Spatial Aggregation Analysis and Systemic Risk Prevention of Internet Finance Based on Neural Network Model

Wangsong Xie*
Business School of Wuxi Taihu University, Wuxi, Jingsu, 214064, China

*Corresponding author e-mail: 192205049@mail.sdufe.edu.cn

Abstract. With the development of science and technology, the application of neural network model is more and more extensive. In order to avoid the outbreak of financial crisis, economists and policy makers around the world pay special attention to the timely warning of financial crisis. If we can make an accurate early warning of the economic crisis, the government and regulatory agencies will have more time to deal with the possible risks and avoid major interference to economic growth. Based on this, this paper studies the spatial aggregation analysis and systemic risk prevention of Internet Finance Based on neural network model. Based on BP neural network, this paper constructs a spatial econometric model by using spatial econometric analysis method, and analyzes the empirical results of financial spatial aggregation. The results show that the Moran's I value of China's Internet finance index in December 2019 is 0.372, P value is 0.001, Moran's I value of Internet payment is 0.395, P value is 0.002, Moran's I value of Internet monetary fund is 0.357, P value is 0.001, Moran's I value of Internet investment and financing is 0.324, P value is 0.002, Moran's I of Internet insurance is 0.313, P value is 0.001. The results show that there is spatial agglomeration in the development of Internet finance in China. In addition, this paper also studies the systemic risk of Internet finance, analyzes its causes and puts forward corresponding preventive measures.

Keywords: BP Neural Network, Internet Finance, Spatial Econometric Analysis, Systematic Risk Prevention

1. Introduction
In recent years, with the rapid development of Internet information technology, mobile phone and e-commerce network technology have driven the intensive development of Internet finance [1-2]. Nowadays, daily payment, resident investment, financial management and enterprise financing can be carried out through Internet finance [3]. Internet finance has the characteristics of low cost, high efficiency, wide coverage, convenience and strong interaction, which plays a huge role in China's economic development [4]. However, the development of Internet finance is also unbalanced and uncoordinated, and the development degree of different regions varies greatly. The development of Internet Finance in China has strong spatial characteristics, and the development level of different geographical locations will be different [5-6].
It is true that with the continuous development of the economy, Internet finance, as an emerging "derivative product", has attracted great attention from the financial industry and even customers. However, everything has its two sides. When seeing the rise and development of Internet finance, we should also pay attention to its potential risks, because a little carelessness will lead to the situation of losing everything and touching the whole situation [7-8]. Therefore, we must pay enough attention to analyze the different problems in different stages, and then put forward a series of effective solutions to avoid the possible Internet financial risks [9-10]. With the promotion of the application of neural network model, many scholars have applied it in financial risk prevention. Based on the neural network model, it is of great significance for the development of Internet finance to study the spatial aggregation analysis and systematic risk prevention of Internet finance.

This paper studies the spatial aggregation analysis and systemic risk prevention of Internet finance based on neural network model. This paper first introduces the related contents of BP neural network. On the basis of BP neural network, the spatial econometric model is established by using the spatial econometric analysis method to formally test the spatial characteristics of Internet financial development in China. Then, the spatial autocorrelation test and Moran index change of Internet financial development index are analyzed one by one, finally, the paper studies the systemic risk of Internet finance, analyzes the causes and puts forward corresponding preventive measures.

2. BP Neural Network and Spatial Econometric Analysis

2.1 BP Neural Network

BP neural network is a kind of special learning network. Its operation steps are to determine the output value of each operation, then input the memory mode we have learned, and transfer it from the input layer to the intermediate layer, and then to the output layer, forming such a three-layer propagation network.

BP neural network algorithm is mainly divided into the following steps:

(1) Initialization parameters

Parameters such as weight and threshold are initialized by random function.

(2) Hidden layer calculation

According to the input characteristic data $X_i$, the weight of input layer and hidden layer $W_{ij}$, deviation $b_1$, the decision value $Z$ is obtained through the conversion function, and $Z$ is input into the activation function to obtain the exit $a$ of the current hidden layer, as shown in equation 1.

$$Z_j = \sum_{i=1}^{n} W_{ij}X_i + a_j, \quad j = 1,2,\ldots,i$$

$$A_j = f(Z_j)$$

(1)

(3) Output layer calculation

According to the exit $a$ of the hidden layer, the weight $V_i$ of the output layer and the hidden layer, and the default $B_2$, the output result $\hat{y}$ of the output layer is calculated, as shown in equation 2.

$$\hat{y}_k = \sum_{j=1}^{f} V_{jk}Z_j + b_k, \quad k = 1,2,\ldots,m$$

(2)

(4) Error calculation

According to the calculation result $\hat{y}$ of lifting process and the expected value $Y$ in the data set, the error $E$ is calculated, as shown in equation 3.
\[ e_k = L(y, \hat{y}) = \frac{1}{2} (y_k - \hat{y}_k)^2 \]  

(3)

(5) Update weights
The error E calculated in the previous step is used, and then the error is transmitted backward through the derivative rule.

(6) Update threshold
Similar to the calculation method in (5), the error E calculated by step (4) is used to update the threshold value by using the chain derivation rule.

(7) Iterative judgment
Judge whether the training is finished according to the error and the set number of rounds. If not, continue to step 2 to continue training, otherwise the algorithm will end.

2.2 Spatial Econometric Analysis
(1) Spatial autocorrelation analysis
According to the principle of spatial econometrics, the thinking of analyzing the spatial effect of Internet finance is as follows: firstly, Moran index is used to test whether there is spatial autocorrelation in Internet finance. If there is spatial autocorrelation, a spatial economic model should be established to evaluate and control the influence of Internet financial factors.

(2) Spatial econometric model
In addition to the single variable spatial correlation test, we can also use the spatial economic model for reverse research to analyze whether the inter-regional internet financial model continues to affect other factors after controlling other factors. The spatial econometric model used in this paper is a spatial lag model.

3. Research Object and Variable Data
(1) Research object
This paper selects the Moran index of financial network development index of several cities in China from January to December 2019 as the research object, in which the weight table is calculated according to the reciprocal of the square of distance between each city.

(2) Variables and data
1) Internet finance development index
The most important variable in this paper is the data describing the development of Internet financing in different regions. As a new business form, this paper uses the official statistics of Internet financial data.

2) Economic characteristics data
The focus of this paper is to analyze the spatial agglomeration effect of Internet finance. In order to make an accurate evaluation, we must scientifically select other economic characteristics as control variables. The main control variables selected in this paper are the level of economic development, industrial structure, population density and so on.

4. Spatial Aggregation Analysis and Systemic Risk Prevention of Internet Finance Based on Neural Network Model

4.1 Empirical Results Analysis of Internet Financial Spatial Aggregation Based on Neural Network Model
Based on BP neural network, this paper uses spatial econometric model to test the spatial characteristics of Internet financial development in different regions of China, and analyzes the spatial correlation test results of Internet economic development indicators, Moran index changes and spatial econometric analysis results. The Moran test results of the total Internet finance index and the sub enterprise index are shown in Figure 1.
Figure 1. Moran index calculated by internet financial development index of 335 prefecture level cities in China in December 2019

As can be seen from Figure 1, Moran's I value of China's Internet finance index in December 2019 was 0.372, P value was 0.001, Moran's I value of Internet payment was 0.395, P value was 0.002, Moran's I value of Internet Monetary Fund was 0.357, P value was 0.001, Moran's I value of Internet investment and financing was 0.324, P value was 0.002, Moran's I value of Internet insurance was 0.313, P value was 0.001. It can be seen that the similarity values of some cities tend to accumulate locally, which indicates that there is spatial agglomeration in the development of Internet Finance in China.

The Moran index change trend of Internet financial development index is shown in Figure 2.

Figure 2. Moran index change trend of Internet financial development index from January 2019 to December 2019

As can be seen from Figure 2, the Moran index of China from January to December in 2019 is different, with some differences. Among them, the Moran index in January is 0.425, the Moran index in February is 0.413, the Moran index in March is 0.376, the Moran index in April is 0.413, and the
Moran index in May is 0.398, the Moran index was 0.372 in June, 0.435 in July, 0.412 in August, 0.376 in September, 0.382 in October, 0.376 in November and 0.372 in December. On the one hand, Moran index is positive every month, which shows that the regional development of Internet Finance in China has strong spatial integration characteristics. On the other hand, Moran index shows a downward trend, from 0.425 in January to 0.372 in December. Although the decline is not large, it can still be seen that the spatial distribution of Internet to regional development funds in China is tending to be decentralized, and the development of Internet funds presents a certain degree of decentralization trend.

### 4.2 Internet Financial Systemic Risk Prevention Based on Neural Network Model

Based on the neural network model of Internet financial systemic risk prevention research, summed up the specific causes and countermeasures, as shown in Table 1.

| Cause of formation                      | Preventive measures                                      |
|----------------------------------------|----------------------------------------------------------|
| Problems in the Internet financial system | Increase transparency and establish information transmission mechanism |
| Internet financial risks are high       | Improve system technical standards and ensure platform security |
| The supervision of Internet finance is not perfect | Establishing a systematic and effective risk early warning mechanism |

It can be seen from Table 1 that the main reasons for the formation of systemic risks of Internet finance are: problems in the Internet financial system, high risks in Internet finance and imperfect supervision of Internet finance. A detailed analysis is made as follows:

1. **The causes of systematic risks in Internet Finance**
   1) Imperfect financial laws and regulations
      Legal risk refers to the use of legal loopholes, violation of the law or no clear definition of the situation. As China's Internet finance is in its initial stage, some laws and regulations corresponding to it are not perfect, and most of them serve the traditional finance. In view of the rapid development of the Internet, China's laws and regulations on Internet finance are very few, and the corresponding legal supervision system is not perfect.
   2) Internet financial risks are high
      Market risk is a kind of undifferentiated risk, which is the most common risk in the financial system. Due to the unique advantages of Internet finance, extremely low marginal cost and advanced network marketing methods and concepts, the Internet finance industry is also faced with market risks due to the influence of market environment.
   3) The supervision of Internet finance is not perfect
      The supervision of Internet finance is not perfect in three aspects: first, the current regulatory laws are too old. There are at least a dozen laws and regulations related to Internet direct selling funds such as yu'e bao, such as the securities investment fund law and the measures for the deposit of customer reserves of payment institutions, which are far from enough.
      Second, the regulatory system and mechanism are not perfect, and the regulatory authorities lack foresight to prevent Internet financial risks.
      Third, regulation is pro cyclical, which will bring pressure on the liquidity of Internet finance.

2. **Prevention measures for systematic risks of Internet finance**
   In view of the above reasons for the formation of Internet financial systemic risk, this paper summarizes the corresponding preventive measures, as follows:
   1) Increase transparency and establish information transmission mechanism
      Because the information is confidential and not transparent enough, there may be financial risks.
      Internet finance has just begun, P2P lending and other rapid development, but there are still many problems in the supervision, supervision is not perfect, has not entered the official regulatory system.
Therefore, for P2P network lending and other financial services, we should not only actively disclose information, improve transparency, but also make information symmetrical. At the same time, we should establish a complete information transmission mechanism to make information disclosure more formal and safe.

2) Improve system technical standards and ensure platform security

If you want to know the authenticity of the financial platform and its content, you can rely on the verification of third-party authentication to create a recognition mechanism of financial platform to make the network environment more secure. Specifically, it is divided into the following aspects:

First, we should formulate consistent technical standards from the aspects of HTML coding, application of web technology, configuration of firewall and so on. Comprehensive technical standards not only give the platform corresponding strategic signals, but also increase the authenticity and security of the network.

Second, reform the method and technology of authentication, from the beginning of the transaction to the end of the transaction, from verifying the identity of the borrower to receiving the loan, the information transmitted should be kept confidential. If there is no authorization, it can not be changed at will to ensure that the whole transaction is safe.

Third, we should pay attention to personnel training and attract high-tech talents. Compared with the long-term development of P2P platform, most financial platforms are not stable enough in technology and lack of technical talents. Therefore, we must actively cultivate and transport advanced talents and improve the system of advanced talents.

3) Establishing a systematic and effective risk early warning mechanism

In the aspect of risk management process, it includes four contents: early warning of latent period risk, risk control in outbreak period, follow-up treatment and assessment in recovery period. Therefore, it is necessary to establish and improve the risk early warning system. Once the risk is found, the relevant personnel should issue a warning as soon as possible, and take appropriate measures according to the severity and urgency of the risk, so as to prevent the risk and reduce the loss.

5. Conclusions

This paper studies the spatial aggregation analysis and systematic risk prevention of Internet finance based on neural network model. On the basis of BP neural network and spatial econometric model, this paper analyzes the spatial agglomeration phenomenon in the development of Internet finance in China, and the change of China's overall financial industry has a great impact on the development of China's financial industry. The combination of Internet technology and traditional financial industry represents the great progress of traditional financial industry, but at the same time, it also produces a series of risks. Therefore, this paper believes that the national government should formulate corresponding complete laws and regulations, strengthen supervision, enterprises should be more strict with themselves, and individuals should also have a certain understanding of relevant laws and regulations to protect their own rights.

References

[1] Bagheri N , Wangdi K , Cherbuin N , et al. Combining Geospatial Analysis with Dementia Risk Utilising General Practice Data: A Systematic Review. Journal of Prevention of Alzheimers Disease, 2018, 5(1):71.

[2] Hoque A A , Phinn S , Roelfsema C . A systematic review of tropical cyclone disaster management research using remote sensing and spatial analysis. Ocean & Coastal Management, 2017, 146(sep.):109-120.

[3] Scholz E , Hartlage C , Bernhardt F , et al. Spatial relationship between the pulmonary trunk and the left coronaries: Systematic risk assessment based on automated three-dimensional distance measurements. Heart Rhythm O2, 2020, 1( 1):14-20.

[4] Zhao J , Jin J , Xu J , et al. Risk assessment of flood disaster and forewarning model at different spatial-temporal scales. Theoretical & Applied Climatology, 2018, 132(3-4):791-808.
[5] Jia P, Cheng X, Xue H, et al. Applications of geographic information systems (GIS) data and methods in obesity-related research. Obesity Reviews, 2017, 18(4):400-411.

[6] Ying-Si L, Xiao-Nong Z, Zhi-Heng P, et al. Risk mapping of clonorchiasis in the People's Republic of China: A systematic review and Bayesian geostatistical analysis. Plos Neglected Tropical Diseases, 2017, 11(3):e0005239.

[7] Huang D, Yu Z, Li Y, et al. Calculation method and application of loss of life caused by dam break in China. Natural Hazards, 2017, 85(1):39-57.

[8] Wang Q, Wang J, He M Z, et al. A county-level estimate of PM2.5 related chronic mortality risk in China based on multi-model exposure data. Environment International, 2017, 110(jan.):105-112.

[9] Albuquerque M T D, Gerassis S, Sierra C, et al. Developing a new Bayesian Risk Index for risk evaluation of soil contamination. ence of the Total Environment, 2017, s 603–604(dec.15):167-177.

[10] Boyda D C, Holzman S B, Berman A, et al. Geographic Information Systems, spatial analysis, and HIV in Africa: A scoping review. PLoS ONE, 2019, 14(5):e0216388.