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Risk Assessment and Dynamic Monitoring of China's Agricultural Investment in Countries Along the Belt and Road Under the Guidance of Cultivated Land Resources

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Abstract: Establishing a sound agricultural investment risk measurement and dynamic monitoring mechanism is a key path to optimize the efficiency of agricultural capital allocation and ensure the stability of the global food supply chain. Based on the five dimensions of politics, economy, society, agricultural management, and bilateral diplomatic and economic relations with China, this paper constructs an index system to assess the risks of China's agricultural investment in 49 countries along "the Belt and Road" and uses nuclear density analysis, a Markov chain, and other methods to analyze the spatio-temporal evolution characteristics of different risks during 1995–2022. A deep neural network model is constructed to monitor the investment risk dynamically. The research shows that China's agricultural investment risk to most of the countries along the route (61.22%) is at a normal level, and risk in bilateral diplomatic and economic relations with China is the most critical influencing factor. The agricultural investment risk among countries along the route has a significant positive spatial correlation and dynamic infectivity and shows a trend of gradually transferring from high risk to low risk in the long run. Endowment of agricultural water resources, natural disasters, and other indicators have the greatest impact on the high risk. Unemployment status and communication level have the greatest influence on the low risk. Investment relationship and endowment of agricultural land resources have the least influence on different investment risk levels. On this basis, the paper puts forward some policy suggestions for expanding the investment scale and strengthening dynamic monitoring. This paper enriches the index system of China's agricultural investment risk and provides a reference for other countries' agricultural investment and regional economic belt construction.

Keywords: risk assessment; dynamic monitoring; agricultural foreign investment; the Belt and Road

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1. Introduction and Literature Review

1.1. Introduction

In recent years, the global food security situation has become more severe. According to the "2024 Global Food Crisis Report", in 2023, nearly 282 million people in 59 countries

and regions in the world experienced sudden severe hunger, an increase of 24 million people over 2022, a record high. Initially, food trade was the main means to solve the problem, but it is vulnerable to external factors, such as price fluctuations and restrictions on exporting countries. Therefore, countries with limited agricultural resources must turn their attention to independent foreign investment in agriculture; in other words, carrying out agricultural management in countries or regions with abundant agricultural resources and transporting the produced food back to China [1,2]. As recently as the last century, countries like Japan and South Korea carried out foreign investment in agriculture, and Japan also formed an investment strategy of "integrating the government and the people" [3]. Major food-importing countries, such as Saudi Arabia, India, and South Africa, as well as financial powers, such as the United States and Germany, have also joined the ranks. Due to restrictions on domestic arable land reclamation, Brazil has also carried out agricultural investment in Paraguay and Bolivia to stabilize its food supply [4,5].

Agriculture is the basic industry for most countries to ensure food security, and agricultural foreign investment activities involve the food security of the host country and even affect the rights and interests of local small farmers and the land system. This leads to political and social sensitivities and more complex risks than typical foreign investment activities [6]. Investment activities involve multiple entities, but enterprises do not have a strong sense of cooperation with the host country's social groups, people, media, and other entities and cannot achieve information sharing and resource sharing. This results in poor sustainability and social responsibility performance of investment activities [7–9]. With the continuous expansion of the scale of China's agricultural foreign investment and the increase in risks, investment enterprises began to pay attention to risk management. However, due to the late start of China's agricultural foreign investment, the accumulated risk management experience is limited, resulting in the current risk management model, which still has many deficiencies. Therefore, investigating the risk status and law of China's agricultural investment in countries along the "Belt and Road" is not only a practical problem that needs to be clarified in the implementation of China's agricultural "going global" strategy but also a theoretical discussion that should be paid continuous attention to in the context of China's development and world integration in the context of globalization. This paper not only helps to enrich the index system of China's agricultural investment risk; it can also provide a reference for other countries' agricultural investment and regional economic belt construction.

1.2. Literature Review

The research on agriculture foreign investment can be divided into four aspects: motivation, influencing factors, effect evaluation, and risk.

First, there are different views in academic circles on the motivation of investment activities. Some scholars believe that the foreign investment in agriculture during the colonial period was due to the plunder and exploitation of resources and the control of the labor force [10], while others believe that such investment was for the development and utilization of local agricultural resources to drive economic development [11]. According to Dunning's transnational investment theory, the motivations of foreign investment can be summarized into four categories: resource seeking, market seeking, efficiency seeking, and strategic resource seeking [12]. As for foreign investment in agriculture, some scholars believe that insufficient domestic land and water resources, substantial increases in national demand for food, and rising commodity prices are the main factors driving developed and developing countries to carry out foreign investment in agriculture [13]. These countries expect to use foreign production factors to produce domestic food and ship it back to China through foreign investment in agriculture. This will reduce the adverse effects of food price

changes and climate change on food security [14,15]. However, some scholars believe that developed countries carry out foreign investment in agriculture mainly to seek capital and technology, while developing countries are mainly motivated by the search for resources and markets [16,17].

Second, the factors affecting China's agricultural foreign investment are complex and diverse. Some scholars have discussed the factors from multiple perspectives and summarized the factors affecting China's agricultural investment abroad into three aspects: the China factor, the host country factor, and bilateral relations.

(1) The China factor. Most scholars have used quantitative methods to discuss the factors affecting China's agricultural investment abroad and summarized the main influencing factors as agricultural productivity, agricultural resource endowment, economic levels, import and export of agricultural products, government behavior, etc. (2) The host country factor. The host country's agricultural resources, market scale, business environment, and institutional environment are the main factors that affect the flow of China's foreign investment in agriculture [18]. (3) Bilateral relations. The bilateral factors affecting China's foreign investment in agriculture mainly include the psychological and geographical distance between China and the host country, bilateral trade relations, and the signing of bilateral agreements. In terms of bilateral investment treaties, the signing of a bilateral investment agreement between the Chinese government and the host country is conducive to improving the relationship between the two countries and creating a good investment environment for enterprises. Therefore, whether to sign a bilateral investment agreement is an important consideration for Chinese enterprises when deciding whether to invest in the host country [19].

Third, agriculture foreign investment has formed three kinds of evaluation: positive, negative, and rational.

(1) Positive evaluations have suggested that foreign investment in agriculture has played a significant role in improving the employment rate of the host country [20,21], promoting gender equality in the host country [22], improving the agricultural technology level of the host country [23,24], improving the infrastructure level of the host country [25], and increasing local food production [26,27]. (2) In terms of negative evaluations of foreign investment, some scholars believe that the positive effect of foreign investment in agriculture is not obvious and that, on the contrary, it will bring threats to the development of the host country, mainly in the aspects of reducing employment in the host country, increasing gender discrimination, affecting local food security, damaging the ecological environment, and harming the interests of small farmers [28–45]. (3) With regard to rational evaluations of foreign investment in agriculture, a few scholars argue that the development of foreign investment in agriculture has both advantages and disadvantages and that it should be based on facts to objectively evaluate this economic activity. Global agricultural policies, climate change, and other factors are the key factors affecting the direction and speed of agricultural development in the host country, and these factors will not change because of the development of foreign investment in agriculture, so the quality of agricultural development in the host country cannot simply be attributed to foreign investment in agriculture [46].

Fourth, the existing research on agricultural foreign investment risk mainly focuses on three aspects.

(1) Identification and assessment of risks of foreign investment in agriculture. Recognition methods mainly include qualitative recognition, quantitative recognition, and comprehensive recognition, which most scholars prefer to adopt [47,48]. Based on the results of risk identification, most scholars build an index system from the political, economic, social, and legal levels and use the entropy weight method, the analytic hierarchy process, the

fuzzy comprehensive evaluation method, the gray correlation method, and other methods to assess the investment risk of the host country [49]. (2) The impact of investment risk on foreign investment in agriculture. Academic circles have paid extensive attention to and studied the relationship between investment risk and investment scale, and three viewpoints have been formed at present. Investment risk has a positive impact on investment scale [50–54], investment risk has a negative impact on investment scale [55–57], and there is a nonlinear relationship between investment risk and investment scale. (3) Early warning, prevention, and control of risks related to foreign investment in agriculture. Only by discovering and dealing with potential risks in time can we protect the interests of investors to the maximum extent and ensure the smooth progression and sustainable development of investment projects. Common early warning and monitoring methods can be summarized as linear discriminant analysis, hierarchical analysis and fuzzy comprehensive evaluation, neural networks, and complex networks [58]. As for the prevention and control of investment risk, academic circles mainly put forward corresponding prevention and control measures from two perspectives: risk classification and investment-related entities.

To sum up, the existing literature provides a rich theoretical basis and experience for this study, but there are still shortcomings. (1) In the construction of the index system of the risk of foreign investment in agriculture, the characteristics of the agricultural industry and the relationship between China and the host country are not considered enough. On the one hand, agricultural investment is affected by the market and the natural environment at the same time, so it faces more risks than investment in other industries. On the other hand, the risk of investment in China and investment in other countries will also be different due to the different relationships between China and the host country, so the index system should include indicators at the agricultural level and the "China-host country" level. (2) Risks among countries may have a certain infectivity relationship, but few studies have explored the spatial correlation of investment risk among countries. (3) The current research on the dynamic monitoring of risk in foreign investment in agriculture is still insufficient, and it is urgent to deeply explore the specific action mechanism of each indicator factor related to risk. In view of this, based on China's relevant data on the agricultural investment environment of 49 countries along the "Belt and Road", this paper constructs an index system to measure the investment risk of various countries based on five aspects: politics, the economy, society, agricultural management, and bilateral diplomatic and economic relations with China. On this basis, exploratory spatial data analysis methods, a Markov chain, and other methods are used to explore the space–time evolution law of investment risk of various countries. Furthermore, a deep neural network model is constructed to dynamically monitor the investment risk in order to provide a reference for reducing the risk of China's agricultural investment abroad and promoting the sustainable development of investment.

2. Materials and Methods

2.1. Establishment of the Index System

On the basis of referring to the existing research, this paper selects 48 indicators from the five levels of the host country's politics, economy, society, agricultural management, and bilateral diplomatic and economic relations with China to construct the agricultural investment risk evaluation index system. Based on the availability of data, the countries with serious missing data are eliminated, and a few missing values are supplemented through an interpolation method. The index system is as follows.

(1) Political risk. Eleven indicators, including the stability of the government, the effectiveness of the government, the control of corruption, the quality of government regulation, external conflict, internal conflict, military intervention in politics, law and order,

democratic accountability, bureaucracies, and integrity in the government, are selected to measure political risk (Table 1).

Table 1. Description of the political risk assessment indicators of China's agricultural foreign investment.

Name of Indicator	Description of Indicators	Source of Data
Stability of government	It measures the degree to which the power of the host country's government is recognized and its legitimacy is guaranteed, and the score ranges from 0 to 12; the higher the value, the more stable the government	ICRG
Effectiveness of government	It measures the efficiency and ability of the host country's government's organizations and institutions in performing their duties, providing public services, and supervising market order, with a score ranging from −2.5 to 2.5; the higher the value, the higher the efficiency	WGI
Control of corruption	It measures the extent to which the host country supervises and holds accountable the government's departments or individuals with public power to punish corruption and the corruption of relevant personnel, with the score ranging from −2.5 to 2.5; the higher the value, the stronger the corruption control ability	WGI
Quality of government regulation	It measures the quality of the supervision and management of the market and industry norms formulated by the government agencies of the host country, and the score ranges from −2.5 to 2.5; the higher the value, the greater the supervision quality	WGI
External conflict	It measures the degree of conflict between the host country and other countries and regions, and the score ranges from 0 to 12; the higher the value, the smaller the conflict	ICRG
Internal conflict	It measures the degree of conflict between the host country and other countries and regions, and the score ranges from 0 to 12; the higher the value, the smaller the conflict	ICRG
Military intervention in politics	It measures the degree to which the host country's military forces interfere with and control the country's political activities, and the score ranges from 0 to 6; the higher the value, the lower the degree of intervention	ICRG
Law and order	It measures the perfection and enforcement level of the host country's legal system, and the score ranges from 0 to 6; the higher the value, the more perfect the law and the higher the enforcement level	ICRG
Democratic accountability	It measures the degree to which the host country's government and public institutions are accountable to the public and accept public supervision and restraint, with the score ranging from 0 to 6; the higher the value, the greater the degree of responsibility	ICRG
Bureaucracies	It measures the leadership style of the government departments of the host country and whether it is divorced from reality, divorced from the people, and corrupt, and the score ranges from 0 to 4; the higher the value, the lighter the bureaucracy	ICRG
Integrity in government	It measures the extent to which government agencies and their staff of the host country abide by integrity and impartiality, with a score ranging from 0 to 100; the higher the value, the higher the level of integrity	IEF

(2) Economic risk. Twelve indicators, including inflation, the level of the exchange rate, the size of external debt, the ability to pay debt, the level of income and expenditure,

the scale of the economy, the economic growth rate, the tax burden, freedom of business, freedom of investment, freedom of currency, and freedom of trade, are selected to measure economic risk (Table 2).

Table 2. Description of economic risk assessment indicators of China's agricultural foreign investment.

Name of Indicator	Description of Indicators	Source of Data
Inflation	It measures the degree of currency depreciation and purchasing power decline of the host country, and the score is 0–10; the greater the value, the smaller the degree of inflation	ICRG
Level of exchange rate	It measures the stability of the exchange rate level of the host country, and the score is 0–10; the higher the value, the more stable the exchange rate	ICRG
Size of external debt	It measures the borrowing status of the host country's government and enterprises from other countries or international organizations, and the score ranges from 0 to 10; the higher the value, the smaller the external debt	ICRG
Ability to pay debt	It measures the external debt repayment ability of the host country, and the score ranges from 0 to 10; the higher the value, the stronger the debt repayment ability	ICRG
Level of income and expenditure	It measures the economic income and expenditure of the host country in a certain period of time, and the score ranges from 0 to 15; the greater the value, the more stable the economy	ICRG
Scale of economy	The scale of economy is measured based on the GDP of the host country; the larger the value, the larger the economic size	WDI
Economic growth rate	It measures the growth trend of the host country's economy, and the score ranges from 0 to 10; the higher the value, the faster the growth	ICRG
Tax burden	It measures the tax environment of the host country on a scale of 0 to 100; the higher the value, the heavier the tax burden	IEF
Freedom of business	It measures the host country's restrictions on starting a business, approval process and time, start-up costs, etc., and the policy environment for closing a business, with a score range of 0–100; the greater the value, the greater the degree of freedom	IEF
Freedom of investment	It measures the degree of restriction of the host country on the flow of investment capital, the degree of transparency and openness of the investment environment, and the fairness of investment opportunities. The score range is 0–100; the greater the value, the greater the degree of freedom	IEF
Freedom of currency	It measures the marketization level of the host country's interest rate, the openness of the financial market, and the independence of monetary policy, and the score ranges from 0 to 100; the higher the value, the greater the degree of freedom	IEF
Freedom of trade	It measures the import and export trade quota, the tariff level, and other non-tariff barriers of the host country, and the score ranges from 0 to 100; the higher the value, the greater the degree of freedom	IEF

(3) Social risk. Eleven indicators, including the social environment, social security, religious conflict, ethnic conflict, the degree of the rule of law, the status of unemployment, the level of traffic, property rights protection, the degree of freedom of labor, the level of education, and the level of communication, are selected to measure social risk (Table 3).

Table 3. Description of social risk assessment indicators of China's agricultural foreign investment.

Name of Indicator	Description of Indicators	Source of Data
Social environment	It measures the level of the overall social environment of the host country, and the score ranges from 0 to 12; the higher the value, the better the environment	ICRG
Social security	The murder rate of the host country is used to represent the degree of social security; the higher the value, the lower the degree of security	WDI
Religious conflict	It measures the contradictions and conflicts caused by different religious beliefs in the host country, and the score ranges from 0 to 6; the larger the value, the smaller the conflict	ICRG
Ethnic conflict	It measures the contradictions and conflicts arising from different ethnic groups in the host country, and the score ranges from 0 to 6; the larger the value, the smaller the conflict	ICRG
Degree of rule of law	It measures the perfection of the host country's laws, the score ranges from −2.5 to 2.5; the greater the value, the greater the degree of rule of law	WGI
Status of unemployment	The unemployment rate of the host country is used to measure the unemployment status; the larger the value, the more unemployed people are	WDI
Level of traffic	The level of traffic is measured by the air traffic volume of the host country; the higher the value, the better the level of transport infrastructure	WDI
Property rights protection	It measures the degree of protection of property owned by individuals, enterprises, and organizations in the host country on a scale of 0–100; the higher the value, the greater the degree of protection	IEF
Degree of freedom of labor	It measures the degree of regulation of the labor market by the host country's government, and the score ranges from 0 to 100; the higher the value, the greater the degree of freedom	IEF
Level of education	The primary school graduation rate in the host country is used to represent the level of education; the higher the value, the higher the level of education	WDI
Level of communication	The level of communication is expressed as the number of people registered for mobile phone services per 100 people in the host country; the higher the value, the higher the levels of communication	WDI

(4) Agricultural management risk. Eight indicators, including the scale of agriculture, the foundation of agriculture, the endowment of agricultural land resources, the endowment of agricultural water resources, the endowment of agricultural labor, the quality of agricultural land, natural disasters, and the cost of labor, are selected to measure agricultural management risk (Table 4).

Table 4. Description of agricultural management risk assessment indicators for China's agricultural foreign investment.

Name of Indicator	Description of Indicators	Source of Data
Scale of agriculture	The proportion of agricultural value added of the host country is used to represent the scale of agriculture; the larger the proportion, the larger the agricultural scale	WDI
Foundation of agriculture	The ratio of agricultural raw material imports to commodity imports of the host country is used to represent the foundation of agriculture; the higher the ratio, the worse the base	WDI

Table 4. *Cont.*

Name of Indicator	Description of Indicators	Source of Data
Endowment of agricultural land resources	The proportion of agricultural land in the host country is used to represent the endowment of agricultural land resources; the greater the proportion, the greater the endowment	WDI
Endowment of agricultural water resources	The ratio of the total freshwater resources of the host country to the cultivated land area is used to represent the endowment of agricultural water resources; the larger the ratio, the greater the endowment	WDI
Endowment of agricultural labor	The ratio of agricultural employment to total employment in the host country is used to represent the endowment of agricultural labor; the higher the ratio, the greater the endowment	WDI
Quality of agricultural land	The grain yield per unit area of the host country is used to indicate the quality of agricultural land; the higher the yield, the higher the quality	WDI
Natural disasters	The magnitude of a natural disaster is expressed by the total number of people affected by the disaster in the host country; the greater the number, the more severe the disaster	EM-DTA
Cost of labor	The private transfer of the host country and employee remuneration are used to represent the cost of labor; the higher the remuneration, the higher the cost	WDI

(5) Risk in bilateral diplomatic and economic relations with China. Six indicators, including political connections, partnerships, investment relationships, mutual visa exemptions, tax relationships, and degree of language similarity, are selected to measure risk in bilateral diplomatic and economic relations with China (Table 5).

Table 5. Description of the risk assessment indicators of China's agricultural foreign investment to China.

Name of Indicator	Description of Indicators	Source of Data
Political connections	The length of the establishment of diplomatic relations between China and the host country is used to indicate political connections; the longer the political relationship, the more stable it is	Summary of the date of establishment of diplomatic relations between the People's Republic of China and other states
Partnerships	The partnership between China and the host country is divided into partnerships, comprehensive partnerships, strategic partnerships, and comprehensive strategic partnerships, which are represented by 1, 2, 3, and 4, respectively, with a higher value indicating a closer relationship	Website of the Ministry of Foreign Affairs, PRC
Investment relationship	The length of the BIT signed between China and the host country is used to indicate the investment relationship, and the longer the length, the better the relationship	List of bilateral investment treaties signed by our country with foreign countries
Mutual visa exemption	It is represented by the duration of mutual visa exemption between China and the host country	List of visa exemption agreements between China and foreign countries
Tax relationship	The tax relationship is represented by the length of time during which China and the host country signed an agreement to avoid double taxation	List of agreements signed by our country to avoid double taxation
Degree of language similarity	It is represented by the linguistic similarity between China and the host country	CEPII

2.2. Research Method

(1) Factor analysis method and entropy weight method

A comprehensive method combining factor analysis and the entropy method is used to measure the risk of China's foreign investment in agriculture. First, the factor analysis method is used to analyze the secondary indicators of the risk of the five sub-dimensions, and the risk scores of the five sub-dimensions of each country are calculated.

(2) Kernel density estimation

This paper uses this method to explore the dynamic evolution process of China's agricultural investment risk in countries along "the Belt and Road" from 1995 to 2022. Suppose *X1*, *X2*, . . ., *XN* is an independently distributed random variable, $f(x)$ is its density function, and the probability density estimation formula of point x is

$$f_k = \frac{1}{Nh}\sum_{i=1}^{N} K\left(\frac{X_i - x}{h}\right) \tag{1}$$

where N represents the number of observations, h is the bandwidth, X_i is the observed value, x is the mean value, and $K(\cdot)$ is the kernel function.

(3) Spatial autocorrelation analysis

This paper uses global spatial autocorrelation to analyze the spatial correlation trend of investment risk in the study area, and the formula is as follows:

$$Global - Moran'sI = \frac{n\sum_{i=1}^{n}\sum_{j=1}^{n} w_{ij}(x_i - \overline{x})(x_j - \overline{x})}{\sum_{i=1}^{n}\sum_{j=1}^{n} w_{ij}\sum_{i=1}^{n}(x_i - \overline{x})^2} \tag{2}$$

where n is the sample size; x_i and x_j are the investment risk score of country i and country j, respectively; and w_{ij} is the spatial weight matrix, which is represented by the spatial adjacency matrix in this paper. The value range of global Moran's I index is $[-1, 1]$.

The local spatial autocorrelation is used to analyze the degree to which the investment risk of each country obeys the global trend, and the formula is as follows:

$$Local - Moran'sI = \frac{n(x_i - \overline{x})\sum_{j=1}^{n} w_{ij}(x_j - \overline{x})}{\sum_{i=1}^{n}(x_i - \overline{x})^2} \tag{3}$$

(4) Markov chain

Based on a Markov chain, a transfer probability matrix is presented to represent the dynamic development process of agricultural investment risk in the host country. The probability distribution and the evolution trend of agricultural investment risk in each host country were calculated. Then, based on the classical Markov chain model, the concept of spatial lag was established to explore the relationship between the agricultural investment risk of the host country and the agricultural investment risk of its neighbors. This paper uses this method to analyze the probability that the risk level of China's agricultural investment in countries along "the Belt and Road" will remain in its original state and that the state will shift and to predict the distribution characteristics of the risks of each country when they reach a stable state in the future.

(5) Deep neural network model

A deep neural network model is constructed to monitor the risks of China's agricultural investment in countries along "the Belt and Road", and the formula is

$$y_k = f(\sum_{i=1}^{n} w_{ik} \times x_i + b_k) \quad (4)$$

where x_i represents a neuron or a node; w_{ik} represents the weight; and b_k represents the bias, reflecting the intercept of gradient descent. Let $f(\cdot)$ denote the activation function. The modeling process includes three steps: data preprocessing, network structure design and training, and network testing.

① Data preprocessing. The input layer of this paper is a risk characteristic data set containing 48 indicators, which need to be normalized before the analysis. The output layer is the risk level. According to the risk score, the risk level of each country is divided into level 1, level 2, level 3, level 4, and level 5 from high to low. In addition, the research object of this paper is China's agricultural investment risk in 49 countries along "the Belt and Road" from 1995 to 2022, which contains a total of 1372 samples and 65,856 eigenvalues. The remaining 30% of the sample is used as a subset of the test sample.

② Network structure design and network training. In this link, it is necessary to determine the number of hidden layers in the network, the number of nodes and the activation function of each hidden layer, the activation function and the loss function in the output layer, the back propagation algorithm and the optimization algorithm, etc. In this paper, the dropout method is used to determine the number of hidden layers and the number of nodes in each layer, because this method can prevent model overfitting, so as to better evaluate the performance of different network structures. ReLU and Softmax functions are used as activation functions of the hidden layer and the output layer, respectively. The Mean Squared Error (MSE) is used to calculate the loss function, which is used to measure the difference between the predicted value of the model and the real value. The back propagation algorithm and the Adam optimization algorithm are used to optimize the model parameters so that the model can better fit the training data and achieve better generalization performance.

③ Network test. The sample data to be tested are input into the deep neural network model designed and trained above, and the predicted value of the output layer is obtained through network calculation and processing. The actual value and predicted value of the output layer are compared and analyzed, and the evaluation accuracy and other indicators of the network model are calculated to evaluate the performance of the network model.

3. Results

3.1. Assessment of Investment Risk

Through the factor analysis method, the common factors are extracted from the risks of the five sub-dimensions of politics, economy, society, agricultural management, and bilateral diplomatic and economic relations with China of 49 countries from 1995 to 2022, and then the risk scores of the sub-dimensions of each country are calculated. A higher value indicates a lower investment risk. On this basis, the entropy method is used to weight the risk score of each sub-dimension and calculate the total investment risk score of each country through weighting. It is worth noting that because the contribution rates of the risks of the five sub-dimensions of politics, economy, society, agricultural management, and bilateral diplomatic and economic relations with China to the total risks may differ each year, in order to ensure the rationality and scientific validity of the results, this paper

separately calculates the weight of the risk score of each sub-dimension in each year. The results show that the average contribution rates of political risk, economic risk, social risk, agricultural management risk, and risk in bilateral diplomatic and economic relations with China to the total risk are 21.89%, 8.19%, 21.93%, 9.17%, and 38.83%, respectively, which reflects that risk in bilateral diplomatic and economic relations with China contributes the most to the total investment risk, followed by social risk and political risk. The contribution of agricultural management risk and economic risk is relatively small. It can be seen that the bilateral relationship between China and the host country is an important factor affecting Chinese enterprises' agricultural foreign investment, but current relevant research does not pay enough attention to the influence of bilateral relationships.

In addition, this paper refers to ICRG's risk classification of national risk levels and divides China's agricultural investment risk and its five sub-risks to countries along "the Belt and Road" into five levels according to the risk score, with score ranges of [0, 20), [20, 40), [40, 60), [60, 80), and [80, 100]. These represent extremely high risk, high risk, average risk, low risk, and extremely low risk, corresponding to risk levels 1, 2, 3, 4, and 5. By using ArcGIS 10.8.1 software (ArcGIS is a geographic information system (GIS) software developed by Esri (Environmental Systems Research Institute, Inc.), a company headquartered in Redlands, CA, USA), the risk value of China's agricultural investment in various countries from 1995 to 2022 and its sub-risk value are divided into five levels using the natural breakpoint method. Limited by space, this paper only shows the distribution maps of 1995, 2004, 2013, and 2022 (Figures 1–6). The results show that there is no country in level 5 in 2022. Among them, Hungary, Bulgaria, and other countries have abundant agricultural resources, moderate climatic conditions, relatively perfect infrastructure, and relatively stable politics and good economic development. There are 30 countries in the third level, accounting for 61.22% of the total, indicating that more than half of the countries have average investment risk, which proves once again that the countries along "the Belt and Road" are suitable for investment. Yemen, Iraq, Syria, and other countries with perennial war and turmoil are not only faced with external conflicts but also with internal sectarian conflicts, religious extremism, and ethnic conflicts. Therefore, the investment risks of these countries are at level 1 and level 2, which are not suitable for large-scale investment (Table 6).

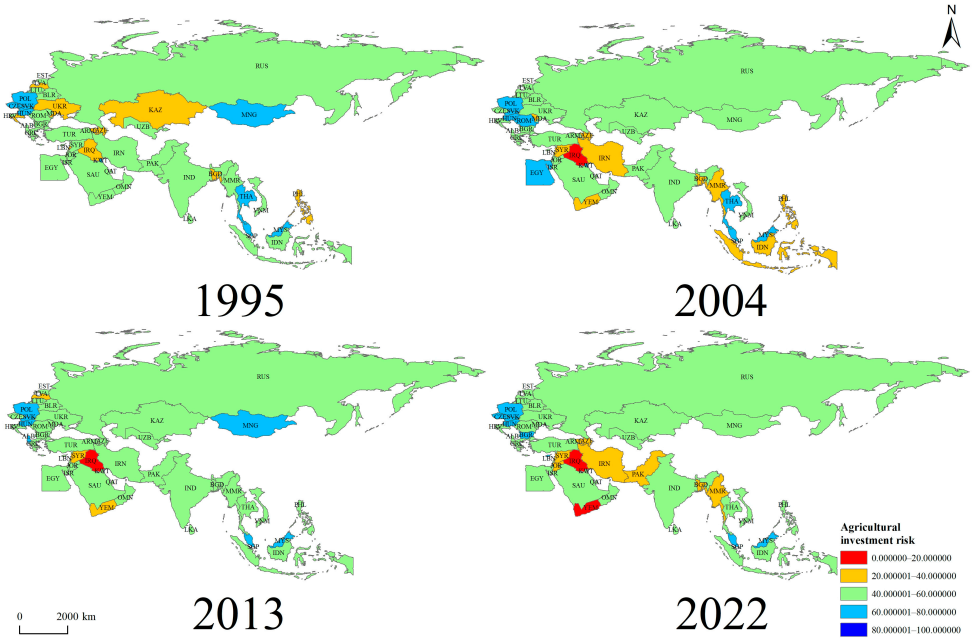

Figure 1. Agricultural investment risk.

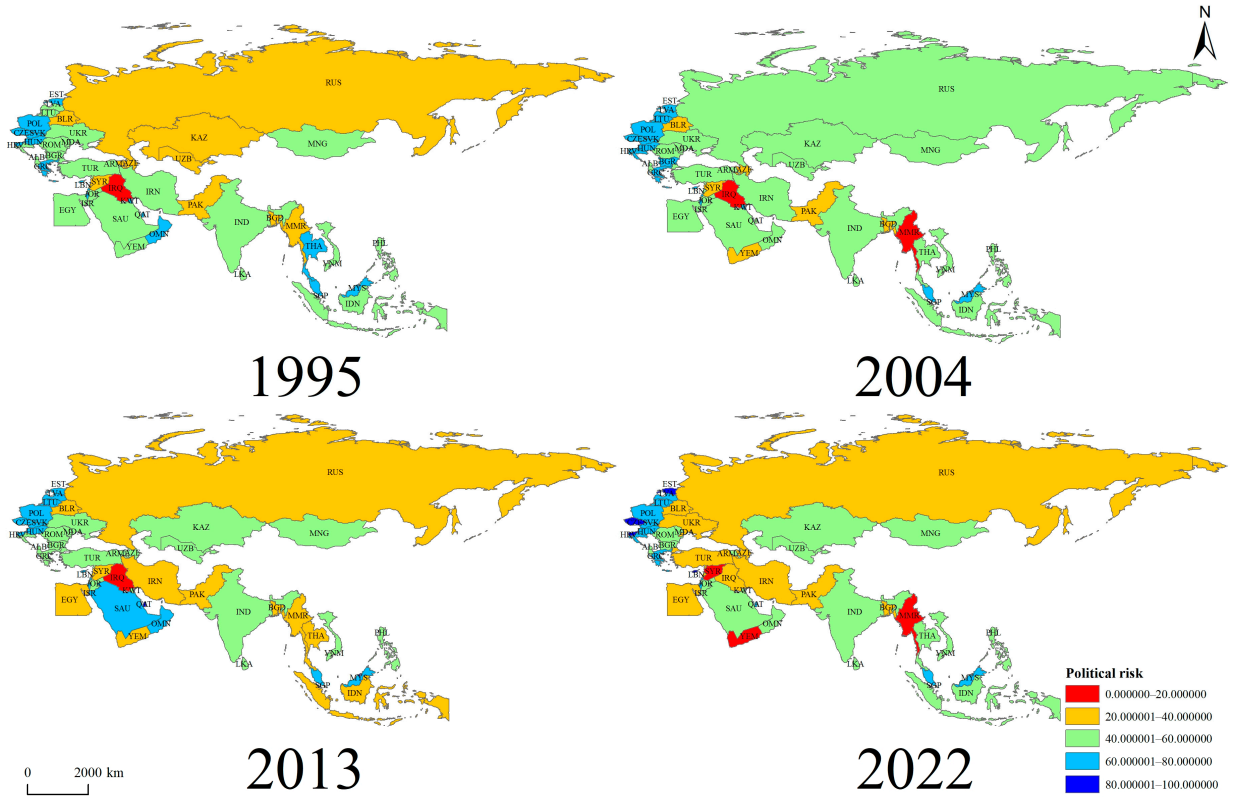

Figure 2. Political risk.

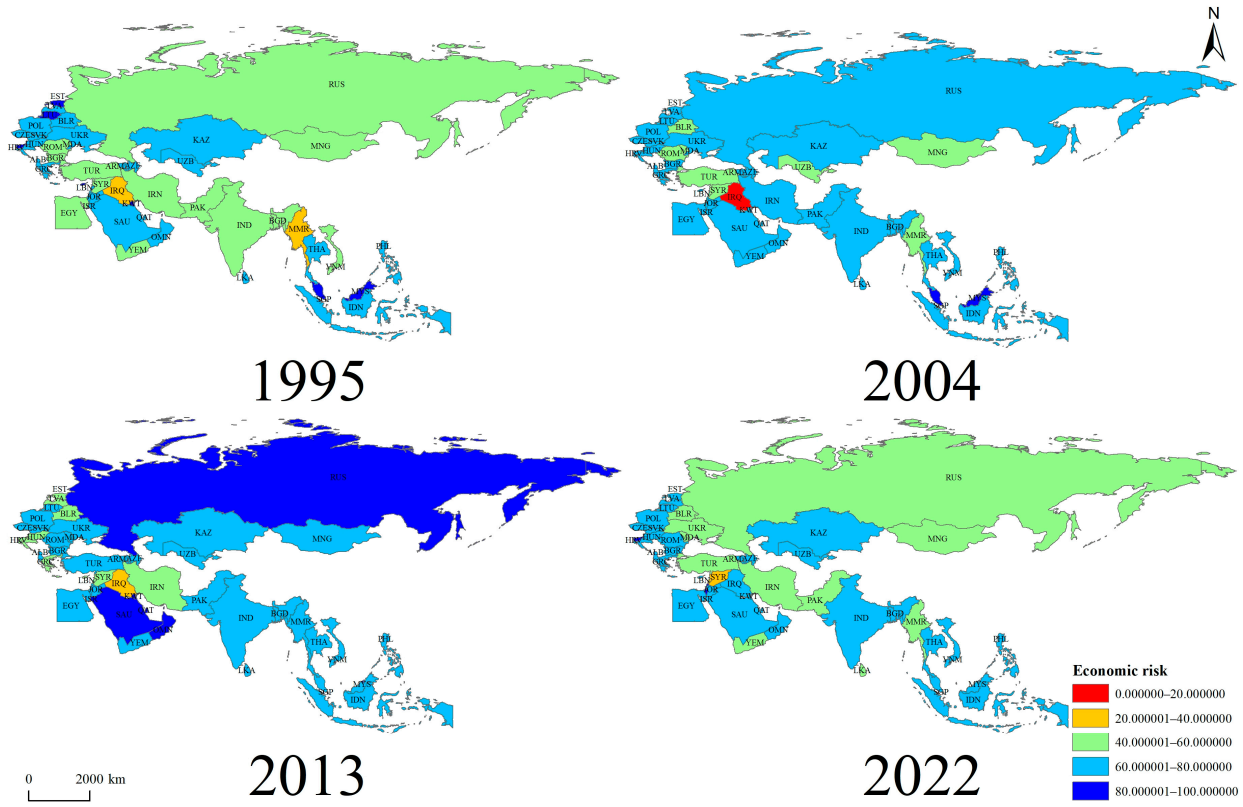

Figure 3. Economic risk.

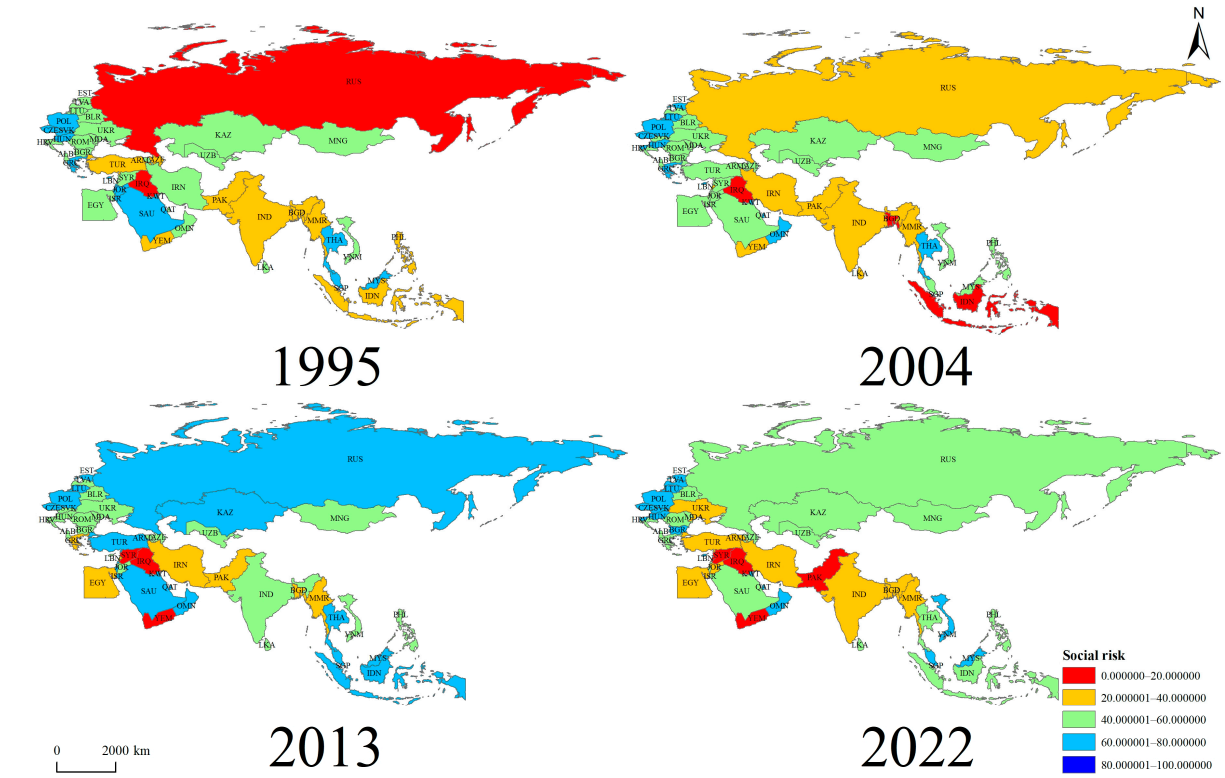

Figure 4. Social risk.

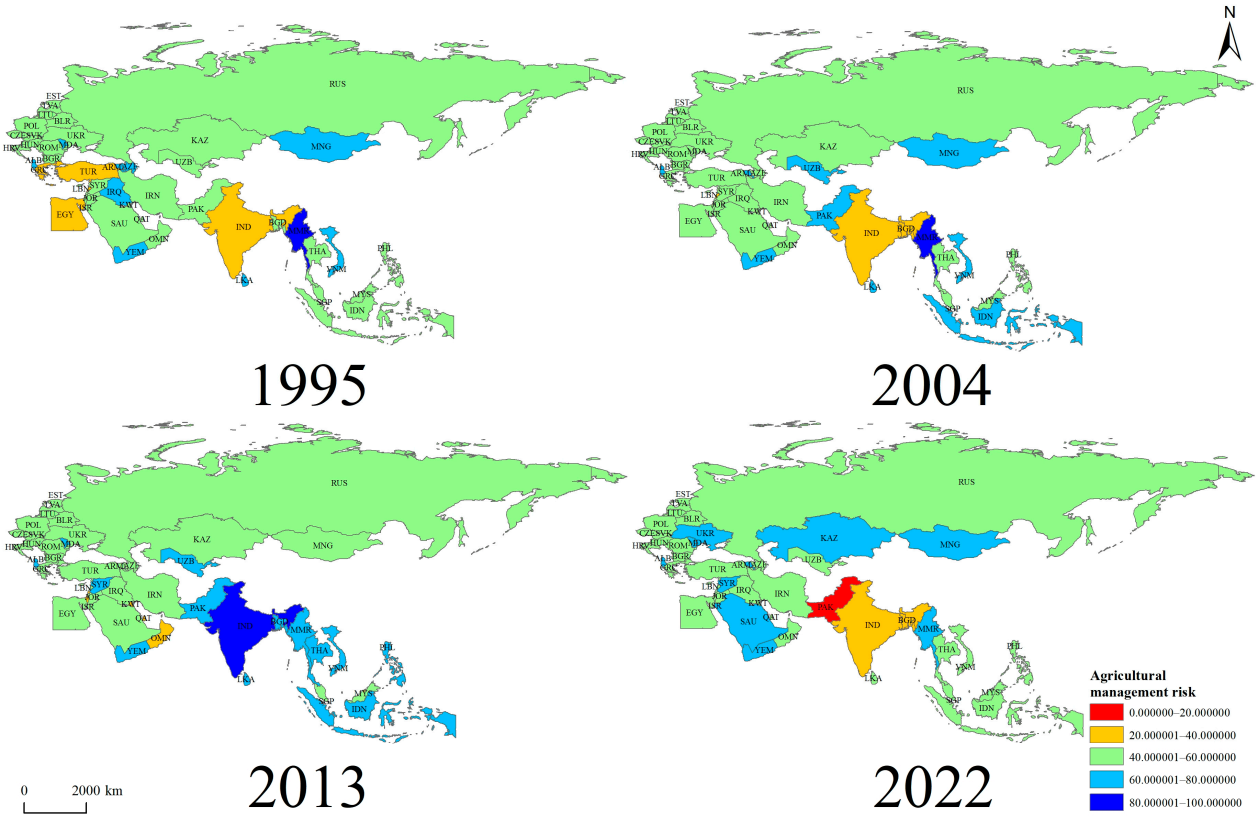

Figure 5. Agricultural management risk.

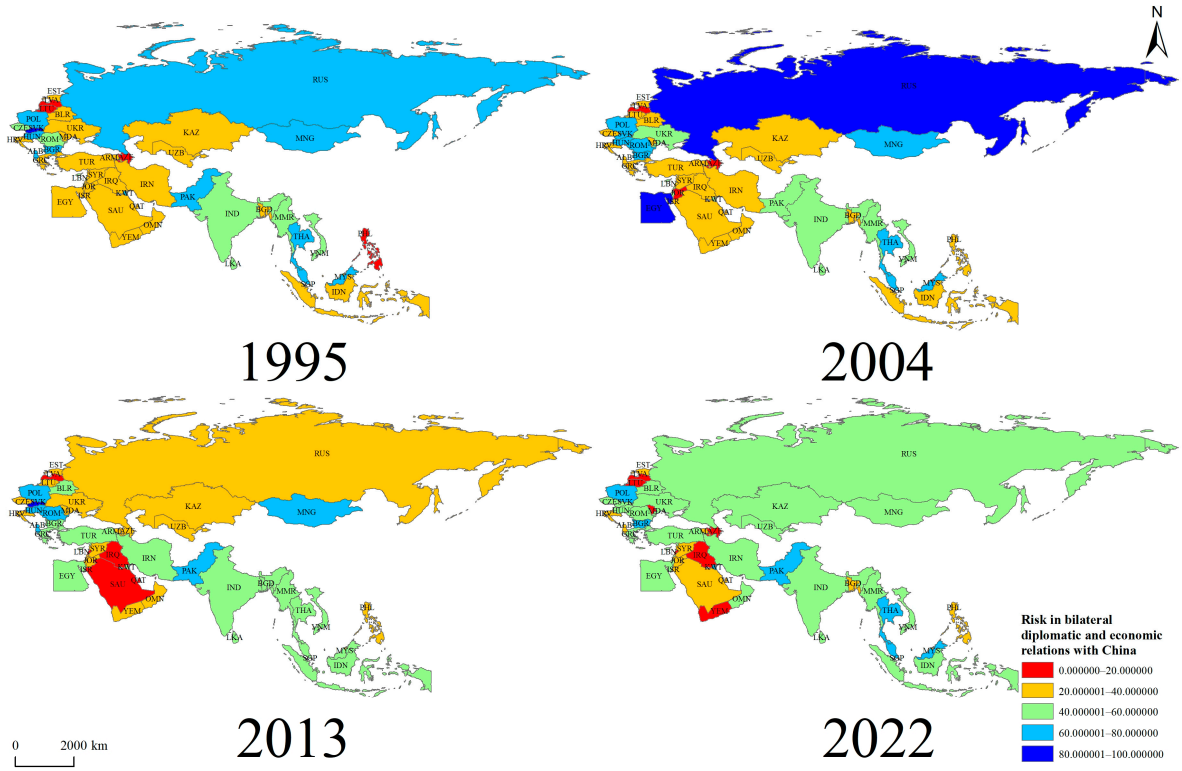

Figure 6. Risk in bilateral diplomatic and economic relations with China.

Table 6. Investment risk ranking and score of countries in 2022.

Ranking	The State	Score of Points	Class of Grades	Ranking	The State	Score of Points	Class of Grades
1	Yemen	15.613	Level 1	26	Saudi Arabia	52.319	Level 3
2	Iraq	19.731	Level 1	27	Kazakhstan	52.516	Level 3
3	Syria	20.230	Level 2	28	Lithuania	52.621	Level 3
4	Lebanon	21.797	Level 2	29	Oman	52.969	Level 3
5	Azerbaijan	33.517	Level 2	30	Croatia	54.647	Level 3
6	Bangladesh	34.438	Level 2	31	Vietnam	54.705	Level 3
7	Myanmar	36.683	Level 2	32	Qatar	55.425	Level 3
8	Jordan	37.320	Level 2	33	Estonia	55.945	Level 3
9	Pakistan	37.394	Level 2	34	Slovenia	56.227	Level 3
10	Iran	38.977	Level 2	35	Brunei	56.434	Level 3
11	Armenia	39.218	Level 2	36	Romania	56.867	Level 3
12	Moldova	41.374	Level 3	37	Mongolia	57.106	Level 3
13	Ukraine	42.525	Level 3	38	Thailand	57.837	Level 3
14	Turkey	42.944	Level 3	39	Israel	58.936	Level 3
15	Bahrain	44.086	Level 3	40	Greece	59.787	Level 3
16	Belarus	44.253	Level 3	41	Kuwait	59.860	Level 3
17	Egypt	44.414	Level 3	42	Hungary	60.190	Level 4
18	Russia	45.413	Level 3	43	Bulgaria	61.244	Level 4
19	Philippines	45.447	Level 3	44	Cyprus	62.068	Level 4
20	Latvia	46.271	Level 3	45	Slovakia	63.079	Level 4
21	Albania	48.465	Level 3	46	Czech Republic	66.677	Level 4
22	Uzbekistan	49.432	Level 3	47	Malaysia	67.546	Level 4
23	Sri Lanka	50.454	Level 3	48	Poland	69.384	Level 4
24	Indonesia	51.408	Level 3	49	Singapore	70.106	Level 4
25	India	52.035	Level 3				

Because agricultural investment risk is a risk assessment that integrates political risk, economic risk, social risk, agricultural management risk, and risk in bilateral diplomatic and economic relations with China, the assessment of agricultural investment risk needs to analyze each sub-risk more specifically in the following paragraphs. In general, some countries in Europe and Southeast Asia are always in the low-risk region, which is suitable for foreign investment in agriculture. Syria, Iraq, and Yemen have always been in the high-risk region, which is not suitable for foreign investment in agriculture.

From 1995 to 2022, the overall political risk showed an upward trend. In terms of geographical distribution, the political risk of some countries in Europe and Southeast Asia is always low, because European countries generally have relatively mature democratic institutions and rule of law systems, while Southeast Asian countries strengthen their cooperation through regional organizations, such as ASEAN, to maintain regional stability. Saudi Arabia's low political risk may be related to its stable monarchy and abundant oil resources. Iraq, Syria, Yemen, and Bangladesh are all high-risk countries because of religious conflict and terrorism in Iraq, civil war in Syria, civil war in Yemen, and political unrest and protests in Bangladesh. In 2022, political risk in Ukraine increased significantly, most likely due to the direct impact of the Russia–Ukraine conflict.

From 1995 to 2022, the overall economic risk showed a downward trend. Economic risks of most countries in Europe and Southeast Asia are always low because their economic sources are diverse and stable, the European economy has a high level of industrial production and agricultural mechanization, and the service industry, the financial industry, and tourism play an important role in the European economy. Southeast Asia also depends on the above industries, and the continuous influx of foreign capital has provided a strong impetus for Southeast Asia's economy. Economic risk in some countries generally reached a low-level in 2013 but rebounded in 2022. The possible reason is that the proposal of "the Belt and Road" initiative in 2013 provides an opportunity for countries along the route to expand the scale of investment. However, the outbreak of the novel coronavirus pneumonia in 2020 encouraged investment protectionism in some countries, and countries have introduced policies to restrict foreign investment and trade, resulting in a rebound of economic risk in some countries in 2022.

From 1995 to 2022, social risk generally declined in most countries owing to increased economic integration and regional cooperation. In Southeast Asia, where other risk coefficients are generally in the range of medium and low values, there is a large risk fluctuation in social risk. The risk coefficient increased significantly in 2004, probably because natural disasters, such as the tsunami in Southeast Asia in 2004, destroyed infrastructure and caused panic in the social atmosphere. In 2013, social risk was generally reduced. The possible reason is that Southeast Asian countries improved the quality of education and promoted the development of human resources through educational reform. For example, Malaysia released the Education Development Blueprint 2013–2025 in 2013 to improve national competitiveness and education standards, which has improved local social stability.

From 1995 to 2022, agricultural management risk showed a downward trend due to technological advances and the use of fertilizers. In terms of distribution, agricultural management risk has changed in some countries, among which risk fluctuates more in Pakistan and India. Agricultural management risk in Pakistan in 2022 rose to an extremely high risk level due to the devastating floods of 2022 that destroyed much of the infrastructure, washed away 45% of the country's farmland, caused an estimated USD 10 billion in damage and affected 33 million people. In 2013, agricultural management risk in India declined to an extremely low level, possibly because the Indian government implemented a series of agricultural support policies, including the land ceiling policy, which helped

reduce land concentration and promote a more equitable distribution of land, which may reduce agricultural management risk caused by land concentration. It is worth noting that agricultural management risk in West Asia has always been in the range of medium and low risk. This may be due to the long history of agricultural development in West Asia. Affected by the climate, irrigation agriculture is important. At the same time, the terrain of West Asia is dominated by the plateau, and the Mesopotamia Plain (also known as the Mesopotamia Valley) has fertile soil, convenient irrigation, and developed agriculture.

China has established good diplomatic relations with most of the countries along "the Belt and Road". From 1995 to 2022, risk in bilateral diplomatic and economic relations with China between countries along "the Belt and Road" and China showed a downward trend. In October 2004, the leaders of China and Russia signed the Supplementary Agreement on the eastern section of the China–Russia Border, marking the demarcation of the more than 4300 km long border between the two countries and the final settlement of the boundary issue that had long affected bilateral relations. This agreement is an important milestone in the strategic partnership between China and Russia, which also brought Russia's risk related to bilateral diplomatic and economic relations with China to an extremely low level in 2004. Southeast Asia's risk in bilateral diplomatic and economic relations with China has also generally declined because the establishment of ASEAN has brought China and Southeast Asia closer economically and culturally.

3.2. Spatio-Temporal Evolution Characteristics of Investment Risk

(1) Dynamic evolution of investment risk

In order to further analyze the dynamic distribution characteristics of China's agricultural investment risk in countries along "the Belt and Road", this paper obtains the kernel density curves of the investment risk score of 49 countries in 1995, 2005, 2015, and 2022 through the Gaussian density estimation method (Figure 7).

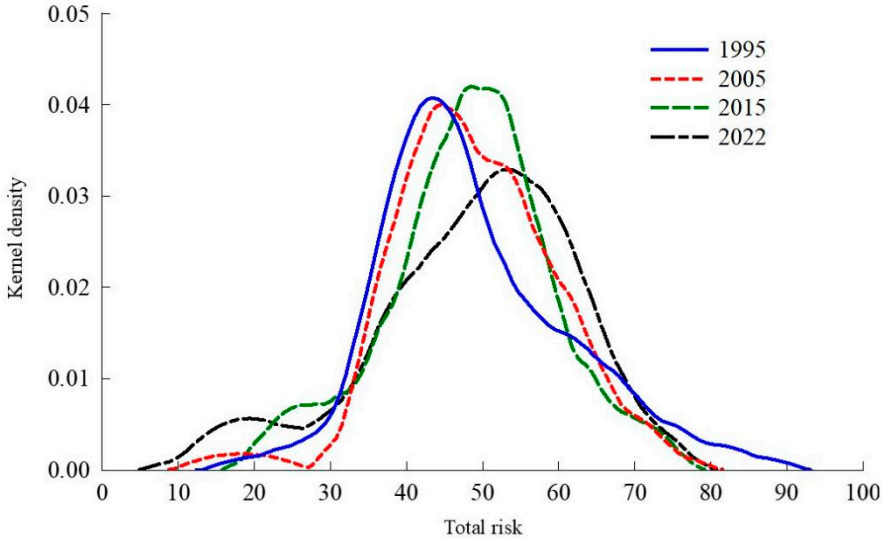

Figure 7. Kernel density estimation of the risk of China's agricultural foreign investment.

The results show that (1) from the central position, the center of the curve keeps moving to the right during the study period, and the curve in 2022 is distributed on the far right, indicating that the risk score of agricultural investment in countries along "the Belt and Road" shows an upward trend, that is, the risk has a downward trend. (2) From the perspective of peak width and height, there is a left-trailing phenomenon in the curve during the study period, and the peak height decreases and the width gradually expands, indicating that agricultural investment risk in most countries is low and that the risk

difference between countries is expanding. (3) From the perspective of the number of peaks, the curve presents a "single peak" in the early stage of the study and gradually becomes a "double peak" in the later stage, but the height of the side peak is significantly lower than that of the main peak, indicating that the agricultural investment risk of various countries presents a weak trend of polarization in the later stage and that the overall convergence trend is reduced. The above situation is consistent with the reality. With the rapid development of globalization and informatization, economic and trade cooperation between countries has been continuously strengthened. In particular, the proposal of "the Belt and Road" initiative has provided great convenience for strengthening cooperation between China and countries along "the Belt and Road". However, due to the differences in resource endowments and economic development among countries, the differences in investment risk among countries are also expanding.

(2) Spatial correlation of investment risk

In order to further explore the spatial heterogeneity of agricultural investment risk in countries along "the Belt and Road", this paper calculates the Moran's I index of investment risk score in each year (Table 7). The results show that the global Moran's I index of the investment risk score is positive, and it passes the significance test at the 5% level at least in most years, indicating that the agricultural investment risk of countries along "the Belt and Road" shows a significant positive correlation in space, that is, investment risk has a trend of spreading to neighboring countries, resulting in the characteristics of risk agglomeration distribution. From the perspective of the index's size, the index shows a fluctuating trend during the study period, which decreases significantly in the early stage and gradually increases in the later stage, from 0.222 in 1995 to 0.265 in 2022. That is, the agglomeration of investment risk was enhanced, and the risk spillover phenomenon was more obvious, indicating that in addition to paying attention to the investment risk of the host country, the risks to its neighbors cannot be ignored, either.

Table 7. Global Moran index test of agricultural investment risk in countries along "the Belt and Road" from 1995 to 2022.

Year	Moran's I	Value of Z	Value of *p*	Year	Moran's I	Value of Z	Value of *p*
1995	0.222 **	1.949	0.026	2009	0.299 ***	2.535	0.006
1996	0.241 **	2.090	0.018	2010	0.179 *	1.602	0.055
1997	0.215 **	1.884	0.030	2011	0.227 **	1.992	0.023
1998	0.143 *	1.317	0.094	2012	0.240 **	2.105	0.018
1999	0.176 *	1.570	0.058	2013	0.195 **	1.741	0.041
2000	0.183 *	1.628	0.052	2014	0.247 **	2.140	0.016
2001	0.123	1.144	0.126	2015	0.332 ***	2.822	0.002
2002	0.186 **	1.656	0.049	2016	0.351 ***	2.982	0.001
2003	0.105	1.011	0.156	2017	0.304 ***	2.612	0.005
2004	0.218 **	1.915	0.028	2018	0.273 ***	2.360	0.009
2005	0.265 **	2.299	0.011	2019	0.264 **	2.290	0.011
2006	0.299 ***	2.579	0.005	2020	0.296 ***	2.550	0.005
2007	0.207 **	1.849	0.032	2021	0.299 ***	2.583	0.005
2008	0.341 ***	2.883	0.002	2022	0.265 **	2.285	0.011

Note: ***, **, and * indicate significance at the statistical levels of 1%, 5%, and 10%, respectively.

Because the global spatial autocorrelation index can only measure the overall spatial correlation structure of investment risk but it covers up the local characteristics of risks,

further analysis is needed at the local scale. The Moran scatter diagram can vividly describe the spatial agglomeration of investment risk, which can be divided into four agglomeration areas. The first quadrant represents the high–high (H-H) agglomeration area, and the third quadrant represents the low–low (L-L) agglomeration area. Quadrant II and quadrant IV denote low–high (L-H) and high–low (H-L) agglomeration areas, respectively. This paper draws the Moran scatterplot of the risk score of China's agricultural investment in countries along "the Belt and Road" in 1995 and 2022 (Figure 8). The results show that most of the investment risk scores of countries along "the Belt and Road" are in the first quadrant and the third quadrant. In addition, during the study period, some countries, such as Qatar and Uzbekistan, moved from quadrant III to quadrant I and from high-risk cluster areas to low-risk cluster areas, while high-risk countries, such as Armenia, Azerbaijan, and Bangladesh, were always clustered in quadrant III. With the deepening development of economic globalization, the degree of economic connection among countries is deepening, but, at the same time, the speed of risk transmission is also accelerated. If the investment risk of a certain country increases, it may quickly spread to neighboring countries or even to the whole trade network through trade cooperation, causing more losses. Therefore, the spatial correlation effect cannot be ignored when analyzing investment risk factors.

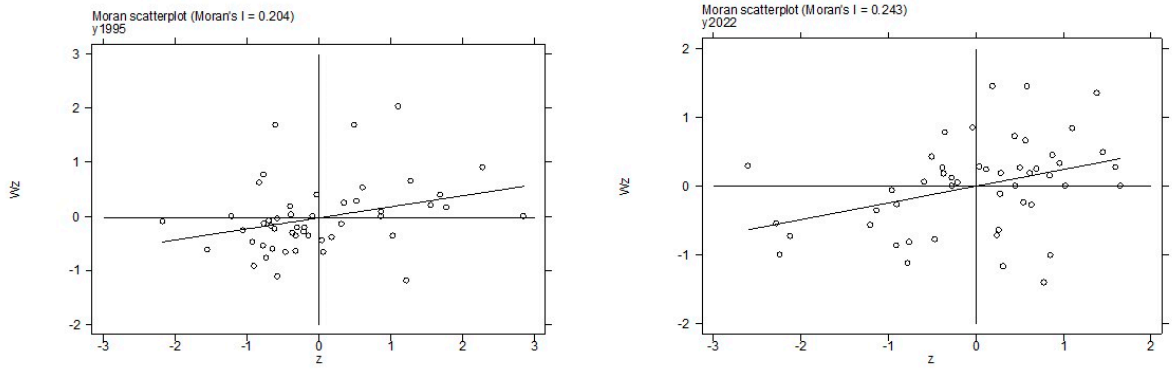

Figure 8. Local Moran index scatterplot of agricultural investment risk score in countries along the "Belt and Road".

(3) Spatial transfer of investment risk

For the convenience of analysis, the agricultural investment risk scores of 49 countries along "the Belt and Road" from 1995 to 2022 are divided into four intervals according to the quantile division method, which are (13.380, 41.793], (41.793, 48.162], (48.162, 55.530], and (55.530, 82.848], respectively. It is denoted by k = 1, 2, 3, and 4. They represent four levels of risk scores: low, relatively low, relatively high, and high. The larger the k, the higher the risk score, that is, the lower the investment risk. Based on this risk classification, this paper successively uses the traditional Markov chain and the spatial Markov chain to analyze the transfer law of investment risk in various countries (Tables 8 and 9).

Table 8. Traditional Markov probability transition matrix of agricultural investment risk in countries along "the Belt and Road" from 1995 to 2022.

t/t + 1	n	1	2	3	4
1	331	0.807	0.166	0.021	0.006
2	335	0.167	0.612	0.203	0.018
3	331	0.009	0.193	0.674	0.124
4	326	0.003	0.018	0.114	0.865

Table 9. Conditional probability matrix of state transition of spatial Markov chain of agricultural investment risk in countries along "the Belt and Road" from 1995 to 2022.

Lag of Space	t/t + 1	n	1	2	3	4
1	1	114	0.825	0.167	0.000	0.009
	2	89	0.180	0.607	0.202	0.011
	3	48	0.000	0.271	0.625	0.104
	4	33	0.000	0.000	0.121	0.879
2	1	131	0.817	0.137	0.038	0.008
	2	104	0.202	0.606	0.173	0.019
	3	74	0.041	0.243	0.649	0.068
	4	26	0.038	0.077	0.231	0.654
3	1	62	0.774	0.210	0.016	0.000
	2	88	0.159	0.625	0.193	0.023
	3	110	0.000	0.173	0.664	0.164
	4	139	0.000	0.022	0.115	0.863
4	1	24	0.750	0.208	0.042	0.000
	2	54	0.093	0.611	0.278	0.019
	3	99	0.000	0.141	0.727	0.131
	4	128	0.000	0.008	0.086	0.906

The diagonal elements in the Markov probability transition matrix represent the probability that the investment risk type remains unchanged in the original state, while the off-diagonal elements represent the probability that the investment risk is transferred between different types. The results show that (1) the probability on the diagonal is much greater than that on the off-diagonal, in which the maximum value of the probability on the diagonal is 0.865 and the minimum value is 0.612, that is, the probability that the agricultural investment risk type of the countries along "the Belt and Road" remains unchanged in the original state is more than 61%, much larger than the probability that the risk state is transferred. This shows that the inherent risk state has a great impact on the transfer of investment risk type, and it has a trend of inertial development. (2) Among the off-diagonal elements, the probability values adjacent to the diagonal elements are all above 10%, and the non-adjacent probability is below 2%, indicating that the investment risk has a certain probability to achieve the transfer of adjacent states, but it is difficult to achieve the transfer of cross-border jumps. (3) The transition of investment risk status has a "path dependence". Countries with high risk scores, that is, low risk, have a higher probability of maintaining the original state. Countries with low investment risk in the initial stage have a probability of maintaining the state of 86.5%, and the probability of transferring to high risk is 13.5%, indicating that regions with low investment risk show the characteristics of internal convergence in the evolution process. The probability of keeping the risk type unchanged in the high-risk area is 80.7%, and the probability of its transfer to the low-risk level is 19.3%, which is higher than the probability of the transfer from low risk to high risk, indicating that the investment environment of all countries is generally developing well.

The results of the state transition probability matrix of the spatial Markov chain show that (1) spatial factors have a great impact on the evolution of investment risk in various countries. For example, when spatial factors are not taken into account, the probability that the risk score remains unchanged at a low level is 80.7%, but when countries with high risk scores are neighbors, the probability that their risk score remains unchanged at a low

level is 75.0%. (2) Different neighborhood types have different influences on the transfer of national investment risk status. In general, when a country is adjacent to a high-risk-score country, the probability of an upward risk score will increase, and the probability of a downward shift will decrease, in which case the neighboring country plays a positive role in its risk status. Conversely, when a country is adjacent to a country with a low risk score, the probability of an upward shift in its risk score will decrease and the probability of a downward shift will increase, and, in this case, the neighboring country plays a negative role in its risk status. For example, the probability of an upward shift is 19.3% for a country with a low risk score, 25% when it is adjacent to a country with a high risk score, and 17.5% when it is adjacent to a country with a low risk score. The probability of a downward shift is 20.2% for a country with a relatively high risk score, 14.1% when it is adjacent to a country with a high risk score, and 27.1% when it is adjacent to a country with a low risk score.

The Markov chain is used to predict the changing trend of investment risk in countries along "the Belt and Road" (Table 10). This shows that in the long-term development process, the types of agricultural investment risks in countries along "the Belt and Road" will gradually shift from low-level to high-level states, showing an evolutionary trend of increasing risk scores from low to high, that is, investment risk are gradually decreasing. When considering the spatial lag term, the limit distribution of agricultural investment risk varies greatly among countries in the context of different spatial patterns. Specifically, when it is adjacent to countries with low and relatively low risk scores (type 1 and type 2), the proportion of countries with low and low risk scores after reaching the steady state is higher than that of the traditional limit distribution, indicating that when it is adjacent to countries with high risk, its investment risk will also change from low risk to high risk, showing the contagiousness of risk. When it is adjacent to countries with relatively high or high risk scores (type 3 and type 4), the types of risk states also show an increasing pattern from low to high after reaching the steady state. On the whole, the long-term evolution trend of agricultural investment risk in countries along "the Belt and Road" is significantly affected by spatial factors.

Table 10. Prediction of the evolution trend of agricultural investment risk in countries along "the Belt and Road".

	Lag of Space	**1**	**2**	**3**	**4**
Initial state		0.327	0.265	0.163	0.245
Limit distributions without spatial lag		0.227	0.240	0.259	0.274
Considering the limiting distribution of spatial lags	1	0.281	0.269	0.219	0.231
	2	0.392	0.297	0.238	0.073
	3	0.166	0.233	0.259	0.343
	4	0.059	0.157	0.317	0.468

4. Dynamic Monitoring of Investment Risk

4.1. Training and Testing of a Deep Neural Network Model of Investment Risk

(1) Data preprocessing

Because the selected 48 input indicators of China's agricultural investment risk in countries along "the Belt and Road" are of an inconsistent magnitude, direct use of original data for modeling will lead to errors. Therefore, these indicators are normalized first to eliminate the influence of units. The formula is as follows:

$$x' = \frac{x - x_{\min}}{x_{\max} - x_{\min}} \quad (5)$$

(2) Training the model

After processing the indicators, 70% of samples, that is, 960 samples, with a total of 46,080 feature values, were used to train the deep neural network, and the structural parameters of the network model were determined after multiple training sessions and comparisons (Table 11).

Table 11. Training parameters of the deep neural network model for agricultural investment risk.

Parameter	Value of Parameters	Description
size	[5, 15, 20, 30, 48]	The dimension of each layer of the network
n	5	Number of network layers
activation_function	Relu	Hidden layer activation function
learning Rate	0.01	Learning rate, that is, the rate of weight update
loss function	MSE	Mean Squared Error of the loss function
momentum	0.500	Weight momentum factor
scaling_learning Rate	0.001	Learning rate change factor (each epoch) is the change rate of the learning rate at each iteration
weight Penalty L2	0	L2 norm constraint term, used to limit the weight range
non-Sparsity Penalty	0	Non-sparse penalty; the purpose is to make the sum of weights of each layer as small as possible, that is, to achieve sparsity
sparsity Target	0.050	Sparse objective value, that is, the objective value of the sum of the weights of each layer
input Zero Masked Fraction	0	The denoising effect of automatic coding increases the anti-noise ability of the network
dropout Fraction	0.2	Dropout network improvement method
epoch	3000	Number of iterations
output	Softmax	Output layer activation function

According to the training results of the network, a deep neural network structure containing one input layer, one output layer, and three hidden layers was finally constructed, with the corresponding dimensions of each layer being 48, 30, 20, 15, and 5, respectively (Figure 9).

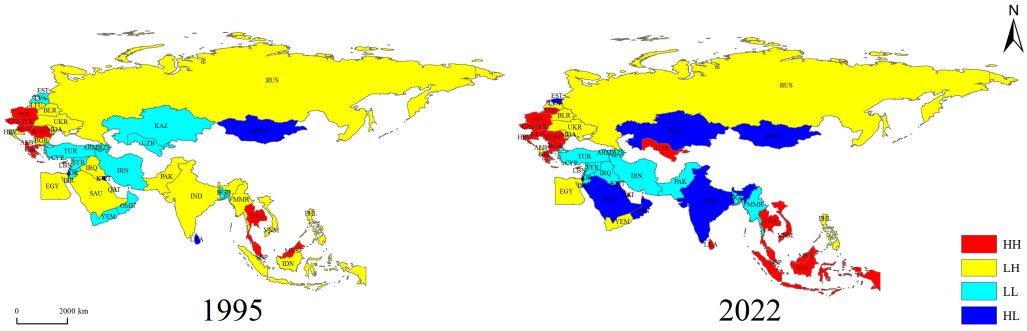

Figure 9. Lisa cluster map of the risk score of China's agricultural foreign investment in countries along "the Belt and Road".

Specifically, the input layer is the starting point where the original data enter the network. This paper corresponds to 48 indicators of China's agricultural investment risk in

countries along the "Belt and Road", so the input layer of the network contains 48 nodes. The number of hidden layers and the number of nodes in each layer are determined after several sessions of network training and testing. The optimal result finally selected contains three hidden layers, and the number of nodes is 30, 20, and 15, respectively (Figure 10). That is, the indexes' data characteristics of investment risk are reduced from 30 dimensions to 20 dimensions and then from 20 dimensions to 15 dimensions. The output layer refers to the five levels (level 1, level 2, level 3, level 4, and level 5) of China's agricultural investment risk in countries along "the Belt and Road", which, respectively, represent extremely high risk, high risk, average risk, low risk, and extremely low risk.

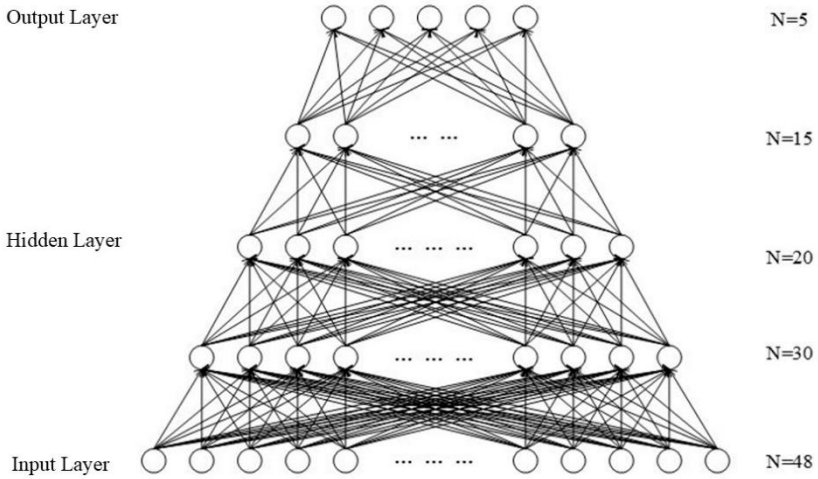

Figure 10. The deep learning network structure of China's agricultural foreign investment risk.

In addition, in the process of model training, the accuracy rate and the minimization loss function can be calculated to test the model. In the training process of this paper, the number of iterations is set to 3000, and the training samples are trained many times after setting other parameters. Figure 11 shows the accuracy and loss function graph of the training set. The abscissa of the two graphs is the number of iterations of training, and the ordinate is the accuracy and the loss function value. The results show that as the number of iterations increases, the accuracy of the training set continues to improve, and the value of the loss function continues to decrease. When the number of iterations reaches about 2000, the accuracy reaches the maximum value and tends to be stable, the mean square error of the loss function is basically close to 0, and the two functions both show a convergence trend. This reflects that the training samples have high accuracy in predicting investment risk, and the test samples can be used to test the model.

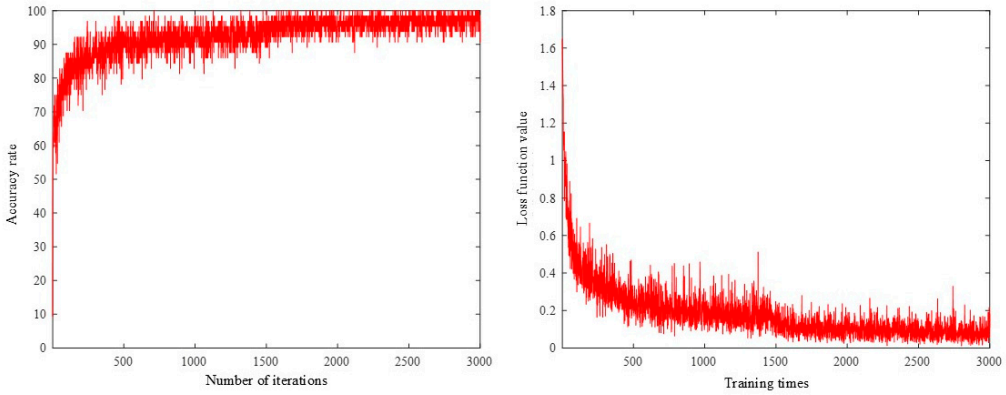

Figure 11. Accuracy and loss function of the deep learning network of China's agricultural foreign investment risk.

(3) Testing of the network model

In order to test the accuracy of the model, the test samples are further substituted into the model for analysis, and the four indicators of accuracy, precision, recall, and F1-Score are used to evaluate the performance of the model. The accuracy rate refers to the proportion of the number of correctly predicted samples to the total number of samples; the precision rate is the proportion of all samples predicted to be positive examples that are actually positive examples; recall refers to the proportion of all samples that are actually positive examples that are predicted by the model to be positive examples; and the F1-Score refers to the weighted harmonic average of the precision rate and the recall rate, which comprehensively considers the precision rate and the recall rate. The formulas are as follows:

$$accuracy = \frac{(TP + TN)}{(TP + TN + FP + FN)} \tag{6}$$

$$precision = \frac{TP}{(TP + FP)} \tag{7}$$

$$recall = \frac{TP}{(TP + FN)} \tag{8}$$

$$F1 = 2 \times \frac{precision \times recall}{precision + recall} \tag{9}$$

In the formula, TP and TN represent positive and negative samples with correct judgment, respectively, and FP and FN represent positive and negative samples with incorrect judgment, respectively.

The results in Table 12 show that the error rate of the test results of the deep neural network model constructed in this paper is 11.65%, that is, the accuracy rate is 88.35%, indicating that 364 of the 412 test samples have the same predicted results as the actual results. Moreover, the precision rate, the recall rate, and the F1-Score of the model are 85.55%, 88.22%, and 86.64%, respectively, indicating that the prediction effect of the model is good. Specifically, among the samples of China's agricultural investment in countries along "the Belt and Road" with the risk level of level 1, there are five samples that are predicted to be successful, the sample size that is misclassified is 0, and the sample of other grades is misclassified as level 1. Among the samples with level 2, 55 were predicted to be successful, 22 were misclassified, and 14 were misclassified as level 2. Among the samples with level 3, 257 were predicted to be successful, 20 were misclassified, and 27 were misclassified as level 3. Among the samples with level 4, 47 were predicted to be successful, 6 were misclassified, and 6 were misclassified as level 4. The sample with level 5 is 0, and there are no samples with another level but misclassified as level 5. According to the results, the prediction accuracy of the samples with level 1, level 2, level 3, and level 4 risk levels are 100.00%, 71.43%, 92.78%, and 88.68%, respectively, that is, the prediction accuracy of the model for the samples with extremely high risk, average risk, and low risk is extremely high, but the prediction accuracy of the samples with high risk is relatively low. And, the wrong direction is biased towards the level of average risk. The reason may be that the output end of the general model is only level 2. In this paper, according to the risk score of China's agricultural investment in countries along "the Belt and Road", the risks are divided into five levels and taken as the output end, resulting in a certain ambiguity of the boundary between adjacent risk levels. For example, countries with risk scores of 39 and 41 are classified as high risk (level 2) and fair risk (level 3), but the difference between the two is not very significant, resulting in some samples with insignificant high risk being classified as fair risk.

Table 12. Confusion matrix of the risk prediction model of China's agriculture foreign investment.

Matrix of Confusion		Risk Prediction Level					Total Amount
		Level 1	Level 2	Level 3	Level 4	Level 5	
Actual level of risk	Level 1	5	0	0	0	0	5
	Level 2	1	55	21	0	0	77
	Level 3	0	14	257	6	0	277
	Level 4	0	0	6	47	0	53
	Level 5	0	0	0	0	0	0
Total amount		6	69	284	53	0	412

In summary, it can be concluded that the deep neural network model constructed in this paper can successfully judge the functional relationship between input indicators and output investment risk levels through machine learning and realize an efficient and accurate assessment of China's agricultural investment risk levels in countries along "the Belt and Road".

4.2. Analysis of Index Contribution Coefficient of Investment Risk

In order to improve the accuracy of China's agricultural investment risk assessment results for various countries, this paper selects rich indicators covering multiple levels as much as possible when constructing the deep neural network model. Therefore, it is necessary to determine the factors that have an important impact on the final output results one by one from multiple factor indicators and further analyze and measure the impact of these important factors on the evaluation results so as to judge China's ability to bear risks for agricultural investment projects in countries along "the Belt and Road", which is called sensitivity analysis. This paper refers to the research of relevant scholars, combines the deep neural network model to conduct a global sensitivity analysis, and measures the contribution of each risk index to the output results. The basic idea is to use the four rights reduction weight matrices in the deep learning model, process these matrices with a series of algorithms, calculate the contribution degree of each indicator factor to each risk level, and then obtain the contribution coefficient matrix of risk indicators (Table 13).

Table 13. Contribution coefficient matrix of risk indicators.

Indicators of Risk	Level 1 Risk	Level 2 Risk	Level 3 Risk	Level 4 Risk	Level 5 Risk
Stability of government	0.0853	0.0751	0.0880	0.0691	0.0770
Effectiveness of government	0.2279	0.1265	0.2026	0.0906	0.1115
Control of corruption	0.1462	0.4246	0.0901	0.3990	0.1821
Quality of government regulation	0.2139	0.5648	0.1055	0.5209	0.2056
External conflict	0.0737	0.1324	0.0696	0.1220	0.0774
Internal conflict	0.0869	0.4680	0.0849	0.4590	0.2652
Military intervention in politics	0.0968	0.3218	0.1612	0.3383	0.2888
Law and order	0.1752	0.0675	0.1673	0.0588	0.1121
Democratic accountability	0.1319	0.4125	0.0714	0.3868	0.1770
Bureaucracies	0.2418	0.4086	0.1539	0.3668	0.0932
Integrity in government	0.1918	0.4674	0.1010	0.4260	0.1603
Inflation	0.2172	0.1478	0.2650	0.2014	0.2909
Level of exchange rate	0.3073	0.4513	0.2129	0.3777	0.0735
Size of external debt	0.0792	0.1158	0.0619	0.1047	0.0481

Table 13. *Cont.*

Indicators of Risk	Level 1 Risk	Level 2 Risk	Level 3 Risk	Level 4 Risk	Level 5 Risk
Level of income and expenditure	0.0780	0.2089	0.0620	0.2038	0.0991
Ability to pay debt	0.0764	0.1623	0.0800	0.1630	0.1197
Scale of economy	0.2348	0.1050	0.2528	0.1156	0.2234
Economic growth rate	0.2208	0.1439	0.1962	0.1000	0.0967
Tax burden	0.1355	0.1510	0.1178	0.1260	0.0658
Freedom of business	0.2323	0.3616	0.1520	0.3172	0.0786
Freedom of investment	0.2145	0.0738	0.2236	0.0712	0.1721
Freedom of currency	0.1164	0.1679	0.0848	0.1445	0.0522
Freedom of trade	0.0989	0.0875	0.0906	0.0798	0.0647
Social environment	0.2711	0.1818	0.2364	0.1219	0.1172
Social security	0.2591	0.1828	0.3155	0.2462	0.3448
Religious conflict	0.1545	0.1906	0.2035	0.2202	0.2496
Ethnic conflict	0.3442	0.6845	0.1900	0.6125	0.1852
Degree of rule of law	0.4230	0.1947	0.3915	0.1107	0.2316
Status of unemployment	0.1681	0.6360	0.0885	0.6199	0.3135
Level of traffic	0.3086	0.0988	0.3082	0.0816	0.2285
Property rights protection	0.2510	0.0809	0.2504	0.0569	0.1778
Degree of freedom of labor	0.1639	0.0793	0.1842	0.1112	0.1909
Level of education	0.3094	0.1002	0.3128	0.0963	0.2323
Level of communication	0.2100	0.2518	0.2926	0.3037	0.3675
Scale of agriculture	0.4102	0.4445	0.3142	0.3638	0.0940
Foundation of agriculture	0.0922	0.2070	0.1061	0.2210	0.1742
Endowment of agricultural land resources	0.0707	0.0515	0.0706	0.0456	0.0544
Endowment of agricultural water resources	0.9311	0.7476	0.7808	0.5176	0.2941
Endowment of agricultural labor	0.0817	0.0654	0.0816	0.0620	0.0716
Quality of agricultural land	0.4968	0.4340	0.4049	0.3097	0.1453
Natural disasters	0.6143	0.6946	0.4622	0.5679	0.1152
Cost of labor	0.2064	0.2379	0.2671	0.2813	0.3299
Political connections	0.1137	0.3180	0.1909	0.3401	0.3004
Partnerships	0.2692	0.4541	0.1688	0.3917	0.0854
Investment relationship	0.0633	0.0536	0.0609	0.0550	0.0590
Mutual visa exemption	0.0858	0.1627	0.0621	0.1558	0.0779
Tax relationship	0.1007	0.3565	0.1476	0.3769	0.2917
Degree of language similarity	0.1035	0.4963	0.0978	0.4912	0.2927

The results show that the determination of the risk grade of China's agriculture foreign investment is affected by multiple indicators at the same time, but the contribution of each indicator to the risk grade evaluation results is different. In addition, by comparing the contribution of each index at different levels, it can be found that at different levels, the impact of each index on the risk level is not consistent, and it is in dynamic change. For example, the contribution of endowment of agricultural water resources to the first-level investment risk is as high as 0.9311, which is the index with the largest contribution to the first-level risk. However, the contribution of this index to the fifth-level risk is reduced to 0.2941, which greatly weakens the impact on the risk assessment results. This dynamic empowerment method avoids equalizing the contribution of each index to risks at all levels. It is conducive to more scientific and accurate investment risk assessment, prediction, and other analyses, with certain advantages.

4.3. Classification of Contribution of Investment Risk Indicators

In order to better understand the impact of different indicators on the risk level, this paper further classifies the contribution degree of indicators and classifies the indicators with a contribution degree of less than 0.15 as low contribution indicators, indicating that these indicators have little impact on the risk assessment results, which can reduce attention in practice. The indicators with a contribution greater than 0.15 but less than 0.25 are classified as medium contribution indicators, which means that these indicators have a significant impact on the risk assessment results but their influence is slightly lower than that of high contribution indicators. The indicators with a contribution greater than 0.25 are classified as high contribution indicators, which means that these indicators have a very significant impact on the evaluation results and are one of the most important indicators, which should be focused on in practice. Due to space limitations, this paper only lists the top five indicators with high contribution and the bottom five indicators with low contribution (Table 14).

Table 14. Ranking list of contribution degree of risk indicators.

Indicator Contribution Category	Level 1 Risk	Level 2 Risk	Level 3 Risk	Level 4 Risk	Level 5 Risk
High contribution index	Endowment of agricultural water resources	Endowment of agricultural water resources	Endowment of agricultural water resources	Status of unemployment	Level of communication
	Natural disasters	Natural disasters	Natural disasters	Ethnic conflict	Social security
	Quality of agricultural land	Ethnic conflict	Quality of agricultural land	Natural disasters	Cost of labor
	Degree of rule of law	Status of unemployment	Degree of rule of law	Quality of government regulation	Status of unemployment
	Scale of agriculture	Quality of government regulation	Social security	Endowment of agricultural water resources	Political connections
Low contribution index	Level of income and expenditure	Freedom of investment	External conflict	Endowment of agricultural labor	Degree of trade freedom
	Ability to pay debt	Law and order	Mutual visa exemption	Law and order	Investment relationship
	External conflict	Endowment of agricultural labor	Level of income and expenditure	Property rights protection	Endowment of agricultural land resources
	Endowment of agricultural land resources	Investment relationship	Size of external debt	Investment relationship	Freedom of investment
	Investment relationship	Endowment of agricultural land resources	Investment relationship	Endowment of agricultural land resources	Size of external debt

Among the high contribution indicators, endowment of agricultural water resources and natural disasters have the greatest impact on the first-, second-, and third-level risks, which further illustrates the particularity of agricultural investments. They are highly dependent on agricultural resources and vulnerable to natural disasters, so investments in countries at these risk levels need to pay more attention to water resources and the frequency of natural disasters.

For example, countries with investment risks in levels 1, 2, and 3 in 2022 include Yemen, Myanmar, Indonesia, and other countries. Especially for countries with large investment scales, such as Myanmar and Indonesia, investment enterprises should have a clear understanding of the supply, availability, water source stability, and water resource

management policies of fresh water resources in these countries. It is also necessary to understand the areas where natural disasters, such as floods, droughts, and typhoons, occur frequently in these countries, avoid investing in these areas, and take precautions in advance. For countries at levels 4 and 5, namely, low and extremely low risk, the status of unemployment, the communication level, social security, ethnic conflict, and other indicators have the greatest impact on them. When investing in these countries, more attention should be paid to social livelihood, infrastructure, ethnic conflict, and other issues. This can also promote local economic development, improve people's livelihood, and further reduce investment risk by investing more funds to build infrastructure in the investment area and create jobs for local people.

Among the indicators with low contribution, investment relationships and endowment of agricultural land resources have the smallest impact on the five investment risk levels, indicating that although the endowment of agricultural land resources of the host country and the duration of the investment agreement between China and the host country are important factors to attract China to carry out agricultural investment in the host country, they are not the main reasons for the increase in risk. Therefore, in the investment process, attention to these factors can be appropriately reduced, and attention can be focused on the indicator factors with greater contributions. In addition, economic factors, such as the size of external debt and the level of income and expenditure of the host country, also have a small impact on investment risk because agricultural investment is often a long-term activity, and, compared with long-term factors, such as land quality, water supply, and market demand, the size of external debt or the level of income and expenditure in the short term contribute less to the long-term risk of agricultural investment.

5. Discussion

5.1. Comparison with Existing Research

This paper provides a comprehensive framework for assessing and monitoring agricultural investment risk. Although this study focuses on countries along "the Belt and Road", the findings and methods of this study can be adopted by other countries or regional organizations.

In terms of agricultural investment risk, both this study and previous studies emphasize the importance of political stability and economic conditions [1,2,33,48,50]. Political risk is the risk with the greatest probability and impact among many foreign investment risks, which can also have a certain impact on economic risk and social risk, and it is the biggest stumbling block in the process of China's agricultural foreign investment [59]. Among them, political instability in the host country, bureaucracy and corruption, and conflicts at home and abroad can all cause political risk. For example, as one of the important investment target countries along "the Belt and Road", Indonesia's political situation is unstable, the presidential election in 2019 caused political turmoil, and a number of terrorist attacks occurred in 2018. The bureaucracy and corruption of the host country are other important factors that increase the investment risk of Chinese enterprises. The main manifestation is that the host country government will occupy social resources by means of power rent-seeking [60], and the relevant staff will abuse their power to take bribes. On the one hand, it will lead to uneven distribution of social resources and aggravate the unfairness of market competition. On the other hand, it will increase the cost of enterprises, making enterprises unable to carry out investment activities in accordance with international practices and market rules and further increase the political risk of investment. Frequent internal and external conflicts and terrorism in host countries will also increase the investment risk of Chinese enterprises and cause them to suffer huge losses. Many countries along "the Belt and Road" are in a complex situation, with long-term

active extremism and terrorism, which, in combination with local political and policy risks, will increase the probability and damaging consequences of investment risk to a certain extent [61].

Economic risk refers to the uncertainty of returns brought to investors due to the fluctuation of the host country's economic environment, which will bring unexpected losses to investment enterprises. For example, according to WDI statistics, Ukraine, Mongolia, Iraq, and other countries have large economic fluctuations and are extremely unstable, which can easily lead to supply chain disruption, local consumers' purchasing power declining, and ultimately reduce the return on investment of enterprises or even make them lose money. The above discussion illustrates the need to include political risk and economic risk in the index system. A stable social environment and the good social order of the host country are conducive to creating a good investment atmosphere for investment enterprises, so we introduce social risk into the index system. In the process of agricultural production and management, there are various uncertainties and challenges, such as the uncertainties of the market and the natural environment. Therefore, for the agricultural field, it is necessary to introduce agricultural management risk into the index system.

In the context of the Belt and Road initiative, there is a greater emphasis on bilateral relations between China and host countries in terms of investment cooperation. Therefore, the index system should contain indicators that can represent the relationship between the two sides. By adding risk in bilateral diplomatic and economic relations with China into the index system, this study further expands the understanding of the index system, which is more in line with reality.

In addition, this study emphasizes the spatial dimension of the risk assessment model. According to Tobler's First Law of Geography [62], "everything is related to everything else, but things near are more related than things far away". This principle shows that spatial agglomeration effects and interactions are universal. Therefore, this study reveals the aggregation of investment risk among neighboring countries, which is consistent with the findings of spatial autocorrelation studies in other fields [63–65].

5.2. Limitations and Prospects

In terms of data sources, first of all, due to the lack of data in some countries along the "Belt and Road", only 49 countries' investment risks were measured and analyzed. Secondly, the relevant data on investment risk are mostly from the World Bank, ICRG, and other databases, but most of the data were only updated until 2022, and there is a certain lag. In view of this, further research needs to focus on supplementing and updating the data in the future.

In terms of index measurement, first of all, agricultural foreign investment risk is a relatively complex concept involving many aspects; it is impossible to enumerate all factors, and some factors, such as the 2019–2022 novel coronavirus epidemic, the outbreak of the Russia–Ukraine conflict, and other risk factors, cannot be quantified, resulting in an incomplete indicator system. Secondly, some indicators on the level of political risk, economic risk, and social risk of the host country are derived from the ICRG database, which is subjective to a certain extent and may lead to inaccurate assessment results. Based on this, future research can improve the index system and enrich the database. For example, field research and related mathematical analysis methods can be used to summarize more risk indicators. For risk elements that are difficult to quantify, qualitative analysis can be adopted to integrate the views of experts and historical cases to establish a more comprehensive risk indicator system. In addition to the ICRG database, data from other international organizations and statistics published by national governments can be

combined to improve the credibility and comprehensiveness of the data, and the credibility of the assessment results can be enhanced by introducing more objective indicators.

6. Conclusions

Based on the relevant data of China's agricultural investment environment in 49 countries along "the Belt and Road" from 1995 to 2022, this paper constructs an index system to measure China's agricultural investment risk in various countries from the perspectives of politics, economy, society, agricultural management, and bilateral diplomatic and economic relations with China, and it analyzes the spatial–temporal evolution characteristics of investment risk. In addition, a deep neural network model is constructed to dynamically monitor investment risk, and conclusions are drawn. (1) From 1995 to 2022, among the five sub-dimensions of risk, risk in bilateral diplomatic and economic relations with China contributed the most to the total investment risk, reaching 38.83%. (2) The agricultural investment risk of countries along "the Belt and Road" has a significant positive spatial correlation, and when spatial factors are not considered, the investment risk types of each country have a high probability of keeping the original state unchanged. However, when spatial factors are considered, different risk types in the neighborhood have different directions of influence on the transfer of the domestic investment risk state, and, in the long-term development process, the risk of agricultural investment in countries along "the Belt and Road" will gradually shift from high risk to low risk. (3) There are differences in the contributions of each index to the risk grade evaluation results, and it is in dynamic change, that is, when the risk level changes, the contribution of the same index to risk will also change. (4) From the perspective of high contribution indicators, endowment of agricultural water resources and natural disasters have the greatest impact on level 1, level 2, and level 3 risks, while unemployment status, communication level, social security, and ethnic conflict have the greatest impact on level 4 and level 5 risks. In terms of the indicators with a low contribution, the investment relationship and endowment of agricultural land resources have the smallest impact on the five investment risk levels.

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