Ekoloji 28(108): 551-555 (2019)

LETTER TO THE EDITOR

Overseas Investment Ecological Environment Evaluation Method Based on Artificial Neural Network

Peng-Ju Zhao[1, 2*]

[1]College of Management and Economics, Tianjin University, Tianjin 300072, China

[2]System and Industrial Engineering Research Center of Zhongyuan University of Technology, Zhengzhou 450007, China

[*]E-mail: arnoldzhao@tom.com

The research on China's foreign investment ecological environment assessment helps to improve the security and stability of "going out" in China, and has important reference value for the location decision and risk management of China's foreign direct investment projects. The existing investment ecological environment assessment methods reveal some influencing factors. Some factors have little significance in the evaluation of overseas investment ecological environment. To address this problem, an overseas investment ecological environment evaluation method based on artificial neural network is proposed in this paper. The results show that there are obvious spatial differences in China's external investment ecological environment. In general, the distribution pattern is "Oceania developed economic circle > Asian and African developing countries and emerging economies". The political and legal environment is characterized by the spatial difference of "the best developed countries in Oceania and the poorer countries in Asia and Africa". The economic and opening environment presents have spatial distribution characteristics that "global environment is better and parts of Asian and African countries are poorer".

Artificial neural network; overseas; investment ecological environment; assessment

1 Introduction

As an important decision-making problem of overseas investment, the evaluation of overseas investment ecological environment has become an important research topic in the field of international investment. Direct investment, indirect investment, the current international popular direct investment methods, merger and acquisition, and the main form of foreign investment in China, have raised higher and higher requirements for the assessment of the investment ecological environment of the host country (Shen 2016). When evaluating the overseas investment ecological environment, Chinese enterprises lack the evaluation model similar to those of developed countries such as Europe, America and Japan. Most of them are made by the decision makers of the enterprise. With the increasing complexity of the international investment ecological environment, this practice will undoubtedly increase the risk of overseas investment (Bararpour et al. 2018, Mi et al. 2015, Singh and Tiwari 2017). Based on the importance and complexity of the overseas investment ecological environment assessment, with the help of the experience of other transnational investment enterprises, a quantitative and objective evaluation model of overseas investment ecological environment is established by using artificial neural network technology, which is to provide an assessment method for overseas investment ecological environment of

domestic enterprises and reduce assessment cost and reduce assessment risk (Fan et al. 2017).

Guan and Tian (2018) published an article entitled "Study on the Dynamic Impact of Ownership Structure and Inefficient Investment in China's Forestry Industry Based on Environmental Responsibility" (Issue 106). This article describes the economic, ecological and social benefits of forestry. Its social responsibility is mainly reflected in the externality of forest resources and bears more environmental responsibilities. Based on the panel data of China Forestry listed companies from 2011 to 2017, this paper uses the dynamic panel system GMM estimation method to study the dynamic endogenous problems of ownership structure and inefficient investment, and discusses the regulation role of Csr in the influence of ownership structure. About corporate investment efficiency. Finally, it is concluded that Chinese forestry listed companies should reduce the concentration of ownership, improve the balance of ownership, and actively implement Csr. The viewpoint of this paper can also be applied to the field of overseas investment ecological environment.

Compared with previous studies, the proposed evaluation method of overseas investment ecological environment based on artificial neural network has the following characteristics.

2 Idea description

The establishment of evaluation index system is the most basic element of China's transnational investment ecological environment evaluation. Based on the shortcomings of the traditional evaluation methods for the overseas investment ecological environment, the evaluation factors that can affect the investment characteristics are increased (Wang 2016), and a new evaluation index system for the overseas investment ecological environment is constructed.

According to the close degree nature of grey relation (Li and Li 2016), the set of evaluation levels of overseas investment ecological environment is divided into:

$V:V=\{V_1(\text{Good}),\ V_2(\text{Relatively good}),\ V_3(\text{General}),\ V_4(\text{Relatively poor}),\ V_5(\text{Poor})\}$. The prescribed closeness value in [0.8, 1) is "good", the one in [0.6, 0.8) is "relatively good", the one in [0.4, 0.6) is "general", the one in [0.2, 0.4) is "relatively poor", and the one in [0, 0.2) is "poor".

Determination of constant weight and variable weight. The determination of weight is generally divided into two categories. One is the subjective weighting method, such as analytic hierarchy process and Delphi method. There is a strong subjectivity in determining weights according to the knowledge and experience of relevant experts. The other is objective weighting method, such as factor analysis and rough set. It is based on the actual data to calculate the weight (Hu et al. 2017). The overseas investment ecological environment is evaluated by AHP method, which is obtained by calculation with YAAHP software. The construction of the judgment matrix was determined by sending out the survey volume to the relevant experts. 20 copies were issued and 15 copies were collected. The expert situation is shown in Table 1.

Table 1 Expert situation

Number	Quantity of questionnaires	Expert source	Expert title
1	5	Higher school	Professor
2	7	Related enterprises	Professor
3	3	Engineering Institute	Professor

The index eigenvalue of the investment ecological environment is used as the input vector of the neural network,

and the index value representing the quality of the investment ecological environment (the comprehensive quality or the quality of a certain object domain) is used as the output (vector) of the neural network to build a suitable neural network structure. The neural network is trained with sufficient standard sample pattern. The weights of evaluation indexes are input into the neural network, and the quality of overseas investment ecological environment can be obtained.

3 Results

The simulation environment is: Windows7 operating system, main frequency of the processor is 3.40 GHz, CPU Intel (R) Core (TM) i7-3770M, and 4 G memories. The simulation is programmed with MATLAB R2010a. On the basis of the geographical distribution of the "going out" of the first industry in China, the country with the first industrial cooperation agreement and the bilateral investment agreement along the "The belt and road" map, which have been signed with China, are included in the evaluation object set.

The potential layout space of China's foreign investment is further expanded from three aspects of reality, resource and policy. The 138 countries are finally selected as the evaluation object. The 2015-2017 year's basic data are mainly from authoritative data released by international organizations such as the World Bank, FAO and the Global Heritage Foundation. The randn function of MATLAB software is used to interpolate randomly the sample data which conform to the normal distribution principle. Combined with the training and test results, 500 groups of samples were randomly inserted between the evaluation threshold and randomly selected samples of 2/3 as training samples, and the remaining 1/3 as a test sample.

The transfer functions of hidden layer and output layer of neural network are tansig and purelin, respectively, the training function is trainlm, and the performance function is mse. The training frequency is set to 1000 times, the expected error is set to 0.0001, and the learning rate is set to 0.02. The selection of the number of nodes in the hidden layer is one of the keys to the neural network algorithm and has a great influence on the network performance. But there is not an ideal analytical formula that can be used to determine a reasonable number of neurons. The empirical formula is used to preliminarily determine the number of hidden layer nodes is 8~14, which is $M' = \sqrt{n' + m'} + a$, a is the constant in the interval $[0,10]$, n' and m' are the number of neurons in the input and output layer. Through network training and test, the number of hidden layer nodes is determined to be 10, as shown in Table 2.

Table 2 Test of the number of nodes in the hidden layer of the neural network

Average results of 10 times	Number of nodes in hidden layer				
	8	9	10	11	12
Training frequency/(times)	8.251	22.251	6.242	7.164	12.083
Mean square error/(%)	0.053	0.085	0.015	0.047	0.032

According to the above setting, a neural network is built, and the extreme data method is used to standardize the original data. 22 variables of the 4 subsystems of the evaluation index system are taken as the input vector, and the evaluation level of overseas investment environment investment ecological environment is taken as the output vector. The statistical indexes of mean square error, maximum absolute relative error, mean absolute relative error and running time are selected for network performance test. The results are shown in Table 3.

Table 3 Performance evaluation results of artificial neural network (Random 10 times)

Sample	Mean square error/(%)		Maximum absolute relative error/(%)	
	Mean of 10 times	Range of change	Mean of 10 times	Range of change
Training sample	0.0038	[0.0008, 0.0100]	2.0165	[0.4252, 6.3725]
Test sample	0.0060	[0.0018, 0.0200]	2.2185	[0.6612, 5.8354]
Sample	Mean absolute relative error/(%)		Network goodness-of-fit	
	Mean of 10 times	Range of change	Mean of 10 times	
Training sample	0.4006	[0.2510, 0.7041]	8.8654	
Test sample	0.4521	[0.2412, 0.9325]	8.8741	

Among the evaluated 135 countries, 21 countries are ranked in I level, mainly in Europe, including developed countries such as Britain, France and Germany. There are 36 countries in the II level, of which Asia is the most, including Kazakhstan, Malaysia and Korea, and Europe secondly, including Romania and Italy. There are 7 countries in Latin America, including Brazil, Uruguay and Chile. Among African countries, only Zambia has a better agricultural investment environment investment ecological environment. 72 countries are in III level, mainly in Africa. 6 countries in the W level are distributed in Africa and Asia.

4 Discussions

The investment ecological environment of developed countries in Europe, North America and Oceania is generally better than that of developing countries in Asia and Africa.

Compared with the current evaluation method, the proposed method can effectively correct the error through the repeated learning of the network and better grasp the relationship between the variables, and the accuracy of the evaluation is higher.

5 Conclusions

(1) The overall environmental difference of China's outward investment is obvious, showing the general pattern of "Oceania developed economic circle in Europe and America > Asian and African developing countries and emerging economies". This conclusion also reflects the differences in the level of economic development, the degree of opening to the outside world, the construction of infrastructure, the level of public service and the conditions of agricultural resources of the 138 evaluated target countries. These are the main aspects of their investment ecological environment.

(2) The environmental differences of China's foreign investment subsystems are also significant. The political and legal environment is characterized by the spatial difference that the developed countries of Oceania, Europe and the United States are the best and most countries in Asia and Africa are poor. The economy and the opening up environment is characterized by the spatial distribution characteristic that the global overall environment is relatively good and some Asian and African countries are poor. The infrastructure and the public service environment is characterized by the spatial gradient characteristic that the developed countries of Oceania,

Europe and the United States are the best, most countries in Asia are good, and most African countries are poor.

(3) The neural network method can be used to evaluate China's external investment ecological environment. Compared with the traditional method, the neural network method, which has high simulation function and nonlinear operation ability, can not only modify the error effectively and grasp the relationship between the variables through the repeated learning of the network, but also bring the influence of the invisible variable to the result as a whole in the calculation process. It can enhance the credibility of the assessment results, so that the conclusion of the study is more scientific and reasonable.

Acknowledgements

This research is supported by National Natural Science Foundation of China (71320107003)

References

Bararpour ST, Feylizadeh MR, Delparish A, et al. (2018) Investigation of 2-nitrophenol solar degradation in the simultaneous presence of k2s2o8 and h2o2: using experimental design and artificial neural network. Journal of Cleaner Production 176:1154-1162.

Fan Q, Shang ZG, Yan XF, et al. (2017) Knowledge-based approach to manage acquisition risk. Journal of China Academy of Electronics and Information Technology 12(3):307-311.

Guan X, Tian G (2018) Study on the dynamic impact of ownership structure and inefficient investment in china's forestry industry based on environmental responsibility. Ekoloji 27(UNSP e106202106):1867-1877.

Hu MZ, Tian SY, Liang YG (2017) Research on environmental performance evaluation of China's sustainable investment fund based on EIO-LCA model. Ecological Economy 33(11):106-111.

Li S, Li JY (2016) Comprehensive evaluation method for overseas oil and gas exploration projects. Natural Gas Geoscience 23(11):205-210.

Mi C, Shen Y, Mi WJ, et al. (2015) Ship identification algorithm based on 3d point cloud for automated ship loaders. Journal of Coastal Research (73):28-34.

Shen HW (2016) Application of analytic hierarchy process in project risk assessment. Automation & Instrumentation (8):118-120.

Singh VK, Tiwari KN (2017) Prediction of greenhouse micro-climate using artificial neural network. Applied Ecology and Environmental Research 15(1):767-778.

Wang Y (2016) Investment ecological environment analysis and evaluation of oil and gas of one belt and one road countries. Industrial Technology & Economy 35(9):118-127.