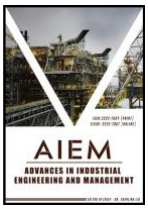
ZIBELINE INTERNATIONAL™ PUBLISHING

ISSN: 2222-7059 (Print)
EISSN: 2222-7067 (Online)

Advances in Industrial Engineering and Management (AIEM)

DOI: http://doi.org/10.7508/aiem.01.2023.10.13



CrossMark

REVIEW ARTICLE

RESEARCH ON EARLY WARNING OF ENTERPRISE FINANCIAL RISK BASED ON NEURAL NETWORK MODEL

Shuping Luo, Ziying Zhang, Shuwen Yang, Huayan Cai*

Accounting School, Guangzhou Huashang College, Guangzhou 511300, China
**Corresponding Author E-mail: he02kenwolin22824@126.com*

ARTICLE DETAILS

Article History:

Received 19 January 2022
Accepted 23 February 2022
Available online 15 March 2023

ABSTRACT

The economic environment is constantly changing in the course of rapid economic development, with more opportunities and more risks for companies. In the unpredictable market environment and fierce business competition, it is particularly important to establish a flexible and efficient early warning mechanism for financial risks. The zeta model and the Fisher linear discriminant model proposed in the existing research results have both passed empirical tests and have been applied in practice for many years, but the effectiveness and stability of early warning still needs to be improved and the failure of early warning mechanisms has become the norm. The geometric growth of large volumes of structured and unstructured data requires a multidimensional, all-encompassing, high-velocity early warning mechanism for financial risks. The emergence of big data technology and artificial intelligence has provided ideas and conditions for the establishment of new models of financial early warning. This paper analyses the financial risk warning situation of Company X by constructing a BP neural network model to obtain the financial risk warning situation from 2016 to 2021 respectively, analyses the internal and external factors leading to the emergence of financial risks, and gives corresponding countermeasure suggestions in a targeted manner.

KEYWORDS

Neural network model, financial risk, warning

1. INTRODUCTION

With the rapid development of big data artificial intelligence, finance is facing great transformation, such as the increasing volume of data, difficulties in information identification, low efficiency and excessive consumption of resources. While the risks in the market economy are increasing, the difficulty and importance of early warning work on corporate financial risks is also increasing. In this context, it is important to use the technology of artificial intelligence to design financial risk warning mechanisms, improve the sensitivity of enterprise financial risk warning, optimise enterprise financial risk control work, enhance the enterprise's risk response capability, better protect shareholders' rights and interests, and improve the economic and social benefits of the enterprise.

2. FINANCIAL RISK WARNING OVERVIEW

2.1 Characteristics of Financial Risk Warning

Financial risks are generally characterised by the following three aspects. Firstly, it is predictive. An effective financial risk early warning system should be able to collect a wide range of financial and non-financial information and, based on the information collected, carry out screening, collation, analysis and forecasting to determine the current level of risk of the enterprise, predict the development trend of the enterprise's financial risk and identify and respond to possible risks in a timely manner. Secondly, sensitivity, the financial risk early warning model is constructed with multi-dimensional financial indicators and different non-financial indicators, through the analysis of indicators to make effective early warning. If there is an indicator that has a significant impact on the early warning results, the early warning model will continuously focus on the changes in that indicator to effectively identify where the risk lies. Finally, effectiveness, enterprises are in the general market environment, the risks they face are constantly changing, there is a certain degree of uncertainty, but the financial risk early warning system can track and monitor some relatively sensitive indicators, to make effective judgments on possible financial risks (Gao, 2021).

2.2 Functions of Financial Risk Warning

Financial risk warning has three main functions; predictive function, diagnostic and therapeutic function, and preventive function (Pan, 2021). The forecasting function refers to the most important function of financial risk early warning, which is to analyse the extent of financial

Quick Response Code	Access this article online	
	Website: www.aiem.com.my	DOI: 10.7508/aiem.01.2023.10.13

Cite The Article: Shuping Luo, Ziying Zhang, Shuwen Yang, Huayan Cai (2023). Research on Early Warning of Enterprise Financial Risk Based on Neural Network Model. *Advances In Industrial Engineering And Management*, 12(1): 10-13.

risks and predict their trends through the development of risk early warning models based on the financial and non-financial information collected. The diagnosis and treatment function means that when there is an abnormality in a certain indicator of the enterprise and it may bring financial risk to the enterprise, the financial risk early warning system can effectively identify the factors affecting the stability, immediately capture and issue warning signals, and remind the relevant personnel to take corresponding measures to prevent further deterioration of the risk. The prevention function means that the final output of the early warning system can determine the causes of risks, identify the problems in the process of enterprise management and improve them, is the enterprise's management into a virtuous cycle, reduce financial risks and at the same time can effectively prevent the generation of financial risks.

3. FINANCIAL RISK EARLY WARNING MODEL

3.1 EMS Model

The Emerging Markets Scoring Model, also known as the EMS model, was first proposed and developed by Altman et al. in 1995 in response to the market. The model is a refinement of the Z-Score model and is used in emerging markets to rate the risk of country bond issues. It is very similar to the 'Z' model, with the first three variables X1, X2 and X3 taking on the same values as the Z-Score model. The difference is that X4 represents the book value of shareholders' equity, removing the asset turnover variable represented by X5 and thus minimising the influence of the industry. As it is replaced by a book value, a broader value in use is created. The emerging market score model is a model for early warning of a company's financial risk, and involves a combination of solvency, profitability, operational capacity and growth capacity.

3.2 Neural network models

A neural network model is a network system with a large number of neurons connected. BP neural networks, also known as back propagation neural networks, consist of 3 parts: model training, model detection and model learning (Guan and Wang, 2016). The BP neural network operation process generally consists of five steps: the first is to determine the number of layers of the model's hidden layers, the second is to determine the number of nodes in the input, output and hidden layers respectively, the third step determines the threshold and learning rate, the fourth outputs the results of the hidden and output layers, and the fifth calculates the error and updates the threshold. Neural network models have obvious advantages over other early warning models, for example, they do not have to consider whether the sample fits the statistical characteristics, they do not have high requirements for the sample, they have better fault tolerance, missing individual data does not affect the final result, and they have better learning power and adaptability. Based on the above advantages this model is chosen to study the early warning of financial risks.

4. NEURAL NETWORK MODEL CONSTRUCTION AND TRAINING

4.1 Training Sample Selection and Indicator Screening

This paper takes into account the financial and non-financial indicators of the enterprise and selects the return on net assets, cost margin, net sales margin and EVA economic value added from the profitability. Selecting total asset turnover, accounts receivable turnover, current asset turnover and inventory turnover from operating capacity. Selection of equity ratio, current ratio, gearing ratio and net cash flow ratio from solvency. Selecting the growth rate of net assets per share and the ratio of total cash liabilities from the development capacity. The debt-to-equity ratio of R&D investment rate and risk level in R&D capability is selected, while the equity structure and legal liability are used as non-financial indicators. On this basis, an early warning system for financial risks is constructed.

4.2 Construction and Training of Neural Network Models

4.2.1 Determination of Input and Output Layer Variables

Table 1: Table of Financial Risk Early Warning Analysis Indicators

	Tier 1 indicators	Serial number	Secondary indicators
Financial Indicators	Profitability	A1	Return on net assets
		A2	Cost Margin
		A3	Net sales margin
		A4	EVA Economic Value Added
	Operating capacity	B1	Total asset turnover ratio
		B2	Accounts Receivable Turnover Ratio
		B3	Current asset turnover ratio
		B4	Inventory turnover rate
	Solvency	C1	Equity ratio
		C2	Current ratio
		C3	Gearing ratio
		C4	Net cash flow ratio
	Development capacity	D1	Net assets per share growth rate
		D2	Total cash liabilities ratio
	R&D capabilities	E	R&D investment rate
	Risk level	F	Debt to equity ratio
Non-financial indicators	Shareholding structure	G	Percentage of shareholding of the largest shareholder
	Legal liability	H	Major Violations

Neural network models usually use the number of independent variables as the number of nodes in the input layer. In this paper, a total of 18 valid indicators are selected through linear relationships, i.e., 18 variables are used as the number of input nodes for neural network models. The neural network model usually takes the number of final sample categories as the number of nodes in the output layer. In this paper, according to the characteristics of real estate listed companies, they are divided into 5 alert levels: safe, good, average, light and heavy, so the output layer nodes are 5, and the labels are set to 0, 1, 2, 3, 4 and 5 respectively.

4.2.2 Determine the Number of Nodes in the Hidden Layer

Scientifically setting the number of nodes in the hidden layer is a very crucial step in building a neural network model, as the number of hidden nodes in the model determines the speed of convergence of the model. If the number of hidden nodes is set low, the BP neural network will not be able to learn the relevant patterns through training, but if the number of nodes is set too high, the training time of the model will be forced to be stretched in the end, and some invalid content will be learned as well. However, there is no uniform statement on how to set the optimal number of nodes in the hidden layer. Therefore, in order to ensure the effectiveness of the model learning, repeated attempts were made in the experiments, and the results of 7 and 8 were relatively good. Finally, in this paper, 7 was chosen as the hidden layer check node and an 18-7-5 neural network model was constructed.

4.2.3 Training of Neural Network Models

This paper calls the python Keras advanced neural network application programming interface to build a BP neural net to set the learning rate of the model to 0.06. According to the experience of previous scholars, the learning rate of the model is set in the range of 0~0.9, which can ensure a good convergence of the model. The Adaptive momentum optimisation algorithm, which uses fewer resources, was also chosen. 200 listed real estate companies in China were used as samples for training, and the number of training sessions was set to 1000. The results of the final model run showed that the accuracy rate for all categories of samples was above 90%, with the highest accuracy rate of 94.2% for the third category of samples.

4.3 Early Warning Analysis of Company X's Financial Risk Based on BP Neural Network

Founded in 1992, X has a diversified business development strategy with groups and subsidiaries in several countries around the world and has been in the top 500 companies in the world for many years. The current X Company combines industrial diversification, rapid growth and global operations, operating and developing in a number of areas such as real estate companies, infrastructure and finance. Company X's rising sales from 2016-2019 have attracted widespread attention, but the growth rate for 2020-2021 has slowed and may have seen a sluggish or even declining growth in the real estate business, which faces certain risks and challenges. The financial indicators of Company X from 2016 to 2021 were input into the neural network model and the simulation results were as follows.

According to the simulation results, it can be seen that since the listing of Company X, its financial risk is relatively good in 2016 and 2018, but less optimistic in 2019-2021, it can be said that the implicit financial risk of the company is gradually increasing, which also illustrates the impact of the general environment of the epidemic on real estate companies. Specific analysis of the company's internal financial risk issues is set out below.

4.3.1 Risks of Financial Leverage

When most real estate companies carry out the initial development of a project, they have the need to borrow from banks and other financial institutions due to their own lack of funds or problems with their turnover rate, which in turn continues to put their financial leverage at a disadvantageous position and predisposes them to the negative impact of financing financial risks. From a risk control point of view, investors are happy to invest in real estate companies like X and most financial institutions, for example, grant higher loan amounts to the company. However, it should not be overlooked that the company relies on absorbing borrowed inputs and so on to obtain benefits, financial leverage will become high, the rate of return will also become high. And high returns are often accompanied by high risks, once the risks are difficult to control with the situation, the income of the company including the entire capital system will be affected or even fall into difficulties, the negative effects of financial leverage will make the interests of the company and investors more and more intense.

4.3.2 Declining Recovery Realisation

The poorer the recovery realisation, the greater the risk of incurring bad debts, significantly reducing the efficiency of the use of corporate funds and ultimately increasing the likelihood of risks arising from the movement of corporate assets. Most companies blindly increase the scale of investment and expand their development projects in this way, neglecting the operation of the internal capital chain of the company, and in fact the cash flow is unstable or even broken at any time. Once funds are in a difficult situation, the company's internal weaknesses in managing funds and high capital indebtedness become apparent and the financial risk increases steeply. This is a drawback caused by the fact that most real estate companies are more concerned with making profits than with the inadequacy of their internal control systems.

4.3.3 Poor Inventory Turnover

A more significant drop in inventory turnover indicates that the company has a lot of appropriated funds, which may affect the liquidity of more funds, which in turn affects capital efficiency and leads to lower cash inflows to the business. If this issue is not taken seriously, it could impact on the short-term solvency of the business. In 2017, Company X's inventory turnover ratio was at its lowest in the last five years, presumably the expansion of the market did not have the desired effect and instead led to an increase in internal raw material inventories, which, combined with a less than perfect management philosophy in terms of inventory management, ultimately resulted in a poor inventory turnover ratio indicator. This is directly related to the reduction of the company's short-term solvency, which affects the profitability of the business and the efficiency of the use of capital.

5. RECOMMENDATIONS

5.1 Enhanced Early Warning Awareness of Financial Risks

Financial risk management is a relatively extensive and comprehensive management, and requires a certain knowledge base of managers. The necessary mathematical and statistical knowledge and the ability to handle and analyse data will better meet the company's development objectives. In addition, the risk awareness and strategic decisions of the managers are directly related to the direction of the company's future development, and the quality and competence of the financial staff have an impact on the ability to carry out their work, and thus on the changes in the structure of the company's financial risk management organisation. They need to have a basic understanding of business operations in the current era, with an emphasis on developing early warning awareness of financial risks.

On the one hand, executives need to work with managers to establish a

Table 2: Table of Financial Risk Warning Results

Reporting period	Financial risk warning situation	Reporting period	Financial risk warning situation
2016	Good	2019	General
2017	General	2020	Mild warning
2018	Good	2021	Severe warning

financial risk early warning system within the business so that internal staff can implement the content of the early warning system well and follow through on risk prevention throughout the financial management process. On the other hand, this is used to improve the ability of internal staff to interpret information. We identify as accurately as possible the static and dynamic financial information of a company, use different indicators for different information, carry out focused calculations and analysis, and then refine the impact of the nature and structure it contains on the business operations of the company. The deeper information on tabular data and surface information requires sound management discussion and analysis of the financial implications and timely guidance on the direction of adjustments. By improving the ability to interpret information, the role of financial early warning analysis and the awareness of risk warning among personnel can be continuously enhanced.

5.2 Establishment of an Early Warning Adjustment Mechanism

The sudden fall of the new crown epidemic at the beginning of 2020 brought an unexpected shock to all sectors. As a result of the epidemic, the real estate sector came to a virtual standstill, with sales of commercial properties and sales volume plummeting nationwide. The establishment of a comprehensive risk warning mechanism by the Company helps to provide early warning before a crisis occurs, to take timely action to address the risk and to reduce the financial risk of significant losses to the Company. Therefore, consider the different aspects of the development of an early warning mechanism for financial risks and the establishment of relevant bodies in the sector to monitor in real time in order to detect risks. Strengthening the collection and use of daily accounting information to complement and improve the financial risk management system. From time to time, risk tests are organised and the results are analysed to propose ways of improvement, reflecting changing trends and economic performance. The updated data will be compared with the normal range of the corresponding indicators, and if the range is exceeded, early warning signals and adjustment suggestions will be automatically generated to maintain a stable operational status of the company.

A good early warning system will inevitably have a real-time database to support its financial information and can quickly identify potential financial risks based on the data. Analyse the linkages between multiple financial indicators in an integrated manner to capture possible adverse factors behind the figures and to speculate on future trends in financial conditions and business operations. With the gradual resumption of work and production across the country and the continued release of effective demand in the property market, the company's situation has only slightly improved. As can be seen, for weaknesses in business development, companies should have contingency plans in place to deal with risks before they occur and be able to respond comfortably and adjust appropriately in response to established plans in order to reduce the impact of risks on the business and ensure the company's smooth and healthy development.

5.3 Improve Financial Risk Early Warning System

The financial risk early warning system is a modern company management model that originated in the Western economy. For a long time, China has been seeking ways to establish a scientific and orderly financial risk early warning system for companies. Firstly, early warning indicators are selected through a sound financial analysis, taking into account factors such as the operational feasibility of the indicators and the accuracy of the data. We understand the aspects of financial crisis and use a combination of methods to determine the financial risk of the company and immediately develop appropriate measures to minimise losses. Secondly, in order to identify in a timely manner the various problems that objectively exist in the company and to strengthen supervision and management, the causes of deviations are explored and analysed for the financial indicators that are not observable, to find out the deeper accounting and management information they contain and then improve them. For example, when the accounts receivable turnover rate decreases, it means that the accounts receivable cannot be collected in a timely manner and collection should be urged or the reasons for the failure to collect should be sought. Finally, through the indicators of the financial early warning system to carry out in-depth financial analysis, according to the current existence of hidden dangers, predict the future development trend of risk, deep investigation of its causes and improve operational strategies to seek reasonable avoidance or transfer of financial management risks. Only through the implementation of internal risk control can the financial early warning analysis system play a warning role in the internal control system.

At the same time, strict control over the follow-up management of financial alerts, the changes in financial data determine that the early warning system is not static, but also requires follow-up updates and maintenance to provide reasonable supervision. The maintenance work is to ensure the security and integrity of the database, so that the financial early warning system can run smoothly and orderly, and smoothly achieve the exchange of information with other management systems. The purpose of updating and improving the financial warning system is to ensure that the basic financial warning mechanism is in place by providing an orderly upgrade of financial transaction data, indicator systems, key criteria and other information. Managers must also take care to implement early warning and risk control measures so that the company can identify deficiencies and remedy them in time to achieve greater operating profitability.

6. CONCLUSION

The advantage of the neural network model is that it is based on a full sample of data and collects real-time data from multiple dimensions, while not limiting itself to analysing specific financial or non-financial indicators, but selecting them according to the needs of each warning, thus guaranteeing the accuracy and stability of the warning. This paper analyses the early warning situation of Company X's financial risk by constructing a BP neural network model and obtains the relevant results, which are good for 2016 and 2018, average for 2017 and 2019, and light and heavy alerts for 2020 and 2021 respectively. The analysis of the general environment is influenced by the epidemic and the domestic economic downturn. From the internal analysis of the company, Company X has problems such as financial leverage risk, declining recovery and realisation ability, and poor inventory turnover. In response to the problems, this paper gives corresponding countermeasures, suggesting Company X to use neural network models to assist management in financial risk management decisions, set up a flexible and effective early warning and adjustment mechanism, and improve the financial risk early warning system.

ACKNOWLEDGEMENT

"Research on early warning mechanism of enterprise financial risk based on neural network model", a young academic research project within the university in 2021(Item number: 2021HSQX01); Research on Early Warning Mechanism of Financial Risks of Enterprises in the Era of Digital Intelligence", a project of Guangdong Province General Universities in 2021(Item number: 2021WTSCX121).

REFERENCES

Gao, S. 2021. Early warning analysis of financial risk of company X based on PSO-BP neural network. Shanghai Business, 2021(01), Pp. 127-129.

Guan, X., and Wang, Z. 2016. Comparison of financial early warning models based on Logistic regression and BP neural network. Statistics and Decision Making, 2016(17), Pp. 179-181.

Pan, Y. 2021. On big data and enterprise financial risk early warning. National Circulation Economy, 2021(06), Pp. 168-170. https://doi.org/10.16834/j.cnki.issn1009-5292.2021.06.053.