4=retained earnings/total assets.
F2 model	F2=-0.1774+ 1.1091X1+ 0.1074X2+ 1.9271X3+ 0.0302X4+ 0.4961X5	X1=(current assets at the end of the period - current liabilities at the end of the period)/total assets, X2=retained earnings/total assets, X3=(net profit+depreciation)/average total liabilities, X4=total market value of stocks/total liabilities, X5=(net profit + financial expenses + depreciation)/average total assets.

If the result of pharmaceutical companies marked with ST is high risk, the prediction result is accurate. If the result of pharmaceutical companies without ST is medium risk or safe, the prediction result is accurate. The accuracy results obtained through analysis are shown in Table 2. Among them, the F1 model is more accurate in predicting the marked ST companies, and the F2 model is more accurate in predicting the unmarked ST companies. Therefore, F1 and F2 models will be selected to study the risk of the case company.

Table 2. Model test standards and test results

Model name	Detection threshold	Is marked ST	Judged as High risk	Judged as medium risk or safe	Total	Accuracy
Z model	Z<1.81, High risk 1.81<Z<2.99, medium risk z>2.99, safe	marked ST	39	13	52	75%
		Not marked ST	9	43	52	83%
F1 model	F<0.5, High risk 0.5<F<0.9, medium risk F>0.9, safe	marked ST	47	5	52	90%
		Not marked ST	15	37	52	71%
F2 model	F<0.0274, High risk -0.0501<F<0.1049, medium risk F>0.0274, safe	marked ST	41	11	52	79%
		Not marked ST	5	47	52	90%

2.2. Research on Risk Level and Core Variables

According to the risk detection results of the sample pharmaceutical companies mentioned above, several pharmaceutical companies with a similar scale are selected from the unlabeled group, all of which are large-scale enterprises. Then, three pharmaceutical companies with high, medium, and low risk are selected, respectively. Finally, the high-risk, medium-risk, and low-risk pharmaceutical companies were identified as North China Pharmaceutical, Northeast Pharmaceutical, and Sinopharm. At the same time, the prediction results of the F1 and F2 models for the three companies are highly consistent.

The greater the fluctuation of the variables, the greater the difference of the indicators among the three pharmaceutical companies, and the greater the impact on the risk results. The standard deviation was calculated according to the variable values of the three pharmaceutical companies, and the product of the two was calculated, combined with the variable coefficient. The larger the product, the greater the influence of variables on the results. It can be seen from Table 3 that in the F1 model, X3 and X4 have a greater impact on risk differences; In the F2 model, X1 and X3 have a greater influence.

Table 3. Calculation results of the standard deviation and the product of the F1 and F2 models

Model name	Index	X1	X2	X3	X4	
F1 model	coefficient	-0.46	-0.388	9.32	1.158	
	standard deviation	0.16	0.19	0.02	0.12	
	product	-0.08	-0.07	0.23	0.14	
F2 model		X1	X2	X3	X4	X5
	coefficient	1.1091	0.1074	1.9271	0.0302	0.4961
	standard deviation	0.19	0.12	0.11	0.76	0.02
	product	0.21	0.01	0.21	0.02	0.01

3. Disassembly of Core Financial Risk Indicators

First, the index analysis of the F1 model. As analyzed earlier, in the F1 model, X3 and X4 have a more significant impact on risk differences, so these two variables are analyzed in detail below. In the F1 model, X3 can reflect the efficiency of asset profit creation. According to the data in Figures 1 and 2, from 2020 to 2024, asset profit-generating efficiency represented by X3 of North China Pharmaceutical remained generally low. Although its net profit showed an upward trend in recent years, the overall scale remained small. Northeast Pharmaceutical X3 showed an overall upward trend, and its net profit increased as a whole. Sinopharm Hyundai X3 is relatively high, and its net profit is also high. In the F1 model, X4 can reflect long-term profitability and risk resistance. From 2020 to 2024, the X4 of Huabei Pharmaceutical was low and declining, and the retained earnings value was low and declining. The X4 of Northeast Pharmaceutical and Sinopharm are both high, and the retained earnings are also high.

Second, the index analysis of the F2 model. The previous analysis has shown that X1 and X3 have a greater impact on the risk difference in the F2 model. First, in the F2 model, X1 can measure the company's short-term solvency. From Figures 1 and 2, it can be seen that from 2022 to 2024, the X1 value of North China Pharmaceutical was generally low and declining, and the current liabilities were also high. Northeast Pharmaceutical X1 showed an upward trend because of the rise in current assets. While Sinopharm Hyundai X1 was relatively high and generally rising, mainly because its current liabilities are low and generally declining. Second, in the F2 model, X3 can reflect the ability of the enterprise's cash flow to cover debt. From 2022 to 2024, North China Pharmaceutical X3's net profit increased, and total liabilities showed a downward trend. Overall, Huabei Pharmaceutical X3 was still low, with high total liabilities. Northeast Pharmaceutical X3 had little change as a whole. Sinopharm Hyundai X3, net profit was high and rising, and total liabilities were low and falling. Through the analysis, it can be concluded that the main indicators affecting the financial risk of pharmaceutical companies are net profit, retained earnings, current liabilities, and total liabilities. Next, the study will continue to analyze more specific causes of risk.

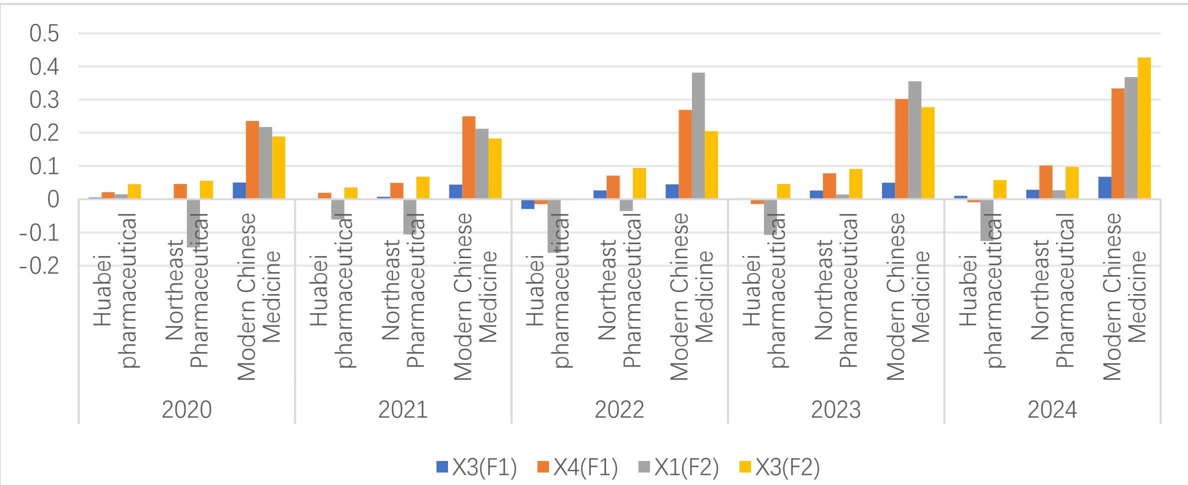

Fig. 1 Model variables of three companies from 2020 to 2024

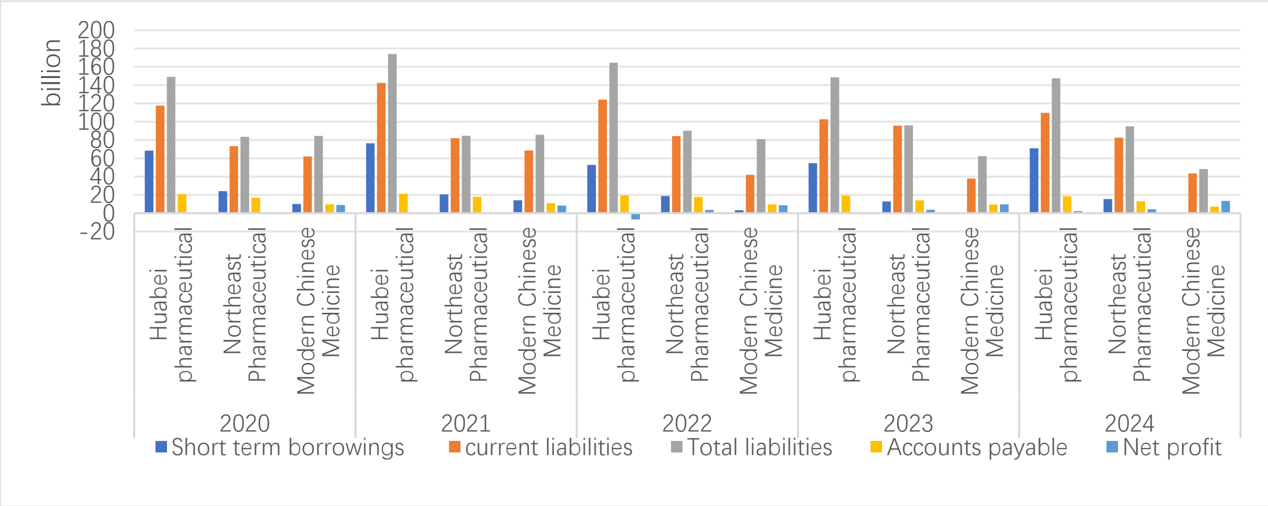

Fig. 2 Relevant financial indicators of the three companies from 2020 to 2024

4. Analysis of Specific Risk Causes

4.1. Analysis of Factors Affecting Net Profit

The analysis shows that North China Pharmaceutical’s net profit was negative in 2022, primarily due to substantial shutdown losses. The increase in net profit in 2024 was due to the acquisition of land compensation. As shown in Figure 3, Huabei Pharmaceutical's gross profit margin was generally low, indicating that its low net profit was due to the lack of product profitability. For the pharmaceutical industry, the pricing of its products was not only affected by China's National Volume-Based Procurement Policy, but also affected by its cost control ability and product innovation level [8].

It can be seen from Figure 3 that North China Pharmaceutical had high R&D investment. Meanwhile, its ratio of capitalized R&D investment reached 60% throughout the sample period, approximately twice that of Northeast Pharmaceutical and Sinopharm, which is atypical in the industry. Its gross profit margin had not increased, so its R&D conversion efficiency was not clear. From 2022 to 2024, the gross profit margin of Northeast Pharmaceutical was high, and its operating costs were relatively low. The study finds that the introduction of a MES production management system can control production information and reduce production waste. At the same time, it actively distributes its supply chain overseas, which can reduce costs compared with domestic production.

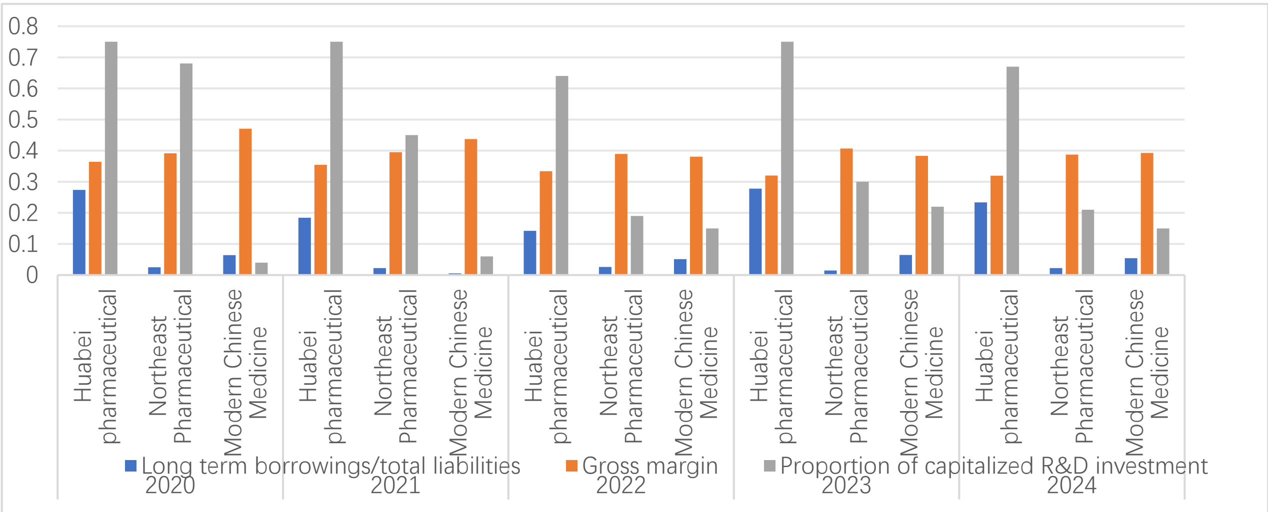

Fig. 3 Relevant ratio indicators of three companies from 2020 to 2024

4.2. Analysis of Factors Affecting Current Liabilities

As shown in Figure 2, Huabei Pharmaceutical's high current liabilities were mainly due to its large short-term borrowings. Combined with the previous analysis, it can be seen that it supported high R&D investment through borrowing. However, if the R&D expenses are stripped off in a reasonable way, such as the sale of subsidiaries' equity mentioned later, it cannot be included in the original company statement, which can reduce the negative impact of R&D investment on enterprise financing. It can be seen from the annual report that North China Pharmaceutical had a high output tax to be transferred in 2024, resulting in the rise of other current liabilities. Sinopharm has less short-term borrowings and focuses its business on Beijing, where customers' credit is high, so the account turnover speed is high. Northeast Pharmaceutical had low short-term borrowings, high inventory turnover, and fast capital return. Its vitamin C products have been exported to more than 60 countries overseas and have a broad market. Supported by the northeast industrial revitalization policy, Northeast Pharmaceutical could receive more financing subsidies [9].

Current liabilities are also affected by accounts payable to a certain extent. It can be seen from Figure 2 that the accounts payable of Huabei Pharmaceutical were much higher than those of Sinopharm. Its accounts payable turnover rate was low, which indicates that its repayment speed was slow. According to the analysis, a large number of raw materials are purchased, but the monetary capital is insufficient, so the payment time can only be extended. Northeast Pharmaceutical had a lower turnover rate of accounts payable, which reduced capital pressure by extending the payment period of accounts. Sinopharm had a high turnover rate of accounts payable, not only because it has a good profit situation, but also because it obtains raw materials mainly through a self-made way, and outsourcing is reduced, which could improve the profit space.

4.3. Analysis of Other Factors Affecting Total Liabilities

It can be seen from Figures 2 and 3 that North China Pharmaceutical had high total liabilities and a high asset liability ratio, and its operation depended on external financing. In addition, the total liabilities were also affected by the medium and long-term borrowings of non-current liabilities. In 2022, the proportion of long-term loans of North China Pharmaceutical in total liabilities was higher than that of the other two pharmaceutical companies, which was partly affected by high R&D investment. While North China Pharmaceutical strengthens technology research and development, it should also pay attention to its possible risks. When the capitalization ratio of R&D investment is high and the conversion efficiency is insufficient, the company is prone to impairment of intangible assets, which will increase the pressure on capital [10].

In addition, more long-term borrowings could bring interest costs and increase capital pressure. The proportion of long-term borrowings of Sinopharm in total liabilities was low. The study finds that it reduced the pressure of debt repayment through the implementation of an equity swap. In addition, Sinopharm focuses on the research and development of ephedrine drugs with monopoly advantages, avoiding the widespread investment in research and development, and the gross profit margin and market share are also high. The analysis shows that the risk causes of North China Pharmaceutical include low gross profit margin, unclear R&D conversion efficiency, high short-term borrowings, low inventory turnover, high operating costs, low accounts receivable turnover, low accounts payable turnover, and a high proportion of long-term borrowings in total liabilities. Next, specific improvement suggestions will be put forward for these problems.

5. Discussion and Suggestions

First, product-level improvement is important. In terms of R&D, North China Pharmaceutical should choose the first generic drug, drugs in specific fields, and core raw materials for targeted investment. Through targeted investment in the first generic drugs, drugs in different fields, and core raw materials, it can not only reduce the market competition pressure of its drugs, but also reduce the capital pressure of R&D investment. If it develops core production raw materials independently, it can reduce dependence on outsourcing and expand profit margins. Secondly, it can also sell the equity of subsidiaries and list the actual R&D expenses on the financial statements of the opposite company, so as to realize the stripping of R&D expenses and beautify the statements [11]. Finally, the government should also strengthen the policy formulation of the integration of production, learning, and research, and introduce more differentiated tax preferential policies to promote the efficiency of pharmaceutical R&D transformation [12]. In terms of production, the company can optimize material allocation and reduce production waste by introducing big data and artificial intelligence technology, and equip itself with an advanced MES production management system. At the same time, the company can also try to lay out the basic supply chain overseas, especially in Asia, Latin America, and other places, to reduce costs.

Second, improving turnover efficiency is important. First, in terms of accounts receivable, the company can securitize its accounts receivable by issuing asset-backed notes with low cost and high efficiency. This practice can not only reduce liabilities and beautify statements, but also promote the return of company funds. At the same time, pharmaceutical companies can comply with the development trend and build a big data analysis platform to find high-value and high-credit customers through real-time and accurate big data analysis. So, it could promote sales collection and reduce the accumulation of bad debts. Second, in terms of inventory, pharmaceutical companies can actively develop exclusive varieties, such as some healthcare drugs and diet therapy products, to occupy market share. The company could also actively use various national pharmaceutical export policies to expand overseas markets, so as to expand sales and reduce inventory accumulation. At the same time, it can also comply with the national pharmaceutical e-commerce industrial chain development plan, actively integrate into the whole industry chain service system, and expand sales channels through major online platforms. For example, it can expand sales through cooperation with e-commerce platforms, and it could also cooperate with takeout platforms to connect online consultation and drug distribution. Pharmaceutical companies can conduct live-streaming promotions through various social media platforms and actively establish customer communities to provide comprehensive and timely sales support services.

Third, it is important to broaden financing methods. Huabei Pharmaceutical can carry out an equity swap to win time to ease the financial pressure. At the same time, it can also reduce short-term and long-term borrowings, optimize the disposal of liabilities, and improve the company's credit rating. In addition, in the later stage of R&D achievements transformation, the market expectation of R&D products is often better. Therefore, pharmaceutical companies can choose to implement patent pledge financing. This approach not only reduces the financial pressure but also has high financing efficiency. Finally, when selling the equity of subsidiaries, pharmaceutical companies can choose to transfer the equity of subsidiaries to other financial companies. In this way, when pharmaceutical companies face financing difficulties in the later stage, they can obtain financing help from partners to a certain extent, so as to relieve their own financial pressure.

6. Conclusion

This paper examines and selects two financial risk early warning models, F1 and F2, and explores the risk causes of pharmaceutical companies by using the method of comparative research within the industry. The study finds that Huabei Pharmaceutical, one of the case pharmaceutical companies, had high financial risks. Through the disassembly of financial indicators and the comparative study with two other pharmaceutical companies in the same industry, the specific risk causes are analyzed. It is found that its financial risk is affected by low gross profit margin, unclear R&D conversion efficiency, high short-term borrowings, low inventory turnover, high operating costs, low accounts receivable turnover, low accounts payable turnover, and a high proportion of long-term borrowings in total liabilities. According to the causes of these risks, combined with the practices of pharmaceutical companies with good risk status, targeted improvement suggestions are put forward. At the product level, North China Pharmaceutical can select the target of R&D investment, sell the equity of some subsidiaries, and optimize the production management system. The government should also strengthen policy and financial support. In terms of turnover efficiency, it can issue asset-backed notes, find high-value customers, and expand overseas markets and online sales channels. In terms of financing methods, it can implement a debt-equity swap, choose patent pledge financing in the later stage, and choose financial companies as the object of equity sale. To a certain extent, this paper can make up for the blank in the current multi-financial risk early warning model research and industry internal comparative research. It could provide certain reference value for managers and investors, and also provide certain research ideas for subsequent researchers in this field. However, this paper also has some shortcomings. First, the case study objects are limited to large-scale pharmaceutical companies, so the conclusions may not be fully applicable to small and medium-sized pharmaceutical companies. In addition, only three financial risk early warning models are selected for detection and analysis. In the future, more new and more efficient financial risk early warning models can be developed.

References

[1] Altman E I. Financial Ratios, Discriminant Analysis and the Prediction of Corporate Bankruptcy. The Journal of Finance, 1968, 23(4): 589-609.

[2] Zhou Shouhua, Yang Jihua, Wang Ping. On Early Warning Analysis of Financial Crisis——F-Score Model. Accounting Research, 1996, (08): 8-11.

[3] Zhang Ling. Financial Crisis Early Warning Analysis Discrimination Model and Its Application. Forecast, 2000, (06): 38-40.

[4] Li Huiyuan, Wang Shufeng. Research on Financial Risk Control of Pharmaceutical Circulation Enterprises Based on Capital Chain—Take RK Medicine as an Example. Finance, 2023, 13: 200.

[5] Endri E, Susanti D, Hutabarat L, et al. Financial Performance Evaluation: Empirical Evidence of Pharmaceutical Companies in Indonesia. Systematic Reviews in Pharmacy, 2020, 11(6): 803-816.

[6] Hui T Y, Yu W H. An Empirical Study on the Relationship Between R&D Investment and Firm Performance. Scientific Journal of Economics and Management Research, 2021, 3(3).

[7] Zhu Z, Zhang J, Gong C, et al. Impacts of China’s National Volume-Based Procurement Policy on the Pharmaceutical Industry: A Systematic Review. Pharmacoeconomics and Policy, 2025.

[8] Zhai Jinlong, Fu Shuyong. Measurement, Influencing Factors and Government Intervention Policies of R&D and Achievement Transformation Efficiency of Domestic Pharmaceutical Enterprises—A Case Study of A-Share Pharmaceutical Manufacturing Listed Enterprises in Beijing-Tianjin-Hebei Region. Chinese Journal of New Drugs, 2025, 34(14): 1478-1485.

[9] Xu Liying, Weng Kunling, Jiang Dan, et al. Evaluation of Innovation Efficiency of China's Pharmaceutical Industry Based on Three-Stage DEA. China Pharmacy, 2020, 31(16): 1921-1926.

[10] Ye Fan, Ye Qinhua, Huang Shizhong. Identification and Response of Financial Fraud Under the “New Medical Policy”—A Case Study Based on Guangyuyuan. Monthly Journal of Finance and Accounting, 2025, 46(04): 12-17.

[11] Liu Hongbin, Chen Zeyuan. Haizheng Pharmaceutical Asset Divestiture: Value Creation of Business Risk Isolation. Accounting Communication, 2023, (10): 121-126.

[12] Sun Li, Meng Haihua. Restriction Factors Analysis and Strategic Planning Suggestions for the Transformation of Biomedical Scientific and Technological Achievements in China. Research on Science and Technology Management, 2023, 43(02): 144-150.