Early warning method for enterprise financial informatisation caused by tax difference

Guojian Lin and Weichuan Chen*

School of Management,
Putian University,
Putian, Fujian Province 351100, China
Email: 49848153@qq.com
Email: weichuan@mls.sinanet.com
*Corresponding author

Abstract: Low accuracy occurs when the traditional method only considers the financial report index when designing the early warning model, and ignores the influence of non-financial data on the early warning model. In order to overcome this problem, based on the discrete-time risk model, this paper proposes an early warning method of enterprise financial information caused by tax differences. Starting from the establishment of enterprise financial information early warning system, this paper analyses the importance of tax indicators to enterprise financial information early warning model. By studying the early warning system, we select index data in the model, add tax difference indicators, select multi-period panel data, and use discrete-time risk model to build enterprise financial information early warning model. The experimental results show that the accuracy of this method is as high as 99.05%, and there is no multicollinearity among the variables in the model, which is reliable.

Keywords: tax differentials; enterprise finance; informatisation; early warning; discrete time risk model.

Reference to this paper should be made as follows: Lin, G. and Chen, W. (2022) 'Early warning method for enterprise financial informatisation caused by tax difference', *Int. J. Information Technology and Management*, Vol. 21, Nos. 2/3, pp.248–263.

Biographical notes: Guojian Lin received his MA in School of Economics from the Xiamen University in 2006. He is currently an Associate Professor in the School of Management of Putian University. His major research includes finance and taxation.

Weichuan Chen received his Doctorate in PhD in Business from the Feng Chia University, Taiwan of China. He is currently an Assistant Professor in the School of Management of Putian University. His major research includes marketing, e-government, and quality of work life for healthcare.

1 Introduction

With the continuous progress of economy, science and technology, the current accounting standards are changing. Under this background, people pay more attention to the tax difference between taxable income and accounting profit. So far, most scholars

have studied the tax difference (Sun, 2018). Scholar Plesko mainly studies the tax differences of listed companies in a certain period of time. Through the research, it is found that the main factors causing the tax differences of listed companies are external economic conditions, tax laws and accounting standards with significant differences. Scholar Desai believes that through the differences between systems, it can solve one part of the causes of tax differences, and the other part is the earnings management between major companies and enterprises. It is related to the motivation of tax avoidance. At the same time, the domestic scholar Lu Zhengfei divides the tax difference into two types, one is the tax difference driven by earnings management, and the other is the tax difference driven by tax avoidance. In order to obtain their own best interests, listed enterprises evade tax revenue by means of earnings management and tax under compulsory tax policy and self-selected accounting policy (Yuwen et al., 2017). After the above analysis, the causes of tax differences are divided into three categories: earnings motivation management, system differences and tax avoidance motivation, and the important deterioration indicator of the financial situation of enterprises is tax difference (Zhao et al., 2017). In order to reduce the financial crisis caused by tax differences and promote the steady and healthy development of enterprises, it is necessary to study a financial information early warning method caused by tax differences. At present, the enterprise financial information early warning method does not take the tax difference index into account. Although some research results have been achieved, there are always some problems. At this stage, the research results of financial information early warning method are as follows.

Han et al. (2016) proposes an early warning method of enterprise financial informatisation based on principal component analysis (PCA) and BP neural network. Taking financial ratio as conditional attribute and financial informatisation risk as decision attribute, a financial early warning decision system is constructed. Through PCA, the minimum attribute set is obtained, and the financial ratio corresponding to the minimum attribute set element is taken as the input of the neural network. The training sample is used to train the neural network. The training samples are used to train the neural network, and the trained neural network model is used to realise the early warning of enterprise financial informatisation. However, the method has the problem of low accuracy in the practical application process. Kim et al. (2018) proposes an early warning method of enterprise financial informatisation based on large data. At present, the problems of enterprise financial management and the necessity of enterprise accounting information construction under the background of big data era are analysed. Based on big data technology, a systematic and scientific enterprise financial information system is established, and a feedback mechanism of 'execution-early warning-feedback-adjustment' accounting information is constructed to realise the early warning of enterprise financial information. However, the precision of early warning is low in this method, and the practical application effect is not good. Diks et al. (2018) proposes an early warning method of enterprise financial informatisation based on multi-expert grey comprehensive evaluation. The qualitative indicator system of financial informatisation early warning and its scoring criteria are designed. Then, according to the characteristics of financial informatisation early warning, a grey comprehensive evaluation model of financial crisis possibility is constructed. The grey types of possibility evaluation for enterprise financial crisis and corresponding grey number and whitening weight function are set up concretely. Finally, an example is given to illustrate

the specific process of early warning for enterprise financial informatisation based on grey comprehensive evaluation, but this method has the problem of low precision of early warning.

Through the above scholars' research, we can partly improve the early warning method for enterprise financial informatisation, but the above scholars have not studied the early warning of enterprise financial informatisation from the perspective of accounting information distortion. At the same time, because listed companies in China do not publish tax returns to the outside world, domestic scholars seldom study the impact of tax indicators on enterprise financial informatisation. But China has certain compulsory in calculating the tax revenue target. Through the fusion of tax revenue target and the accounting target, it has the positive influence to the high-efficiency forecast of enterprise's own crisis situation. Therefore, this article will set the entry point as the tax difference, will set the research object as our China's listed enterprise, at the same time, in the early warning method for enterprise financial informatisation, the tax target will be added. It is of great significance for expanding the research field of early warning of enterprise financial informatisation and promoting enterprise development. The overall framework of the method is as follows:

1 Starting from the establishment of the early warning system for enterprise financial information, this method explores the importance of tax indicators for early warning of enterprise financial information.

2 By researching the indicator data of the selection model in early warning system, tax difference indicator in the traditional early warning model for financial informatisation is added, to select multi-period panel data. Discrete-time risk model is used to build the early warning model for enterprise financial informatisation.

3 The prediction accuracy of different research methods is compared by the experiment.

4 Conclusion.

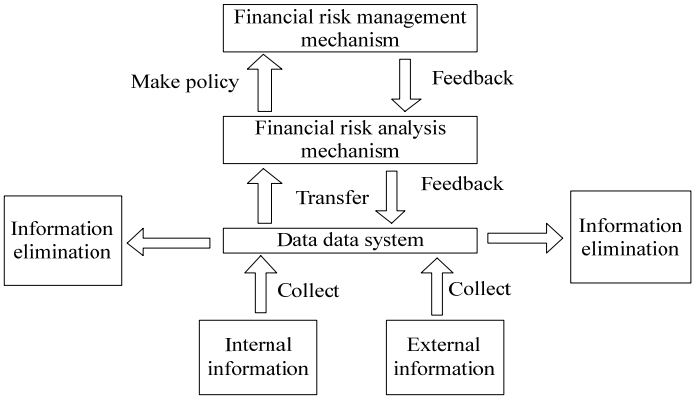
2 Early warning method for enterprise financial informatisation caused by tax difference

Because the traditional methods do not study the early warning of enterprise financial information from the perspective of accounting information distortion, nor do they study the impact of tax indicators on enterprise financial information. Therefore, this paper sets the starting point as tax difference, sets the research object as listed enterprises in China, and proposes the early warning method of enterprise financial information based on discrete-time risk model. The main purpose of this study is to make the financial information early warning model constructed in this paper have the characteristics of high early warning accuracy and no multicollinearity among the variables in the model, so as to promote the stable and healthy development of the enterprise economy.

2.1 Construction of early warning system for financial informatisation caused by tax difference

Before designing the early-warning method for enterprise financial informatisation, it should design the early-warning system for enterprise financial informatisation. Through the early-warning system, it can check the financial status of enterprises (Cipollini et al., 2018). At the same time, it can select the more important indicators in the early-warning method for enterprise financial informatisation by studying the early-warning system. The overall structure of the early-warning system for enterprise financial informatisation is shown in Figure 1.

Figure 1 Structure diagram of enterprise financial information early warning system



As can be seen from Figure 1, the early warning system of enterprise financial informatisation firstly collects internal and external information of the enterprise, including tax policy, financial situation and operating results. The collected information is stored into the data system, and the information which has less influence with enterprise financial informatisation is eliminated through the data system (Hong et al., 2016). The remaining letters are analysed through the financial risk analysis mechanism. The influence degree of financial informatisation of interest-bearing enterprises is dealt with through the financial risk processing mechanism, and the results are fed back to the financial risk analysis mechanism, and finally to the data and data system.

2.2 Construction of early warning model for enterprise financial informatisation caused by tax difference

2.2.1 Variable design of enterprise financial information early warning model

Before constructing the early warning model for enterprise financial informatisation, the variables in the model should be designed. The design process is as follows.

2.2.1.1 Variable of enterprise financial crisis

On the basis of the designed warning system, after investigation and analysis, it is found that when the enterprise has delisting risk due to two consecutive years of loss, the above risk is defined as enterprise financial crisis, and the sign of enterprise falling into financial crisis and deteriorating financial situation is set as enterprise being excluded due to two consecutive years of loss (Huang et al., 2016). When choosing samples of financial crisis, we can judge whether an enterprise has financial crisis in the n^{th} year by warning whether it has been withdrawn from the market in the $n + 1^{th}$ year. At the same time, *DIST* is used to express the enterprise financial crisis variable. When the enterprise is warned to withdraw from the market in the $n + 1^{th}$ year, the value of the enterprise financial crisis variable is 1. When the enterprise is not warned to withdraw from the market in the $n + 1^{th}$ year, the value of the enterprise financial crisis variable is 0.

2.2.1.2 Variable of tax difference

When estimating the variable of enterprise tax difference, the total income tax expenses and profits in the consolidated statement are mainly used. The actual income tax rate of the enterprise is the applicable tax rate. The detailed calculation process is as follows:

$$SSC = \frac{(LZ - YN)}{QZ} \tag{1}$$

In the formula, *SSC* denotes the tax difference, *LZ* denotes the total profit, *YN* denotes the taxable income, *QZ* denotes the total assets at the end of the period, and *LZ* is selected from the data of the current consolidated statements of listed enterprises. The formula for calculating the taxable income is as follows:

$$YN = \frac{DS}{QS} = \frac{SD - DY}{QS} \tag{2}$$

In the formula, *DS* denotes current income tax expenses, *QS* denotes actual income tax rates of enterprises, *SD* denotes income tax expenses, *DY* denotes deferred income tax expenses, and tax differences are divided into positive tax differences and negative tax differences (Panda and Rath, 2016). Among them, positive tax differences are arranged in ascending order according to the annual quintile, with the highest five points in the current year. When there is a tax difference in the position, it shows that the tax difference at this time is a large positive tax difference. *LPB* is used to express the positive tax difference. When *LPB* is a large positive tax difference, the value of *LPB* is 1, whereas the value of *LPB* is 0. At the same time, when the annual minimum quintile contains tax difference, it is regarded as a large negative tax difference, and the negative tax difference is expressed by *LNB*. When *LNB* is a large negative tax difference, the value of *LNB* is taken as 1, whereas the value of *LNB* is taken as 0.

2.2.1.3 Indicators of financial crisis early warning

By investigating and analysing the operating characteristics of domestic listed enterprises, it should select a comprehensive financial indicator system, which can cover all aspects of financial information of enterprises. PCA is used to extract the principal component factors with a greater degree of explanation, and the logic is established by

extracting the factors. The PCA method is used to extract the principal component factors with a greater degree of interpretation. By extracting factors, a logistic regression model is established, and the selected sample data are brought into the logistic regression model, then the financial crisis prediction value is obtained, to obtain the final financial crisis early warning index. Among them, financial reporting indicators refer to the obtained forecast value of financial crisis. In this method, eight categories of financial indicators are selected to represent the cash flow of enterprises. Eight types of indicators include operating capacity, short-term and long-term solvency, profitability, growth capacity, cash flow status, shareholder profitability and enterprise risk ability (Yan et al., 2016). At the same time, *FIN* is used to express the early warning indicator of financial crisis.

2.2.1.4 Control variables

The control variables designed in the early warning model of enterprise financial informatisation constructed in this paper should include three control variables: virtual variables, earnings quality indicator and enterprise scale. The three control variables are analysed in detail in following.

Firstly, *NEG* is used to represent the virtual variables, and virtual variables are added to the model to make the model more detailed. Through this model, we can explore the systematic differences between loss-making enterprises and profit-making enterprises. When the net profit of enterprises is negative, the value of *NEG* is 1, whereas the value of *NEG* is 0. Secondly, the indicator of earnings quality is expressed by *YZ*, through which earnings management can be affected, so as to control the extent of the impact of earnings management on the financial situation of enterprises. In the enterprises with high earnings quality, the value of *YZ* is 0, whereas the value of *YZ* is 1. At the same time, it should adopt some methods to define the low earnings quality. This paper sets the definition standard as the manipulative accrued profit of the enterprise. Low earnings quality refers to the earnings quality of the listed enterprise which contains the manipulative accrued profit in the top 20% of the annual industry. At the same time, the revised Jones model should be adopted to calculate the manipulative accrued profit. Finally, *Tq* is used to express the size of the enterprise. One of the important reasons for the financial crisis is the size of the enterprise. The size of the enterprise is calculated by the logarithm of the total assets at the end of the period (Bogicevic et al., 2016).

2.2.2 Establishment of information-based early warning model

Based on the financial crisis variables, tax difference variables, financial crisis early warning indicators and control variables mentioned above, the enterprise financial information early warning model is designed. Because the discrete-time risk model has the advantages of fast calculation speed and low calculation complexity, and can accurately reflect the information-based risk, the discrete-time risk model is used in the early warning of enterprise financial information, which solves the problem that the high complexity of tax difference index leads to the calculation time, and can effectively improve the accuracy and efficiency of enterprise information early warning. The model was evaluated by experiments to verify the practical application effect of the model.

2.2.2.1 Selection of financial early warning indicators

The PCA of dimensionality reduction method is used to select financial early warning indicators, and the selected financial early warning indicators can explain most of the financial indicators. The essence of the principal component method is to transform the original correlative indicators into irrelevant variables. In the principal component method, irrelevant variables are obtained mainly by dimension reduction. There is a significant positive correlation between principal component variance and information content. The first principal component is set as the indicator with the largest variance. All the indicators are arranged according to the above rules. Several important principal component factors are selected in the whole research process, among which the variance of the selected principal component factor should be greater than 1 (Hou et al., 2017). The calculation process of PCA is as follows:

$$Y_n = b_{1n}XD_1 + b_{2n}XD_2 + b_{3n}XD_3 + ... + b_{mi}XD_m \tag{3}$$

In the formula, Y_n denotes the n^{th} principal component, b_{1n}, b_{2n}, b_{3n}, ..., b_{mi} denotes the eigenvector of variable D_m, which corresponds to the eigenvalue of the covariance matrix of the variable D_m, and i = 1, 2, 3, ..., n, XD_1, XD_2, XD_3, ..., XD_m denotes the value of the normalised processing D_m.

2.2.2.2 Modified Jones model

In the original Jones model, a constant term is added to reduce the estimation deviation caused by omitting other variables (Markose et al., 2017). The process of estimating manipulative accrued profits is as follows.

Firstly, the total accrued profit should be calculated. The calculation formula is as shown in formula (4):

$$TC_{it} = JN_{it} - CD_{it} \tag{4}$$

In the formula, TC_{it} represents the total accrued profit of the i^{th} enterprise in the period t, JN_{it} represents the net profit of the i^{th} enterprise in the period t, CD_{it} represents the net cash flow of the i^{th} enterprise in the period t. The net cash flow is generated by the business activities of the enterprise. Next, the non-manoeuvrable accrued profit of the enterprise should be estimated. The ratio of the total accrued profit of the i^{th} enterprise to the total assets at the end of the period should be calculated first. The calculation formula is as follows:

$$\frac{TC_{it}}{TM_{it-1}} = \alpha_0 + \alpha_1\left(\frac{1}{TM_{it}}\right) + \alpha_2\left(\frac{\Delta RE_{it}}{TM_{it}}\right) + \alpha_2\left(\frac{PE_{it}}{TM_{it}}\right) + \beta_{it} \tag{5}$$

In the formula, TM_{it-1} denotes the total assets at the end of period t – 1 of the i^{th} enterprise, α denotes the correlation coefficient, ΔRE_{it} denotes the difference of main business income between the period t and period t – 1 of the i^{th} enterprise, PE_{it} denotes the initial value of fixed assets in period t of the i^{th} enterprise, β_{it} denotes the non-fixed assets in period t of the i^{th} enterprise. Regression processing is carried out to formula (5), and the obtained regression coefficient is introduced into the formula (6) to obtain the accrued profits that can not be manipulated by the enterprise.

$$\frac{ND_{it}}{TM_{it}} = \chi_0 + \chi_1\left(\frac{1}{TM_{it}}\right) + \chi_2\left(\frac{\Delta RV_{it} - \Delta RE_{it}}{TM_{it}}\right) + \chi_3\left(\frac{PE_{it}}{TM_{it}}\right) \tag{6}$$

In the formula, ΔRV_{it} denotes the accounts receivable difference between the two periods of t and $t - 1$ of the i^{th} enterprise, and the manipulative accrued profit is calculated. The formula is as follows:

$$\frac{CZ_{it}}{TM_{it-1}} = \frac{TC_{it}}{TM_{it-1}} - \frac{ND_{it}}{TM_{it-1}} \tag{7}$$

2.2.2.3 Establishing early warning model of enterprise financial informatisation

One method of survival analysis is discrete-time risk model, through which the probability of occurrence from observation point to a given time is explored. Individual survival time refers to the period from observation point to a given time, in which listed companies are warned of delisting risk by the outside world as a given event, and the financial crisis of enterprises is dynamically predicted by discrete-time risk model. At the same time, the discrete-time risk function includes survival function, density function and risk function (Li et al., 2016; Choi et al., 2016).

The probability of financial risk occurrence is a density function, which represents the probability of event occurrence in a given period of time. Assuming that a given period of time is (t, $t + \Delta t$), the density function is $m(t)$, an individual is in normal state at t, the probability of risk occurrence in the range (t, $t + \Delta t$) is a risk function, and the risk function is $f(t)$. The probability that an individual is still in the normal state at t is the survival function, which is expressed by $s(t)$. The calculation formulas of survival function and risk function are as follows:

$$s(t) = \int_t^{\infty} f(u)du \tag{8}$$

$$f(t) = \frac{m(t)}{s(t)} \tag{9}$$

The formulas for calculating the cumulative risk function in the discrete-time risk model are as follows:

$$sf(t) = \int_0^t f(u)du \tag{10}$$

The discrete-time risk model is as follows:

$$\ln\left(\frac{f(t)}{1 - f(t)}\right) = \delta(t) + \varepsilon x \tag{11}$$

In the formula, $\delta(t)$ denotes enterprise financial risk when x equals zero, ε denotes variable estimation parameter. If enterprise i appears financial risk at a certain point in time t and q_i denotes the possibility of financial risk occurrence, then q_i takes 1, whereas q_i takes 0. At this time, $s(t, g, \varepsilon) = \prod_{j=1}^{t}[1 - f(j, g, \varepsilon)]$ and g represents the observed

value of variable of sample enterprise. When the selected samples contain n enterprises, the estimated parameters of variables can be expressed as follows:

$$\begin{aligned} L(\varepsilon) &= \prod_{t=1}^{n}\left\{f\left(t_1, g_i, \varepsilon\right)^{q_i} \prod_{j=1}^{t}\left[1-f\left(j, g_i, \varepsilon\right)\right]\right\} \\ &= \prod_{i=1}^{n} f\left(t_1, g_i, \varepsilon\right)^{q_i}\, s\left(t_1, g_i, \varepsilon\right) \end{aligned} \tag{12}$$

The logistic regression model of tax difference is established through the above model. At the same time, the early warning model of enterprise financial based on logistic regression is established and two variables (Tian et al., 2016; Xue et al., 2016) are added to the model, in which the year is represented by *NI*, and the industry is represented by *HY*. The two models are respectively shown in formula (13) and formula (14):

$$\begin{aligned} DIST_{i,t+n} &= \varepsilon_0 + \varepsilon_1 SSC_{i,t} + \varepsilon_2 NEG_{i,t} + \varepsilon_3 YZ_{i,t} + \varepsilon_4 Tq_{i,t} \\ &\quad + \sum_{m=5}^{9} \varepsilon_m NI_{i,t} + \sum_{m=10}^{29} \varepsilon_m HY_{i,t} + \varepsilon_{i,t} \end{aligned} \tag{13}$$

$$\begin{aligned} DIST_{i,t+n} &= \varepsilon_0 + \varepsilon_1 FIN_{i,t} + \varepsilon_2 NEG_{i,t} + \varepsilon_3 YZ_{i,t} + \varepsilon_4 Tq_{i,t} \\ &\quad + \sum_{m=5}^{9} \varepsilon_m NI_{i,t} + \sum_{m=10}^{29} \varepsilon_m HY_{i,t} + \varepsilon_{i,t} \end{aligned} \tag{14}$$

Through formula (14) and formula (15), the early warning model of enterprise financial informatisation under the difference of tax revenue is constructed.

$$\begin{aligned} DIST_{i,t+n} &= \varepsilon_0 + \varepsilon_1 FIN_{i,t} + \varepsilon_2 SSC_{i,t} + \varepsilon_3 NEG_{i,t} + \varepsilon_4 YZ_{i,t} \\ &\quad + \varepsilon_5 Tq_{i,t} + \sum_{m=5}^{10} \varepsilon_m NI_{i,t} + \sum_{m=10}^{30} \varepsilon_m HY_{i,t} + \varepsilon_{i,t} \end{aligned} \tag{15}$$

In the formula, the value of n is 1, 2, 3, 4, 5. Through the early warning model of enterprise financial informatisation under the difference of tax revenue, the early warning of enterprise financial informatisation can be realised and the risk of enterprise operation can be reduced (Yan et al., 2017; Wang et al., 2018).

3 Experimental analysis

In order to verify the practical application effect of this method, and compare the comprehensive performance difference between this method and the traditional method, a simulation experiment is carried out. The overall test scheme is as follows.

Firstly, the experimental environment and sample data are designed, and the methods in Han et al. (2016), Kim et al. (2018) and Diks et al. (2018) are used as experimental comparison methods. Firstly, the validity of variable indicators of the model constructed in this paper under the difference of tax revenue is verified. On this basis, the accuracy of different methods is verified. The higher accuracy shows that this method can achieve a higher precision of early warning of enterprise financial information. The specific experimental process is as follows.

3.1 Setting up experimental environment and sample

Listed companies in a certain period of time are selected. This paper selects all A-share listed companies in Shanghai and Shenzhen as research samples in the selected period of time from 2012 to 2017. The selected data are multi-period panel data. Financial crisis enterprises are regarded as enterprises whose A-share listed companies are warned by the outside world to withdraw from the market in 2013–2018. Assuming that the sample selected above contains more than two warnings of withdrawal from the market by the outside world. The sample mentioned above is regarded as the second survival of the enterprise, and the sample is regarded as a new sample.

Through the following methods to screen samples:

1 after actual investigation and analysis, compared with the general enterprises, the current report disclosure and accounting treatment methods of financial and insurance industry are different, so it is necessary to eliminate the financial and insurance industry in the market

2 when constructing the early warning model of enterprise financial informatisation under the tax difference, the discrete-time risk model should be used to exclude the first listed enterprises in 2012

3 the samples whose current income tax expenses are less than zero are eliminated

4 data missing and data abnormal samples are eliminated.

At the same time, the continuous variables at the level of 1% and 99% in the model are processed by tailing. In the experiment process of this paper, the original experimental data is integrated, all data is input to the simulation platform, and the data can be input to the simulation platform, so that the experiment can be carried out smoothly, so as to improve the accuracy of the simulation experiment. The experimental sample data is shown in Table 1.

Table 1 Selected samples

Particular year	*Normal enterprise (domestic)*	*Financial crisis enterprise(domestic)*	*Total sample (domestic)*
2012	1,206	-	1,335
2013	1,147	128	1,279
2014	1,219	134	1,356
2015	1,300	139	1,393
2016	1,316	91	1,358
2017	1,326	42	1,359
2018	-	37	-
Amount to	7,514	571	8,080

In order to verify the validity of the model designed by this method, descriptive statistics are needed for the whole sample. At the same time, statistical descriptions and saliency descriptions are used to analyse the validity of the model in selecting variables. The descriptive statistical results of the whole sample are shown in Table 2. The validity description of variable indicators is shown in Table 2.

Table 2 Descriptive statistical results of full samples

Indicator	*Tax difference*	*Tax change*	*Absolute value of tax*	*Positive tax difference*	*Reverse tax difference*	*Financial crisis early warning*	*Dummy variable*	*Surplus quality*	*Enterprise scale*
Sample capacity	8,084	8,084	6,622	8,084	8,084	8,084	8,084	8,084	8,084
Mean value	–0.0154	0.0355	0.0042	0.2003	0.1998	0.1412	0.1143	0.1998	3.4507
Median	–0.0048	0.0164	–0.0007	0.0000	0.0000	0.1157	0.0000	0.0000	3.3659
Standard deviation	0.0658	0.0578	0.0812	0.4001	0.3997	0.1684	0.3182	0.4001	1.4354
Least value	–0.3837	0.0000	–0.5398	0.0000	0.0000	7.44E-0.7	0.0000	0.0000	–7.6008
Crest value	0.1562	0.3837	0.5398	1.0000	1.0000	0.9998	1.0000	1.0000	10.0615

Table 3 Test results

	Financial crisis variable	*Tax difference*	*Absolute value of tax difference*	*Positive tax difference*	*Reverse tax difference*	*Financial crisis early warning indicator*	*Surplus quality*	*Dummy variable*	*Enterprise scale*
Financial crisis variable	1	–0.1283***	0.2648***	0.2401***	0.0276**	0.2146***	0.0251***	0.3879***	–0.3061***
Tax difference	–0.2961***	1	–0.2974***	–0.6935***	0.6922***	–0.1112***	0.1243***	–0.4761***	0.01755
Absolute value of tax	0.4385***	–0.7176***	1	0.6241***	0.3514***	0.0913***	0.0549***	0.4087***	–0.1629***
Positive tax difference	0.2401***	–0.6673***	0.5883***	1	–0.2503***	0.1482***	–0.0612***	0.5593***	–0.1063***
Reverse tax difference	0.0279**	0.4512***	0.0761***	–0.2502***	1	–0.0451***	0.1302***	–0.1801***	–0.0813***
Financial crisis early warning indicator	0.3167***	–0.2934***	0.3048***	0.2305***	–0.0542***	1	0.0507***	0.3002***	–0.2546***
Surplus quality	0.0248***	0.1342***	0.0194*	–0.0609***	0.1302***	0.0213*	1	–0.1035***	–0.0301***
Dummy variable	0.3884***	–0.5405***	0.4913***	0.5589***	–0.1803***	0.3879***	–0.1031***	1	–0.1752***
Enterprise scale	–0.3478***	0.1321***	–0.2704***	–0.1173***	–0.0874***	–0.2534***	–0.0463***	–0.1834***	1

Notes: ***indicates a significant level of 1%, **indicates a significant level of 5% and *indicates a significant level of 10%.

From Table 2, we can see that the median and mean tax differences in the selected samples are –0.0048 and –0.0154, respectively. The above data can show that the taxable income of listed enterprises in China is higher than the total profits of listed enterprises. The statistical results are consistent with the actual survey. The reason for the above situation is that China's tax law is more stringent than accounting standards. From the data of positive tax difference and negative tax difference in the table, we can see that there are large negative tax difference in a small part of enterprises and positive tax difference in a small part of enterprises. The financial crisis warning indicators of mean and median in the table are 0.1412 and 0.1157, respectively. This shows that listed companies in the sample have a higher probability of financial crisis. From the data in the table, we can see that each variable indicator in the model has certain significance.

3.2 Analysis of the relationship between variables and early warning of enterprise financial informatisation

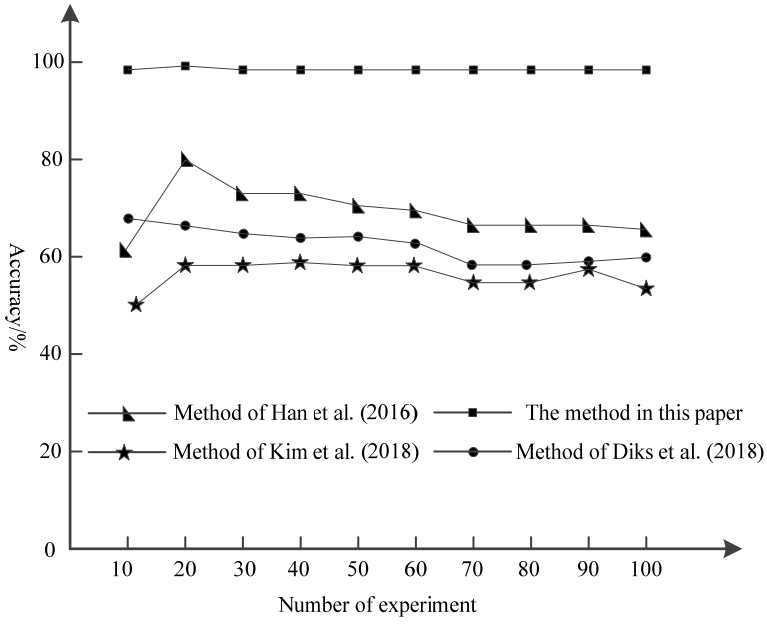
In order to study the relationship between the variables in the early warning model and the early warning of enterprise financial informatisation, Person test and Pearman test are needed. The test results are shown in Table 3.

Analysis Table 3 shows that there is a correlation between financial crisis variables and various variables of early warning model, showing a significant positive correlation at the level of 10%, indicating that when there is a financial crisis, all variables of the model constructed in this paper will react to realise the early warning of enterprise financial information. We can see that there is a correlation between financial crisis and tax disparity of listed companies, showing a significant positive correlation at the level of 1%. It shows that when the tax disparity of listed companies decreases gradually, the financial crisis of listed companies will gradually decrease. Among them, the financial crisis variables in the model are also correlated with the positive tax differences and the negative tax differences, and the positive tax differences and the financial crisis variables show a significant positive correlation at the level of 5%, while the negative tax differences and the financial crisis variables show a significant positive correlation at the level of 1%. At the same time, we can see from the data in the table that there are many variables in a relatively small correlation, it shows that the model constructed in this paper does not have the problem of multiple collinearity, and the model can effectively reflect the financial information status of enterprises. The reason is that this method starts from the establishment of enterprise financial information early warning system, and analyses the importance of tax indicators to enterprise financial information early warning. Through the study of early warning system, index data in the model are selected, tax difference indicators are added to the traditional financial information early warning model, and multiple indicators are used to reflect enterprise financial information, and each indicator has strong relevance Therefore, the model constructed in this paper can effectively realise the early warning of enterprise financial information and has reliability.

3.3 Accuracy of early warning

In order to verify the practical application effect of the proposed method, it is necessary to test the accuracy of early warning. The test results are shown in Figure 2.

Figure 2 Accuracy test results of different research methods



From the data in the figure above, it can be seen that the early warning accuracy of Han et al. (2016) method changes from 60% to 80%, and that of Kim et al. (2018) method changes from 51% to 60%, which is the lowest of the four methods. In Diks et al. (2018), the accuracy of early warning varies from 59% to 67%. With the increase of the number of experiments, the early warning accuracy of this method is gradually rising, the highest accuracy is 99.05%, which shows that the early warning effect of the enterprise financial information early warning model constructed from the perspective of tax differences under this method is better. The reason why the method in this paper has a high accuracy of early warning is that the method starts from the establishment of enterprise financial information early warning system and analyses the importance of tax indicators to enterprise financial information early warning. Through the research of early warning system, index data in the model is selected, tax difference index is added to the traditional financial information early warning model, multi-period panel data is selected, and discrete time wind is adopted The insurance model constructs the early warning model of enterprise financial information, so it can realise the high-precision early warning of enterprise financial information.

To sum up, in the experimental part, this paper first designs the experimental environment and experimental sample data, then describes the effectiveness of variables, then analyses the relationship between the variables of this model and the early warning of enterprise financial information, and finally compares the early warning accuracy of different methods. The experimental results show that the variables of this model and the early warning of enterprise financial information are significant The reason is that the novelty of this method lies in that this paper studies the financial information early warning of enterprises from the perspective of accounting information distortion, solves the problems of traditional methods, so it has better application effect.

4 Conclusions

Through the actual investigation and analysis, it is found that there is a weakening phenomenon in the current market investor information in China. In view of the above phenomenon, this paper, from the perspective of tax differences, combines the financial reporting indicators and tax differences and other indicators together, and proposes an early warning method of enterprise financial information based on discrete-time risk model. This method starts from the establishment of enterprise financial information early warning system, and analyses the importance of tax indicators to enterprise financial information early warning. Through the study of early warning system, we select index data in the model, add tax difference indicators in the traditional financial information early warning model, select multi-stage panel data, and use discrete-time risk model to build enterprise financial information early warning model. The experimental results show that there is no multicollinearity among the variables in the model, and the maximum warning accuracy of the model can reach 99.05%, which can realise the accurate warning of the financial information of the enterprise. This method can effectively provide enterprise managers with financial information, provide scientific basis for enterprises to effectively predict their own crisis situation, improve the response speed of enterprises to financial crisis, reduce the economic loss of enterprise police, and is of great significance to expand the research field of enterprise financial information early warning and promote the development of enterprises.

Acknowledgements

This work was supported by Fujian Provincial Social Science Foundation Key Project under Grant No. FJ2018MGCA041.

References

Bogicevic, J., Domanovic, V. and Krstic, B. (2016) 'The role of financial and non-financial performance indicators in enterprise sustainability evaluation', *Social Science Electronic Publishing*, Vol. 62, No. 3, pp.1–13.

Choi, Y., Ye, X., Lu, Z. et al. (2016) 'Optimizing enterprise risk management: a reference review and critical analysis of the work of Wu and Olson', *Annals of Operations Research*, Vol. 237, No. 1, pp.281–300.

Cipollini, F., Giannozzi, A., Menchetti, F. et al. (2018) 'Financial companies' failures: early warning information from systematic and systemic risk measures', *The Quarterly Journal of Finance*, Vol. 8, No. 4, pp.142–152.

Diks, C., Hommes, C. and Wang, J. (2018) 'Early warning method of enterprise financial informatization based on multi-expert grey comprehensive evaluation', *Empirical Economics*, Vol. 62, No. 7, pp.1–28.

Han, C.F., Xiao, X., Sun, D.T. et al. (2016) 'Early warning method of enterprise financial informatization based on principal component analysis BP neural network', *ISPRS – International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences*, Vol. 34, No. 8, pp.335–338.

Hong, Y., Sun, W., Qianling, B. et al. (2016) 'SOM-BP neural network-based financial early-warning for listed companies', *Journal of Computational & Theoretical Nanoscience*, Vol. 13, No.10, pp.6860–6866.

Hou, L., Huang, J. and Wang, J. (2017) 'Early warning information, farmers' perceptions of, and adaptations to drought in China', *Climatic Change*, Vol. 141, No. 2, pp.197–212.

Huang, T.H., Leu, Y. and Pan, W.T. (2016) 'Constructing ZSCORE-based financial crisis warning models using fruit fly optimization algorithm and general regression neural network', *Kybernetes the International Journal of Systems & Cybernetics*, Vol. 45, No. 4, pp.650–665.

Kim, C.W., Yoo, W.S., Lim, H. et al. (2018) 'Early warning method of enterprise financial informatization based on big data', *International Journal of Project Management*, Vol. 36, No. 5, pp.730–743.

Li, C., Qin, J., Li, J. et al. (2016) 'The accident early warning system for iron and steel enterprises based on combination weighting and grey prediction model GM (1, 1)', *Safety Science*, Vol. 89, No. 6, pp.19–27.

Markose, S.M., Giansante, S., Eterovic, N.A. et al. (2017) 'Early warning and systemic risk in core global banking: balance sheet financial network and market price-based methods', *Social Science Electronic Publishing*, Vol. 45, No. 2, pp.78–85.

Panda, S. and Rath, S.K. (2016) 'Investigating the structural linkage between IT capability and organizational agility: a study on Indian financial enterprises', *Journal of Enterprise Information Management*, Vol. 29, No. 5, pp.751–773.

Sun, F. (2018) 'The role of cash flow in financial early warning of agricultural enterprises based on logistic model', *IOP Conference Series: Earth and Environmental Science*, Vol. 108, No. 2, pp.042094–0420100.

Tian, L., Ma, L.Y., Huang, Y. et al. (2016) 'Risk study of service outsourcing projects undertaken by high-tech innovative enterprise', *Journal of Discrete Mathematical Sciences & Cryptography*, Vol. 19, No. 3, pp.635–647.

Wang, Q., Hui, F., Wang, X. et al. (2018) 'Research on early warning and monitoring algorithm of financial crisis based on fuzzy cognitive map', *Cluster Computing*, Vol. 72, No. 2, pp.1–9.

Xue, Y., Ni, M., Yu, W. et al. (2016) 'Power grid blackout defense system including communication/information security early warning and decision support', *Automation of Electric Power Systems*, Vol. 26, No. 5, pp.19–26.

Yan, C., Lin, W., Wei, L. et al. (2017) 'Financial early warning of non-life insurance company based on RBF neural network optimized by genetic algorithm', *Concurrency & Computation Practice & Experience*, Vol. 42, No. 6, p.e4343.

Yan, H., Gang, K. and Yi, P. (2016) 'Nonlinear manifold learning for early warnings in financial markets', *European Journal of Operational Research*, Vol. 258, No. 2, pp.12–21.

Yuwen, H., He, X., Qian, X. et al. (2017) 'Constructing early warning information release system in towns enterprise clean production', *IOP Conference Series Earth and Environmental Science*, Vol. 81, No. 1, p.012048.

Zhao, N.N., Wang, Y.X. and Wang, Y.B. (2017) 'Application of GRNN optimized by LVFOA in the financial warning', *Computer Systems & Applications*, Vol. 12, No. 8, pp.12–19.