

## Research Article

# Research on Supply Chain Financial Risk Assessment Based on Blockchain and Fuzzy Neural Networks

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With the development of supply chain finance, the credit risk of small- and medium-sized financing enterprises from the perspective of supply chain finance has arisen. Risk management is one of the key tasks of the credit business of banks and other financial institutions, which runs through all aspects of the credit business before, during, and after the loan. This article combines blockchain and fuzzy neural network algorithms to study the credit risk of SME financing from the perspective of supply chain finance. This article builds a supply chain financial system through blockchain technology and integrates supply chain financial information into blocks. The fuzzy neural network algorithm is used for financial data processing and risk assessment, effectively solving and improving the risk processing level of the supply chain. Through further simulation, the application effect of blockchain and machine learning algorithms in the supply chain financial system was verified.

## 1. Introduction

The banking industry is one of the lifeline industries of the country's economy, and it plays a vital role in economic development, social stability, and people's livelihood. With the progress of the times, the banking industry is also facing new tasks and challenges [1, 2]. Against this background, supply chain finance is springing up and growing. Supply chain finance began in the 1970s and went through the bill discounting and trade finance phases.

Since the concept of supply chain financial risk was put forward, it has attracted the attention of many scholars [3, 4]. From the early stage of the research, scholars discussed the risks of different supply chain finance models, to the mid-term of the research, scholars conducted a comprehensive risk analysis of the entire supply chain finance through a macroperspective, and in recent years, scholars analyzed the risks of a single industry through an industry perspective [5]. Supply chain characteristics analyze the operating mechanism of the industry supply chain financial model and explore the industry supply chain financial risks. Berge defines the wait for defining supply chain finance from the

perspective of SME loans [6, 7]. They believe that it is difficult to obtain loans due to the lack of good credit support for small- and medium-sized enterprises and proposed a new financing model; that is, large enterprises or financial institutions control transactions to finance small- and medium-sized enterprises that are difficult to finance [8, 9].

Aberdeen defines supply chain finance from the perspective of financial institutions such as commercial banks. He believes that the core of supply chain finance is composed of financial institutions, core enterprises, and information platforms [10, 11]. By focusing on financing and cost settlement in the supply chain, the cost of enterprises in the supply chain can be optimized and reduced [12]. Against this background, supply chain finance is springing up and growing. The base defines it as a financial institution that provides financial services to companies in the supply chain to help them manage logistics and information flow [13, 14]. Lamoureux and Evans proposed that supply chain finance is an innovation that combines financial services and technology. It strengthens logistic services through a service platform and reduces the financing costs of all participants in the supply chain [15]. Compared with traditional financial

models, supply chain finance has the advantages of low financing costs and efficient loans. Favored by financial institutions such as enterprises and banks, supply chain finance has not only improved the difficulty of financing for SMEs [16].

It also provides a new way for banks with operating difficulties to transform. However, with the development of supply chain finance, credit risk arises with the constraints of the quality of SMEs and supply chain finance management policies [17, 18]. Credit risk runs through all aspects of the credit business before, during, and after the loan. In the context of preventing financial risks, it is important to evaluate the credit risk of supply chain finance based on the perspective of commercial banks. With the development of supply chain finance, the credit risk of small and medium financing enterprises from the perspective of supply chain finance has arisen [19, 20]. Risk management runs through all aspects of the credit business before, during, and after the loan. By combining blockchain and fuzzy neural network algorithms, this paper studies the credit risk of financing for small- and medium-sized enterprises from the perspective of supply chain finance.

## 2. Blockchain Technology

In recent years, the research and industrial development of blockchain technology has attracted more and more attention from various countries. The blockchain has become an important competitive link in the deployment of the next generation of Internet information technology in various countries [21, 22]. As one of the most informatized countries in the world, China, we should seize the opportunity of this information industry revolution in time, increase capital and policy investment, cultivate blockchain talents in enterprises and universities, speed up the construction of blockchain standards, and grasp the right to speak and command heights in the development of the global blockchain [23]. The development of the blockchain is a process of point by line and side by side, from a single digital currency to the financial field, and then to a comprehensive range of industries, realizing “blockchain+” to empower the industry and promote the development of the industry [24]. Figure 1 shows the research on financial risk assessment of supply chain based on the blockchain.

At present, the blockchain is between 2.0 and 3.0. If you want to reach the 3.0 stage, it requires the popularization of the blockchain concept in various industries and the whole society and solve the constraints such as storage space [25]. Several core technical difficulties are in large-scale industrial applications. For the blockchain, it is composed of several blocks. The block is a data structure, which mainly includes two parts: intrablock structure and interblock structure [26]. The intrablock structure is mainly composed of data blocks, and the data blocks include two parts: block header and block body. The block header is mainly composed of the metadata of the block, which is mainly used to verify the block.

The composition of the block body mainly includes information such as version number, previous block hash

value, random number, timestamp, Merkle root, and block hash value [27]. Blockchain technology is extracted from Bitcoin. From the data point of view, the blockchain is regarded as an unalterable distributed database that all nodes jointly maintain and safely store data. The blockchain has the characteristics of decentralization, tamper-proof, traceability, and maintainability [28]. The structure and technology of the data layer can protect the integrity of the block. The network layer is responsible for the transmission and verification of data between distributed nodes. The consensus layer combines the application layer with the appropriate scenario to complete the integration with the actual application. This scheme verifies the consistency of node data and completes the filtering of nodes to ensure consensus [29].

## 3. Supply Chain Financial Risk Assessment

The concept of supply chain finance originated in the 1980s, and it was Stemler and Securing’s proposal of “supply chain finance” that first attracted academic attention. Berger and Udall and others put forward the idea of supply chain finance earlier. Hofmann made a theoretical definition of supply chain finance [30]. He believes that supply chain finance is a new interdisciplinary combining finance, logistics, and supply chain management. It is to plan, guide, and jointly create value for the members of the supply chain. Methods: The Aberdeen group believes that supply chain finance is a process of optimizing supply chain cost processes.

According to Michael Lamoureux’s definition, supply chain finance is a process of systematically optimizing the availability and cost of funds in a corporate ecosystem dominated by core companies. Initially, enterprises solved the problem of shortage of funds by discounting bills. Before the bills expire, the enterprises endorsed the bills receivable to the bank for discounting [31]. The discounted amount is the remaining value after the maturity value of the bill minus the interest. By the 1990s, banks developed trade financing from bill discounting to grant credit to companies. This is in the field of import and export trade. Banks applied structured short-term financing tools based on prepayments, deposits, and accounts receivable in commodity transactions. Current assets such as loans are a new way for companies to issue credit. By the beginning of the 21st century, supply chain financial services have become popular. Banks have developed supply chain financial services based on core enterprises, using accounts receivable, inventory, and pre-paid accounts [32]. Construction framework of the supply chain financial risk indicator system is shown in Figure 2.

The credit risk assessment of general commercial banks is based on the financial indicators of financing enterprises, and the credit risk assessment of small- and medium-sized enterprises in the financing process is comprehensively examined [33]. The same is true for chain finance, but the difference is that supply chain finance can be used as an indicator of credit risk evaluation in addition to the financing enterprise itself, and the conditions of the core enterprise related to the financing enterprise and the entire supply chain can be used as a reference indicator for credit risk evaluation.

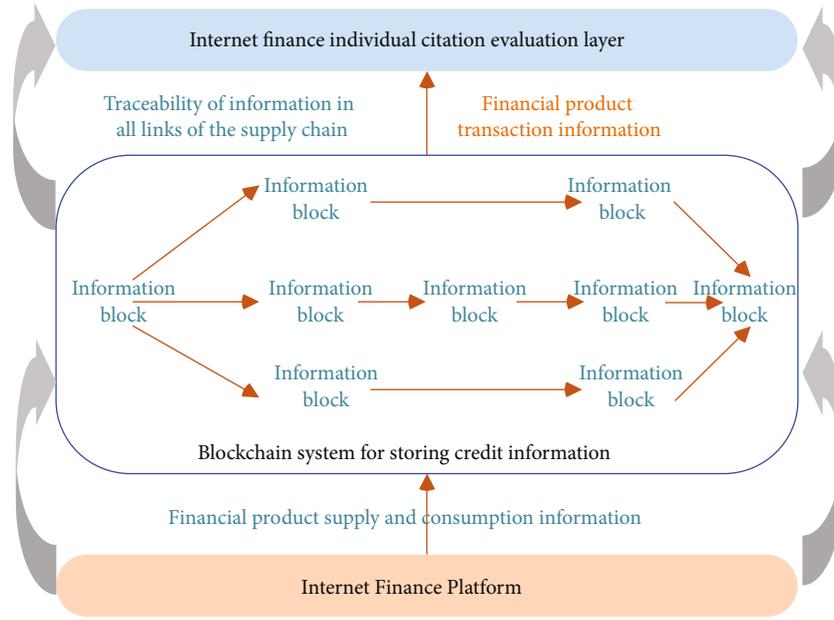


FIGURE 1: Research on the supply chain financial risk assessment based on the blockchain.

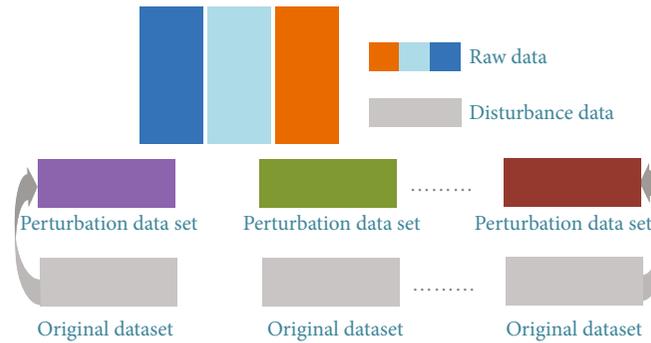


FIGURE 2: Construction framework of the supply chain financial risk indicator system.

#### 4. Supply Chain Financial Risk Assessment Based on the Fuzzy Neural Network

Humans' understanding of objective things is often based on abstracting their characteristics first and then generalizing them. This leads to the connotation and extension of every concept, and its extension is the uncertainty of determining the concept. Based on this principle, Lazada proposed the fuzzy set theory and for the first time, also proposed the membership function representing the membership attribute, laying the foundation of the fuzzy theory.

The development of fuzzy theory has formed a rigorous mathematical science [34]. This article specifically introduces the basic theories of fuzzy sets, fuzzy matrices, and fuzzy inference systems in fuzzy theory. The traditional neural network structure and initial weights are generally determined based on empirical knowledge. Parameters such as network weights are obtained through offline training and then applied to the control system. It is obviously inappropriate to use a fuzzy neural network trained offline. In order to solve these problems, this paper proposes a fuzzy online adaptive

neural network control method based on the fuzzy control and fuzzy neural network, which realizes the online determination and adaptive adjustment of the structure and parameters of the fuzzy neural network [35]. This leads to the connotation and extension of every concept, and its extension is the uncertainty of determining the concept. Based on this principle, Lazada proposed the fuzzy set theory and for the first time, also proposed the membership function representing the membership attribute, laying the foundation of the fuzzy theory. The fuzzy neural network has the advantages of fuzzy theory and neural network. It can not only complete the processing of fuzzy information. With the uncertainty of the characteristics, the neural network structure can be used to complete the learning and adaptation of the model.

Each basic unit of the fuzzy neural network is composed of fuzzy neurons. The basic ones included are the following types of fuzzy neurons. The function of the fuzzy neuron is to convert the determined value into a fuzzy output value.

$$y_t = Ft\theta_t + vt, vt \sim N[0, Vt]. \quad (1)$$

Fuzzy neurons convert fuzzy values into certain signals and output them. This type of neuron, which is glided with camphor, is formally similar to previous neurons, but has the opposite effect.

$$\theta t = \theta t - 1 + wr, wr \sim N[0, Wt]. \quad (2)$$

Because different samples have differences in the range of data, the neural network learning algorithm needs to determine the parameters of the network based on the data. The differences in these data will make the parameters of the neural network difficult to determine, and the accuracy cannot be guaranteed.

$$(\theta 0 | D0) \sim N[m0, C0]. \quad (3)$$

To solve this problem, this research normalizes all the fuzzy adaptive data to the range. The method of normalization is given by

$$Dt = \{yt, Ft, Dt-1\}. \quad (4)$$

$$(\text{theta } t | Dt - 1) \sim N[at, Rt]. \quad (5)$$

The adaptive adjustment of the neural network has a great advantage, and on the contrary, people are not clear about the logic.

$$(YT, Dt - 1) \sim N[ft, Qt]. \quad (6)$$

The structure of the fuzzy neural network is extended from the RBF neural network, the extended structure does not exceed three layers, and its connection weight is not pre-set but determined by the input function. The dynamic fuzzy neural structure used in this article has five layers. The structure of four-input single-output is still adopted here.

$$X = 0, 1 \text{ and } X * x | 2U(x) - c - v] - U(x) x = 0+, \quad (7)$$

$$G(x) = [2U(x) - c - v] - U(x). \quad (8)$$

Each node of this layer corresponds to the fuzzy rules of the fuzzy rule library, and the main function is to serve as the antecedent of matching fuzzy rules and then to solve the fitness of the corresponding rules. That is, the solution of ignition intensity is mainly obtained by combining each fuzzy neural node. The input and output of each node in this layer represent

$$\left\{ \begin{array}{l} \text{Max } G(x) = 2U(0) - c - V \\ \text{Min } G(x) = U(1) - c - v \end{array} \right\}, \quad (9)$$

$$[2U(x -) - c - v] - U(x -) x - = 0. \quad (10)$$

In the conjugate gradient method, the first search is specified as the negative gradient direction, and the second and subsequent search directions are all conjugated with the previous search direction. As one of the most informatized countries in the world, China, we should seize the opportu-

nity of this information industry revolution in time, increase capital and policy investment, cultivate blockchain talents in enterprises and universities, speed up the construction of blockchain standards, and grasp the right to speak and command heights in the development of the global blockchain. The development of the blockchain is a process of point by line and side by side, from a single digital currency to the financial field and then to a comprehensive range of industries, realizing "blockchain+" to empower the industry and promote the development of the industry. In the fry method, after improving the FR method, the convergence speed of the fuzzy neural network algorithm is greatly improved. Perform a linear search along the new search direction to determine the best learning rate. Compared with the standard neural network algorithm, this method can usually converge more quickly.

## 5. Case Analysis of Supply Chain Financial Risk Assessment

Since the knowledge about classification contained in the training data is the only source of information for optimizing the classifier, sample data that contains good prior information about the problem to be processed has a direct impact on the final performance of the classifier and the test effect.

Therefore, it is necessary to achieve the two purposes of improving data separability and improving system processing efficiency through the data preprocessing process. Before conducting empirical analysis, due to the large number of indicators, it is necessary to eliminate indicators with higher correlation based on sample data. This article will use SPSS 25.0 to deal with the correlation between indicators in the risk assessment index system. In the 95% confidence interval, the indicators with the absolute value of the correlation coefficient greater than or equal to 0.7 are filtered and deleted. In addition, since the credit level of financing companies is relatively high, the score is 5 points, so removing this indicator is not included in the analysis. During the training process, the classification of the training sample set is shown in Figure 3.

First, randomly select the generated \_5000 samples in the model and extract them into a combination of 3300 training sample sets and 1700 test sample sets. In order to eliminate the robustness of the model, this paper sets the model to perform 10 extractions in total, and the extraction becomes a combination of 10 different 3300 training sample sets and 1700 test sample sets for training. Distribution of the fuzzy neural network test results is shown in Figure 4.

Finally, this paper establishes a credit risk assessment model applicable to Internet supply chain finance. The training sample set consisting of 3300 samples first trains the fuzzy neural network model, and then the fuzzy neural network model analyzes and learns through the classification of the training sample set. Figure 5 shows a comparison of the classification accuracy of different index systems.

After that, it is compared with the experimental results of the traditional supply chain financial credit risk evaluation index system. In the traditional supply chain financial credit risk evaluation index system, there is no Internet-based

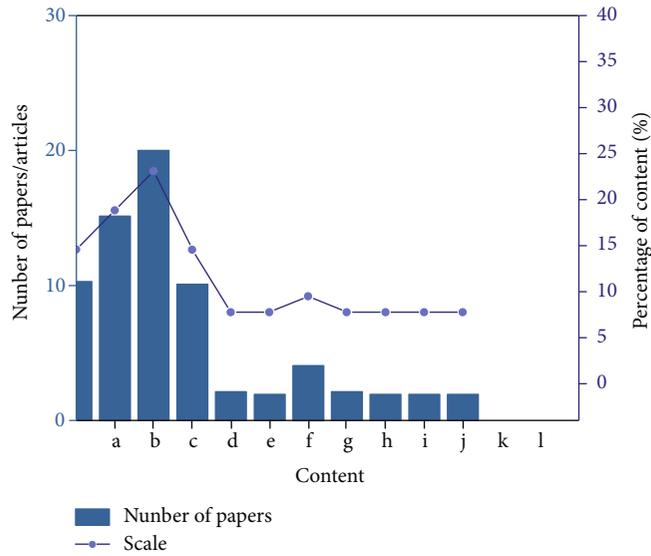


FIGURE 3: The classification of the fuzzy neural network training sample set.

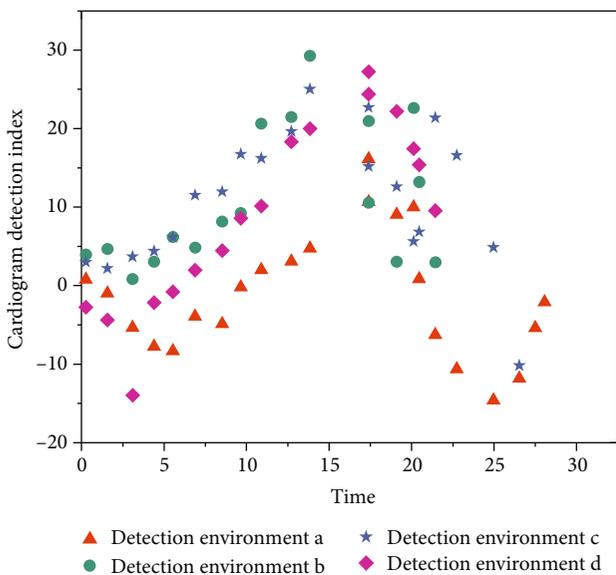


FIGURE 4: Distribution of fuzzy neural network test results.

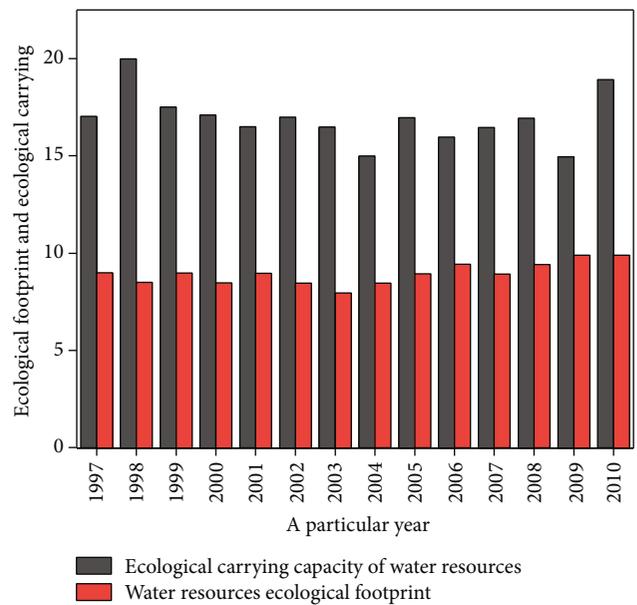


FIGURE 5: Comparison of classification accuracy rates for different index systems.

supply chain financial credit risk evaluation index system for the transaction situation. In the investigation, there are no two indicators of transaction volume and total profit margin of the supply chain. The first 24 three-level indicators constitute the traditional supply chain financial credit risk evaluation indicator system as independent variables. Still, use 1 to indicate that there are no overdue loans or accounts and 0 to indicate that there are overdue loans or accounts. Comparison of the effect of fuzzy neural algorithms in data reset is shown in Figure 6. Comparison of the effects of different methods in data reset is shown in Figure 7.

In order to eliminate the robustness of the model, this paper sets the model to perform 10 extractions in total, and the extraction becomes a combination of 10 different 3300 training sample sets and 1700 test sample sets for training.

The training sample set composed of 3300 samples first trains the fuzzy neural network model, and the fuzzy neural network model analyzes and learns through the classification of the training sample set. After that, it is compared with the experimental results of the traditional supply chain financial credit risk evaluation index system. In the traditional supply chain financial credit risk evaluation index system, there is no Internet-based supply chain financial credit risk evaluation index system for the transaction situation. The discounted amount is the remaining value after the maturity value of the bill minus the interest. By the 1990s, banks developed trade financing from bill discounting to grant credit to companies. This is in the field of import and export trade. Banks applied structured short-term financing tools based on

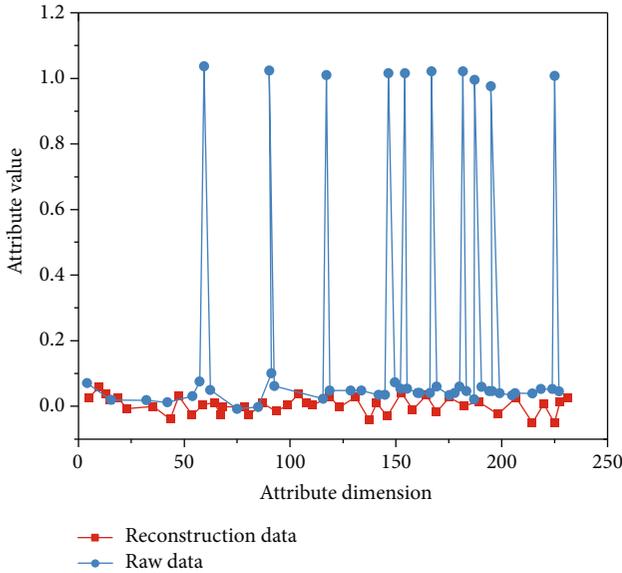


FIGURE 6: Comparison of the effect of fuzzy neural algorithms in data reset.

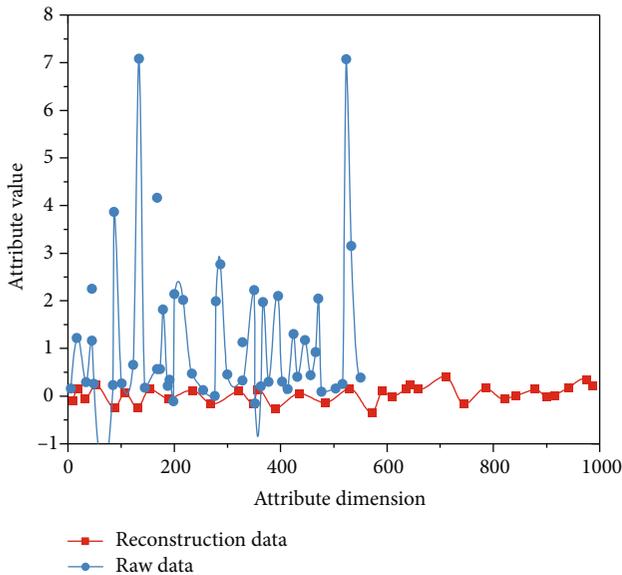


FIGURE 7: Comparison of the effects of different methods in data reset.

prepayments, deposits, and accounts receivable in commodity transactions. In the investigation, there are no two indicators of transaction volume and total profit margin of the supply chain.

## 6. Conclusion

The article first defines the related concepts of supply chain finance and supply chain financial credit risk and analyzes the generation mechanism of supply chain financial credit risk from a theoretical level. Secondly, from the level of development status, analyze the current status and existing prob-

lems of supply chain financial credit risk management and lay the foundation for building a supply chain financial credit risk assessment system, then focus on analyzing the sources and influencing factors of supply chain financial credit risks, and from financing enterprises, core enterprises, the overall operation of supply chain finance, and the macroeconomic environment to select indicators to build a supply chain finance credit risk assessment system. Finally, a modified fuzzy neural network model is used to conduct empirical analysis and research on credit risk.

Credit risk runs through all aspects of the credit business before, during, and after the loan. In the context of preventing financial risks, it is important to evaluate the credit risk of supply chain finance based on the perspective of commercial banks. The same is true for chain finance, but the difference is that supply chain finance can be used as an indicator of credit risk evaluation in addition to the financing enterprise itself, and the conditions of the core enterprise related to the financing enterprise and the entire supply chain can be used as a reference indicator for credit risk evaluation. With the development of supply chain finance, the credit risk of small and medium financing enterprises from the perspective of supply chain finance has arisen. Risk management is one of the key tasks of the credit business of banks and other financial institutions, which runs through all aspects of the credit business before, during, and after the loan. This article combines blockchain and fuzzy neural network algorithms to study the credit risk of SME financing from the perspective of supply chain finance.

## Data Availability

The authors approve that data used to support the finding of this study are included in the article.

## Conflicts of Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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