

The Revenue Distribution Strategy to Promote the Development of the Sharing Economy Driven by Blockchain Technology

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ABSTRACT

Blockchain is a decentralized and trusted data support platform. Any third-party organization or individual has no right to modify or delete blockchain records. In addition, the blockchain-based smart contract system can easily deploy various rules and autonomously perform corresponding operations based on the content of the contract, providing a viable platform support for participating entities' behavior supervision and revenue distribution. With the continuous expansion of the application areas of the sharing economy model, problems such as vicious competition between industries and imperfect management systems within society and enterprises have become increasingly prominent, which have seriously hindered the development of the sharing economy. In order to ensure that the income distribution of each participant is balanced and the overall income is optimal, this article analyzes the income problem of the sharing economy and points out that blockchain technology plays an important role in the income distribution of the sharing economy. Combining the characteristics of influencing factors closely related to income distribution, this article proposes an income distribution strategy based on blockchain smart contract technology. It can increase the overall income while ensuring the maximization of their respective income, so that the shared platform, the supplier and the demander can maintain a long-term cooperative relationship, thereby promoting the healthy and prosperous development of the sharing economy.

Keywords: *Sharing economy, income distribution, blockchain, intelligent contract*

1. INTRODUCTION

Sharing economy is a new economic model, which comes into being with the rapid improvement of China's economic society and Internet information technology. It breaks the traditional economic system, takes the network platform as the carrier, carries on the effective integration and the redistribution to the idle resources, thus reduces the service cost effectively, produces the new market value. However, with the continuous expansion of the application field of sharing mode, investors in the income distribution mode are unable to participate in the supervision of the project, unable to deeply understand the project to grasp the project risk, no channels to protect the basic rights and interests, and other problems become increasingly prominent. As a supporting platform for decentralized and trusted data, blockchain records have no right to be modified or deleted by any third-party institution or individual. In addition, the intelligent contract system based on block chain can easily deploy various rules and independently execute corresponding operations according to the contract content, which solves the problems of platform data disclosure and supervision and protects the legitimate rights and interests of investors.

Therefore, based on the chain block and big data as the main technical means, the influence factors of combined closely related to income distribution characteristic, put forward based on the income distribution under the block chain intelligent contract strategy, promote investors a fair income distribution, provides a better decision support for industry management and the basis, has the very good practical guiding significance and commercial value.

Blockchain technology has a wide range of applications, involving various fields such as technology, medical care, finance, and society. Mahdi Farnaghi pointed out that blockchain technology has the characteristics of anonymity, openness, security, and information that cannot be tampered with, which provides an open and transparent environment for citizens to participate in the daily management of the government[1]. Lyudmila L.Titova pointed out that the application of blockchain technology in the supply chain of agricultural products will provide close connections between financial, logistics and commercial participants in trade and economic transactions, and provide opportunities for unification of payment and supply[2]. Tsan-Ming Choi conducts customer risk assessment based on blockchain technology to achieve optimal pricing in the operation of the on-demand service platform[3]. Dehua Zhang pointed out that blockchain technology plays an important role in improving the credit system and improving information

asymmetry [4]. Wenbo Zhang proposed a lightweight data consensus algorithm for the Industrial Internet of Things (IIoT) based on blockchain technology. This algorithm reduces the average number of hops in data transmission and improves data security and reliability[5]. Regarding income distribution, many scholars have done in-depth research. Among them, Yong Liu et al. fully considered consumer preferences and used game analysis techniques to analyze optimal decisions, and designed a coordination mechanism based on value-added profit distribution[6]. Song Huihui et al. analyzed the impact of the supply chain game model based on revenue sharing contracts on the overall profitability of the supply chain[7]. Hamed Vafa Arani et al. introduced the revenue sharing option contract to coordinate the revenue distribution among the companies in the supply chain [8].

In summary, scholars have done in-depth research on blockchain technology and income distribution, but there are few studies on the application of blockchain technology to income distribution in the development of the sharing economy. This article applies blockchain technology to the issue of sharing economic income distribution, using blockchain technology as a carrier and income distribution strategy as a starting point, and proposes a sharing economy income distribution strategy driven by blockchain technology.

2. SUPPLY CHAIN COOPERATIVE INCOME DISTRIBUTION MODEL BASED ON SHAPLEY VALUE METHOD

Regarding the profit distribution problem of the supply chain that each enterprise participates in is regarded as the profit distribution problem of the multiplayer cooperative game, we can adopt the Shapley value method to solve it. Specific steps are as follows:

The income distribution of each enterprise in the supply chain under the alliance N is the Shapley value, which is recorded as the vector $\phi(v)=(\phi_1(v), \phi_2(v), \dots, \phi_n(v))$, where $\phi_i(v)$ Represents the income distribution of enterprise i under participating in the supply chain alliance N. When $\phi_i(v)$ satisfies the four axioms of symmetry, validity, additivity, and non-contributor non-distribution at the same time, there is a unique supply chain income distribution The Shapley value can be expressed as:

$$\phi_i = \sum_{i \in S_i} w(|s|) [v(S) - v(S_i)], i = 1, 2, \dots, n \quad (1)$$

$$w(|s|) = \frac{(n - |S|)! (|S| - 1)!}{n!} \quad (2)$$

Among them, S represents an arbitrary alliance that belongs to N among the companies on the chain; S_i represents all the sub-sets of the alliance including member company i ; $v(S)$ represents the income value of the company under the cooperation mode; $v(S_i)$ is expressed as an arbitrary alliance formed by all enterprises on the chain after enterprise i is removed, and the profit value of other enterprises participating in the alliance; $|S|$

expressed as an arbitrary alliance formed by all enterprises on the chain The number of participating companies included in the alliance S ; $v(S)-v(S_i)$ is expressed as the total income obtained by enterprise i in an arbitrary alliance S formed by companies on the chain The contribution value of can also be called the added value of income brought by the joining of enterprise i for alliance S ; $w(|S|)$ is the probability that each enterprise forms different alliance methods.

3. SUPPLY CHAIN COLLABORATIVE INCOME DISTRIBUTION MODEL BASED ON IMPROVED SHAPLEY VALUE

The Shapley value method is not evenly distributed, but based on the value added by each enterprise in the supply chain. It is relatively fair. However, this method assumes that each enterprise has the same risk-taking, innovation level, and effort level, which is not consistent with reality. In order for the distribution of profits of each enterprise to be reasonable, thereby ensuring the stability of the supply chain and maximizing the profits of each enterprise, it is necessary to fully consider the impact of risk factors, innovation level, effort level, and value-added factors on the distribution of profits, based on the Shapley value Law's income distribution model was improved.

3.1. Determination of the Weight of Influencing Factors

Since the importance of each influencing factor to the overall income of the supply chain is not consistent, it is necessary to analyze the importance of each influencing factor in the comprehensive income one by one to determine the influence weight of each factor, and use the analytic hierarchy process for weight analysis. The specific steps are as follows:

- 1) The problem is analyzed hierarchically to construct a hierarchical structure model.
- 2) Construct a judgment matrix A for pairwise comparison.
- 3) Consistency check. We can use the largest characteristic root λ_{max} of the judgment matrix to weigh the consistency of each element in the judgment matrix A, and define the consistency index: $CI = \frac{\lambda_{max} - n}{n - 1}$ to weigh the size of CI, the random consistency index RI is introduced.

Define the agreement ratio: $CR = \frac{CI}{RI}$, when

$CR < 0.1$, we believe that the judgment matrix A has satisfactory consistency and passes the consistency test. Otherwise, the judgment matrix A needs to be adjusted to meet the test standard of $CR < 0.1$.

- 4) Determine the weight of each influencing factor in the comprehensive income. If the matrix satisfies the

above conditions, the eigenvector corresponding to its largest eigenvalue can be expressed as the importance weight of each influencing factor.

3.2. Improved Shapley Value Method with Integrated Factor Adjustment Coefficient

The income distribution model based on the Shapley value method solves the disadvantages of equal distribution, but this method assumes that the influencing factors of enterprises in the operation process are equal, which can easily cause enterprises to dissatisfied with the distribution method, which is not conducive to long-term cooperation between enterprises. Therefore, fully consider the relevant factors that affect the income distribution, based on Shapley's supply chain income distribution model, introduce comprehensive factor adjustment coefficients, and construct an improved Shapley value method of income distribution model.

By introducing the comprehensive factor adjustment coefficient $A_i(i=1,2,3,...)$, the income distribution model based on the Shapley value method is improved. Methods as below:

$$\phi_i(v) = \sum_{i \in S_i} w(|S|) [v(S) - v(S_i)], i = 1, 2, \dots, n \quad (3)$$

$$w(|S|) = \frac{(n - |S|)! (|S| - 1)!}{n!} \quad (4)$$

$$\phi_i(v)' = \phi_i(v) + v(N) \times \left(W_i - \frac{1}{n} \right) \quad (5)$$

In the model, the comprehensive factor coefficient W_i is introduced, where n represents the number of companies in the supply chain, $|S|$ represents the number of companies in the supply chain, $w(|S|)$ is the probability of the cooperation method, $\phi_i(v)$ It represents the income distribution of each enterprise in the supply chain calculated based on the Shapley value method, $v(N)$ represents the total income brought by the cooperation of the enterprises in the supply chain, and $\phi_i(v)'$ represents the improved Shapley value method The income distribution of each enterprise in the supply chain.

3.3. Paper Structure

In the process of calculating the adjustment coefficient of the comprehensive factor, each influencing factor should be quantified and measured by the risk coefficient, the innovation level coefficient, the effort level coefficient, and the value appreciation coefficient. Therefore, the calculation formula of the comprehensive factor adjustment coefficient is:

$$W_i = w_1 x_i + w_2 y_i + w_3 z_i + w_4 m_i \quad (6)$$

Among them, W_i represents the comprehensive factor coefficient of enterprise i , w_i represents the weight corresponding to the influencing factors, x_i represents the

risk coefficient, y_i represents the innovation level coefficient, z_i represents the effort level coefficient, and m_i represents the value appreciation coefficient.

4. CASE ANALYSIS

4.1. Supply Chain Cooperative Income Distribution Based on Shapley Value

If three independent companies A, B, and C form a supply chain, and the three companies A, B, and C operate independently, A can earn 10 million yuan, B can earn 8 million yuan, and C can earn 5 million yuan; if A and B cooperation can get 26 million yuan of income, B and C can get 16 million yuan of revenue, A and C can get 20 million yuan of revenue, if A, B, C cooperate, they can get 40 million yuan Total income, if the total income distributed among enterprises is the total income of the supply chain, the Shapley value method is now used to obtain the distribution amount of each enterprise in the supply chain. The calculation process of A company's income distribution is shown in Table 1.

Therefore, adding up the last row of data is the income distributed by Enterprise A, which is 16.8333 million yuan.

In the same way, it is calculated that the amount of income distributed by enterprise B is 13.8333 million yuan, and enterprise C is distributed by 9.33333 million yuan.

4.2. Supply Chain Cooperative Income Distribution Based on Shapley Value

Following the supply chain collaborative income distribution model based on the improved Shapley value and its solution process, the specific solution steps are as follows:

Step 1: Solve the weight W_i of each influencing factor in the model through the analytic hierarchy process. Construct a judgment matrix through expert scoring:

Table 1 Business income distribution calculation table

S	A	AUB	AUC	AUBUC
v(S)	1000	2600	2000	4000
v(S\{A})	0	800	500	1600
v(S)-v(S\{A})	1000	1800	1500	2400
S	1	2	2	3
W(S)	1/3	1/6	1/6	1/3
W(S)[v(S)-v(S\{A})]	1000/3	300	250	800

$$A = \begin{bmatrix} 1 & 2 & 7 & 5 \\ \frac{1}{2} & 1 & 4 & 3 \\ \frac{1}{7} & \frac{1}{4} & 1 & \frac{1}{2} \\ \frac{1}{5} & \frac{1}{3} & 2 & 1 \end{bmatrix}$$

Calculate and pass the consistency test, and finally get the weight of each influencing factor as shown in Table 2.

The second step is to solve the coefficients of each influencing factor in the model.

Factors such as the risks taken by each enterprise in the process of cooperation, the level of effort, the level of innovation, and the incremental value of the products provided are evaluated by experts, as shown in Table 3.

The risk coefficient, the innovation level coefficient, the effort level coefficient and the value appreciation coefficient are normalized, and the formula is:

$$x_i = \frac{R_i}{\sum_{i=1}^n R_i} \quad (7)$$

Through calculation, the coefficient of various influencing factors of each enterprise are shown in Table 4.

The third step: Solve the comprehensive factor adjustment coefficient W_i . Put the results obtained in steps 1 and 2 into formula 6, you can get the comprehensive factor adjustment coefficient of each enterprise:

$$W_A = w_1x_A + w_2y_A + w_3z_A + w_4m_A = 0.4363$$

In the same way, calculate the adjustment coefficients of the comprehensive factors of B and C enterprises to be 0.3108 and 0.2529 respectively.

The fourth step: Solve the distribution of cooperative income of each member enterprise participating in the coordinated operation of the supply chain. Substituting the comprehensive factor adjustment coefficient W_i obtained in the third step and the result of the supply chain synergy distribution based on the Shapley value method into formula 5, the supply chain synergy distribution plan based on the improved Shapley value can be obtained:

Table 2 Weight table of each influencing factor

	Risk factors	Innovation level	Effort level	Value added
Weights	0.53	0.29	0.07	0.11

Table 3 Related parameter table of each enterprise

	Company A	Company B	Company C
Risk assumed R_i	8	5	5
Innovation level C_i	600	500	300
Effort level N_i	6	4	3
Value increment of the products provided J_i	1000	800	600

Table 4 Related parameter table of each enterprise

	Risk impact coefficient	Innovation level coefficient	Effort level coefficient	Value appreciation ratio coefficient
Company A	0.44	0.43	0.46	0.42
Company B	0.28	0.36	0.31	0.33
Company C	0.28	0.21	0.23	0.25

$$\phi_A(v) = \phi_A(v) + v(N) \times \left(W_A - \frac{1}{n} \right) = 20.952 \text{million}$$

In the same way, enterprise B is allocated 12.932 million yuan and enterprise C is allocated 6.116 million yuan.

The individual investment income value of each enterprise is compared with the income value obtained based on the Shapley value method and the improved Shapley value method model, and the result is shown in Figure 1.

It can be seen from Figure 1 that the greater the contribution of each enterprise in terms of risk-taking, innovation level, effort and value appreciation, the more benefits will be obtained, which is more in line with the actual situation. Through comprehensive consideration of the influencing factors of income distribution, the comprehensive adjustment factor is introduced into the income distribution model to make the income distribution rules more reasonable and fair.

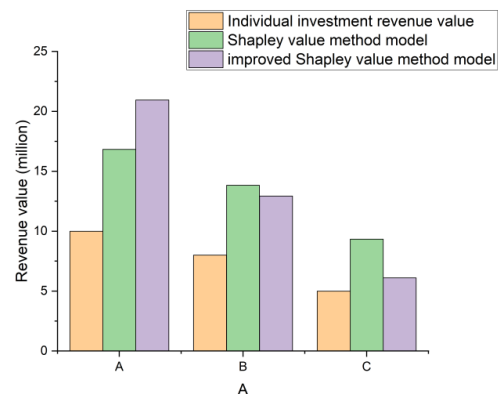


Figure 1 Comparison chart of calculating income distribution by each method

5. THE OVERALL REALIZATION OF INCOME DISTRIBUTION BASED ON BLOCKCHAIN SMART CONTRACT TECHNOLOGY

5.1. Principle of Smart Contract

Smart contracts can be used for transactions between multiple parties. Smart contracts are coded by developers.

They will not generate smart contracts and will not be modified. There are conditions in the code that trigger the automatic execution of the contract. When a transaction is generated, the transaction data is passed to the smart contract. When the smart contract meets the conditions, the automatic state mechanism will automatically execute according to the triggered conditions.

5.2. Principle of Smart Contract

Smart contracts can be understood as computer programs that can be automatically executed. Blockchain technology guarantees the transparency and non-tampering of data during the storage, reading, and execution of information, and the consensus algorithm implements data update operations to establish a set Efficiently operating smart contract system, the system can respond to received information, but also can send information out. It can be seen that smart contracts can replace traditional intermediaries, and previous transaction information can be queried through smart contracts, thereby enhancing the credibility of both parties to the transaction. Blockchain technology can reduce the cost of communication between enterprises in the sharing economy, promote the coordinated management of benefits, and realize the reasonable distribution of the benefits of all parties involved in the sharing economy. At the same time, the decentralized consensus mechanism can also promote the security and fairness of revenue distribution.

With the establishment of the supply chain, the sharing platform, the supplier and the demander can use the smart contract system to improve the efficiency of enterprise income distribution, reduce the cost of income in the distribution process, and increase the respective income of participants. Therefore, a profit distribution mechanism that integrates smart contracts and blockchain technology is proposed, smart contracts are set in advance in the supply chain trading platform, relevant information between companies is published on the blockchain, and transaction information between companies is saved In the blockchain, complete the verification, transmission, storage, maintenance and settlement of data between the participants in the sharing economy, so as to realize the rapid and accurate distribution of profits between enterprises and ensure the interests of all parties in the sharing economy. Ensure the healthy and long-term development of the sharing economy. The profit distribution mechanism of the integration of smart contract and blockchain technology is shown in Figure 2.

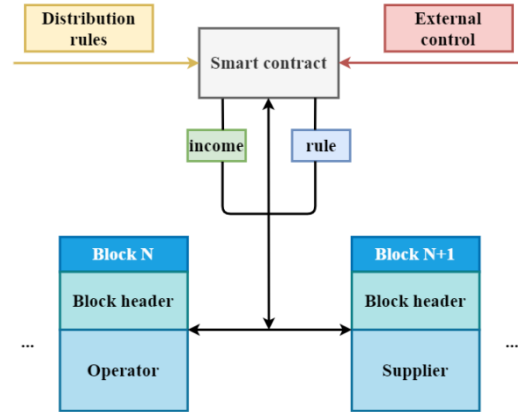


Figure 2 Sharing economy income distribution mechanism based on blockchain technology

5.3. Principle of Smart Contract

5.3.1. Smart contract development

Companies such as sharing platforms, product suppliers, product repairers, etc. register on the blockchain, including the company name, transaction type, etc., and obtain a pair of private and public keys on the blockchain. Enterprises sign an agreement. When an agreement is reached, the content of the agreement is written into machine language and placed in the blockchain. The parties cannot tamper with it at will to ensure the authenticity and validity of the contract.

5.3.2. Store smart contracts on the blockchain

In the sharing economy, the participating parties write their respective income conditions into the blockchain smart contract to participate in the income distribution, and dynamically write the income distribution factor into the blockchain smart contract. Each node in the blockchain contains data such as participants' income and sharing factors.

5.3.3. Automatic execution of smart contracts

The income of the participants in the sharing economy is automatically distributed according to the income distribution factor, and the income is recorded in the blockchain for later query.

5.3.4. Smart contract automatic settlement

Periodic settlement of the income of the participants in the sharing economy, due to the transparency of the income distribution information in the blockchain, there is no need for third-party inspection and verification. The revenue

distribution mechanism integrated with smart contracts and blockchain can reduce the transmission of information, improve the efficiency of revenue distribution, and realize the sharing of revenue information between enterprises, so as to automatically match the overall optimal revenue distribution mechanism.

6. CONCLUSION AND OUTLOOK

The competition in the sharing economy market is becoming increasingly fierce, and mutual cooperation between enterprises can enhance the competitiveness of enterprises, so that the sharing industry can be based on the market, and the fairness of income distribution between enterprises is the prerequisite for win-win cooperation between enterprises. Because the information in the blockchain is transparent and information can be traced, smart contracts can easily deploy various rules and independently perform corresponding operations based on the content of the contract, providing a feasible platform support for participating entities' behavior supervision and revenue distribution. Through literature analysis, model analysis and other methods, this paper makes an in-depth discussion and analysis on the problem of promoting income distribution driven by blockchain technology, and constructs an income distribution model that is more in line with the actual situation, and verifies and analyzes it through corresponding examples. Finally, put the revenue distribution model on the blockchain platform, and propose a revenue distribution strategy based on blockchain smart contract technology, which solves the problems of undisclosed information, insufficient credibility and unreasonable revenue distribution in the current development of the sharing economy. , To ensure the basic rights and interests of investors, thereby promoting the healthy and prosperous development of the sharing economy.

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