Application of BP Neural Network in Tax Assessment of Real Estate Industry

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ABSTRACT

As one of the economic pillar industries in China, the real estate industry has great influence. The real estate industry involves many taxes, and the tax business is complicated, so it needs more attention. Tax assessment is an important part of tax work. Combined with the important economic significance of the real estate industry, the tax assessment of the real estate industry is particularly important. The tax assessment of real estate industry has the characteristics of long cycle, rich links, many taxes and so on, and it is very dependent on the subjective judgment of appraisers, so it takes a lot of energy. Therefore, the tax assessment of real estate industry based on artificial intelligence is a work worthy of in-depth study. This paper analyzes the common problems in tax assessment of real estate industry, including long development cycle leading to complicated tax-related business, imperfect contract management system, risk of paying less taxes, confusion of cost accounting objects, etc. This paper studies the commonly used evaluation indexes of tax assessment, including the related indexes of expense change rate and business profit change rate. Based on BP neural network, the tax assessment model of real estate industry is established, and the effectiveness of this method is verified by the actual data of five real estate enterprises in recent five years.

Keywords: *Real estate industry; Pay taxes; Neural network; Evaluation index*

1. INTRODUCTION

With the advent of the era of "big data" and the continuous progress of artificial intelligence technology, tax risk assessment based on artificial intelligence has been widely concerned by scholars at home and abroad, and artificial intelligence technology has been gradually applied to tax assessment [6] [7] [8]. The development process of artificial intelligence in tax assessment of real estate industry is shown in Figure 1.

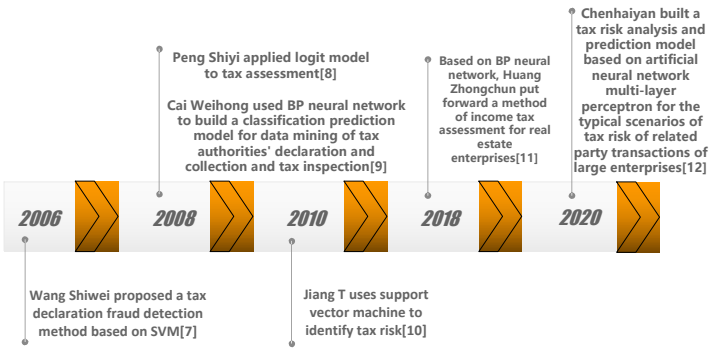

Figure 1 The development of artificial intelligence in tax assessment of real estate industry

The tax assessment of real estate industry based on artificial intelligence is worthy of in-depth study, but it needs further study to protect the healthy development of China's tax industry [1] [2] [3]. BP neural network has the

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characteristics of nonlinear mapping ability, self-learning ability and strong fault tolerance, and is suitable for solving tax assessment problems. Based on this, this paper will study the application of BP neural network in tax assessment of real estate industry by combining artificial intelligence with tax assessment of real estate industry based on the practice of real estate tax assessment and the characteristics of tax assessment of real estate industry [4] [5].

2. COMMON PROBLEMS IN TAX ASSESSMENT OF REAL ESTATE INDUSTRY

2.1 Long development cycle leads to complicated tax-related business

From project establishment to delivery, due to different development forms, capital investment and development purposes, the development cycle is long. The business links of real estate are as follows: there are many kinds of taxes involved, the ways of tax collection and management are complicated, and it is difficult to calculate the tax amount. For example, when an enterprise acquires land, it involves deed tax, farmland occupation tax, urban land use tax, etc. In the design and construction of real estate projects, development cost accounting is closely related to enterprise income tax and land value-added tax, and also involves withholding and paying personal income tax. The real estate (pre-sales) link involves prepaid value-added tax, enterprise income tax, land value-added tax and other projects; The liquidation process involves land value-added tax liquidation, settlement and payment of enterprise income tax, etc.

2.2. The contract management system is not perfect

In the process of real estate development, enterprises must sign a series of economic contracts, such as construction contract, construction survey and design contract, project supervision contract, technical service contract, purchase and sale (supply) contract, consultation contract, commercial housing sales contract, housing lease contract, etc. Among them, the number of sales contracts is relatively high. Before the reform of the camp, the business tax is an in-price tax. After the enterprise actually obtains the price, the business tax is calculated as the product of turnover and business tax rate. After the reform of the camp, real estate enterprises should pay value-added tax when selling real estate projects. Value-added tax is extra-tax. Enterprises sign sales contracts with buyers, and the price of the contracts is generally tax-included. When calculating, it is necessary to separate the price and tax and convert them into sales excluding tax, and then the product of sales excluding tax and VAT rate will confirm the output tax. Therefore, some enterprises do not consider the price including tax when formulating the terms of the sales price contract, resulting in tax risk.

2.3 There is a risk of underpaying taxes.

The return of land transfer fees received from government departments fails to declare and pay taxes according to regulations, and there is a risk of underpaying taxes. The state implements the method of bid invitation, auction and listing for land transfer. After acquiring the land, real estate enterprises receive a certain percentage of the land transfer fee paid by the government departments. After receiving the refund of the land transfer fee from the enterprise, it is included in the subjects such as "special payables", "capital reserve", "other payables" and "long-term receivables". The cost of land acquisition is not offset in the land value-added tax liquidation, so there is a risk of underpayment of land value-added tax. If the enterprise income tax returns are not processed, there is a risk that the enterprise income tax will not be paid.

3. COMMONLY USED ASSESSMENT INDICATORS FOR TAX ASSESSMENT

3.1 Related indicators of cost change rate

Comparing the change rate of main business expenses r_{zybd} with the early warning value r_{zybd0}, if there is a big difference, there may be a number of expenses. The calculation formula of main business expense change rate r_{zybd} is as follows:

$$r_{\text{zybd}} = \frac{y_{\text{bzy}} - y_{\text{jzy}}}{y_{\text{jzy}}} \times 100\% \quad (1)$$

Where: y_{bzy} is the main business expenses of the current period; y_{jzy} is the main business expenses in the base period.

The main business expense ratio r_{zyfy} can be expressed as:

$$r_{\text{zyfy}} = \frac{y_{\text{zy}}}{I_{\text{zy}}} \times 100\% \quad (2)$$

Where: y_{zy} is the main business expenses; I_{zy} is the main business income.

Comparing the change rate of business (management, finance) expenses with the previous value, if there is a big difference, there may be the problem of paying more business (management, finance) expenses before tax. Operating (management, finance) expense change rate r_{byy} is calculated as follows:

$$r_{\text{byy}} = \frac{y_{\text{byy}} - y_{\text{jyy}}}{y_{\text{jyy}}} \times 100\% \quad (3)$$

Where: y_{byy} is the current operating (management, financial) expenses; y_{jyy} is the operating (management,

financial) expenses of the base period. The cost rate is used to analyze the relationship between taxpayers' period expenses and sales costs. Compared with the early warning value, if there is a big difference, the enterprise may have multiple period expenses. The calculation formula of cost rate $r_{cb\text{fy}}$ is as follows:

$$r_{\text{cbfy}} = \frac{y_{\text{byy}} + y_{\text{bgl}} + y_{\text{bcw}}}{C_{\text{bzyyw}}} \times 100\% \tag{4}$$

Where: y_{bgl} is the current management expense; y_{bcw} is the current financial expense; C_{bzyyw} is the main business cost of the current period. Compared with the early warning value, if the cost profit rate of the enterprise is abnormal in the current period, there may be many problems such as costs and expenses. The calculation formula of cost profit rate $r_{cb\text{fylr}}$ is as follows:

$$r_{\text{cbfylr}} = \frac{p_z}{C_{\text{zcb}}} \times 100\% \tag{5}$$

Where: p_z is the total profit; C_{zcb} is the total cost. The total cost is the sum of the total cost and expenses of the main business.

3.2 Indicators related to the rate of change of business profit

If the profit change rate index is quite different from the early warning value, there may be the problem of over-carrying-over cost or ignoring or under-accounting income.

The main business profit change rate $r_{zyywlrbd}$ and other business profit change rate $r_{qtywlrbd}$ can be expressed as:

$$r_{\text{zyywlrbd}} = \frac{p_{\text{bzyyw}} - p_{\text{jzyyw}}}{p_{\text{jzyyw}}} \times 100\% \tag{6}$$

Where: p_{bzyyw} is the profit of main business in the current period; p_{jzyyw} is the profit of main business in the base period.

$$r_{\text{qtywlrbd}} = \frac{p_{\text{bqtyw}} - p_{\text{jqtyw}}}{p_{\text{jqtyw}}} \times 100\% \tag{7}$$

Where: p_{bqtyw} is the profit of main business in the current period; p_{jqtyw} is the profit of main business in the base period.

Pre-tax deduction limit for making up losses. According to the provisions of the tax law, audit and analyze the allowable amount of losses, if the declared compensation loss is greater than the deduction limit of pre-tax compensation loss, there may be some problems such as failure to declare pre-tax compensation according to regulations.

Increase or decrease of operating income and expenditure. Compared with the base period, the increase or decrease of non-operating income is much lower, and there may be the problem of concealing non-operating income. Compared with the base period, the increase or decrease of operating expenses increases more, and there may be non-conforming expenses included in operating expenses.

4. APPLICATION OF BP NEURAL NETWORK IN TAX ASSESSMENT OF REAL ESTATE INDUSTRY

4.1 Basic principle of BP neural network

Let the neural network have n inputs, q outputs p hidden layer units, and the connection weights of hidden layer and output layer are p and q. Implicit layer neurons can be expressed as:

$$s_j = \sum_{j=1}^{n} w_{\text{kj}}\, b_j - \theta_k \tag{8}$$

Where: w_{ji} is the connection weight between the jth neuron in the hidden layer and the ith neuron in the input layer; x_i is the stimulation of the ith neuron in the input layer; θ_j is the threshold of the j momentum. Output function of neurons in each layer adopts logsig function:

$$b_j = \frac{1}{1 + e^{-s_j}} = \frac{1}{1 + e^{-(\sum_{i=1}^{n} w_{\text{ji}} x_i - \theta_j)}} \tag{9}$$

The neurons of the output layer can be expressed as:

$$s_k = \sum_{j=1}^{n} w_{\text{kj}}\, b_j - \theta_k \tag{10}$$

Where: w_{kj} is the connection weight between the kth neuron in the output layer and the kth neuron in the hidden layer; θ_k is the threshold of the kth momentum.

By outputting the actual result y_k and the expected result o_k, the weights of each neuron can be corrected. The weights and threshold corrections of the hidden layer and the input layer are as follows:

$$\Delta w_{\text{ji}} = \beta \cdot [\sum_{k=1}^{q} v_{\text{kj}}(o_k - y_k) y_k(1 - y_k)] b_k(1 - b_k) \cdot x_i \tag{11}$$

$$\Delta \theta_j = \beta \cdot [\sum_{k=1}^{q} v_{\text{kj}}(o_k - y_k) y_k(1 - y_k)] b_j(1 - b_j) \tag{12}$$

Where: β is the correction coefficient.

The weight correction amount and threshold correction amount of the output layer and the hidden layer can be expressed as:

$$\Delta w_{\text{kj}} = \alpha \cdot (o_k - y_k) y_k(1 - y_k) b_j \tag{13}$$

$$\Delta \theta_k = \alpha \cdot (o_k - y_k) y_k(1 - y_k) \tag{14}$$

Where: α is the correction coefficient.

4.2 Tax assessment model of real estate industry based on BP neural network

Take the commonly used assessment indicators of tax assessment as the input of BP neural network and the assessment results as the output. The tax assessment model of real estate industry based on BP neural network is shown in Figure 2.

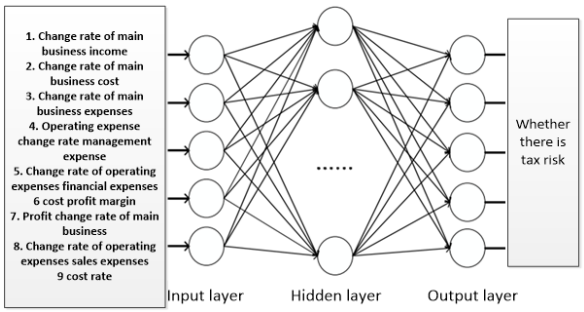

Figure 2 Tax assessment model of real estate industry

The input layer in Figure 2 is the numerical value of each index. The output level is whether there are tax risks such as multi-column costs and expenses, expanding the scope of pre-tax deduction, etc., and assign values to results 0 and 1, setting 0 as no risk and 1 as risk.

4.3 Example analysis

Some economic indicators are selected from the annual financial statements of some real estate enterprises as the training data of BP neural network. The specific data is shown in Figure 3.

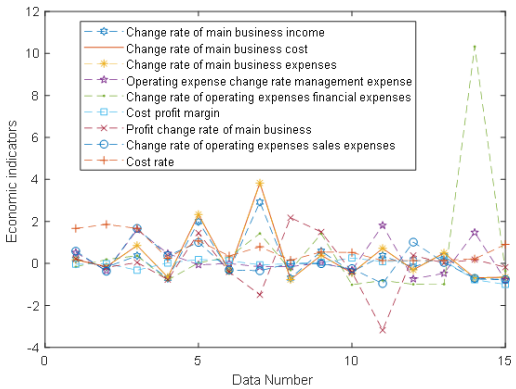

Figure 3 BP neural network training data

Among them, groups 1, 2, 4, and 6 are data with no tax risks such as multi-column costs and expenses, expanding the scope of pre-tax deduction, and others are data with tax risks.

Table 1 BP neural network test data

Inspection data group number	Change rate of main business income	Change rate of main business cost	Change rate of main business expenses	Operating expenses change rate	Operating expenses change rate
1	-0.329339297	-0.164489757	-0.164489757	-0.280008836	-69.12121212
2	-0.330515239	-0.29000909	-0.29000909	-0.056917749	-1.445542008
Inspection data group number	Ratio of profits to cost and expense	Change rate of main business profit	Operating expenses change rate	Cost rate	
1	0.096693336	-0.647827177	-0.469350676	0.097357021	
2	-0.290846782	235.6169431	0.023315754	0.154740174	

Fifteen groups of data in Figure 3 are used to train the BP neural network, and the other two groups of data are used to verify the effectiveness of the BP neural network. The test data are risky data, as shown in Table 1. Table data is used as the input of neural network. 12 hidden neurons are set, and the output results are 0.9768 and 0.9999, which is about 1. That is, there are tax risks such as multi-column costs and expenses, expanding the scope of pre-tax deduction, etc., which indicates that this method can effectively identify whether there are tax risks such as multi-column costs and expenses and expanding the scope of pre-tax deduction.

5. CONCLUSION

This paper analyzes the common problems in the tax assessment of the real estate industry. The research shows that in the tax assessment of the real estate industry, the long development cycle leads to the complexity of tax related businesses, the imperfect contract management system, the risk of paying less tax, and the confusion of cost accounting objects. Through the in-depth study on the common evaluation indicators of tax evaluation, the tax evaluation model of the real estate industry is established based on BP neural network. At the same time,

the effectiveness of this method is verified by the actual data of five real estate enterprises in recent five years.

From the perspective of the tax management department, this study discusses the tax evaluation methods for the real estate industry, and provides effective management suggestions and micro theoretical support for tax supervision.

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REFERENCES

[1] Albert Lai. Irish tax assessment system reform and enlightenment [J]. International Taxation, 2000, (05):38-40.

[2] Cai Weihong, Guo Chenxi. Application of BP neural network optimized by genetic algorithm in tax assessment [J]. Journal of Shantou University (Natural Science Edition), 2008, (02):62-68.

[3] Chen Haiyan, Gong Liangqin, Cheng Li, You Zhuhong. Tax Risk Assessment Model of Large Enterprises Based on Multilayer Perceptron [J]. Computer Application Research, 2020,37(2):41-43+46.

[4] Huang Zhongchun. Research on Enterprise Income Tax Assessment Based on BP Neural Network [D]. Jinan University, 2018.

[5] Jiang T, Hong G. Anomaly detection combining one-class SVMs and particle swarm optimization algorithms[J]. Nonlinear Dynamics, 2010, 61(2):303-310.

[6] Lu Qiang. On the challenges and countermeasures faced by real estate enterprises after the third phase of the Golden Tax [J]. Tax Payment, 2021,5(5):33-34.

[7] Peng XI, Zhou Wuyang. Application of Logit model in tax assessment [J]. statistics and decision, 2008, (5):71-73.

[8] Qu Mingrong. Problems and solutions of tax evasion in China's real estate industry at present [J]. Accounting Monthly, 2008, 12(1):35-37.