

Game Analysis of New Rural Financial Institutions and Farmers from the Perspective of Moral Hazard

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Abstract. As a newcomer in the financial market, new rural financial institutions play an important role in promoting rural economic development and improve the efficiency of capital allocation in rural areas. Since there is moral hazard between rural financial institutions and debtor farmers (small and medium-sized enterprises) caused by the relatively high costs of supervision and verification and the serious information asymmetry, this paper constructs a game model to analyze how new rural financial institutions and farmers can make their most favorable decisions respectively according to the actual situations.

1. Introduction

There has always been a severe financial deficit in the development of China's rural economy. According to the Annual Report on the Development of "Tri-agricultural" Internet Finance in China (2016) released by the National Academy of Economic Strategy, CASS, the country had been suffering a capital shortage of over 3 trillion yuan to solve the "three rural issues" since 2014, which seriously hindered the further development of China's rural economy. Whether China's economy can achieve sustained, rapid and healthy development depends on how its rural economic problems are solved, while these problems cannot be solved without the support of the rural financial system. Rural finance is the central link of modern rural economy, an important force to deepen rural reform in an all-round way and accelerate agricultural modernization, and a solid pillar sustains the new normal of "steady growth, structural adjustment, promotion of reform and benefit of people's livelihood".

The main reason for the significant information asymmetry in the rural credit market lies in the relatively high cost of information acquisition and screening. It is difficult for financial institutions to obtain relevant information about farmers' credit worthiness and credit behavior in a cost-free manner. As a valuable supplement to formal financial institutions, new rural financial institutions are also faced with the contradiction between the implementation of credit policies and farmers' default behavior in their development in rural areas. The analysis by scholars at home and abroad on the relationship between farmers' borrowing behavior and financial institutions has been used for reference in the follow-up researches[1,2,3,4,5,6]. However, in China, a country with a huge gap between urban and rural areas and a serious imbalance in regional development, a research on risks of new rural financial institutions cannot be divorced from external socio-economic environment, nor can it be based on an analysis model with strict assumptions. The marginal contribution of this paper lies in proposing studying the influences of moral hazard on rural financial institutions in different financial market structures in the existing macroeconomic environment based on the theoretical analysis of actors in the game that cause financial risks, so as to put forward corresponding risk prevention strategies and suggestions for policy makers.

2. Modeling and analyzing

2.1 The borrower does not provide collateral and his family bears limited responsibilities.

Borrowers' assuming unlimited liabilities exists only in the ideal contract. In reality, due to the legal system and social culture, borrowers bear only limited liabilities, which in this article refers to the fact

that borrowers repay their loans with the income from household production [1]. In this case, the return matrix is shown as in Table 1.

Table 1 The return matrix under the condition that borrowers without collateral bear limited responsibilities

	The borrower	The financial institution
Succeed	$F_{il}(L_i, K_i, R_i) - rLoan_i - D(a)$	$rLoan_i$
Fail	$-D(a)$	0

Assuming that both the borrower and the financial institution are risk neutral, the expected income of the borrower is:

$$Y_i = \rho(a)[F_{il}(L_i, K_i, R_i) - rLoan_i - D(a)] - [1 - \rho(a)]D(a) = \rho(a)[F_{il}(L_i, K_i, R_i) - rLoan_i] - D(a) \text{ And}$$

the expected return of the financial institution is: $\pi' = \rho(a)rLoan_i + [1 - \rho(a)]*0 = \rho(a)rLoan_i$

The income of the financial institution depends on the borrower's effort level a and the interest rate r . Hence, if the financial institution cannot observe the borrower's effort level, it will draw up an incentive contract and set a reasonable interest rate to relieve moral hazard, ensuring that the borrower will repay on time when his project succeeds. By adding incentive terms into the loan contract, the financial institution is to provide a contract preferred by the borrower with the given interest rate. Since financial institutions in rural areas are now operating in competitive financial markets free of monopoly, this paper focuses only on the analysis of the equilibrium in competitive financial markets. In competitive financial markets, the maximization problem is:

$$\text{Max} \rho(a)[F_{il}(L_i, K_i, R_i) - rLoan_i] - D(a) \text{ In equilibrium, the expected income of the family can be}$$

obtained through $\Pi_0 = \rho(a_0)[F_{il}(L_i, K_i, R_i) - r_0Loan_i] - D(a_0) \geq wL_i + r_f(K_i - Loan_i)$.

It can be seen that in competitive financial markets, a borrower is able to raise the marginal benefits from his effort to be equal to the marginal costs by putting more effort. Under the condition that borrowers bear limited liabilities, when the entrance of new financial institutions makes the rural financial market a competitive one, borrowers will obtain all the producer surplus, i.e. getting a higher income.

2.2 The borrower provides collateral and his family bears limited responsibilities.

When collateral, the value of which is assumed as M , is used to mitigate moral hazard, the borrower will have to hand over the collateral to the financial institution if his project fails[1]. See the table 2

Table 2 The return matrix under the condition that borrowers using collateral bear limited responsibilities

	The borrower	The financial institution
Succeed	$F_{il}(L_i, K_i, R_i) - rLoan_i - D(a)$	$rLoan_i$
Fail	$-D(a) - M$	M

In competitive financial markets, the maximization problem is expressed as:

$$\text{Max}_{(a,r)} \rho(a)[F_{il}(L_i, K_i, R_i) - rLoan_i] - [1 - \rho(a)]M - D(a)$$

According to the first order condition:

$$\rho'(a)F_{il}(L_i, K_i, R_i) - D'(a) = 0$$

$$\rho'(a)[F_{il}(L_i, K_i, R_i) - rLoan_i] + \rho'(a)M - D'(a) = 0$$

$$\rho(a)rLoan_i + [1 - \rho(a)]M = r_sLoan_i + bLoan_i^2 + q$$

In the state of equilibrium, $M = r_sLoan_i = r_sLoan + bLoan_i^2 + q = C_*$ and the effort level $a_* = a_1 = a_2$.

Under the condition that moral hazard exists, mortgage loan can help to partially alleviate the adverse consequences. In fact, rural families that can put up collateral for loans are more welcome in

the credit market. Due to the requirement of security, only families with a certain amount of wealth are able to take out loans for production, which means that borrowers without property to be used as security cannot invest in production and thus cannot obtain income from production. As a result, the sources of income for the poor are confined to wages earned by offering labor service and interest on deposit while the rich can obtain production profits through investment. Thus, the unequal distribution of wealth deteriorates with the passage of time. The income gap between the poor and the rich becomes even wider because the rich who can take out loans become richer through financing while the poor can only get basic income.

3. Conclusions and suggestions

As financial institutions and debtor farmers both focus on maximizing their own interests, high opportunity costs are inevitable in the financing process, which means that the optimal balance between the two sides is hard to reach. The rural financial market has been affected by the information asymmetry between new rural financial institutions and borrowers. Therefore, taking moral hazard into consideration, both financial institutions and borrowers will manage to make the most favorable decision according to the game analysis of the actual situations.

Under the condition that moral hazard exists, there are two major relations between new rural financial institutions and borrowers in rural areas: the borrower does not provide collateral and his family bears limited responsibilities; the borrower provides collateral and his family bears limited responsibilities. In reality, it is rare that a family assumes unlimited responsibilities if without security or the financial institutions have full access to all of the information of the debtor farmers.

In competitive financial markets, a borrower is able to improve the extent of his effort until the marginal benefits from his effort equals the marginal costs. Under the condition that borrowers bear limited liabilities, when the entrance of new financial institutions makes the rural financial market a competitive one, borrowers will obtain all the producer surplus, i.e. getting a higher income.

Mortgage loan can help to eliminate the adverse consequences brought by moral hazard. In fact, it is easier for rural families that can put up collateral for loans to enter the credit market. Since borrowers have to provide security for a mortgage, only families with a certain amount of wealth can take out the loans they need for production. Whereas borrowers without property that can be used as collateral are unable to invest in production. As a result, the sources of income for the poor are confined to wages earned by offering labor service and interest on deposit while the rich can obtain production profits through investment.

To reduce moral hazard, the following suggestions are put forward:

Establishing and improving the rural credit evaluation system. Credit is the foundation for the healthy development of the market economy. Information asymmetry is an important reason for credit risks in the rural financial market. Therefore, on the one hand, the construction of the rural credit reference system must be promoted by establishing and improving the credit rating system and credit files for farmers as well as small and medium-sized enterprises in rural areas; on the other hand, credit agencies with standard behavior must be set up in rural areas so as to provide better credit services.

Establishing and improving the rural financial guarantee system. Characteristics of the rural economy and the rural financial market must be taken into account in the establishment of the rural financial guarantee system, while the construction of support systems must be accelerated. At present, the most important task is to speed up the construction of the rural land circulation system to form a rural land circulation market as soon as possible, and to accelerate the reform of the rural property right system.

Establishing and improving the agricultural insurance system. One of the effective ways to help farmers and rural financial institutions to transfer risks is to establish an agricultural insurance system, which on the one hand, provides a strong guarantee for farmers' livelihood and on the other, reduces the risks of agriculture-related loans for new rural financial institutions. Agricultural insurance system includes commercial insurance and policy-based insurance. Currently, speeding up the establishment of a policy-based agricultural insurance system is of great significance. This depends

on the development of three systems: the agricultural insurance premium subsidy system, the reinsurance system of agricultural insurance and the catastrophe reserve system of agricultural insurance[7].

Establishing and improving the income growth system for rural residents. Economy is the foundation for the development of the financial industry. Therefore, an important measure to assist new rural financial institutions in the reduction of risks is to continuously improve the income of rural residents. In the past few decades, we have developed the secondary industry at the expense of the interests of agriculture and farmers. Now, in order to achieve coordinated development of urban and rural areas, we should make full use of the advancement of the secondary industry and cities to boost the development of agriculture and to gradually increase the income of farmers. In the future, to continue to raise the income of farmers, it is necessary to further increase agricultural subsidies, promote vocational training oriented to farmers and encourage farmers to start their own businesses[8].

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