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Research Article

Comparative Research on the Game Behavior of the Participants in the Traditional Supply Chain Finance and the Supply Chain Finance on the Blockchain

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The authors took the financing warehouse in supply chain finance as an example, used the game between capital providers (banks and their entrusted logistics supervision enterprises) and capital demanders (core enterprises of supply chain, upstream suppliers, and downstream dealers) as the research object, and constructed the income matrices, respectively, and the Nash equilibrium of pure decision and mixed decision was calculated. The authors compared the game behavior of the participants in the traditional supply chain finance and the supply chain finance on the blockchain and the difference of the mixed decision Nash equilibrium whether blockchain rewards and punishment were added. When the rewards and punishment were added to encourage the transaction information placing in the blockchain, the Nash equilibrium point would be further away from the origin point, and the capital provider and the capital demander would choose to cooperate with greater probability. When the cost of the blockchain is gradually reduced, the two sides of the game choose to place the transaction information in the chain, which can improve the cooperation of the participants of the supply chain finance, and they can get more profit.

1. Introduction

The authors constructed the income matrices by using chicken game theory and income analysis theory, compared the game behavior of the participants in the traditional supply chain finance and the supply chain finance on the blockchain, and compared the difference of the mixed decision Nash equilibrium whether blockchain rewards and punishment were added. When the rewards and punishment were added to encourage the transaction information placing in the blockchain, the Nash equilibrium point would be further away from the origin point. The distance of the mixed Nash equilibrium point from the origin is much longer, meaning that the possibility of "cooperation" between the capital provider and the capital demander increases from 1/5 to 3/5. The difference of the Nash equilibrium of the mixed decision showed that when the transaction is included in the blockchain, meaning that when the reward or punishment is added, the Nash equilibrium is further away from the origin, and the two parties will cooperate with a greater probability. The research showed that the probability of choosing cooperation is strongly correlated with the degree of reward and punishment trading information in the blockchain. By encouraging trading information to be recorded in the blockchain and improving the sharing degree of trading information, the willingness of both parties to cooperate can be promoted. Therefore, promoting the application of blockchain technology in the field of supply chain finance and strengthening the cooperative behavior of participants will be conducive to the healthy and rapid development of supply chain finance and will better solve the financing problems of SMSE in the supply chain.

China's supply chain finance has developed rapidly since it was piloted in Ping An Bank (formerly Shenzhen Development Bank) in 2006, which has solved the financing problems of many small- and medium-sized enterprises

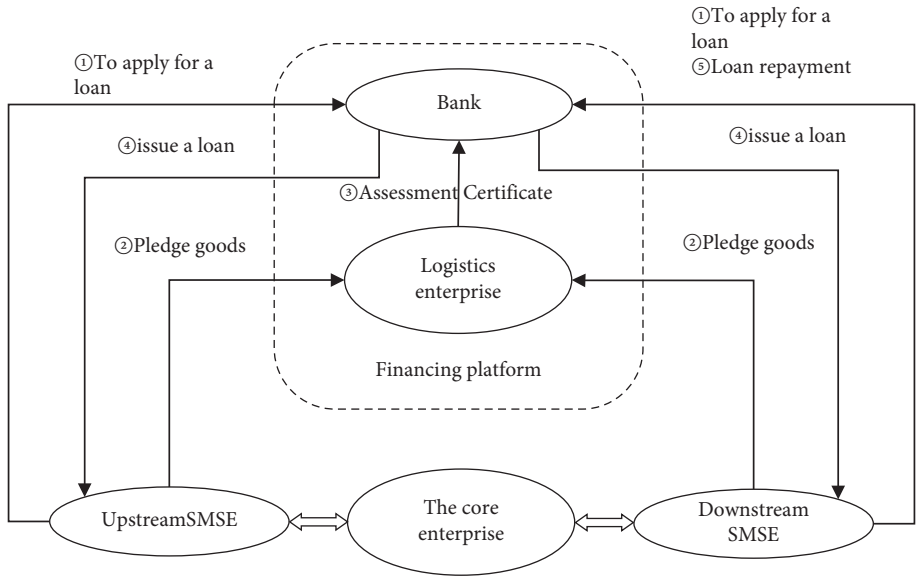

Figure 1: Financing flowchart of financing warehouse.

(hereinafter referred to as SMSE) and greatly promoted the healthy development of the economy. In recent years, blockchain, as a new technology, has been gradually introduced into supply chain finance. As an emerging FinTech, it empowers the supply chain industry. Under this background, the authors took financing warehouse in supply chain finance as an example and analyzed and contrasted game behavior of the participants in supply chain finance whether blockchain reward is added. They wanted to understand the changing rule of the game behavior and to provide the reference for the application scenarios and promotion of supply chain finance in the blockchain.

2. Analysis of Research Status

2.1. Overview of Supply Chain Finance and Its Financing Warehouse. Supply Chain Finance (SCF) [1] refers to a package of services such as financing, settlement, and financial management, which design and provide for different links of the supply chain. It takes the transaction with the core enterprise as the risk control variable on the basis of analyzing the transaction structure within the supply chain and takes current assets such as inventory, work in process, manufactured goods, and accounts receivable in the supply chain as mortgage or pledge. The logistics company will supervise the collateral or pledge.

According to the pledges and their positions in the upstream and downstream of the supply chain, the bank-led supply chain finance [2, 3] can be divided into three financing types: accounts receivable, financing warehouse, and confirmation warehouse. In the supply chain, financing carried out with raw materials, work in process, and finished products as collateral can be called financing warehouse, as shown in Figure 1. The demander of the financing warehouse is the whole supply chain, mainly SMSE, such as upstream suppliers and downstream dealers of the supply chain. The capital provider is the bank and its entrusted logistics supervision enterprises. Banks, the core enterprise supply chain, upstream suppliers and downstream distributors, and logistics enterprises sign the agreement. It takes materials in the supply chain as the pledge. The logistics enterprise is as the pledge mediation, issued the pledge proves after receiving the raw materials, work in process, and finished products as collateral, then the bank provides capital to the demand side according to the certain loan-to-value ratio, and the core enterprise takes its own credit or repurchase pledge as collateral. Financing warehouse is the most common way in supply chain finance. It can partly solve the capital shortage problem of SMSE in the upstream and downstream of the supply chain, realize smooth production of the supply chain, increase product sales in the chain, and improve the collecting reserves and profits of banks in capital.

2.2. Research on the Game Behavior of Supply Chain Finance. Many scholars have discussed the game behavior of the parties involved in supply chain finance from different perspectives, providing a reference for the business development and risk prevention of supply chain finance. Du et al. [4] built a game model to analyze the impact of supply chain finance on the supply chain and the enterprises in the chain and pointed out that supply chain finance, to a certain extent, solved the financing problem of small- and medium-sized enterprises, promoted financial innovation, and improved the ability of supply chain to resist capital chain fracture. Cao and Ma [5] introduced default penalty number and used the game theory method to solve and compare the Nash equilibrium of the traditional accounts receivable financing and supply chain finance accounts receivable financing. They concluded that the supply chain financial accounts receivable financing could achieve Pareto efficient equilibrium, reduce the enterprise financing costs, and increase the lending rate at the same time. Luo and Chen [6]

discussed the game behavior between the capital provider and the capital demander in supply chain finance based on the game theory and calculated the Nash equilibrium of pure decision and mixed decision. Through the example, it was concluded that when the incentives and penalties were added to the financing contract, the Nash equilibrium point was further away from the origin, and the two parties would choose cooperation with greater probability, which could reduce the risk of supply chain finance. Wang and Zhou [7] established an evolutionary game model of banks and SMES in supply chain finance, calculated and analyzed the influence of information sharing factors and blockchain technology factors on the model according to the position of equilibrium points, and then verified the reliability of the calculation results through MATLAB data simulation analysis. The results showed that factors such as information sharing incentive and blockchain incentive would promote banks to choose blockchain supervision, while factors such as information sharing risk and blockchain cost were on the contrary. Finally, some corresponding suggestions were put forward according to the results of the evolutionary game model.

2.3. Research on Supply Chain Finance in the Blockchain. Blockchain was originally built by Nakamoto as a digital currency solution based on a distributed ledger. Blockchain technology provided an imtamable data integrity proof in terms of digital products, permission, finance, and other aspects, which had a profound impact on the work and life of human society in the era of big data and had landed a series of application scenarios [8, 9]. Yermack [10] believed that the low-cost, high liquidity, high accuracy, and high transparency information provided by blockchain would subvert the balance of power among managers, different shareholders, intermediaries, and other participants, forming a new corporate governance mechanism. Sabari et al. [11] believed that the distributed ledger technology in blockchain technology solves the problem of original information asymmetry, making the information among multiple entities recorded and shared on each unit. The consensus mechanism of blockchain made the protocols in the supply chain immutable. No node could unilaterally or privately change the protocols and manipulate the data among only a few subjects. Even if all subjects or a valid percentage of subjects agreed to change the contract or data, the original information would remain intact, and new information would be recorded. Shunzi et al. [12] discussed the application of blockchain technology in cross-border payment and settlement, electronic loan, supply chain finance, asset custody, and other business fields. Chu and Gao [13] introduced the distributed ledger of blockchain, encryption technology, and smart contract into the business link of supply chain finance, which would effectively promote the depth of transaction data acquisition by all parties, accelerate the speed of business identification and settlement, and improve the risk control ability of financial institutions. Bai et al. [14] realized the quantification, transmission, and transaction of contract elements such as credit and reputation in the industrial chain by building a digital system corresponding to logistics and applying a new supply chain finance platform, thus forming a new framework for the development of supply chain finance in the digital economy environment. Guo and Chen [15] believe that blockchain technology should be used to optimize supply chain finance to break through the transmission mechanism of "information island," build industrial alliance, improve supervision and reduce risks, and so on.

2.4. Research Literature Review. The researchers at home and abroad carried out a lot of research on the basic form of supply chain finance, development obstacle, the main risk, and the game behavior of participants in supply chain finance. They thought that the cooperation and information sharing among supply chain participants could reduce the risk of supply chain finance and improve the profit level of each participant. However, there were not many studies on the combination of blockchain and supply chain finance; especially, the game behavior analysis of the participants of supply chain finance on the blockchain was relatively less. Therefore, this paper took the financing warehouse as an example to carry out the research on the game behavior of supply chain finance on the blockchain. It had certain theoretical research value and practical guiding significance for the development of supply chain finance in the new era by comparing the change of the game behavior of the participants in supply chain finance and the supply chain finance on blockchain.

3. Problem Description

As shown in Figure 1, the participants of traditional financing warehouse mainly include capital demanders composed of enterprises in the supply chain whose credit is endorsed by the core enterprise; capital providers composed of banks and the logistics enterprise entrusted by the bank to supervise pledges. The participants of the financing warehouse on the blockchain have increased the blockchain technology provider, but whether to introduce the blockchain technology is mainly decided by the bank, so the blockchain technology provider can be classified as the capital provider, and the game subject can still be simplified as the capital provider and the capital demander. Based on the above definitions, the problems studied in this paper can be described as follows:

Capital providers decide whether to lend based on supply chain credit assessment. By comparing and analyzing the game behavior of participants on traditional financial warehouse and blockchain financing warehouse, people can understand the changes of game behavior and provide reference for the application and promotion strategy of blockchain in the supply chain finance scene.

4. Game Behavior Analysis of Traditional Financing Warehouse and Blockchain Financing Warehouse

4.1. Game Behavior Analysis of Traditional Financing Warehouse

4.1.1. Basic Assumptions of the Game Model

(1) The Game Participants. Banks and logistics supervision enterprises shall be the capital providers. Logistics supervision enterprises shall provide collateral supervision services according to the requirements of banks and be responsible to the banks. Core enterprises of supply chain and their upstream and downstream SMSE are the demanders of capital, which take the pledge of raw materials, products in process, and finished products corresponding to the transaction business of core enterprises as the guarantee for financing. This paper analyzes the game behavior of the participants in the financing position of supply chain finance based on the chicken game. Chicken game, also known as a coward game, is a very important model in game theory. Suppose that there are two people, A and B, who meet on a narrow road and both sit in their cars waiting at the starting line; each party has two options: back and forward. If A retreats, but B does not, and B wins, A is a coward. If Party B also chooses to retreat, then both parties will be in a draw. If A does not choose to retreat and B retreats, then A wins, and B is a coward. If both parties choose to move forward, they will both fail. Therefore, for both Party A and Party B, it is the best result for the opponent to choose to retreat while moving forward.

(2) The Game Behavior. The capital provider is {cooperation, betrayal}, and the capital demander is {cooperation, betrayal}. Cooperation of the capital provider means to strictly supervise that the quantity, quality, storage, and transportation conditions of the pledges of the capital demander meet the requirements of the contract and ensure that the pledge ratio is within a controllable range. Capital demander cooperation refers to that the capital demander guarantees that all the incoming pledges meet the initial requirements of the contract and that the value of the pledges meets the quantity requirements agreed in the contract and will not take concealment or fraud and replace the defective ones with the good ones, leading to increased risk of lending. The probability of capital supply and demand parties to choose each strategy according to their own judgment is as follows: the probability of cooperation of the capital provider is p, the probability of noncooperation is $1 - p$, the probability of cooperation of the capital demander is q, and the probability of noncooperation is $1 - q$.

(3) Game Benefits. Parameter description: the loan interest rate charged by the capital provider is α_b, the regulatory rate is r_s, the operating cost rate is c_s, the increase income of betrayal is U_s, the probability of choosing cooperation is p, the probability of betrayal is $1 - p$, and the income of the capital provider is $\pi_s\pi_s$. The capital provider for each year can be selling more products to the customer and need to increase liquidity through loans D, assuming that the demand increase revenue is Dr_d because of the loan capitals, capitals demand rate of operating cost is c_d, capital demanders earnings of betrayal is U_d, the probability of capital demanders choose cooperation is q, the probability of betrayal is $1 - q$, and capital demanders earned is π_d.

The payoff of the game is as follows: First, the payoff of the capital provider $\pi_s = D(\alpha_b + r_s - c_s)\pi_s = D(\alpha_b + r_s - c_s)$. Second, in the financing supply chain, sales opportunities are obtained through loan support, and Dr_d is the gross profit of sales. The total cost expenditure is the sum of operating cost and financial cost expenditure brought by loan, that is, $D(\alpha_b + c_d)$, and income is $\pi_d = Dr_d - D(\alpha_b + c_d) = D(r_d - \alpha_b - c_d)$. Third, to simplify the calculation, if one party cooperates and the other defies, the partner will have no income, and the defector will have an increase in income. Therefore, if the capital provider defies, its income is $\pi_s = D(\alpha_b + r_s - c_s) + U_s\pi_s = D(\alpha_b + r_s - c_s) + U_s$. If the capital demander defies, its income is $\pi_d = D(r_d - \alpha_b - c_d) + U_d$. Fourth, to simplify the calculation, if both parties default, there will be no revenue, and the cost is the operating cost of both parties. Therefore, when both parties betray, the income of the capital provider is $\pi_s = -Dc_s$, and that of the capital demander is $\pi_d = -Dc_d$.

(4) Game Information. The capital provider and the capital demander fully understand and comply with the contract, understand their own behavior, and at the same time are able to judge the other party's basic situation and predict the choice of strategy. The capital provider can judge whether the capital demander is cooperative from the information on the goods in the supervised warehouse and the information of the entry and exit of the warehouse. The capital demander can also judge whether the capital provider is cooperative from the arrangement of the capital provider's supervisors and the seriousness of the supervision process. In other words, the game information is symmetric and complete.

4.2. Construction of the Game Model between Capital Provider and Capital Demander. According to the above parameters and assumptions, the profit matrix of the capital provider and the capital demander is shown in Figure 2.

4.2.1. The Optimal Response of the Capital Provider. According to the above parameter description, the probability of the capital provider choosing "cooperation" is "p"; therefore, the probability of choosing "betrayal" is "$1 - p$." The probability of the capital demander choosing "cooperation" is "q," and the probability of choosing "betrayal" is "$1 - q$." Based on Figure 2, the expected returns of the capital provider and the capital demander in the chicken game are calculated.

Start with the capital providers. The following are the expected benefits of the "cooperation" and "betrayal" of the capital provider.

The expected benefits of the capital provider choosing "cooperation" are as follows:

		Capital demander			
		cooperation q		betrayal $1-q$	
Capital provider	cooperation p	$\pi_s = D(\alpha_b + r_s - c_s)$	$\pi_d = D(r_d + \alpha_b - c_d)$	$\pi_s = 0$	$\pi_d = D(r_d - \alpha_b - c_d) + U_d$
	betrayal $1-p$	$\pi_s = D(\alpha_b + r_s - c_s) + U_s$	$\pi_d = 0$	$\pi_s = -Dc_s$	$\pi_d = -Dc_d$

Figure 2: Profit matrix of capital provider and capital demander.

Table 1: Optimal response strategy of the capital provider.

$q < Dc_s/(Dc_s + U_s)$	Cooperation $(p = 1)$
$q > Dc_s/(Dc_s + U_s)$	Betrayal $(p = 0)$
$q = Dc_s/(Dc_s + U_s)$	Any choice is right (the probability of any choice will be equal to p)

$$D(\alpha_b + r_s - c_s)q + 0(1-q) = D(\alpha_b + r_s - c_s)q. \quad (1)$$

The expected return of the capital provider choosing "betrayal" is as follows:

$$\begin{aligned}&[D(\alpha_b + r_s - c_s + U_s)]q + (-Dc_s)(1-q)\\ &= D(\alpha_b + r_s)q - Dc_s + U_s q.\end{aligned} \quad (2)$$

Then, the probability of "cooperation" and "betrayal" of the capital provider was set as "cooperation p" > "betrayal $1-p$," meaning that the probability of cooperation was greater, and this was used as the equation to solve q.

$$\begin{aligned}&D(\alpha_b + r_s - c_s)q < D(\alpha_b + r_s)q - Dc_s + U_s q,\\ &(Dc_s + U_s)q < Dc_s,\\ &q < D\frac{c_s}{(Dc_s + U_s)}.\end{aligned} \quad (3)$$

This means that when the probability of the capital demander choosing "cooperation" is "$q < Dc_s/(Dc_s + U_s)$," the probability of the capital provider choosing "cooperation" is "$p > 1-p$," meaning that the probability of the capital provider choosing "cooperation p" is 1. On the contrary, when the probability of the capital demander choosing "cooperation" is "$q > Dc_s/(Dc_s + U_s)$," the probability of the capital provider choosing "betrayal $1-p$" is 1, namely, "$p = 0$." When the probability that the capital demander choosing "cooperation" is "$q = Dc_s/(Dc_s + U_s)$," the capital provider can choose all "p" to deal with it. The optimal response strategy of the capital provider is shown in Table 1 after the above three scenarios are summarized.

4.2.2. Optimal Response of Capital Demander. The expected income of the capital demander choosing "cooperation" is

$$D(r_d - \alpha_b - c_d)p + 0(1-p) = D(r_d - \alpha_b - c_d)p. \quad (4)$$

The expected return of capital demander choosing "betrayal" is

$$\begin{aligned}&[D(r_d - \alpha_b - c_d) + U_d]p + (-Dc_d)(1-p)\\ &= D(r_d - \alpha_b)p - Dc_d + U_d p.\end{aligned} \quad (5)$$

Then, the probability of "cooperation" and "betrayal" of the capital demander is set as "cooperation q" > "betrayal $1-q$," meaning that the probability of cooperation is greater. And this is taken as the equation to solve p.

$$\begin{aligned}&D(r_d - \alpha_b - c_d)p > D(r_d - \alpha_b)p - Dc_d + U_d p,\\ &(Dc_d + U_d)p < Dc_d,\\ &q < cD_d/(Dc_d + U_d).\end{aligned} \quad (6)$$

This means that when the probability of the capital provider choosing "cooperation" is "$p < Dc_d/(Dc_d + U_d)$," the probability of the capital demander choosing "cooperation" is "$q > 1-q$," meaning that the probability of the capital demander choosing "cooperation q" is 1. In contrast, when the probability of the provider choosing "cooperation" is "$p > Dc_d/(Dc_d + U_d)$," the probability of the capital provider choosing "betrayal 1-q" is 1; that is, "$q = 0$." When the probability that the capital demander choosing "cooperation" is "$p = Dc_d/(Dc_d + U_d)$," the capital provider can choose all "q" to deal with it. The optimal response of the capital demander is shown in Table 2 after summarizing the above three situations.

4.2.3. The Diagram of the Optimal Reaction. An optimal response diagram is drawn on the basis of parameter assignment in order to clearly show the optimal response of the two parties of the chicken game involved in supply chain finance.

Example 1. In a supply chain finance project, the operating cost rate of the capital provider is $c_s = 4\%$. The betrayal income is the ratio of the capital demander to increase the working capital D as the base, which is 16%. And the operating cost rate of the capital demander is $c_d = 4\%$. The calculation results of Tables 1 and 2 are shown in Table 3.

Table 2: Optimal response strategy of the capital provider.

$p< Dc_d/(Dc_d + U_d)$	Cooperation ($q = 1$)
$p> Dc_d/(Dc_d + U_d)$	Betrayal ($q = 0$)
$p = Dc_d/(Dc_d + U_d)$	Any choice is right (the probability of any choice will be equal to q)

Table 3: Optimal response strategy of game participants.

The optimal response of the capital provider		The optimal response of capital demander	
$q< 1/5$	Cooperation ($p = 1$)	$p< 1/5$	Cooperation ($q = 1$)
$q> 1/5$	Betrayal ($p = 0$)	$p> 1/5$	Betrayal ($q = 0$)
$q = 1/5$	Any choice is right (the probability of any choice will be equal to p)	$p = 1/5$	Any choice is right (the probability of any choice will be equal to q)

According to Table 3, the optimal decision of the supply and demand parties in the chicken game is shown in Figure 3, made by Excel.

4.3. Game Behavior Analysis of Blockchain Financing Warehouse. In Figure 2, Nash equilibriums (dots marked with circles) exist only in "cooperate • betray" and "betray • cooperate" in pure strategy. However, when the range is expanded to include mixed strategies, Nash equilibrium can be achieved "with the probability 1/5 that both parties will cooperate (or betray)." The probability of the capital provider and demander choosing cooperation is very low, and the main reason is to choose the betrayal of income that is higher, meaning that when the trading information of the capital provider and demander is not on the blockchain, asymmetric information, there is no better technology or mechanism constraints default behavior, the cost of betrayal is low, and then the possibility of the game participants choosing cooperation will be very low.

In order to improve the possibility of cooperation, the capital provider timely introduces the new financial technology-blockchain. The capital demander is required to record all transactions on the blockchain. It will give full play to the technology advantages of blockchain such as distributed bookkeeping, nontamper, openness and transparency, privacy protection, and smart contracts. By making information more transparent, the cost of default will be higher for both parties, and the benefits of cooperation will be greater. At this point, it is equivalent to adding cooperation reward and breach penalty to both sides of the game. When the capital provider or the capital demander chooses cooperation, the upper chain reward is added; when choosing to betray, they should be punished. For simplicity of calculation, the amount of the reward is Dc_i, and the penalty for default is Dc_p (both are based on the loan amount D). The profit matrix is shown in Figure 4.

In this case, the calculation shows that when the probability of the capital demander choosing "cooperation" is "$q< (Dc_s + Dc_i + Dc_p)/(Dc_s + U_s)$," the probability of the capital provider choosing "cooperation " is "$p> 1 - p$," meaning that the probability of choosing "cooperation p" is 1. Similarly, when the probability of the capital provider choosing "cooperation" is "$p< (Dc_s + Dc_i + Dc_p)/(Dc_s + U_s)$," the probability of the capital demander choosing

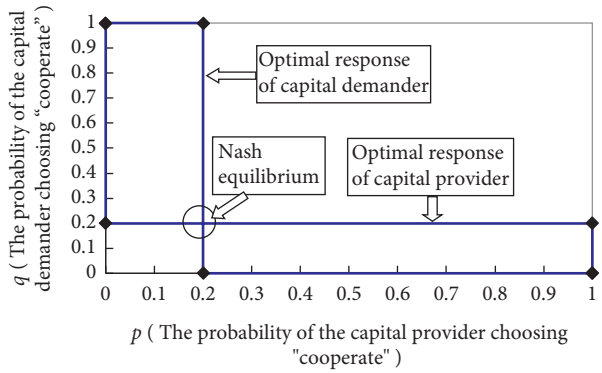

Figure 3: Optimal response strategy of game participants.

"cooperation" is "$q> 1 - q$," meaning that the probability of choosing "cooperation q" is 1. Assuming that the other coefficients in the above example remain unchanged, $c_i = 4\%, c_p = 4\% c_i = 4\%, c_p = 4\%$. Table 4 can be obtained.

According to Table 4, the optimal decision of the supply and demand parties in the chicken game is shown in Figure 5, made by Excel, too.

When the transaction information of the supply chain is recorded in the blockchain, the optimal reaction diagram of reward through cooperation and punishment through betrayal changes greatly compared with the previous one. At this time, the distance of the mixed Nash equilibrium point from the origin is much longer, meaning that the possibility of "cooperation" between the capital provider and the capital demander increases to 3/5. Therefore, in the development of supply chain finance, it can greatly improve the probability of "cooperation" between the supply and demand parties by stipulating in advance the incentive and punishment conditions for the transaction information to be recorded in the blockchain.

5. Analysis of Rewards and Punishment Conditions of Blockchain Supply Chain Finance

5.1. Establishment of Rewards and Punishment Standards for Blockchain Supply Chain Finance. When the capital provider and the capital demander of supply chain finance reach an agreement for a project, the capital provider will generally

The capital demander	The capital provider: cooperation q	The capital provider: betrayal $1-q$
Cooperation p	$\pi_s = D(\alpha_b + r_s - c_s) + Dc_i$ $\quad \pi_d = D(r_d - \alpha_b - c_d) + Dc_i$	$\pi_s = Dc_i$ $\quad \pi_d = D(r_d - \alpha_b - c_d) + U_d - Dc_p$
Betrayal $1-p$	$\pi_s = D(\alpha_b + r_d - c_d) + U_d - Dc_p$ $\quad \pi_d = Dc_i$	$\pi_s = -Dc_s - Dc_p$ $\quad \pi_d = -Dc_d - Dc_p$

Figure 4: Payoff matrix of game participants of blockchain financing warehouse.

Table 4: Optimal response strategy of game participants of blockchain financing warehouse.

The optimal response of the capital provider		The optimal response of capital demander	
$q < 3/5$	$(p = 1)$	$p < 3/5$	$(q = 1)$
$q > 3/5$	$(p = 0)$	$p > 3/5$	$(q = 0)$
$q = 3/5$	Any choice is right (the probability of any choice will be equal to p)	$p = 3/5$	Any choice is right (the probability of any choice will be equal to q)

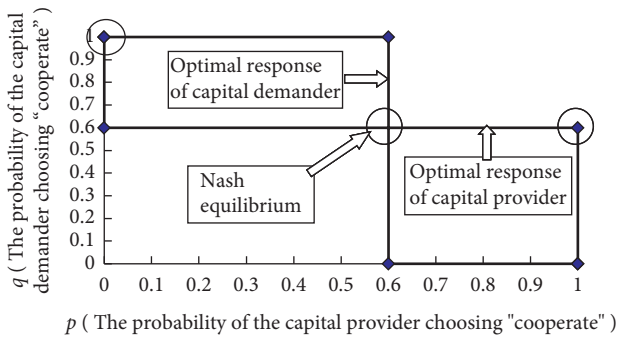

Figure 5: Optimal response strategy of game participants on blockchain.

conduct an overall evaluation of whether the project can introduce blockchain. The competitiveness of the supply chain, the stability of intrachain transactions, the compliance of intrachain enterprises, the performance of logistics supervision enterprises, and the information level of the supply chain will be evaluated. This is the basis for determining the rewards and penalties for adding transactions recorder in the blockchain. Therefore, in the multiparty agreement of the financing warehouse, the evaluation standard of the up-chain project should adopt a relatively systematic, multi-index, and whole-process evaluation method. There are 6 things that should be considered: the loan recovery, interest income, time point of recovery, whether the value of the pledge can always meet the minimum requirements in the process of lending and payment collection, whether the requirement is lower than the minimum pledge rate in the process, and the times of its occurring. Only by evaluating the process and results together can we effectively avoid the risk of the capital provider and reduce the possibility of loss.

5.2. Determination of the Rewards and Punishment Intensity of Blockchain Supply Chain Finance. In order to introduce FinTech blockchain technology into supply chain finance, the optimal reaction diagram of the rewards and punishments on the blockchain added from the above analysis has changed greatly from the previous one. At this time, the distance of the mixed Nash equilibrium point from the origin is much longer, which means that the possibility of both sides of the game choosing "cooperation" has increased. Therefore, in order to motivate the supply chain finance transaction recorded in the blockchain, adding the rewards and punishments in the lending agreement can effectively promote the enthusiasm of both parties, provide power for the application of new science and technology, increase participants' willingness of supply chain finance, and create better conditions for stable economic and social development.

6. Conclusions and Prospects

The authors took the financing warehouse as an example to study the game behavior of the participants in supply chain finance. By calculating examples, they compared and calculated the game behavior of the participants in the traditional supply chain finance and the blockchain supply chain finance. The difference of the Nash equilibrium of the mixed decision showed that when the transaction is included in the blockchain, meaning that when the reward or punishment is added, the Nash equilibrium is further away from the origin, and the two parties will cooperate with a greater probability. The research showed that the probability of choosing cooperation is strongly correlated with the amount of reward and punishment trading information in the blockchain. By encouraging trading information to be recorded in the blockchain and improving the sharing degree of trading information, the willingness of both parties to cooperate can be promoted. Therefore, promoting the application of blockchain technology in the field of supply chain finance and strengthening the cooperative behavior of participants will be conducive to the healthy and rapid development of supply chain finance and will better solve the financing problems of SMSE in the supply chain. In the future, in-depth research can be carried out on the game behavior in

the application scenario of blockchain technology so as to provide more specific guidance for the development of reward and punishment strategies' transaction information in the blockchain.

Data Availability

The data used to support the findings of this study are available from the corresponding author upon request.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

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