Chapter 23

Financial Distress Prediction of Chinese–Listed Companies Based on PCA and WNNs

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ABSTRACT

The operating status of an enterprise is disclosed periodically in a financial statement. Financial distress prediction is important for business bankruptcy prevention, and various quantitative prediction methods based on financial ratios have been proposed. This paper presents a financial distress prediction model based on wavelet neural networks (WNNs). The transfer functions of the neurons in WNNs are wavelet base functions which are determined by dilation and translation factors. Back propagation algorithm was used to train the WNNs. Principal component analysis (PCA) method was used to reduce the dimension of the inputs of the WNNs. Multiple discriminate analysis (MDA), Logit, Probit, and WNNs were employed to a dataset selected from Chinese-listed companies. The results demonstrate that the proposed WNNs-based model performs well in comparison with the other three models.

1. INTRODUCTION

The ability to predict the possibility of financial distress of a company is important for many user groups such as investors, creditors, regulators and auditors (Xu, 2000; Becchetti & Sierra, 2003). With the radical changing of global economy and customer demand, business enterprises are confronted with strong competition and uncertain operational environment. In 2008, financial tsunami started to impair the economic development of many countries. The prediction of financial crisis turns to be much more important when the world economy goes to depression. Firms which cannot recognize financial distress and take measures at an early stage will run into bankruptcy, which not only brings great loss to stockholders, creditors, managers and other interest parts, but also affects the stability of social economy (Anandarajan, Lee, & Anandarajan, 2001; Ko & Lin, 2006).

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However, bankruptcy is not just happened by accident but a continuously developed process. Most enterprises that ran into bankruptcy had experienced financial distress, which usually have some symptoms indicated by company’s account items. It is significant to explore effective financial distress prediction models with various classification and prediction techniques (Li, Sun, & Sun, 2009). Great efforts have been made to apply various statistical and machine learning methods to forecasting corporate financial distress. Early studies used statistical techniques, such as univariate statistical methods, multiple discriminate analysis (MDA), logistic regression (Logit) and prohibit regression (Probit) (Beaver, 1966; Altman, 1968; Altman, Edward, Haldeman, & Narayanan, 1977; Aamodt & Plaza, 1994; Martin, 1977; Ohlson, 1980; Andres, Landajo, & Lorca, 2005). However, strict assumptions of traditional statistics (linearity, normality, etc.) limit their application in the real world (Hua, Wang, Xu, Zhang, & Liang, 2007). With the rapid development of artificial intelligence, machine learning techniques such as decision tree (DT), case-based reasoning (CBR), artificial neural networks (ANNs), genetic algorithm (GA) and support vector machine (SVM) were also applied to financial distress prediction (Frydman, Altman, & Kao, 1985; Li & Sun, 2008; Hu, 2008; Liao, 2005; Lin & McClean, 2001; Shin & Lee, 2002; Ding, Song, & Zen, 2008; Min, Lee, & Han, 2006).

The ability of nonlinear approximation of wavelets and neural network models has been shown by many researchers (Zhang, 1992; Hossen, 2003). Combining the ability of wavelet transformation for revealing the property of function in localize region with learning ability and general approximation properties of neural network, different types of wavelet neural networks (WNNs) have been proposed, which is suitable for the approximation of unknown nonlinear functions with local nonlinearities and fast variations because of its intrinsic properties of finite support and self-similarity (Zhang, Walter, Miao, & Lee, 1995; Banakar & Azeem, 2008). Neural network (NNs) with sigmoidal activation function has already been shown to carry out large dimensional problem very well. WNNs instigate a superior system model for complex and seismic application in comparison to the NNs with sigmoidal activation function and can handle large dimension problem (Zhang, 1997).

The main contribution of this paper is to propose a financial distress prediction method based on WNNs. The financial and non-financial ratios were used to enhance the accuracy of the financial distress prediction model. The dimension of the inputs was reduced using a principal component analysis (PCA) method, and then WNNs were used to predict the financial distress.

2. PRINCIPLES OF WNNS AND PCA

2.1. The Principle of WNNS

Wavelets are a class of functions used to localize a given function in both space and scaling. They have advantages over traditional Fourier methods in analyzing physical situations where the signal contains discontinuities and sharp spikes. Recently, there are many new wavelet applications such as image compression, turbulence, human vision, radar, and earthquake prediction (Cao & Lin, 2008; Kumar, Ravi, Carr, & Kiran, 2008; Du, Jin, & Yang, 2009).

A family of wavelets can be constructed from a function \( \psi(x) \), sometimes known as a “mother wavelet”. “Daughter wavelets” \( \psi_{a,b}(x) \) are then formed by translation and dilation. Wavelets are especially useful for compressing image data, since a wavelet transform has properties that are in some ways superior to a conventional Fourier transform. An individual wavelet is defined by