Building the Cash Dividend Policy Identification Model for China's Agricultural Listed Companies Based on 2007 to 2010 Data

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Abstract The dual agency relation and lack of effective incentive and restraint mechanism make stock right structure of China's listed companies special. This special stock right structure will inevitably exert direct and profound influence on formulation of cash dividend policies. Based on the 2007 to 2010 data of China's agricultural listed companies and focusing on the stock right structure, this paper selected 6 indicators and the BP ANN to build the cash dividend policy identification model, in the hope of helping investors accurately predict influence of stock right structure on cash dividend policies, so as to reduce investment risk to some extent.

Key words Agricultural listed companies, Stock right structure, Cash dividend policies, Identification model, BP ANN

Both theory and practice fields have reached a common understanding on the direct influence of stock right structure of listed companies on formulation of cash dividend policies. However, as investors, particularly small and medium ones, it is difficult to accurately predict cash dividend policies according to related indicators of stock right structure. This paper focuses on this problem to reduce investment rick to some extent.

1 General information of BP neural network

The Artificial Neural Network (ANN), introduced and developed on the basis of modern neural science, is an abstract mathematical model intended to reflect structure and functions of human brain. The error Back Propagation (BP) neural network is named by learning algorithm of back propagation adopted by its connection weight and threshold. It can represent an extremely complex non-linear model system. In addition, it has highly parallel processing mechanism and flexible topological structure, and also has self-learning and self-organizing ability. The purpose of building BP neural network is to find out non-linear mapping relation between input and output variables through network learning and memory. In the training, it is required to minimize the error between actual output and target output of the BP neural network, and the neural network has certain generalization ability.

1.1 Topological structure of BP neural network The BP neural network is a multi-layer feed-forward neural network. With the ability of approximating any complex and continuous function, it is the neural network that has the widest application. Typical BP network usually adopts three-layer topological structure: input layer, hidden layer and output layer. Each layer is connected in sequence, and sample data is propagated from input layer to output layer through hidden layer, as shown in Fig. 1. The activation function of hidden layer is generally non-linear, Sigmoid function, for instance. To activate the output layer, the function can be linear or non-linear, depending on the demand of mapping relation between actual input and output.

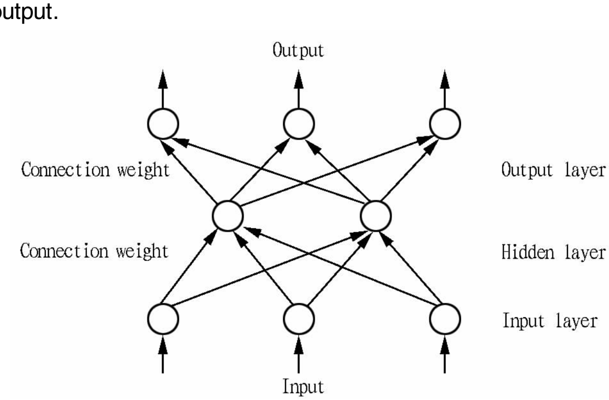

Fig. 1 Topological structure of BP neural network

1.2 BP neural network learning algorithm BP network algorithm includes forward propagation of data and back propagation of error. Training of BP network is carried out in supervised learning manner. After being supplied to the network, training sample data is firstly propagated forward to neural nodes at hidden layer, where it is propagated to output layer through algorithm of activation function. At the output layer, it obtains output result. If the output layer fails to obtain the expected output, in other words, if there is error between actual output value and expected output value, it will turn to back propagation process. On the principle of reducing the error between expected and actual output, data will firstly enter the output layer, then go back to input layer through hidden layer, to revise connection weight and threshold layer by layer. Such revision

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process is carried out layer by layer from output layer to input layer, so it is called "Error Back Propagation Algorithm". With constant training of such error back propagation, the error is minimized. When the error reaches the set requirement (target error accuracy and maximum training times, *etc*), the neural network stops learning training, as shown in Fig.2.

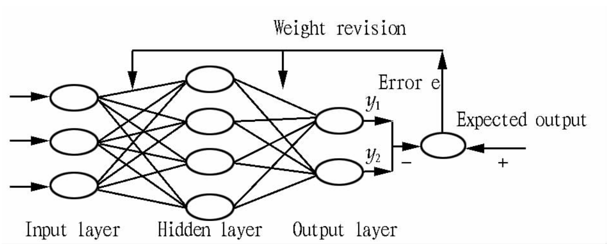

Fig.2 Schematic drawing for BP neural network learning algorithm

2 Research design

2.1 Selection of samples Compared with other industries, China's agricultural listed companies are special to some degree. On the one hand, China's agricultural listed companies stay in an extremely important position in socio-economic development. On the other hand, influenced by natural conditions and operating situations, China's agricultural listed companies have instable income. In recent years, central government attaches greater and greater importance to issues concerning agriculture, farmers and rural areas and provides greater and greater support. These promote rapid development of agricultural listed companies and make those companies representative and demonstrative in the overall development of China' listed companies. Besides, cash dividend policies of China's agricultural listed companies are also special to some extent. Firstly, cash dividends of agricultural listed companies are higher than other ways of dividend distribution. Secondly, agricultural listed companies basically have stable dividend distribution policy every year and the payment of cash dividend is highly continuous. Thirdly, the dividend payout ratio has some increase after the stock reform. In view of these, I took 2007 to 2010 data of 22 agricultural listed companies in the main board of the stock market as research samples, took 2007 to 2009 data of these 22 companies as "training sample set", and took 2010 data as "testing sample set". According to the actual distribution amount of these cash dividends, these 22 agricultural listed companies are divided into three types: actual distribution amount within $-\infty$ to 0.01 belongs to Type A (zero cash dividend); actual distribution amount within 0.01 to 0.1 belongs to Type B (low cash dividend), and actual distribution amount within 0.1 to $+\infty$ belongs to Type C (high cash dividend), as shown in Table 2.

2.2 Selection of indicators Since 2007 to 2010 data of 22 agricultural listed companies in the main board of the stock market was taken as research sample, for China's listed companies, around 2007, there is no other change larger than changes of stock right structure resulted from reform of stock right distribution. According to the agency cost theory and stock right structure theory of dividend policies, the stock right structure of listed companies is directly related to distribution of cash dividends. China's listed companies are special in their stock right structure, characterized by dual agency relation and lack of effective incentive and restraint mechanism. Such special stock right structure will inevitably exert direct and profound influence on formulation of cash dividend policies. Therefore, apart from focusing on building an identification model for cash dividend policies of China's agricultural listed companies, this paper mainly selected six indicators: shareholding ratio of the first largest shareholder, shareholding ratio of the second to the tenth largest shareholders, number of independent directors, shareholding ratio of the first largest circulating shareholder, size of the Board of Directors, and shareholding ratio of senior executives.

2.3 Data source and data processing Data in this paper was mainly sourced from China Stock Market Accounting Research (CSMAR) database of GUO TAI AN Information Technology Co., Ltd. The data not available in this database was supplemented by websites of Shanghai Stock Exchange and Shenzhen Stock Exchange, as well as Dazhihui Analysis and Transaction software. Then, the collected data was calculated and processed with Excel 2007, and programmed with Matlab7.0 software for relevant program.

3 Building the identification model for cash dividend policies

3.1 Building BP neural network For three-layer BP feedforward neural network, number of nodes for both input layer and output layer depends on actual problem itself. Based on influence of China' special stock right structure on cash dividend policies of listed companies, the input layer consists of 6 nodes, respectively corresponding to following 6 variables: shareholding ratio of the first largest shareholder, shareholding ratio of the second to the tenth largest shareholders, number of independent directors, shareholding ratio of the first largest circulating shareholder, size of the Board of Directors, and shareholding ratio of senior executives. The output layer includes one node, *i.e.* actual distribution amount of cash dividend. The hidden layer gradually increases according to the formula $l = \sqrt{n+m} + a$, $n=6$, $m=1$, take $a=0$. In the course of calculation, it is found that when $a=12$, the error between training sample and testing sample is minimal, thus

$$l = \sqrt{6+1} + 12 = 15.$$

66 normalized data from 2007 to 2009 was taken as training sample. When the function *newff* is used to build network, initialization of connection weight and threshold is a random number between [−1, 1]. The parameter trainlm represents that using Levenberg – Marquardt algorithm training has faster convergence rate. In the neural network, the activation function influences the network performance. In this paper, the activation function of input layer adopts tansig; the activation function of input layer to hidden layer uses tansig; the activation function of hidden layer to output layer chooses purelin. The target error accuracy is 0.0001; the maximum training iteration number is

10000; momentum factor is 0.5; learning rate is 0.05.

3.2 BP neural network training

3.2.1 The BP neural network training process is shown in Fig.3.

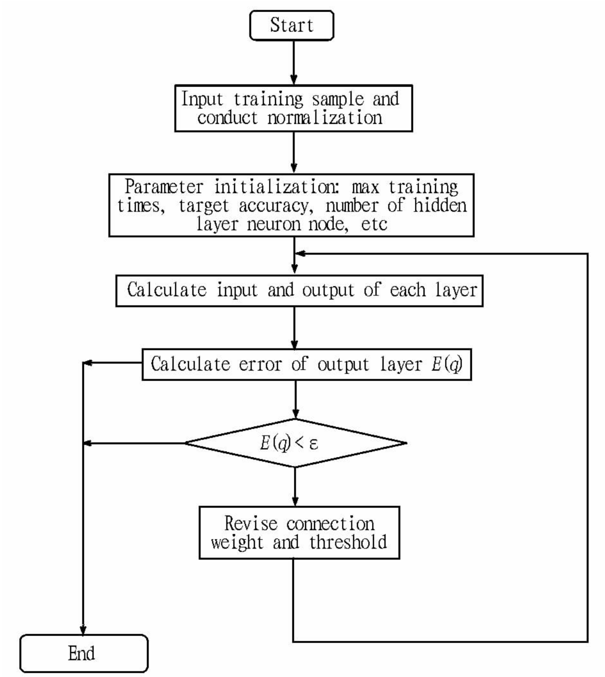

Fig.3 Flow chart of BP neural network training

3.2.2 Performance comparison between different BP neural network training errors.

Table 1 Performance comparison between different BP neural network training errors

	Iteration number	Training error
Gradient descent algorithm BP neural network (traingd)	10 000	0.002 18
Adaptive learning rate BP algorithm (traingda)	10 000	0.001 98
Momentum factor BP neural network (traingdm)	10 000	0.001 63
BP algorithm with momentum factor and adaptive learning rate (traingdx)	10 000	0.001 13
LM algorithm optimized BP neural network (trainlm)	59	9.958 71e−005

From Table 1, it can be known that: if choosing traingd-gradient descent algorithm, when it reaches the maximum training iteration number 10 000, the neural network is converged at 0.002 18, failing to reach the requirement of target accuracy. If choosing traingda-adaptive learning rate algorithm, when it reaches the maximum training iteration number 10 000, the neural network is converged at 0.001 98, slightly better than the gradient descent algorithm. If choosing traingdm-gradient descent algorithm with momentum factor, when it reaches the maximum training iteration number 10 000, the neural network is converged at 0.001 63. If choosing traingdm-BP algorithm with momentum factor and adaptive learning rate, when it reaches the maximum training iteration number 10 000, the neural network is converged at 0.001 13, still not reaching the requirement of target accuracy. When choosing trainlm-IM algorithm, the training is converged at target accuracy only after iterating 59 times.

3.3 BP neural network simulation 22 normalized data in 2010 was taken as testing sample to conduct simulation test. Function of testing sample is to test generalization ability of newly built neural network, *i. e.* to test extrapolation ability of network. From Fig.4, it can be seen that actual output and expected output are very close to each other, the largest error is only 0.35.

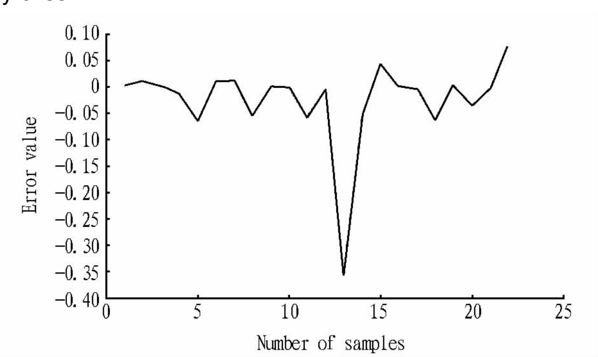

Fig.4 Error curve

Table 2 indicates that although there is certain error in network output and target values for 22 testing samples, if mapping the data to Type A, Type B and Type C, only 3 samples have wrong judgment. The correct identification rate is up to 86.36%, better verifying the prediction accuracy of BP neural network identification model.

Table 2 Neural network output of testing samples

Code	Name	Actual distribution amount of cash dividend	Type	Network output	Type	Wrong judgment or not
000702	Zhenghong Science and Technology	0	A	−0.0027	A	No
000713	Fengle Seed	0	A	−0.0104	A	No
000735	Luoniushan	0	A	−0.0007	A	No
000798	China National Fisheries Corporation	0.03	A	0.0441	A	No
000876	New Hope Group	0.116	C	0.1826	C	No
000998	Yuan Longping High – Tech	0.07	B	0.0594	B	No
600097	Kaichuang International	0	A	−0.0109	A	No
600108	Yasheng Group	0	A	0.0454	B	Yes
600127	Jinjian Rice	0	A	0.0005	A	No
600257	Dahu Aquaculture	0	A	0.0019	A	No

(Table 2)

Code	Name	Actual distribution amount of cash dividend	Type	Network output	Type	Wrong judgment or not
600313	ST Zhongken Agricultural Resource Development	0	A	0.0579	C	Yes
600354	Dunhuang Seed	0	A	0.0039	A	No
600359	Xinjiang Talimu Agriculture Development	0.1	C	0.4587	C	No
600371	Wanxiang Denong	0.2	C	0.2544	C	No
600438	Tongwei Group	0	A	−0.0426	A	No
600467	Homey Group	0.06	B	0.0605	B	No
600506	Xinjiang Korla Pear	0	A	0.0052	A	No
600540	Xinjiang Sayram Modern Agriculture	0.04	B	0.1028	C	Yes
600543	Gansu Mogao Industrial Development	0	A	−0.0034	A	No
600598	Heilongjiang Agriculture Company	0.14811	C	0.185	C	No
600965	Fortune Ng Fung Food	0.03	B	0.0358	B	No
600975	Hunan New Wellful	0.12	C	0.0938	C	No

Remarks: actual distribution amount within $-\infty$ to 0.01 belongs to Type A (zero cash dividend); actual distribution amount within 0.01 to 0.1 belongs to Type B (low cash dividend), and actual distribution amount within 0.1 to $+\infty$ belongs to Type C (high cash dividend).

4 Conclusions

Taking 2007 to 2010 data of China's agricultural listed companies as samples, according to agency cost theory and stock right structure theory of dividend policies, and focusing on 6 indicators of listed companies' stock right structure, this paper uses BP ANN to build the identification model for cash dividend policies, and verifies the classification and identification ability of the model. Results show that the model established in this study has higher accuracy, relatively small error fluctuation, indicating high stability and generalization ability. The identification model of cash dividend policies can help investors accurately predict distribution of cash dividend of listed companies, to reduce investment risks to some extent. Since only 2007 to 2009 data of agricultural listed companies in the main board market was taken as training samples and corresponding data of 2010 taken as testing samples, number of samples needs to be increased and applicability of the model needs to be further verified.

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3.5 It should gradually promote agricultural product identification, to constantly improve the farmers' awareness of agricultural product identification The popularization of agricultural product identification can not be reached at a single leap. In the situation of weak awareness of farmers and enterprises in identification, it is required to seize the opportunity, base on actual situations of Xinjiang, and follow the principle of first simple then difficult, to gradually promote the identification system. All levels of agricultural departments should take various measures to bring into full play propagation function of news media, stress the capability of increasing farmers' income, and propagate the significance of agricultural product identification in many ways such as law dissemination, training or going to fields, to help agricultural product producers and farmer households strengthen their awareness of agricultural product identification. In addition, it is required to popularize knowledge that should be possessed in making and using identification of agricultural products. Finally, it is recommended to guide farmers and agriculture-related economic organizations to realize the benefits of obtaining added value of through strengthening identification of agricultural products.

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