

THE LETTER TO EDITOR

Financial Risk Measurement of High Energy Consumption Enterprises Based on Data Mining from the Perspective of Low-Carbon Ecological Environment

Lili You

School of Management, Wenzhou Business College, Wenzhou 325035, China

Email of Corresponding Author: Lalaeunice@163.com

With the advent of the low-carbon economy era, the impact of high energy consumption enterprises on the ecological environment has been paid more and more attention by the state and high energy consumption enterprises, and economic and social contradictions have become increasingly prominent. The internal and external environmental factors of high-energy consuming enterprises are changing day by day, various uncertainties and risks facing high-energy consuming enterprises are increasing, and the probability of financial crisis occurring in high-energy consuming enterprises is increasing. The research on financial crisis warning can help high-energy consuming enterprises to prevent the occurrence of crisis in advance and take effective measures to ensure the healthy development of high-energy consuming enterprises. Select the companies was announced in 2013 that special treatment in the 21 ST companies with the corresponding 89 non-ST companies as research samples, on the basis of Z-SCORE financial forewarning model, time series analysis using data mining method, according to the financial data of ST companies were announced special processing in front of 5years and the corresponding data of non-ST companies, to predict Z-SCORE values of year 2012 and 2013. The predicted data were analyzed from two aspects: First, the predicted value in 2012 was compared with the real value to verify the prediction accuracy; Second, the accuracy of judgment is tested by comparing the predicted value in 2013 with the possibility of actual financial crisis. Through comparison and analysis, the accuracy and judgment accuracy of the above two cases are above 80%, indicating that the analysis method adopted has broad application prospects.

Low-carbon ecological environment; Z-SCORE Model; Data mining; Time series analysis.

1. Introduction

Under the advocacy of green environmental protection and low-carbon development, all economic entities in the world actively undertake environmental responsibilities to promote low-carbon development, while high-energy consuming enterprises, as the main part of micro-economic activities from the perspective of low-carbon economy, should also actively fulfill their corresponding responsibilities. On the basis of the research, McKinsey Co. published "the road to low carbon", and the report clearly pointed out that high energy consumption enterprises is the "culprit" global ecological imbalance, think energy-intensive enterprises pay attention to environmental responsibility is the important driving force to realize low carbon economic development, encourage

energy-intensive enterprises should actively take on social and environmental responsibility, the pursuit of maximization of economic benefits will ever goal to pursue economic benefit, social benefit and ecological benefit coordinated development. The gradual promotion of the concept of low-carbon economic development has brought severe challenges to the production and operation environment of enterprises with high energy consumption. The previous development mode of relying on high energy consumption and zero pollution treatment has been rejected. Therefore, enterprises with high energy consumption have to change their development mode and choose a new business mode (Lin 2017; Wang 2016) that meets the requirements of low-carbon economic development. Many of the world's top 500 enterprises with high energy consumption take the lead in responding to the concept of low-carbon economic development. On the basis of the original development strategy, they supplement and improve the low-carbon development planning and strategy. By setting up a low-carbon and environmental protection business model, they actively fulfill their social responsibilities and build the green core competitiveness of enterprises with high energy consumption. Many scholars have analyzed this problem and obtained some research results.

Yuqing Shen, Can Chen, Jianqiang Gu published an article titled "Research on the Design of Supply Chain Financial Ecology Model and Risk Management" in Ekoloji Issue 107, 2019. It is mentioned in this paper that with the development of social division of labor, the social product chain becomes more complex. Under such social background, supply chain finance is an innovative financial model, and the application of supply chain finance in the current market is more widespread and will become more and more mature. Therefore, this paper introduces the ecological model of supply chain finance, risks and risk prevention and control measures to help relevant social development and research. This article is helpful to the research of this paper.

With the increasingly fierce market competition, and the rapidly changing market environment, combined with a variety of internal and external factors, high energy consumption enterprises face all kinds of uncertainty and risk is more and more big, it also predicts an increased energy-intensive enterprise potential crisis, concentrated expression in the 1997 Asian financial crisis and the global financial storm in 2008. Financial crisis, also known as financial storm, directly leads to stock plunge, large number of bankruptcy or large-scale layoffs of high-energy consuming enterprises, rising unemployment rate, general social economic depression, national bankruptcy, and sometimes even accompanied by social or political turmoil. Research after the financial crisis has shown that in the crisis of bankruptcy energy-intensive enterprises, as early as 4-5 years preceding the crisis, is a potential crisis forewarning signals, not sudden financial crisis, but a progressive, gradual process, the occurrence of financial crisis not only has the aura, and predictably, these financial forewarning information and financial conditions change can be reflected through the financial statements, concrete embodiment in some financial indicators on the change of the financial indicators have predictive power for company's future financial condition, if before the energy-intensive enterprise financial crisis, and adopt certain technical and analytical means to give early warning of the changes in the financial status of high-energy consuming enterprises, and predict the possibility of crisis in high-energy consuming enterprises, so that high-energy consuming enterprises can prepare for a rainy day and prevent the crisis in advance (Ma 2015; Ma 2017). It is of great practical significance to correctly predict and judge the financial crisis situation of high energy consumption enterprises, to protect the interests of investors and creditors, to prevent the financial crisis of operators, and to supervise the quality of listed companies and the risk of securities market by government departments.

2. Idea Description

In the forewarning research of financial crisis, several related concepts are involved, and the terms are relatively

similar, such as corporate failure (failure of high energy consumption enterprises), financial failure, financial distress and corporate bankruptcy. Although there are some differences in the expression of these concepts, the basic content and essence are similar, but the level and emphasis of the performance of high energy consumption enterprises are different. This paper mainly adopts the expression of financial crisis.

Foreign research has two ideas:

One is to declare bankruptcy financial definition of financial crisis. For example, Charles and Altman considered that “the failure of high energy consumption enterprises includes the breakdown, connection and reconsolidation in law”, Deakin, Casey, Entryetal and others also hold this view.

Second, the financial crisis is divided into light and heavy crisis levels. High energy consumption enterprises may be in different stages of financial crisis, bankruptcy is the most serious degree of crisis. For example, Beaver defined financial crisis as follows: “bank credit default”, “bond default” and “declaration of bankruptcy”. Carmichael replenished to the former’s point of view. He believed that if the high energy-consuming enterprises were prevented from fulfilling their debt obligations due to insufficient liquidity and capital and other factors, it would be considered that the high energy-consuming enterprises had financial crisis.

At present, domestic research on financial crisis of high energy consumption enterprises tends to be standardized, which is different from foreign research. In terms of connotation, financial crisis is a gradual evolution process caused by financial distress. Along with our country securities market is mature and perfect, announced the shares listed rules on April 22, 1998, the financial condition or other abnormal condition of the listed company, the Special treatment decommissioning (the abbreviation is “ST”), so the stock is referred to as ST shares, Chinese scholars adopt common research train of thought, will be ST listed company, as the object of empirical study. The purpose of this study is to find out the potential crisis in the management of high energy consumption enterprises in advance, solve the problem in time and prevent the occurrence of financial crisis, so as to avoid high energy consumption enterprises going bankrupt. In the process of sample selection, in order to ensure the accuracy and reliability of the analysis results, only the listed companies that were listed by ST due to abnormal financial conditions were selected, and the following companies were excluded: If the company is specially dealt with within 2 years after the listing, if there is serious financial information falsification, if the auditor issues an audit opinion report that cannot be expressed (because the financial data is not true, it is meaningless to analyze the data), or if the company is specially dealt with due to governance disorder or major accident and is frozen. There are two broad categories of sample data: ST companies and Non-ST companies, which are from Shenzhen and Shanghai A shares, according to 2013 by ST companies, select the corresponding Non-ST company, not than ST companies, ST companies choose sample for empirical analysis to do the sample selection and replacement, in the final samples including ST and the ST companies sample size to 117, which can reach the effect analysis and validation. After testing and checking, the final data includes 21 ST companies, 89 Non-ST companies. Institute selected financial data is ST company for five years before that was announced special processing of financial data, this essay uses to be ST company in 2013 as reference, selected by ST financial information of annual report date in the 5 years included 2012, 2011, 2010, 2009, 2008. And the same choice of Non-ST company with the same years’ annual financial information accordingly (He 2017).

This article mainly through time series analysis method, based on historical financial data, on the basis of Z-SCORE financial crisis forewarning model proposed by the United States scholars Altman, through five years of annual reports data, is obtained by computing the corresponding predicted value, Z-SCORE change trend forecast for the future, by comparing the real value and predictive value of 2012, 2013 by ST company Z-SCORE predicted values and the financial crisis of the critical value of Z-SCORE comparison, to test and analysis in this paper, the

method adopted by the, and the influence degree and application value of time series analysis method based on z-score value on financial crisis forewarning of high energy consumption enterprises. Z-SCORE model's basic representation as:

$$Z = 0.012X_1 + 0.014X_2 + 0.033X_3 + 0.0006X_4 + 0.999X_5 \quad (1)$$

In the formula, X_1 is net operating capital / total assets=(current assets-current liabilities)/total assets; X_2 is retained earnings / total assets=(earned surplus+undistributed profit) / total assets; X_3 is earnings before interest and tax / total assets=(total profits+financial expense) / total assets; X_4 is equity market value / total book value of liabilities=shareholders' equity / total liabilities; X_5 is operation revenue / total assets=total assets turnover. In general, the lower Z is, the more possibly it is to go bankrupt. Altman considered that: 2.675 is the critical value of Z , which is greater than 2.675 represents the financial condition of enterprises with high energy consumption; Z is less than 2.675 high energy consuming enterprises are considered as high energy consuming enterprises with financial crisis. Z is less than 1.81, for the bankruptcy of high energy consumption enterprises; Z is equal to 1.81-2.675 indicates that high energy consumption enterprises already have a financial crisis, which Altman called a "gray area".

Financial forewarning is the result of the company's financial empirical research at first, but from the perspective of the development of current research and application of demand, the financial forewarning is not only a model or prediction technology, actual it is a complex and comprehensive management activities, its theory and practice involved in company management, information technology, simulation technology and other multi-disciplinary knowledge.(Perenyi and Yukhanaev 2016) At present, the application of data mining technology to financial crisis early warning analysis is more and more giving play to its unique advantages which are different from the traditional statistical methods. This paper mainly adopts the time sequence analysis method to predict the possibility of the company's future financial crisis.

Time series is a collection of observed values occurring at continuous time points or in the whole continuous period. The time series analysis model uses certain algorithms to analyze these values to predict the future trend of data. The time series model is usually composed of trend component, periodic component, seasonal component and irregular component. In this paper, the goal is to identify the time series data of the model's continuous values, which can be used for data mining and to support accurate prediction.

Time series variables $Y=(Y_1, Y_2, \dots, Y_T)$ represented in this article. Time series data is a sequence of values, denoted by variables $y=(y_1, y_2, \dots, y_t)$. In this paper, we define the time series model as probability, stationary and Markov chain, which means $f(\cdot, \cdot, \theta)$ is a combination of conditional probability distributions, it represents the functional form of the model and model parameters; The stationary means that the correlation of the above variables does not change with time, that is, the state transition probability at each moment remains stable; The Markov chain hypothesis means that Y_t is independent of previous observations. The equation as follows:

$$p(y_t | y_1, \dots, y_{t-1}, \theta) = f(y_t | y_{t-p}, \dots, y_{t-1}, \theta), p < t \leq T \quad (2)$$

$f(y)$ is usually called a regression, when the Y_t is the target variables, Y_{t-p}, \dots, Y_{t-1} is regression variable. The most common type used in time series analysis models is linear autoregressive, as follow, $f(y_t, y_{t-p}, \dots, y_{t-1}, \theta)$ is the linear regression:

$$f(y_t | y_{t-p}, \dots, y_{t-1}, \theta) = N(m + \sum_{j=1}^p b_j y_{t-j}, \sigma^2) \quad (3)$$

N is the normal distribution on the mean value of μ and the variance of σ^2 , $\theta = (m, b_1, \dots, b_p, \sigma^2)$ is parameter. The autoregressive tree model is a piecewise linear autoregressive model, the boundary is defined by the decision tree whose leaves contain the linear autoregressive model. Each leaf of the decision tree contains an autoregressive model and the selection of time series variables for the variables split by the decision tree. In the decision tree, each non-leaf node is associated with a Boolean function, which is the p variable Y_{t-p}, \dots, Y_{t-1} function. Associate each edge of the “positive” (the formula is negative) with the parent node, if the label edge is “true” (otherwise it is “false”). Each leaf L_i and tab function ϕ_i , When the intersection of all edges between root and leaf L_i is “true”, it returns 1, otherwise it returns 0.

In this paper, the data mining tools of Microsoft are used for analysis and prediction. In Microsoft time sequence analysis, the ARTXP algorithm and ARIMA algorithm are used at the same time. By combining the two algorithms, the obtained results can improve the accuracy of prediction. The ARIMA algorithm is optimized for long-term prediction. The ARTXP algorithm can be described as an automatic regression tree model used to represent periodic time series data. This algorithm associates a variable number of past items with each current item to be predicted. ARTXP applies the ART method (an ART algorithm) to multiple unknown previous states and thus gets its name, which is used for the realization of the process of calculating the moving average value of automatic regression integration. With the ARIMA method, which also supports seasonal variability, it is possible to determine the dependencies between observations in chronological order, and random impulse can be used as part of the model input.

3 Discussion

By using the timing analysis function of SQLServer2008BI, according to the Z-SCORE value of listed companies in the past few years, the future trend of these companies' z-score value can be predicted, that is, to a certain extent, the possibility of listed companies being listed by ST can be predicted. The predicted value of Z-SCORE of ST company in 2012 and 2013 can also be used to predict the Z-SCORE value of Non-ST company in 2012 and 2013, which is no longer shown here.

The Z-SCORE values of 2012 and 2013 were predicted by the time sequence analysis method, so as to judge whether the analysis method is effective in predicting the future and to what extent the effective performance is, it is necessary to analyze and verify the results according to the data. According to the annual report data of listed companies, has collected financial reporting information from 2008 to 2012, on the basis of the Z-SCORE values in 2012 can be calculated, table 3 is Z-SCORE of the predicted values in 2012 and the calculated value of comparative data, the prediction accuracy of more than 80%, with perfect accuracy.

At the same time, according to this method, the use of the history of financial data from 2008 to 2012, can predict the Z-SCORE values of 2013, according to Z value interval and standards, with Z-SCORE prediction of 2013, can get correct diagnosis rate of the predicted values and the possibility of a real crisis, as shown in table 4, the judgment accuracy is above 80%, this article adopts the method in the aspect of the financial crisis warning has certain scientific prediction.

4 Conclusion

Financial crisis warning which is different from traditional method, this study uses the data mining of time series analysis method to analyze financial crisis forewarning and forecasting, low requirements for data preparation, data processing speed and prediction accuracy is ideal, the next step to consider how to according to different industry of high energy consumption enterprises summed up the general algorithm and prediction model, areas of the study

can be combined with other aspects, such as internal control, at the same time, the future will study how to apply data mining technology to establish the financial early warning system, and embedded in energy-intensive enterprise management information system (such as ERP), to predict financial condition change trend, fully integrated with the information organization of enterprises with high energy consumption, the prediction and warning of financial crisis of enterprises with high energy consumption can be made in advance, and the warning can be made to managers of enterprises with high energy consumption in real time and dynamically. Finally realize real-time dynamic warning to the management of high energy consumption enterprises, which will be the next step to need in-depth research.

References

- He D (2017) Application of Data Mining Technology in Local Government Debt Risk Research. *Modern Electronics Technique*, 40(11):107-110.
- Lin YH (2017) Chen CF. Research on Enterprise Financial Risk Evaluation Based on Association Rules. *Friends of Accounting* (1):32-35.
- Ma Q (2017) Research on Financial Diagnosis Based on Data Mining. *Automation & Instrumentation*, (10):139-141.
- Ma XJ (2015) The Construction of New Standard Customer Credit Risk Management Rules Based on Data Mining—Taking the Central Enterprise Zhonghang International Steel Trading Company as an Example. *Management World* (3):184-185.
- Perenyi, A., Yukhanaev, A. (2016). Testing Relationships Between Firm Size and Perceptions of Growth and Profitability: An Investigation Into the Practices of Australian ICT SMEs. *Journal of Management & Organization* 22(5): 680-701.
- Shen, Y., Chen, C., & Gu, J. (2019). Research on the Design of Supply Chain Financial Ecology Model and Risk Management. *Ekoloji* 28: 3653-3660.
- Wang AQ (2016) Analysis of the Impact of Big Data Mining Technology on Financial Decision. *Review of Economic Research* (48):30-31.