

# Game Behavior Analysis of the Interaction Between Commercial Banks and Users

Si Liu, Shaobin Huang

School of Economics, Guangzhou College of Commerce, Guangzhou 511363, China.

## Abstract

In recent years, the development of blockchain technology and digital currency has been in full swing, and the private digital currency led by Bitcoin has caused an uproar in the entire financial industry. Central banks around the world are also developing legal digital currencies that are legally valid and recognized by the world. This article mainly analyzes the basic situation and participating subjects of digital currency from a micro perspective. Then set the variables for the respective advantages and disadvantages of the two participating entities (commercial banks and consumers) under the digital RMB. Then build a game model to analyze the evolutionary game of the interaction between commercial banks and users under the digital RMB system. Finally, according to the equilibrium results of the income matrix, conclusions are drawn, and relevant suggestions are put forward.

## Keywords

Digital RMB, Commercial bank, Evolutionary game.

## 1. Introduction

In recent years, the popularity of digital currency has remained high, especially the explosion of Bitcoin, which has quickly attracted widespread attention from all walks of life. Digital currency based on block chain technology has many characteristics such as transparency of transaction information, decentralization, controllable anonymity, traceability, consensus mechanism and smart contracts.

The popularity of the digital RMB issued by the People's Bank of China has continued to increase since the pilot work was carried out at the end of 2019. As of early November 2021, there have been more than 3.5 million digital RMB pilot scenarios, and a total of 140 million people in China have registered digital RMB accounts. 123 million personal wallets were established, and the transaction amount was about 56 billion yuan. The central banks of various countries have also increased their investment in the field of block chain technology and digital currency, and are constantly exploring the future development of digital currency. Table 1 the number of students in the university and doctoral degree.

Lin Guo(2021) pointed out that there are still problems such as technical defects and insufficient legal supervision in the process of solving the financing of small, medium and micro enterprises. In view of the existing problems such as difficult data processing, technological development bottlenecks and security risks, countermeasures such as establishing an information sharing platform, improving blockchain technology, and strengthening risk management and control are proposed[1].

Lei Zhou, Yu Deng, Yuyan Zhang(2021), using the innovative features of blockchain to improve network collaboration efficiency, improve incentive compatibility mechanisms, and build a new digital supply chain financial ecosystem to better meet the financing needs of small and micro enterprises and the real economy[2].

Lu Xie, Xiaoying Wei, Chuoqing Li, Rui Chang, Xin Wang(2020), learn from foreign advanced practices, and finally put forward feasible policy suggestions from the aspects of restricting capital chain and increasing efforts to crack down on illegal capital transfers[3].

Minggui Xiang(2018) pointed out that during the development of digital currency, there are technical, legal, market and security risks. In this regard, we should clarify development ideas, revise laws and regulations, improve technical standards, and strengthen market supervision to promote the healthy and stable development of digital currency[4].

Compared with traditional paper money, the digital RMB issued by the central bank has several advantages such as low transaction cost, fast transaction speed and high anonymity. In view of the current rapid development of the financial industry, exploring the feasibility and effectiveness of digital RMB promotion has become an innovative development path for the central bank and commercial banks.

Due to the short development time of digital currency in my country, users have certain concerns about the use of digital RMB, commercial banks also lack certain experience in promoting digital currency policies and methods, and there are also certain problems in the supervision and management of digital currency. uncontrollable factors. What preparations should commercial banks make on the road to the promotion and supervision of the central bank's digital RMB? How can users get involved? In this regard, this article will analyze the evolutionary game based on the current central bank's legal digital currency as an example, and explore the benefits and risks that digital currency brings to banks and users, as well as its corresponding promotion strategies and risk prevention strategies.

Explore the costs and benefits behind the interaction between commercial banks and users under the digital RMB system, and implement and promote the digital RMB for the smooth operation of my country's economy, the construction of the digital financial system, the transformation and upgrading of the traditional banking industry, and the improvement of its core competitiveness, etc. aspect has far-reaching significance.

## **2. Commercial banks and users under the digital RMB system**

### **2.1. Commercial Banks under the Digital RMB System**

#### **2.1.1. Central bank digital currency will improve the efficiency of currency issuance and circulation**

In the digital currency environment, the central bank's digital currency is separated from the physical form, breaking the time and space boundaries of currency transactions and circulation, greatly reducing the daily operating costs of commercial banks, and improving the efficiency of commercial banks' transportation. It will have the following impacts on the business model of commercial banks:

First, it will have an impact on the personnel structure. Commercial banks will reduce the demand for cash-related positions such as cash counting, cashiers, and tellers, while the demand for technical positions such as financial technology and big data analysis will further increase;

Second, with the popularization and application of digital currency, the demand for physical outlets of commercial banks will decrease. Commercial banks must reposition the functions and layout of physical outlets, reduce the number, and greatly reduce the investment in cash-related equipment such as ATMs.

#### **2.1.2. Central bank digital currency will affect the credit expansion of commercial banks**

The central bank issues digital currency and requires commercial banks to pay 100% reserves. After the financial institution pays 100% of the deposit, the central bank transfers the

corresponding amount of DCEP from the central bank's digital currency issuance library to the commercial bank library. Therefore, the central bank's digital currency is only used as a currency for payment and circulation, and is only stored in digital wallets without entering the credit market. It will not produce any derivative deposits and currency multiplier effects.

The central bank's digital currency replaces cash as well as demand deposits. Due to its specific issuance method and full reserve policy, it will suppress the money multiplier and control the degree of credit expansion, thereby affecting the loan-to-deposit ratio and loan scale of commercial banks. Further This has led to pressure on the profits of commercial banks.

**2.1.3. Risks of commercial banks implementing digital RMB**

- (1) Impacting the interest pattern of the current financial system, the issuance of digital RMB will have a certain impact on commercial banks and payment institutions in the short term, and will also infringe the vested interests of WeChat, Alipay, etc.;
- (2) It increases the complexity and sensitivity of monetary policy implementation;
- (3) Expanding the boundaries of financial supervision and increasing the difficulty of financial supervision;
- (4) It increases the technical risk of the financial system.

**2.2. Users under the digital RMB system**

**2.2.1. User perception and usage of digital RMB**

**Table 1:** User perception and usage of digital RMB

Name	Options	Frequency	Percentage(%)
You are willing to download the digital wallet APP in order to use digital RMB	5	18	30.000
	4	15	25.000
	3	15	25.000
	1	9	15.000
	2	3	5.000
You are willing to use digital RMB in daily consumption scenarios (such as consumption in convenience stores and restaurants)	4	18	30.000
	5	18	30.000
	3	12	20.000
	1	9	15.000
	2	3	5.000
You are willing to use digital RMB for large-value payments	5	18	30.000
	3	15	25.000
	1	9	15.000
	4	9	15.000
	2	9	15.000
Total		60	100.000

From the data in the table and the corresponding percentages, it can be seen that more than half of the investigators have a high willingness to use digital RMB, both for micropayments (individual users) and large payments (manufacturers/institutions). Both account for more than half, and the central bank's legal digital currency has a good development prospect.

### 2.2.2. The benefits of using digital yuan for users

- (1) The issuance cost is low, and the transaction is more convenient than RMB, which saves people the trouble of getting change. And based on the increasing difficulty of cash management in modern society, digital RMB can effectively reduce issuance costs;
- (2) The digital RMB does not need to be bound to a bank account and gets rid of the control of the traditional bank account system;
- (3) In the absence of a network, digital RMB can also be used for consumption, provided that the mobile phone has a DC/EP digital wallet installed;
- (4) The biggest advantage of digital RMB is that it can be traced, which has a great curb effect on corruption and money laundering. Subsidies and relief funds can be directly sent to the accounts of ordinary people.

## 3. Evolutionary game analysis of commercial banks and users

### 3.1. Analysis of Participants in the Digital Currency System

All three participants in the digital currency system can benefit from digital currency, but also pay the corresponding costs, and various potential risks may also lead to the loss of funds for some participants.

The role played by the central bank in the digital currency system is the "leader" and the first bearer of risks. With the central bank as the guarantor, commercial banks can stand up and actively promote and develop digital RMB business. Under the centralized management of legal digital currency, not only does not change the transmission mechanism of traditional monetary policy, but further optimizes the transmission mechanism of currency.

After the commercial bank obtains the digital currency from the central bank, it can carry out the corresponding digital RMB business. Due to the characteristics of digital currency, such as information transparency, high anonymity, and traceability, users of digital currency are not in an obvious weak position in information transmission, but digital currency is an emerging product. In the early stage, we will maintain a cautious wait-and-see attitude, which requires commercial banks to invest a large amount of publicity and promotion costs, improve the breadth and flexibility of digital currency use, and make users willing to participate in it, forming a mutually beneficial and win-win mechanism for both parties. However, in order to prevent the emergence of various illegal acts of using digital currency, commercial banks must carry out effective supervision and management to ensure the normal operation of this benign mechanism and the smooth operation of digital RMB in the currency market.

With the active participation of users, banks expanding their business, and careful supervision, the development prospects of the digital RMB will become considerable. However, bank promotion requires costs, supervision also requires investment of funds and some operation and management fees, which will inevitably require users to pay a certain percentage of handling fees when using digital personal tokens conveniently, but digital RMB will inevitably be circulated and used in the currency market. With a multiplier effect, some of the increased value will be transferred to banks and users, which is undoubtedly a virtuous cycle mechanism. However, to maintain the smooth and healthy operation of this mechanism requires the joint efforts of the central bank, commercial banks and users.

To sum up, this paper starts with the obvious evolutionary characteristics of the game process between commercial banks and users, uses the theory and method of evolutionary games, and assumes that the two parties to the game, commercial banks and users, are bounded rational economic persons, and their decision-making is a dynamic process of constant imitation, learning, and change is more realistic. Study the game evolution and stability strategy between commercial banks and users, dynamically analyze the impact of commercial banks' supervision

of digital currency business and the benefits and costs of users' use of digital currency on the strategic choices of both parties, and then find out the key factors that affect strategic choices. The key factors are analyzed, and some suggestions are provided to commercial banks and users.

### 3.2. Model assumptions

Assumption 1: The model only considers two parties, commercial banks and users;

Hypothesis 2: Based on the principle of bounded rational economic man, the participating commercial bank chooses the strategy as (implement, do not implement), and the participant user chooses the strategy as (use, do not use), so the game model has four strategy spaces: (implementation) , use), (promote, do not use), (do not promote, use), (do not promote, do not use);

Assumption 3: The game is based on a state of complete information. Regardless of whether commercial banks choose to implement or not, users have the choice to use or not to use digital RMB.

Assumption 4: There is no difference between commercial banks, the bank's digital RMB has no monopoly, the price truly reflects the product information, and there is no transaction fee except for the service fee paid by the user.

**Table 2: Model Variable Description**

Variable	Variable description
$c_0$	Costs related to the implementation of digital currency system construction by commercial banks (such as website, software construction, government audit, etc.)
$R_0$	Receiving subsidies, the benefits brought by consumers using digital currency (including saving the cost of paper currency printing, circulation, supervision, and cracking down on counterfeiting of paper currency)
$Q_0$	Commercial banks' implementation of digital currency cannot trace losses caused by criminal funds
$E$	Social and environmental benefits brought about by the implementation of digital currency (the benefits of saving and protecting the environment from paperless)
$T$	Subsidies for those who use digital currency (digital currency given directly)
$F$	The loss of resources from customers turning to third-party payment institutions due to the failure of commercial banks to implement digital currency
$C1$	Consumers need to learn and understand the cost of relevant expertise and equipment to use digital currency
$R1$	The benefits brought by consumers using digital currency (including the psychological utility brought by the convenience of life, the time cost saved, etc.)
$Q_1$	Loss of funds caused by consumers' use of digital currency (including fraud, improper operation, etc.)

The probability that a commercial bank chooses to implement digital currency is  $x$ , and the probability that it chooses not to implement it is  $1-x$ . The probability of consumers choosing to use digital currency is  $y$ , then the probability of choosing not to use is  $1-y$ . Obviously,  $0 \leq x \leq 1, 0 \leq y \leq 1, 0 \leq z \leq 1$ . Next, through the analysis of the income matrix of commercial banks and consumers, the expected income and average income of commercial banks and consumers are calculated respectively.

Plot the return matrix for both as follows:

**Table 3:** Return Matrix

		commercial Bank	
		implement	not implemented
consumer	use	$(E - C_1 + R_1 - Q_1 + T, -C_0 - Q_0 - T + E + R_0)$	$(E - C_1 + R_1 - Q_1, -F)$
	Do not use	$(0, -C_0 - Q_0 - T)$	$(0,0)$

Solve 5 equilibrium points  $(0, 0)$ ;  $(0, 1)$ ;  $(1, 0)$ ;  $(1, 1)$ ;  $(\frac{Q_1+C_1-E-R_1}{T}, \frac{C_0+Q_0+T}{E+F+R_0})$

**3.3. Stable point analysis**

The Jacobian matrix is used as a model matrix to measure the stability of the system at the local equilibrium point of the evolutionary game. The Jacobian matrix of the system is obtained by copying the dynamic equation:

$$\begin{matrix} (1 - 2x)[y(E + F + R_0) - C_0 - Q_0 - T] & x(1 - x) * (E + F + R_0) \\ (1 - 2y)(xT + E + R_1 - C_1 - Q_1) & y(1 - y) * x \end{matrix}$$

**Table 4:** Jacobian matrix column and formula of each equilibrium point

Equilibrium	Det(J)	Tr(J)
A	$(-C_0 - Q_0 - T)(E - C_1 + R_1 - Q_1)$	$-C_0 - Q_0 - T + E - C_1 + R_1 - Q_1$
B	$(E + F + R_0 - C_0 - Q_0 - T)(C_1 - E + Q_1 - R_1)$	$E + F + R_0 - C_0 - Q_0 - T + C_1 - E + Q_1 - R_1$
C	$(T + C_0 + Q_0)(E - C_1 + R_1 - Q_1 + T)$	$T + C_0 + Q_0 + E - C_1 + R_1 - Q_1 + T$
D	$(E + F + T + R_0 + C_0 + Q_0)(C_1 - E + Q_1 - R_1 + T)$	$E + F + T + R_0 + C_0 + Q_0 + C_1 - E + Q_1 - R_1 + T$
E	-	0

When each point satisfies the quantitative  $Det(J) > 0$  and  $Tr(J) < 0$  relationship at the same time, this point is balanced, and then the stable point is analyzed as follows:

**3.3.1. A point**

(1) when  $-C_0 - Q_0 - T > 0$  and  $E - C_1 + R_1 - Q_1 > 0$ ,  $Det(J) > 0$ , but  $Tr(J) > 0$ , the stationary condition does not hold. Analyzing commercial banks from the perspective of financial theory, the cost of commercial banks implementing digital currency is less than 0, and commercial banks will choose to implement them. Then analyze consumers, and the difference between the benefits of using and not using digital currency is greater than the cost difference. At this time, consumers will choose to use digital currency. Commercial banks implement digital currency business. In theory, this is a stable equilibrium point, but due to commercial banks It has no practical significance for the cost of implementing digital currency to be less than 0, so this stable equilibrium point is discarded.

(2) when  $-C_0 - Q_0 - T < 0$  and  $E - C_1 + R_1 - Q_1 < 0$ ,  $Det(J) > 0$ , but  $Tr(J) < 0$ , The stationary condition is established. Analyzing commercial banks from the perspective of financial theory,

the cost of implementing digital currency is fixed  $C_0 + Q_0 + T$ , that is  $F$ , if digital currency is not implemented, additional costs will be incurred (the loss of resources from customers to third-party payment institutions caused by commercial banks not implementing digital currency). Therefore, commercial banks will most likely choose to implement it. Re-analyzing consumers, when commercial banks do not implement them, the difference between consumers' use and non-use income is less than 0. At this time, consumers will most likely choose not to use them; however, because commercial banks will most likely choose to implement them, consumers will obtain additional benefits (subsidies for those who use digital currency) and will choose to use digital currency at this time due to the motivation of interests. At this time, the strategic choices of commercial banks and consumers have formed a strong game. Commercial banks will invest a large proportion of funds in the construction of digital currency businesses and scenarios, further optimizing their business structure and improving their income levels. Consumers choose to convert bank deposits into digital currency, increase the frequency of digital currency use, and more actively participate in various digital RMB businesses carried out by commercial banks. The final equilibrium point will tend to the stable point.

### 3.3.2. B point

The final equilibrium point will tend to the stable point.

### 3.3.3. C point

The final equilibrium point will tend to the stable point.

### 3.3.4. D point

The final equilibrium point will tend to the stable point.

## 4. Model conclusion

From the analysis results of the above evolutionary game, it can be seen that in order to achieve the evolutionary abandonment state (implemented by commercial banks and used by consumers), the initial evolutionary conditions of  $C_0 + Q_0 + T > 0$ ,  $C_0 + Q_0 + T + E - C_1 + R_1 - Q_1 < 0$ , must be satisfied. The selection of participants includes two aspects.

### 4.1. Analysis of commercial banks

The choice of the game strategy of commercial banks is affected by factors such as the relevant costs of implementing digital currency system construction, the inability to trace the losses caused by criminal funds in the implementation of digital currency, the subsidies given to users, and the social and environmental benefits brought about by the implementation of digital currency. Among them, the lower the cost related to the construction of a digital currency system by a commercial bank, the more likely it is to implement digital currency business; the lower the loss caused by a commercial bank's inability to trace criminal funds when implementing digital currency, the more likely it is to implement digital currency. The greater the sex, the more relevant laws and regulations and the construction of the system must be improved in order to reduce this loss. If this part of the cost cannot be controlled, then commercial banks will tend not to implement digital RMB business; commercial banks will implement digital currency. The level of social benefits brought by it depends on the precision and breadth of its implementation. If the implementation is more specific and the business scope is wider, the social benefits it will bring will be higher, and the optimal strategy of commercial banks is to reach the goal together with users. The stability point of win-win, so when promoting the digital RMB business, it must always pay attention to users, address the needs and pain points of my consumers, and guide consumers to actively use digital RMB, Only in this way is the situation that both parties hope for.

## 4.2. Analyze consumers

The consumer's gaming strategy choice is affected by the difference between the benefits of using digital currency and the cost of learning and understanding relevant expertise and equipment that consumers need to use digital currency, and the financial loss caused by consumers using digital currency. Will consumers benefit from using digital currency? This is the core issue of its concern. The benefits of consumers using digital currency are mainly brought about by the characteristics of digital currency that are different from paper currency, such as reducing transaction fees (handling fees for transfers, withdrawals, etc.) and saving time costs; consumers learn and understand related digital currencies. This requires commercial banks to increase publicity and strengthen the construction of digital currency-related infrastructure; the loss of funds caused by consumers' use of digital currency is mainly caused by their own improper use, and the confidentiality of digital currency is Very high, as long as consumers do not disclose their personal information casually and do not use digital currency to do illegal things, the cost of this part will be minimal. At the same time, commercial banks strengthen management and legal construction, which is also a win-win cooperation with consumers. a means.

## 5. Suggestions

### 5.1. Suggestions for commercial banks to expand digital RMB business

#### 5.1.1. Strengthen infrastructure

The construction of the digital RMB system should be based on a unified IT planning framework, and fully consider the boundaries and relationships with systems such as core, payment, acquiring, business middle-office, Internet finance, open banking platforms, and unified channel platforms, so that the digital RMB system can be integrated into it. Become an important part of the bank's IT infrastructure.

#### 5.1.2. Improve regulatory capacity

Digital currency is still in its infancy and pilot stage, and the relevant laws, regulations and systems are not perfect, which can easily lead users to the wrong path of illegally using digital RMB, and some criminals will also use digital RMB for illegal money laundering, tax evasion, illegal financing, etc. Illegal and criminal behavior, so commercial banks and relevant regulatory agencies should strengthen the supervision of the digital RMB transaction process and use channels, ensure the safety and effectiveness of its promotion and operation, and escort the property safety of the people.

#### 5.1.3. Build a customer ecosystem with digital wallets as the origin

In order to achieve the goal of "building a business ecosystem with customers as the center", commercial banks can take advantage of the opportunities provided by the application of digital RMB to adopt the strategy of "high-end and low-frequency scenarios driven by small amounts of money", build an ecosystem based on financial services, and revitalize traffic. Master the data and retain customers.

### 5.2. Suggestions to users under the digital RMB system

#### 5.2.1. Users should pay attention to protecting personal privacy and information

The central bank's digital RMB is legal tender with a high degree of anonymity and encryption. As a consumer group, it is still in the initial stage, and the understanding of digital RMB is relatively small, so we need to do a good job of personal information protection. When using digital RMB for payment transactions, we must guard against personal information leakage and improve protection awareness.



### **5.2.2. Users should actively participate in the promotion and application of digital RMB**

The central bank's digital RMB is still in the pilot stage. As consumers in the financial market, we must actively participate in digital RMB-related applications. Only in this way can digital RMB, as an emerging financial tool, be continuously updated and iterated, and thus better serve We serve ordinary people, make our daily necessities more convenient, and make the financial market more vibrant.

### **5.2.3. Users need to learn relevant legal knowledge and improve prevention awareness**

The promotion of the central bank's digital currency is currently in the preliminary stage, and the relevant laws and regulations are not perfect, which also gives criminals the opportunity to use it for illegal activities. As a consumer group, you must learn to keep your eyes open, strengthen your legal training, improve your awareness of prevention, and don't use your digital currency for illegal profits, and don't give criminals an opportunity.

## **5.3. Prospects for the development prospects of digital RMB**

### **5.3.1. Digital RMB helps boost financial inclusion**

While satisfying the public's demand for electronic payment in legal tender, the digital RMB will further reduce the threshold for mobile payment, extend the reach of the information-based financial era to the grassroots, and improve the level of inclusive finance in the entire society; the improvement of technical capabilities will also further improve the currency. The efficiency of policy implementation, combating corruption and money laundering, and escorting the special poverty alleviation fund

### **5.3.2. Digital RMB will become a "stimulant" for RMB internationalization**

The peer-to-peer and end-to-end payment characteristics of digital currency will play an important role in cross-border trade, effectively improving the efficiency of cross-border transactions and reducing the cost of settlement. In the future, a fairer, more efficient and more advanced global cross-border digital currency payment system will be established.

### **5.3.3. Digital RMB will break through payment barriers between platforms and expand diversified and integrated payment scenarios**

In recent years, domestic mobile payment methods have been highly developed, and user habits have basically been solidified. In the face of a fixed payment market ecological pattern, the current red envelope promotion strategy is not sustainable, and there is a lack of user accumulation and high-frequency drainage scenarios. It is necessary to link the apps of various platforms and continue to explore the feasibility of linkage between platforms; in addition, the implementation of "one person, one code" will also break through the payment barriers between major platforms, access the platform's huge transaction flow, and help the promotion of digital RMB application.

### **5.3.4. Vigorously promote the digital RMB, and the cross-border payment field has great potential**

Digital currency has great potential in the field of cross-border payment, which can directly realize point-to-point and end-to-end payment settlement, effectively improve the efficiency of cross-border transactions, and reduce settlement costs. According to public information, some countries have successively carried out research work related to digital legal currency. With the implementation of digital currencies in various countries, the commercial and financial forms of human society will usher in great changes, and it is expected to establish a fairer, more efficient and more advanced global cross-border digital currency payment system in the future.

## References

- [1] Lin Guo:Research on Supply Chain Financing Based on Blockchain Technology Taking Micro-enterprise Chain as an Example(MS, Shandong Normal University, China 2021),p.43-47.
- [2] Lei Zhou, Yu Deng, Yuyan Zhang:Financing Game Analysis of Supply Chain Financial Services for Small and Micro Enterprises Empowered by Blockchain ,Financial Theory and Practice, 2021,No.9, p.21-31.
- [3] Lu Xie, Xiaoying Wei,Chuoqing Li, Rui Chang, Xin Wang:An Exploration on Anti-Money Laundering Helping Combat Illegal Wildlife Trafficking from the Perspective of Game Theory,Research on Regional Finance,2020,No.9, p.79-84.
- [4] Minggui Xiang:A brief discussion on the development trend of digital currency ,Modern Economic Information, 2018,No.17, p.306.