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Complex Systems: Modeling and Simulation

**The analysis of peasant household's credit behavior**Lv gang<sup>1</sup> Yu bulei<sup>1</sup> Chen zhangqi<sup>1</sup> Zhou zongfang<sup>1</sup> Shi yong<sup>2\*</sup><sup>a</sup>*School of Management and Economics, University of Electronic Science & Technology of China, Chengdu, 610054, China*<sup>b</sup>*Chinese Academy of Sciences Research Center on Data Technology & Knowledge Economy, Graduate College of the Chinese Academy of Sciences, Beijing, China 100080 & College of Information Science & Technology, University of Nebraska at Omaha, NE 68182, U.S.A***Abstract**

Peasant household's credit behavior not only affect the financial ability of the peasant household, but also influence the credit decisions of the rural financial institution, consequently impact on the development of the Chinese rural economic and the peasant household economic. This paper, based on the credit behavior of peasant household in the process of the Chinese rural economic development<sup>1</sup>, analysis the credit behavior game in rural credit and loan process between peasant households and rural financial institution, and the game among peasant households in rural joint warrant process. Finally, provides methods to improve the credit behavior of peasant household in credit game.

*Keywords:* Peasant household; Loan; Joint warrant organization; Game; Credit behavior

**1. Introduction**

China is a large agricultural country, the main problem currently facing the rural areas is that the peasant household's average income is very low, to solve this problem is one of the most important and difficult task in building a well-off society in an all-round way in the near future. For such a large agricultural country, the key to the full realization of well-off lies in the rural areas, the primary task is to solve the problem of increasing the peasant households' income effectively, but the growth of peasant households' income and the development of rural economic need a lot of credit funds. Peasant households' credit being not high is the greatest risk facing the rural financial institution, like rural credit union, consequently leads to peasant households' credit difficulty. Thus, improve the peasant household credit behavior, is not only the basic solution to rural credit financing difficulty

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Author Introduction: Lv Gang, male, doctoral candidate of School of Management and Economics of UESTC; Main Research Fields: Credit risk management, Rural Finance.

Corresponding Author: Zhou Zongfang, male, professor and doctoral supervisor of School of Management and Economics of UESTC; Main research fields: Credit risk evaluation and management, Operations research and optimization, etc.

*E-mail address:* Zhouzf@uestc.edu.cn.

<sup>1</sup>Peasant household's credit behavior is the credit behavior under the comprehensive influence of the repayment capacity and willingness, in which repayment capacity is the key element.

problem, but the key to develop the rural economic and increase the peasant households' income.

Based on the above, this paper start with the analysis of the long formation mechanism of the Chinese rural peasant households' credit system; and then analyzes the credit behavior game in financing process among peasant households and between peasant household and financial institution; finally, proposes some suggestions to upgrade the peasant household's credit level.

## 2. Analysis of the formation mechanism of the peasant household's credit

The emergence and development of traditional peasant household's credit stem from the development of a special trust system. In traditional closed economy state, peasant households are subject to geographical constraints, they form relatively stable mutual relations according to blood and geopolitical connection, and these mutual relationships is built according to some special relation trust system. The emergence of the peasant household's credit system just makes use of this peculiarity to meet the financing needs of the economic activity<sup>[1]</sup>. In Chinese rural areas, banks and other formal financial sectors lack of credit funds, which give birth to the informal finance based on special trust. When the peasant household need funds in economic activity informal finance, private bands and other financing forms becomes important financing channels. Trust system based only on special trust relations can't integrate into the big social credit system because the lack of a sound market and legal system. However, Trust system based only on special trust relations can reduce the credit risk and transaction costs, Thus it is the second-best choice for the peasant household<sup>[2]</sup>. The credit trade area of peasant households is within the game scope of finance contract inner the rural credit organization, the social trade area is within the rural community where they live. It can be considered as a complete information market, for the information transfer very fast, and its credit trade area and social trade area are strongly linked, making the social default cost of the peasant household increased. Peasant households don't want to be regarded as the unfaithful by others, and the high social cost as a result of it, Therefore, the peasant household participated will build their credit in credit contract game within trade area, and will not break the contract; In other words, the threats from multi-sides in the peasant household's living area, form the cooperation standards among the peasant households gradually.

## 3. Gaming analyzing of peasant household's credit behavior

In rural areas, natural connection based on blood and geography takes a significant high proportion, therefore, the rural community is a community with frequent contacts between individuals, and strong traditional moral binding; In addition, in rural areas, the division of labor in society is undeveloped, the marketization degree of commodities is low, the trading range is narrow, the credit activities among the peasant households can be modeled as infinitely repeated gaming. In such case, if the borrower default, the consequence is not only that the financial institution will terminate the credit relation with the borrowing peasant household, but the expand effect of punishment facing the default borrower, due to the rapid spread of information.

### 3.1. Game between peasant household and financial institutions

when the financial institution and the peasant households are playing onetime game, the credit union can only make decision on credit according to subjective judgment on the limited related information, if choosing to loan, and the peasant household choose to refund, then the financial institution can get profit  $R_1$  (with principal and interest), the peasant household get profit  $R_2$  from capital; if the peasant household choose to default, then the financial institution will loss  $R_1$ , the peasant household don't pay principal and interest  $R_1$ , but this is not the whole income of the peasant household, its income is related with default penalty factor  $r$  (depends on its default cost), their income should be  $(1-r)(R_1 + R_2)$ ; if the financial institution choose not to loan, then both sides have no income.

In onetime game, the peasant households' choice depend on the weighing of  $R_2$  and  $(1-r)(R_1 + R_2)$ , when

$$R_2 > (1-r)(R_1 + R_2) \quad (1)$$

which means their income is higher when abide by the contract, the peasant household will choose to repay; otherwise, when

$$R_2 < (1-r)(R_1 + R_2) \tag{2}$$

the peasant household might choose to default. In Chinese rural area, to make  $R_2 > (1-r)(R_1 + R_2)$ , it can begin from two aspects:

i) Increase the peasant household’s income. Because when the peasant households spend the money borrowed from financial institutions, or informal financing, in agriculture, forestry, livestock production, their income will be influenced by natural disasters and market prices. Therefore, by building and completing the Chinese rural insurance and protection system, providing professional technical guidance to the peasant household by the government or other professional organizations to ensure the quality and quantity of rural product and protect the production and market channel, consequently guarantee the income of the peasant household, the peasant households’ credit default rate can effectively reduce.

ii) Improve peasant households’ default penalty factor  $r$  that is to increase the costs of default. It can be controlled by ethical and legal channels. On one hand, if the peasant household’s default can be known to the public by the reveal of the forks and related institutions, it will be difficult for the peasant household to make credit trade again with his related companies, organizations or individual in the future, then the peasant household's cost of default (the default penalty factor) will rise; on the other hand, punish them severely in the legal aspect, to reduce the expected return significantly, resulting even negative returns<sup>[3]</sup>. In the case of high penalty factor  $r$ , if  $R_2 > (1-r)(R_1 + R_2)$ , the peasant household will choose to abide by the contract, and finally the financial institution and the peasant household will reach the Nash equilibrium (to loan, to refund), both a gain  $(R_1, R_2)$ .

In the real process of the rural economy, game between the peasant household and the rural financial institution is often repetitive. Generally, the rural financial institution will investigate the previous loans information of the peasant household before issuing them new loans. The financial institution will refuse or reluctant to lend to those peasant households who have records of default. In such case, the peasant household have to find a third party as guarantor to support them in borrowing from financial institution, or to turn to informal finance, for the later, the peasant household have to pay interest rates several times higher than the rate of the financial institution.

If the game between financial institution and peasant household are not onetime game, but repeated game, the peasant household will get income of  $nR_2$ , because they income remains formula (1), if

$$nR_2 > (1-r)(R_1 + R_2) \tag{3}$$

the peasant household will choose to abide by the contract.

Game between the financial institution and the peasant household is shown in Figure 1:

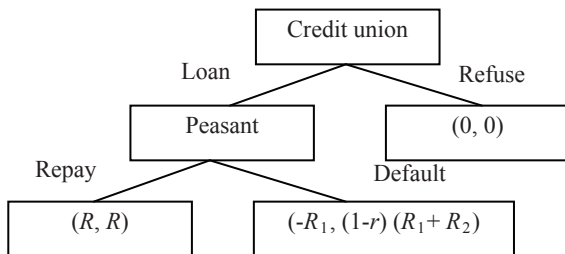


Fig. 1. Figure financial institutions and peasant household Game

### 3.2. Game among peasant households in rural joint warrant process

According to the possibility of repayment, the peasant household that rural financial institution is facing can be dividing in two types<sup>2</sup>: low-risk type and high-risk type. Based on the principle of symmetry of risk and profit, the probability of low-risk peasant household succeed in getting loans is  $p_2$ , the profit after the success is  $R_2$ ; the probability of high-risk peasant household succeed in getting loans is  $p_3$ , the profit after the success is  $R_3$ . Obviously,  $p_2 > p_3$ ,  $R_2 > R_3$ . If there is no loan, both types' peasant households can get a relatively stable income  $R$ . Due to information asymmetry, the financial institution cannot identify the low-risk peasant household and the high-risk peasant household in the joint warrant organization, in other words, the financial institution can't distinguish between the expected income  $R$  that these two types of peasant can get from their production and management. Supposing the expected return of both high-risk and low-risk peasant household is  $R = p_2 R_2 = p_3 R_3$ . In addition, supposing the principal and interest rate that the financial institution in the loans to peasant households are the same, recorded as  $D$  and  $\tau$ . When the peasant households succeed in their business with the loans, we set the profit (interest) that the financial institutions get as  $R_c = D \tau$ , The profit of the financial institution is the cost of the peasant household, and

$$R - R_c \cdot p_2 < R - R_c \cdot p_3 \quad (4)$$

So in the case that the financial institution cannot distinguish between high-risk and low risk peasants in the joint warrant organization, the expected income of low-risk peasant is lower than the high-risk peasant, which means that the income of low-risk peasant is occupied by the high-risk peasant. Especially if

$$R - R_c \cdot p_2 < \bar{R} \quad (5)$$

the expected net return of low-risk type peasant household is even lower than what they get when they don't borrow the loan. Therefore the peasant household will choose not to borrow loans. Though the analysis of the game between peasant household and financial institutions, we found that joint warrant organization with heterogeneity fail to get the results of survival of fittest in market competition, but lead to adverse selection problem for the financial institution.

If in the process of peasant joint warrant, through the effect of mutual supervision and mutual restriction produced by the advantage of game among peasant households and information symmetric, the joint warrant organization can be purified in some extent, and the credit risks can be reduce. Simply, supposing that the joint warrant organization only consists of two peasant households, who act independently in their own business: If either party default causing the failure of the joint warrant, the peer has to take joint warrant duty  $L$ . Normally, if the joint warrant loan fail, due to overdue and intermediate cost increases,  $L > D(1 + \tau)$ .

Supposing the default risk probability of low-risk type and high-risk type are  $p_2'$  and  $p_3'$ , obviously  $p_2' < p_3'$ . When the low-risk and high-risk peasants formed joint warrant organization, the expected loss of low-risk type and high-risk type are  $p_3' L$  and  $p_2' L$ , obviously,  $p_3' L > p_2' L$ , which means, when the low-risk type and high-risk type formed a joint warrant organization, the joint warrant loss of low-risk type is higher than high-risk type high risk-type peasant household. And once the high-risk type is in peasant household in the event of a high-risk type of risk and the high-risk type cannot pay back the money to the low-risk type for a long period of time. Therefore, the low-risk type peasant household is unwilling to form a joint warrant organization with the high-risk type peasant household. Thus, all joint warrant organizations that finally formed must be homogeneous, that is, only the same risk type's peasant household will join each other. In this case, the loan risk is unevenly distributed within the joint warrant organization; it's more accurate for the finance institution to identify the credit risk of the joint warrant organization.

<sup>2</sup> These organizations are called "heterogeneous" joint warrant organization

#### 4. Suggestions for improving the credit of peasant household in credit game

With the Chinese reform and opening up, the constraint for the rapid development of the rural economy is the difficulty of financing funds for the peasant household. The main reason for financing difficult for the peasant households is that their credit level is generally low. Through the analysis of the credit game between the peasant and the rural financial institution, we found that in order to improve the credit behavior of the peasant household, and low the risk of the rural financial institution, it's necessary to reduce the possibility of subjective default of the peasant households, from the legal, institutional, moral and other aspects, and increase the willingness of the repayment of the loans from the objective aspects like increase the expected return. So as to achieve the goal of upgrading the credit level of the peasant household and reduce the peasant households' default risk. Specific suggestions are as follows:

i) Rural related government department and financial institutions should according to the local economic development state and actual situation of the peasant household, expand the area of service and actively support and promote the development of homogeneous joint warrant organization.

ii) Emphasis on long-term interests of peasant household, the intrinsic to improve peasant household credit behavior is to make the peasant households pursue long-term interests instead of short-term interests. More emphasis on long-term interests, the more likely for the peasant household credit will be improved.

iii) Rural financial institutions should encourage the peasant household to repeated game with them. Generally, the number of repeated games and the borrower's credit behavior has a positive correlation.

iv) Rural financial institutions and agriculture insurance company should actively develop agricultural insurance business. Avoid or reduce the influence from natural disaster to peasant household' default.

v) Rural financial institutions should establish enforceable default penalty mechanism. Such as establish peasant households' credit information system, publish the list of trustable peasant household and default peasant household should be regularly. For peasant household who repays the loan afterwards, their name will be removed from the list. It is because of repeated game that provide a punish mechanism to default peasant household, which makes the peasant household actively improve their credit behavior<sup>[4]</sup>.

The efforts government needs to take in solving problem of rural credit, such as the increase or stabilize prices of agricultural products, improve the rural management of risk compensation mechanism. These measures, to some extent, can improve the expected income of the peasant from agricultural production and management, and abate the credit alienation problem caused by the information asymmetry<sup>[5,6]</sup>, and then improve the willingness and capacity of repay the money.

#### 5. Conclusion

In the process of rural economic development, the peasant household form relatively stable mutual relations according to blood and geopolitical relations, this relation formed a kind of "special trust relations". The peasant household just makes use of this special trust relation to meet the financing needs of the economic activities, and then the joint warrant organizations emerge, while the key to reduce the credit risk for rural financial institution is to identify the credit risk of the joint warrant organization. This paper analyzes the credit game process between the peasant household and the finance institutions, research concludes:(a) the repeated game between the rural financial institution and the peasant household can improve the borrowing peasant household's credit behavior; (b) heterogeneous rural joint warrant organization cannot get the results of survival of fittest, therefore they generally cannot survive for long; While in the homogeneous joint warrant organization, the credit risk is evenly distributed, its more accurate for the finance institution to identify the credit risk.

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