

# Research on Consumer Credit with Game Theory:

## a Case of China's Consumer Credit

### RECHERCHES SUR LA CONSOMMATION A CREDIT AVEC LA THEORIE DU JEU :

#### UN CAS PARTICULIER DE LA CONSOMMATION A CREDIT EN CHINE

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**Abstract:** This article introduces the development of China's consumer credit, and analyses consumer credit behaviors with three game theory models, including fundamental game theory model of consumer credit behavior, improvement game theory model and repeated game model. Though analyzing these models, the article obtains the operating mechanism of consumer credit, and comes to conclusion that the complete sharing of consumer credit information in society is the technical support to develop consumer credit, and building Personal Credit Information Management System as soon as possible is the most urgent affair to the development of China's consumer credit now.

**Key words:** consumer credit, game theory, consumer credit information

**Résumé:** L'article présente le développement de la consommation à crédit de la Chine et analyse les comportements de consommation à crédit avec trois modèles de la théorie du jeu, à savoir le modèle de la théorie du jeu fondamental, le modèle de la théorie du jeu amélioré et le modèle de la théorie du jeu répété. A travers l'analyse de ces trois modèles, l'auteur trouve le mécanisme opératoire de la consommation à crédit et tire la conclusion que le partage des informations sur la consommation à crédit dans la société constitue le support technique du développement de cette consommation et que l'établissement du Système de Management de l'Information sur le Crédit personnel le plus vite possible est l'affaire la plus urgente dans le développement de la consommation à crédit de la Chine.

**Mots-Clés:** consommation à crédit, théorie du jeu, information sur la consommation à crédit

## 1. INTRODUCTION

The goal of the economic system reform of China is to set up the socialist market economy with Chinese characteristics. Market economy is an economic system that market is the main way to distribute the social resource. Market economy is a kind of contract economy, and credit is its foundation. So, it becomes an important stage in the economic system reform course of China that setting up a social environment of

stressing credit. The credit environment in the range of the whole society includes the contents of three respects: Public Credit, or call it the Government Credit, Business Credit and Personal/Consumer Credit.

Personal credit consumption is one of the concrete expression forms of Consumer Credit. It development will promote the development of Consumer Credit further, and will be favorable to the building-up work of the credit environment of the whole society too. At the same time, the consumer market of China transformed seller's market from buyer's market from the second half of 1996, the economy of China has been facing the

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problem that the effective demand is insufficient. This has influenced the development of national economy to a certain extent. Personal credit consumption which can transfer future consumption into immediate consumption will improve the immediate consumption demand, and expand the immediate consumer market, and stimulate immediate economic development.

Personal credit consumption has a history of more than 100 years in the West, and China's modern consumer credit began in 1987, signed by the housing mortgage loan of China Construction Bank. Although China's consumer credit has gained a great development, and there have been all kinds of credit facilities for consumer in the market, but the development level of China's personal credit consumption is still low. In developed countries, personal credit loan is a main revenue source to commercial banks, but in China's commercial banks, the personal credit loan is one percent of their total loan, and the revenue from the personal credit is much lower than those commercial banks' in developed countries. At present, the main personal credit facilities are still only limited to Personal Housing Loan, Personal Automobile Consumption Loan, Education Loan, and Daily Consumption Loan in China, even if credit card, rely mainly on debiting to type credit card (the real credit card is a remembering type credit card of the loan). Personal credit consumption doesn't popularize and get extensive development yet in China.

Under the background, it is necessary to research the operating mechanism of consumer credit behavior. Based on the research, we can find the key factor in the whole process of the behavior, and make a theoretical foundation for the development of the consumer credit. The research is useful to build a healthy personal consumption credit system for China.

## 2. METHODOLOGY

Game Theory is a tool which is used to research the decision and the equilibrium, when the decision makers' behaviors affect directly each other. For example, when a person's or a company's choice is affected by another person's or another company's choice, and the choice can also affect other's, Game Theory can be used to study the decision and equilibrium. So, Game Theory can also be called "Theory of Games".

In consumer credit activities, the consumer applies the credit loan to the commercial bank. According to the consumer's credit investigation information, the commercial bank makes decisions that whether give agreement or not, and how much loan would be given. Once the consumer gets the loan, he would pay off in the prescriptive time, or not pay off. This process is a game between the commercial bank and the consumer in substance. We can use game theory to study what the commercial bank and the consumer would do in order to get maximum income in the process under different conditions.

## 3. GAME THEORY MODEL OF CONSUMER CREDIT BEHAVIOR

Let  $M_i$  ( $M_i > 0$ ) is the credit facility that the commercial bank gives the consumer in  $i$ th time;  $r_i$  is the load interest ( $0 < r_i < 1$ );  $R_i$  is the rate of return on  $M_i$ . In most conditions,  $R_i$  is bigger than  $r_i$ .

### 3.1 Fundamental Game Theory Model of Consumer Credit Behavior

According to the actions of the players and their payoff in the game, we can give the Payoff Matrix of the consumer and the commercial bank in some credit activity (see Fig.1).

If the commercial bank chooses "agree", the consumer will get  $M_i(R_i - r_i)$  income when his choice is "fulfilling agreement" or get  $M_i$  income when his choice is "Violating agreement". The consumer's best response is "violating agreement", when the commercial chooses "agree". If the commercial chooses "refuse", the consumer will get zero no matter what he may do. Correspondingly, if the consumer chooses "Performing agreement", the commercial bank will get  $M_i r_i$  income when its choice is "agree" or get zero when its choice is "refuse". Obviously, in one shot game, the players will act according to the principle of maximizing respective interest, and the Nash equilibrium of the game is (refuse, violating agreement).

		<b>Commercial Bank</b>	
		Agree	Refuse
<b>Consumer</b>	Fulfill Agreement	$M_i(R_i - r_i), M_i r_i$	0,0
	Violate Agreement	$M_i, -M_i$	0,0

Fig. 1 Fundamental Game Theory Model of Consumer Credit behavior

### 3.2 Improvement Game Theory Model of Consumer Credit Behavior

The substance of consumer credit is a kind of lending behavior on the foundation of contract, and this kind of contract is protected by the laws in our modern society. The consumer's violating agreement is a kind of behavior against the laws, and he would get punishment more than the income of violating agreement.

We suppose that the commercial would prosecute when the consumer broke the agreement.  $N_i$  is the consumer's punishment of the breach of the agreement about in *ith* time;  $n_i$  is the indemnity that the consumer gives the commercial bank;  $C$  is the commercial bank's litigation expense. We can get the game tree of the game in Fig. 2.

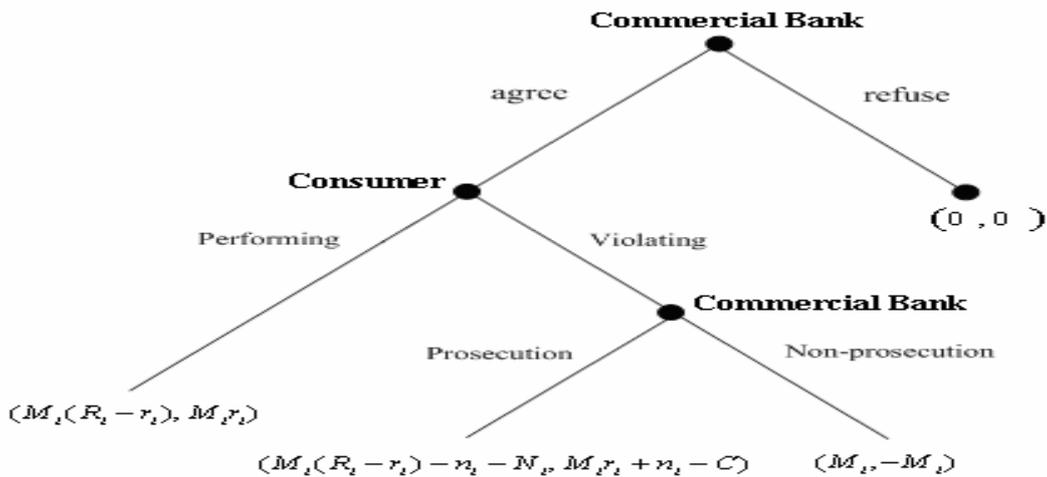


Fig. 2 Improvement Game Theory Model of Consumer Credit Behavior

We use backward induction to solve the game.

$$(1) M_i r_i + n_i - C > -M_i$$

From the game tree, the commercial bank's best action is "prosecution" in the third stage (the commercial bank's second choice). In the second stage, the consumer knows that if he chooses "violating agreement", the commercial bank will choose "prosecution" in the third stage, so the consumer's best action is "fulfilling agreement" in the second stage. In the same, the commercial bank's best action is "agree" in the first stage. Then, we can get the dynamic game's sub-game perfect Nash equilibrium — (agree, fulfill agreement), and the plays' payoff is  $(M_i(R_i - r_i), M_i r_i)$ .

$$(2) M_i r_i + n_i - C < -M_i$$

As the same deduction as (1), in the case, (refuse, violating agreement) is the game's sub-game perfect Nash equilibrium, the players' payoff is (0, 0).

From the game model, if the litigation expense is too high, the commercial bank's best action will be "non-prosecution", and the game's result is the same as the first model, and the consumer credit also can't circulate.

### 3.3 Repeated Game Model of Consumer Credit Behavior

Actually, a consumer could not apply the credit facility only one time in his whole lifetime, but a lot of times. So

the game is a repeated game between the consumer and the commercial bank. We can see the game in Fig 3.

CB----the commercial bank  
C-----the consumer

A-----agree  
R-----refuse  
F-----fulfill agreement  
V-----violate agreement

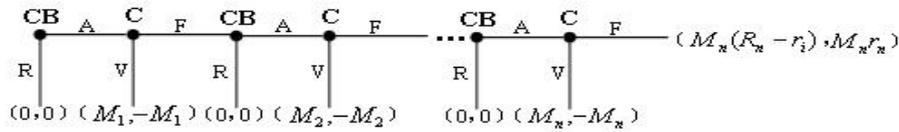


Fig. 3 Repeated Game Model of the Consumer Credit

We suppose that the consumer apply the loan for the commercial bank  $n$  times, and then the game is a repeated game. We use backward induction to draw a conclusion that the consumer chooses “violating agreement” every time, and the commercial chooses “refuse” every time. It is the so-called “Chain Store Paradox”. The unique solution of “Chain Store Paradox” is to master the concept of incomplete information. If the information is incomplete and the repeated game has limited times, the game will have different equilibrium with one shot game. Supposing the game repeats many times, and the players have enough patience, (agree, fulfilling agreement) is a sub-game perfect Nash equilibrium of the game.

Because the repeated game has not the last stage, we can not solve the game by backward induction. In the process of the repeated game, we let  $\delta$  discount factor. If the consumer chooses “violating agreement” in some stage of the game, he will get  $M_i$  income and  $M_i - M_i R_i$  net income. If the game satisfies the following condition:  $M_i \leq \frac{M_i R_i}{1 - \delta}$  and  $\delta \leq 1 - R_i$

If  $\delta \leq 1 - R_i$ , in the game between the consumer and the commercial, the commercial bank will agree the consumer’s apply, and the consumer would fulfill the agreement. (fulfilling agreement, agree) is a sub-game perfect Nash equilibrium. B

But in the repeated game between the consumer and the commercial bank, the consumer’s later applies will be refused by the commercial bank because of his violating agreement at one time. And the amount of load increases in direct proportion to the times of the fulfilling agreement, so the consumer’s losses are not

$$(n - i)M_i(R_i - r_i) \quad , \quad \text{but} \quad \sum_{t=i}^n M_{t+1}(R_t - r_t)$$

(  $i = 1, \dots, n ; M_{t+1} \geq M_t$  ) .Then, because the long-range benefits are more than the present benefits, the consumer will choose “fulfilling agreement” under the drive of rational maximum self’s benefits in the repeated game, and the players will choose the

(fulfilling agreement, agree) strategies. At last, the game attains Pareto Dominance, and the payoff of the players is  $(M_i(R_i - r_i), M_i r_i)$ .

### 3.4 The importance of sharing consumer credit information completely

The improvement game model or the repeated game model is based on the complete sharing of consumer credit information. Contrarily, without the sharing of the information, the measures in the later two models wouldn’t be carried out easily.

In order to increase the possibility of the loan on credit and obtain more, credit applicants might fill in some false consumer information. Moreover judging the consumer information true or not is difficult, for example, consumer properties, because the commercial bank has not enough true information about it. At one time, because of the limitation of punishment dynamics in law, these people who broke promise could not be punished in law. As a result, the cost price of the violating agreement behavior is little in practical life, and the probability of consumer violating agreement behavior will increase.

In addition, if consumer credit information isn’t completely shared among the commercial banks, the consumer’s behavior of the violating agreement behavior in one bank will not be known by other banks. After he gets credit facility from one bank, he will break the contract, and then he will continue applying to the credit from other banks. So the sum that he has got all of the credit from the banks maybe is larger than the income of the credit in all of his life.

Therefore, consumer credit information being fully shared in whole society, at least in all of commercial banks, is the most important technical support to the development of consumer credit. It makes the finite game between a consumer and a commercial bank into the infinite game between the consumer and all of commercial banks. Based on the transformation, the credit consumption can get a safety support and develop stably. Furthermore, sharing consumer credit information completely is a complementarities and extension of law punishment for the violating

agreement behavior. To a greater degree, sharing consumer credit information completely in whole society can heighten the punishment's intensity to the consumer who broke the contract. If a consumer broke the contract after contracting with commercial bank, the bank could get the information from PCIMS, and other banks can obtain his information through the system later. Then, his credit grade in other banks will be reduced, and he will be given less, or even be refused in future. At the same time, the open system can afford the reference for the people. The people will know the consumer's record of violating agreement. Thus, consumers that have the record of violating agreement will not be awarded the credit. This lesson even is more than law punishment.

#### 4. CONCLUSION

From the above analysis, we can see that the essential of consumer credit activities is a kind of games between commercial banks and consumers, and the most important condition to guarantee each player's to maximize their own revenue, is the personal credit information being shared completely in whole society, at least in all of commercial banks.

In present China's personal credit consumption market, consumers give enough believe to the commercial banks. On the contrary, the commercial banks are much difficult to learn about the consumers' credit statuses who apply for the bank's credit facilities, because there is not a right channel, from which the commercial banks can obtain enough these consumers' credit information with a low cost. The profit from personal credit consumption market is high, and the market possesses the capacity for growth or

development, so the banks want to develop consumer credit services certainly. But the banks have to pay more on estimating the consumers' credit grades which can reflect the probability of the consumer returning the loan, because of the lack of the consumer's credit information. In order to counteract the risk, the commercial banks set a more fuzzy process for consumers to obtain the credit facilities, for example, more serve guarantee system, mortgage terms, or qualification. In China's personal credit consumption market, if a person wants to buy some durable consumer goods with credit facilities, he must disburse a large number of the first payment, and then he must offer enough personal information to a commercial bank with a lot of document which can reflect his income, marriage, capital asserts, and so on. The process is so complex and fuzzy.

The greatest obstacle of the development of China's consumer credit has been that there is not a right information platform, through which the commercial banks can obtain enough personal information, to sustain the consumer credit behavior's operating healthily. The information platform, which can be called Personal Credit Information Management System, can (1) obtain all kinds of information which contain the credit applicant's Character, Capacity, Capital, Condition and Collateral (5C) from correlative social departments, especially commercial banks; (2) coordinate the information; and (3) spread the information in whole society at a enough low cost. In china, the government has the greatest capability to distribute the social resource, so the PCIMS's building requires the main support from the government. For example, the collection of credit information relates to a lot of social departments, and the work can only be achieved under the government's support, including correlative policies, laws, manpower, and fund.

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