

Improvement of Micro-credit's Sustainability and Farmers' Welfare: the Study on the Institutional Reformation of Rural Credit Cooperatives in China

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Synopsis

Since 1951, Rural Credit Cooperatives (RCCs) have played an important role in supporting the development of rural China. By the institutional reformation on 2000, RCCs' got larger independency on management from the government, while they are now faced by some problems of sustainability caused by staffs' inappropriate management and farmers' ignorance about RCCs' economic conditions. In this paper, we formulate a model to investigate how to increase RCCs' sustainability as well as farmers' welfare. It is found that with farmers' decision making both on disaster mitigation and RCCs' financial management, both RCCs' sustainability and farmers' long-term benefit are improved.

Keywords: Rural Credit Cooperatives, sustainability, disaster mitigation, financial risk management

1. Introduction

Chinese Rural Credit Cooperatives (RCCs) were founded in 1951 (Baidu, 2008a). At the beginning, RCCs financed from farmers and mainly supplied members with financial service. And the initial purpose of RCCs is to support agricultural production through supplying mutual aid among local farmers. After more than 50 years development, the current objective of RCCs has been enriched to support agriculture, rural development, cooperative economy and members' domestic economy (Baidu, 2008b). The capital sources have been extended to share-selling income, common reserve fund and saving while the main job of RCCs is still supplying members with financial services. And in general, RCCs' managers should be decided by the democratic election system based on members. Top decision-making body is members' congress. The executive body is council that is in charge of daily management and

operation.

During the past 50 years, RCCs have been doing much positive affect on the development of rural China such as supplying farmers with necessary production capital, improving farmers' employment opportunities, increasing farmers' income and completing rural financial system (Chen and Qiu, 2006).

Besides above active effort on rural economy, RCCs still have some insufficiencies that motivate one reformation started from 2000 (Zhang, 2006). The core of the reformation is construction of property right system under the supervision and direction of local government. The main purpose is to improve RCCs' commercial sustainability. Although some improvements have been achieved, there are still some insufficiencies that are pointed by preceding studies as follows:

[1] Share holders (RCCs' members) do not participate in the management of RCCs efficiently. As for individual farmers, it is not economical to

participate in the management of RCCs for their small investments. For most farmers, to invest in RCCs is only the way to get the loan from RCCs. As long as the stable income gain from investment in RCCs is guaranteed, individual shareholders do not care about the daily operation and management of RCCs (Wang, 2006; Shangguan, 2006).

[2] There are too much political interventions that affect RCCs' operation and management seriously. The principle-agent relationship between shareholders and managers is intervened by the government. As a matter of fact that is observed generally, the provincial government decides the senior managers of the Provincial Union of RCCs that appears during the process of above reformation. And the Provincial Union of RCCs decides the senior managers of the County Union of RCCs. That makes managers' objective different from shareholders' (Zhang, 2006; Tao, 2006; Ji and Zhang, 2006).

[3] The loan from RCCs is mainly allocated to traditional agricultural production that suffers a lot from disasters. If the disaster happens, RCCs' repayment rate and profit rate will be affected seriously (Wang, 2006).

[4] In general, farmers do not care about RCCs' sustainability. Farmers are not aware of the possibility of RCCs' bankruptcy after the reformation because of their deficient participation in RCCs' management and operation. They think the government will support RCCs anyway if the unsuccessful repayment (induced by huge disasters) makes it difficult for RCCs to survive. That opinion makes the disaster mitigation effort of farmers is not adequate (Zhang, 2006; Shangguan, 2006).

[5] RCCs' staff is without enough motivation to focus on RCCs' daily operation and business extension. Without active participation and efficient supervision from members, it is difficult to make staff do adequate management and operation for the long-term benefit of RCCs' members (Wang, 2006; Shangguan, 2006; Ji and Zhang, 2006).

Correspondingly, according to present related research, the following countermeasures should be considered.

[1] Give members corresponding discount on loan interest rate according to their individual investment to RCCs. Further more, RCCs should

allocate the profit to the members according to their individual contribution (Wang, 2006; Shangguan, 2006).

[2] Make RCCs more independent through the legislation for rural credit cooperation (Zhang, 2006; Wang, 2006; Shangguan, 2006).

[3] Support rural enterprises and make relatively higher profit income from them (Zhang, 2006; Wang, 2006; Tao, 2006; Ji and Zhang, 2006).

[4] Carry out new management mode and property right system reformation according to local realities (Zhang, 2006; Wang, 2006; Shangguan, 2006; Ji and Zhang, 2006; Liang, 2006).

[5] With adequate financial risk management and proper operation, RCCs should mainly support agriculture, rural economy and farmers (Zhang, 2006; Shangguan, 2006; Tao, 2006; Liang, 2006).

According to above statement, we found that the participation of shareholders (RCCs' members) in RCCs' management is very important for RCCs' efficiency and sustainability improvement. Only with the efficient management from members, RCCs can really work for their real owners' benefit and the development of rural China. In this study, we would like to focus on farmers' participation in the management of RCCs. The rest of this paper consists of the following parts. In Chapter 2, we will talk about the analytical description of our model. And in chapter 3, the numerical analysis will be carried out. Finally, in chapter 4, some corresponding conclusions will be discussed.

2. The Model

2.1 Model environment

As mentioned above, we only talk about farmers' participation in RCCs' management. So in our model, there are only two parties: RCCs and farmers. The latter is the only investor to RCCs. That means farmers are the only member and owner of RCCs. After the investment, the managers of RCCs will make the decision about daily operation and loan allocation. During the decision process, we suppose there is no intervention from the government after some successful institutional reformation. And farmers can voluntarily choose to participate in RCCs' management or not. As we mentioned before, the main loan of RCCs is

allocated to traditional agricultural production that depends too much on natural disaster. Correspondingly, that will affect the repayment and profit rate of RCCs very much. It is natural for us to think about lending the main loan to other kind of production with relatively stable return. But one important job of RCCs' is to support agriculture. That means we should make some kind of balance among several loan allocations. As one innovative way, we suppose RCCs' loan will be separated to three parts: agricultural loan, credit to other financial institutions (such as saving in commercial banks) and some risky investment (such as lending to rural enterprises). The main job of RCCs' management process is to decide the exact ratio among that three loan allocations. After the ratio decision, farmers will get the loan from RCCs and do the cultivation. In general, the crop will be affected if the disaster happens. We suppose farmers' disaster mitigation investment will decide the remaining ratio of post-disaster crop. Finally, RCCs will get the repayment from farmers' crop, interest income from other banks and profit return from risky investment. After that, we will check RCCs' asset is less than before or not. If the answer is negative, the similar process of loan allocating, loan lending, cultivating, disaster mitigating, loan repaying and RCCs' asset checking will happen continuously. And if the answer is positive, that means RCCs can not afford the loan to farmers anymore. In other words, at least as for farmers, RCCs fall in the bankruptcy. That will disable farmers' continuous agricultural production.

For simplification, we would like to arrange event-sequence as follows:

- [1] Farmers make investment to RCCs.
- [2] RCCs' managers make loan allocation among agricultural loan, safe investment and risky investment.
- [3] Farmers get the loan from RCCs.
- [4] Farmers cultivate land and mitigate disaster.
- [5] Disaster happens with the probability of μ .
- [6] RCCs' get the repayment from farmers, other banks and risky investment.
- [7] RCCs will continue to supply farmers with loan in next period if their asset is more than initial one.

According to above arrangement, we found that loan allocation ratio and farmers' mitigation

investment will affect RCCs' sustainability. And RCCs' sustainability decides farmers' long-term benefit. That means there are farmers' potential motivation to participate in RCCs' management and optimal disaster mitigation effort for optimizing their own long-run benefit. In other words, our job is to find out how to encourage farmers to participate in RCCs' management and what is the optimal disaster mitigation investment through the coming model.

For simplification, the number of farmers and that of RCCs are respectively standardized to be 1. The initial asset of RCC consists of common reserve fund and farmers' investment (necessary for becoming RCC's member). And we suppose the loan amount for agricultural loan is fixed. The management process of RCC is to decide the ratio between the safe investment and the risky investment.

2.2 Farmers' utility before institutional reformation

Before institutional reformation of RCC, we suppose farmers do not know and care about RCC's decision on the ratio between the safe investment and the risky investment. They only care about their income from cultivating. And they think RCC will not fall in bankruptcy even if they fail to pay loan and interest back to RCC because of huge disasters. Because they believe the government will support RCC anyway. In other words, farmers believe the disaster will not affect the probability of getting the loan in next time. For the coming analysis, the following symbols will be used:

- [1] μ : the probability of disaster.
- [2] l : the loan from RCC to farmers.
- [3] hl : the production function of farmers. h is a constant.
- [4] ρ : the loan interest rate asked by RCC from farmers.
- [5] β : the discount factor.
- [6] σ : farmers' disaster mitigation effort that varies from 0 to 1.
- [7] c : the opportunity cost of farmers' disaster mitigation effort.
- [8] $\alpha\gamma(\sigma)$: the remain rate of crop after disaster.

α is a constant while $\gamma(\sigma)$ is a function of σ , and the both distribute between 0 and 1. In numerical simulation, we specify $\gamma(\sigma)$ like

$$\gamma(\sigma) = \sigma(2 - \sigma).$$

[9] I : the investment from each farmer to RCC.

[10] r : the constant interest rate for farmers' investment to RCC before institutional reformation.

According to above, farmers' net income should be $hl - (1 + \rho)l$ if the disaster does not happen. Correspondingly, farmers' net income will be $\max[\alpha\gamma(\sigma)hl - (1 + \rho)l, 0]$ if the disaster happens. Because we suppose farmers should give all the crops to RCC if the post-disaster crop is less than the repayment farmers should give to RCC. Then, we can write farmers' expected utility as follows.

$$\begin{aligned} W^I &= (1 - \mu)\{[hl - (1 + \rho)l] + \beta W^I\} \\ &+ \mu\{\max[\alpha\gamma(\sigma)hl - (1 + \rho)l, 0] + \beta W^I\} \\ &- c\sigma + Ir \end{aligned} \quad (1)$$

Respectively, we can state farmers' optimal problem as follows.

[1] If $\alpha\gamma(\sigma)hl \geq (1 + \rho)l$. That means post-disaster crop is more than the repayment that farmers should give to RCC.

$$\begin{aligned} \underset{\sigma}{Max} W^I &= \frac{(1 - \mu)[hl - (1 + \rho)l]}{1 - \beta} \\ &+ \frac{\mu[\alpha\gamma(\sigma)hl - (1 + \rho)l] - c\sigma + Ir}{1 - \beta} \end{aligned} \quad (2)$$

[2] If $\alpha\gamma(\sigma)hl < (1 + \rho)l$. That means post-disaster crop is less than that farmers should give to RCC.

$$\underset{\sigma}{Max} W^I = \frac{(1 - \mu)[hl - (1 + \rho)l] - c\sigma + Ir}{1 - \beta} \quad (3)$$

With considering the consistency of the constraints about $\alpha\gamma(\sigma)hl$ and $(1 + \rho)l$, we can get farmers' optimal disaster mitigation effort, σ^{I^*} , and expected utility, W^{I^*} , by comparing the results of formula (2) and (3).

2.3 Farmers' utility after institutional reformation

From now, we start to study farmers' utility after RCC's institutional reformation. We would like to discuss farmers' utility under three different situations orderly: without perfect information about RCC's management, with perfect information about RCC's decision and with efficient participation in RCC's management.

(1) Farmers' utility without perfect information about RCC's management

In this case, we suppose farmers still behave according to their original knowledge about RCC's management and operation before institutional reformation. That means farmers will do σ^{I^*} for disaster mitigation and expect utility as W^{I^*} . But their real expected utility, $W^{I^{**}}$, in this situation will be different from W^{I^*} because RCC now faces the possibility of bankruptcy after institutional reformation. The probability for farmers to get loan in next period will be affected if RCC's sustainability is destroyed by the unsuccessful repayment induced by the huge disaster. At the end of each period, after getting the repayment from farmers, the return from safe investment and that from risky investment, RCC's asset will be compared with that initial one. If the former is bigger than the latter, RCC will survive and farmers will get RCC's net income at the end of this period and the agricultural loan in next period. If RCC's asset is smaller than that initial one, RCC

will fall in bankruptcy and farmers will not get the agricultural loan in next period. That means farmers' cultivation will be stopped.

For above extended discussion, we would like to mark the following symbols:

[1] A_0 : RCC's initial asset. In our model, we

suppose the loan allocated to other investment than agricultural loan is constant in each period as long as the RCC's operation continues. Then the total loan allocated to safe investment and risky investment is $A_0 - l$.

[2] η : the ratio of the loan allocated to risky investment. It varies from 0 to 1. That means the loan allocated to safe investment is

$(1-\eta)(A_0 - l)$ and that to risky investment is

$\eta(A_0 - l)$.

[3] θ : the stochastic rate of return from risky investment.

[4] R : the deterministic rate of return from safe investment.

[5] A_i^n : RCC's asset at the end of period i when there is no disaster in period i .

$$A_i^n = (1+\rho)l + \eta(A_0 - l)\theta + (1-\eta)(A_0 - l)R \quad (4)$$

[6] A_i^d : RCC's asset at the end of period i when there is disaster in period i .

$$A_i^d = (1+\rho)l + \eta(A_0 - l)\theta + (1-\eta)(A_0 - l)R$$

$$\text{if } \alpha\gamma(\sigma)hl \geq (1+\rho)l \quad (5)$$

$$A_i^d = \alpha\gamma(\sigma)hl + \eta(A_0 - l)\theta + (1-\eta)(A_0 - l)R$$

$$\text{if } \alpha\gamma(\sigma)hl < (1+\rho)l \quad (6)$$

[7] $P^n = \Pr ob(A_i^n \geq A_0)$: the probability that RCC's asset at the end of period i is bigger than

that initial one when there is no disaster in period i .

[8] $P^d = \Pr ob(A_i^d \geq A_0)$: the probability that

RCC's asset at the end of period i is bigger than that initial one when disaster occurs in period i .

In this case, for simplicity, we suppose RCC's staff just allocate the loan between the safe investment and the risky one averagely because they do not have enough motivation to maximize the income from investment without farmers' participation in RCC's management. That means $\eta=0.5$.

We additionally assume that the profit of RCC in each period, $A_i^n - A_0$, is consumed by the farmer in that period and can not be saved for the following periods.

Till now, we can write farmers' utility as follows:

$$\begin{aligned} W^u = & (1-\mu)\{[hl - (1+\rho)l] + P^n(A_i^n - A_0 + \beta W^u)\} \\ & + \mu\{\max[\alpha\gamma(\sigma)hl - (1+\rho)l, 0] \\ & + P^d(A_i^d - A_0 + \beta W^u)\} - c\sigma \end{aligned} \quad (7)$$

Where

$$A_i^n = (1+\rho)l + 0.5(A_0 - l)\theta + 0.5(A_0 - l)R;$$

$$A_i^d = (1+\rho)l + 0.5(A_0 - l)\theta + 0.5(A_0 - l)R$$

$$\text{if } \alpha\gamma(\sigma)hl \geq (1+\rho)l;$$

$$A_i^d = \alpha\gamma(\sigma)hl + 0.5(A_0 - l)\theta + 0.5(A_0 - l)R$$

$$\text{if } \alpha\gamma(\sigma)hl < (1+\rho)l.$$

With considering the consistency of the constraints about $\alpha\gamma(\sigma)hl$ and $(1+\rho)l$, we

can get farmers' real expected utility, W^{u*} , in this

case by applying σ^{II*} , equals to σ^{I*} , in equation (7).

(2) Farmers' utility with perfect information about RCC's decision

In this case, we suppose farmers have perfect information about RCC's decision about the loan allocation ratio between safe investment and risky investment. Although farmers can get all the profit from above investment, they cannot affect the investment ratio. Farmers can only maximize their expected utility by choosing adequate disaster mitigation effort. That means the ratio of the loan allocated to risky investment, η , will still be 0.5.

Let's recall the expression of farmers' real expected utility mentioned in above case.

$$\begin{aligned} W^{III} = & (1-\mu)\{[hl-(1+\rho)l] + P^n(A_1^n - A_0 + \beta W^{III})\} \\ & + \mu\{\max[\alpha\gamma(\sigma)hl - (1+\rho)l, 0] \\ & + P^d(A_1^d - A_0 + \beta W^{III})\} - c\sigma \end{aligned} \quad (8)$$

Where

$$A_1^n = (1+\rho)l + 0.5(A_0 - l)\theta + 0.5(A_0 - l)R;$$

$$A_1^d = (1+\rho)l + 0.5(A_0 - l)\theta + 0.5(A_0 - l)R$$

if $\alpha\gamma(\sigma)hl \geq (1+\rho)l$;

$$A_1^d = \alpha\gamma(\sigma)hl + 0.5(A_0 - l)\theta + 0.5(A_0 - l)R$$

if $\alpha\gamma(\sigma)hl < (1+\rho)l$.

Then we can state farmers' optimal problem as follows:

$$\begin{aligned} Max_{\sigma} W^{III} = & \frac{(1-\mu)[hl-(1+\rho)l] + (1-\mu)P^n(A_1^n - A_0)}{1-(1-\mu)P^n\beta - \mu P^d\beta} \\ & + \frac{\mu \max[\alpha\gamma(\sigma)hl - (1+\rho)l, 0] + \mu P^d(A_1^d - A_0)}{1-(1-\mu)P^n\beta - \mu P^d\beta} \\ & - \frac{c\sigma}{1-(1-\mu)P^n\beta - \mu P^d\beta} \end{aligned} \quad (9)$$

So we can get the following optimal solutions

respectively.

[1] If $\alpha\gamma(\sigma)hl \geq (1+\rho)l$. That means

$$A_1^n = A_1^d \text{ and } P^n = P^d.$$

$$\begin{aligned} Max_{\sigma} W^{III} = & \frac{(1-\mu)[hl-(1+\rho)l]}{1-P^n\beta} \\ & + \frac{\mu[\alpha\gamma(\sigma)hl - (1+\rho)l]}{1-P^n\beta} \\ & + \frac{P^n(A_1^n - A_0) - c\sigma}{1-P^n\beta} \end{aligned} \quad (10)$$

[2] If $\alpha\gamma(\sigma)hl < (1+\rho)l$.

$$\begin{aligned} Max_{\sigma} W^{III} = & \frac{(1-\mu)[hl-(1+\rho)l] + (1-\mu)P^n(A_1^n - A_0)}{1-(1-\mu)P^n\beta - \mu P^d\beta} \\ & + \frac{\mu \max[\alpha\gamma(\sigma)hl - (1+\rho)l, 0] + \mu P^d(A_1^d - A_0)}{1-(1-\mu)P^n\beta - \mu P^d\beta} \\ & - \frac{c\sigma}{1-(1-\mu)P^n\beta - \mu P^d\beta} \end{aligned} \quad (11)$$

With considering the consistency of the constraints about $\alpha\gamma(\sigma)hl$ and $(1+\rho)l$, we can get farmers' optimal disaster mitigation effort, σ^{III*} , and expected utility, W^{III*} , by comparing the results of formula (10) and (11).

(3) Farmers' utility with efficient participation in RCC's management

In this case, we suppose farmers efficiently participate in RCC's management by deciding loan allocation ratio between safe investment and risky one. Here, farmers can maximize their expected utility by choosing adequate disaster mitigation effort and loan allocation ratio.

We can write farmers' utility as follows:

$$\begin{aligned} W^{IV} = & (1-\mu)\{[hl-(1+\rho)l] + P^n(A_1^n - A_0 + \beta W^{IV})\} \\ & + \mu\{\max[\alpha\gamma(\sigma)hl - (1+\rho)l, 0] \end{aligned}$$

$$+P^d(A_i^d - A_0 + \beta W^{IV})\} - c\sigma \quad (12)$$

Where

$$A_i^n = (1 + \rho)l + \eta(A_0 - l)\theta + (1 - \eta)(A_0 - l)R;$$

$$A_i^d = (1 + \rho)l + \eta(A_0 - l)\theta + (1 - \eta)(A_0 - l)R$$

$$\text{if } \alpha\gamma(\sigma)hl \geq (1 + \rho)l;$$

$$A_i^d = \alpha\gamma(\sigma)hl + \eta(A_0 - l)\theta + (1 - \eta)(A_0 - l)R$$

$$\text{if } \alpha\gamma(\sigma)hl < (1 + \rho)l.$$

So we can get the following optimal solutions respectively.

[1] If $\alpha\gamma(\sigma)hl \geq (1 + \rho)l$. That means

$$A_i^n = A_i^d \text{ and } P^n = P^d.$$

$$\begin{aligned} \text{Max}_{\sigma, \eta} W^{IV} &= \frac{(1 - \mu)[hl - (1 + \rho)l]}{1 - P^n \beta} \\ &+ \frac{\mu[\alpha\gamma(\sigma)hl - (1 + \rho)l]}{1 - P^n \beta} \\ &+ \frac{P^n(A_i^n - A_0) - c\sigma}{1 - P^n \beta} \end{aligned} \quad (13)$$

[2] If $\alpha\gamma(\sigma)hl < (1 + \rho)l$.

$$\begin{aligned} \text{Max}_{\sigma, \eta} W^{IV} &= \frac{(1 - \mu)[hl - (1 + \rho)l] + (1 - \mu)P^n(A_i^n - A_0)}{1 - (1 - \mu)P^n \beta - \mu P^d \beta} \\ &+ \frac{\mu \max[\alpha\gamma(\sigma)hl - (1 + \rho)l, 0] + \mu P^d(A_i^d - A_0)}{1 - (1 - \mu)P^n \beta - \mu P^d \beta} \\ &- \frac{c\sigma}{1 - (1 - \mu)P^n \beta - \mu P^d \beta} \end{aligned} \quad (14)$$

With considering the consistency of the constraints about $\alpha\gamma(\sigma)hl$ and $(1 + \rho)l$, we can get farmers' optimal disaster mitigation effort,

σ^{IV*} , expected utility, W^{IV*} , and the ratio of the loan allocated to risky investment, η^* , by comparing the results of formula (13) and (14).

2.4 Farmers' acceptance on institutional reformation

In China, there are enormous numbers of RCCs, each of which has inherent long history and custom respectively. Hence the central government must have been uncertain about how deeply and promptly farmers' participation on decision making is adopted in each RCC. In other words, it is reasonable to presume that the central government might have thought that only partially the democratic decision making where farmers were involved would penetrate at the beginning of the new system. Putting it in other way, if farmers had known the economic environment after the institutional reform correctly as well as the likelihood that they could not take part in the decision making, farmers would not have approved of the reformation.

Now we finally assume in the model that RCC introduces the decision making system (where farmers decide) with the probability of ν . In other words, not all the RCCs follow the new decision making rule the central government tries to introduce. That means, if farmers decide to involve themselves in RCC's reformation process, their expected utility (from the the view point of the central government) will be

$$W^{V*} = \nu W^{IV*} + (1 - \nu)W^{III*}.$$

And if and only if $W^{V*} > W^{I*}$, RCC's institutional reformation will improve farmers' welfare and accepted by farmers finally. Otherwise, after knowing RCC's economic environment correctly, farmers would like to continue behaving with the mind of original RCC's mechanism. That means there is some kind of

threshold value, ν^* , for ν to decide farmers' acceptance on RCC's institutional reformation. So, for improving farmers' long-run benefit and giving farmers enough motivation to support and involve RCC's institutional reformation, the central

government should make the probability of RCC to introduce the post-reformation decision making system in which farmers can represent and practise their opinion higher than v^* .

3. The Numerical Analysis

For doing numerical analysis, we would like to do the following assignments for the symbols mentioned in above model.

- [1] μ , the probability of disaster, equals to 0.01;
- [2] l , the loan from RCC to farmers, equals to 20000.
- [3] h equals to 1.2 while hl is the production function of farmers.
- [4] ρ , the loan interest rate asked by RCC from farmers, equals to 0.05 (The People's Bank of China, 2007; Haiyan Rural Credit Cooperative Union, 2007; Baidu, 2008c).
- [5] β , the discount factor, equals to $1/(1.04)$ (The People's Bank of China, 2007).
- [6] σ , farmers' disaster mitigation effort, varies from 0 to 1.
- [7] c , the opportunity cost of farmers' disaster mitigation effort, equals to 50.
- [8] α equals to 0.9 while $\alpha\gamma(\sigma)$ is the remain rate of crop after disaster and $\gamma(\sigma) = \sigma(2 - \sigma)$.
- [9] I , the investment from each farmer to RCC, equals to 10000.
- [10] r , the constant interest rate for farmers' investment to RCC before institutional reformation, equals to 0.05.
- [11] A_0 , RCC's initial asset, equals to 30000.
- [12] $\eta(A_0 - l)$, the loan allocated to risky investment, equals to 10000η .
- [13] $(1 - \eta)(A_0 - l)$, the loan allocated to safe investment, equals to $10000(1 - \eta)$.
- [14] θ , the rate of return from risky investment, obeys a uniform distribution with the mean of 1.05.

For comparative statistics, we let the value range of θ respectively be $[0.3, 1.8]$, $[0.5, 1.6]$ and $[0.7, 1.4]$.

[15] R , the rate of return from safe investment, equals to 1.05 (The People's Bank of China, 2007).

According to above assumptions, we can get the following results showed in Table 1.

After the institutional reformation, without comprehensive understanding about RCC's new mechanism, farmers will behave as before and their real utility will be much less than they expect.

With RCC's institutional reformation and perfect information about that, farmers' optimal disaster mitigation effort is increased from 0 to 0.88. That means farmers' comprehensive information about RCC's management and operation will increase farmers' optimal disaster mitigation effort. Because farmers get to know their disaster mitigation effort will affect RCC's sustainability and their own long-term benefit.

Farmers' optimal expected utility will be decreased if they have no ability to affect RCC's management while the amount of optimal expected utility will be increased if farmers can participate in RCC's decision process efficiently. That means farmers will accept RCC's reformation if and only if the probability of RCC to introduce the post-reformation decision making system in which farmers can represent and practise their opinion is higher than v^* .

In any case of value range for θ , $W^{III*} < W^{I*} < W^{IV*}$. That means the final outcome of investment in capital market depends on there is efficient financial risk management or not. With adequate risk management, the investment in capital market can increase farmers' long-run benefit.

With the rise of the variance of θ , under the situation in which it is impossible for farmers to affect RCC's management, farmers' expected utility decreases. That means, without adequate management about investment risk, the more risky the capital market is, the more farmers' expected utility gets hurt.

In Table 1, we always have $P^{dIV} > P^{dIII} > P^{dII}$.

That means, after institutional reformation, giving farmers' perfect information about RCC's management will increase RCC's sustainability during disaster time. And with full ability to affect RCC's decision, that positive influence becomes more active. Similarly, we have $P^{n^{IV}} > P^{n^{III}} = P^{n^{II}}$ in Table 1. That means only the integration of perfect information and management participation can increase RCC's sustainability during the years without disaster.

In Table 1, we always have $P^{n^{IV}} = P^{d^{IV}} = 1$. That means, with perfect information and full ability to affect RCC's decision, farmers would like

to make sure RCC will continue in next period during either disaster time or normal seasons.

With the rise of the variance of θ , the optimal ratio of the loan allocated to risky investment decreases. That means, with the full ability to affect RCC's decision, the more risky the capital market is, the more carefully farmers manage investment.

With the rise of the variance of θ , the threshold value, v^* , increases. That means the more risky the capital market is, the more important RCC's introduction about the post-reformation decision making system in which farmers can represent and practise their opinion.

Under the situation in which farmers have full

Table 1 Results of numerical analysis (Continued)

θ	σ^{I^*}	σ^{II^*}	σ^{III^*}	σ^{IV^*}
[0.3, 1.8]	0	0	0.88	0.88
[0.5, 1.6]	0	0	0.88	0.88
[0.7, 1.4]	0	0	0.88	0.88

Table 1 Results of numerical analysis (Continued)

θ	W^{I^*}	W^{II^*}	W^{III^*}	W^{IV^*}
[0.3, 1.8]	90,220	14,354	14,580	115,151
[0.5, 1.6]	90,220	17,380	17,786	115,151
[0.7, 1.4]	90,220	38,458	41,419	115,151

Table 1 Results of numerical analysis (Continued)

θ	$P^{n^{II}}$	$P^{n^{III}}$	$P^{n^{IV}}$	η^*
[0.3, 1.8]	0.70	0.70	1	0.20
[0.5, 1.6]	0.77	0.77	1	0.27
[0.7, 1.4]	0.93	0.93	1	0.43

Table 1 Results of numerical analysis

θ	$P^{d^{II}}$	$P^{d^{III}}$	$P^{d^{IV}}$	v^*
[0.3, 1.8]	0	0.70	1	0.75
[0.5, 1.6]	0	0.77	1	0.74
[0.7, 1.4]	0	0.93	1	0.66

Note: P^{n^i} and P^{d^i} mean the final value of P^n and P^d in case i .

ability to affect RCC's management, farmers' expected utility will not depend on the variance of θ . That means, with efficient participation and supervision from farmers on RCC's financial risk management, farmers' expected utility will be free from the risk of the capital market.

4. Conclusions

Based on above calculation and discussion, we can get the following conclusions.

[1] Farmers' long-run benefit depends on RCCs' sustainability which is decided by the repayment rate and profit rate. In general, the repayment rate is decided by farmers' disaster mitigation effort and the profit rate depends on RCCs' loan allocation. Without enough knowledge about RCCs' management, farmers will not make adequate disaster mitigation effort and without the supervision from RCCs' members (farmers), RCCs' staff will not have enough motivation to do efficient loan allocation to maximize profit rate. So the key way to improve farmers' long-run benefit is to make farmers efficiently participate in RCCs' management. Here participation has two aspects: comprehensive understanding about RCCs' new operation mechanism and deciding RCCs' loan allocation between different investments.

[2] Under RCCs' original mechanism, the government will support RCCs when the huge disaster induces great unsuccessful repayment from farmers. From farmers' aspect, their disaster mitigation effort will not affect RCCs' post-disaster sustainability. So they just consider how to maximize their long-term expected utility with taking the loan as granted. That makes farmers' disaster mitigation effort far from enough and RCCs' sustainability is un-adequate for farmers' long-run benefit.

[3] After the institutional reformation, with the perfect information about RCCs' operation, farmers will increase their disaster mitigation effort and RCCs' sustainability. Because farmers get to know their disaster mitigation effort will affect RCCs' sustainability and their own long-term benefit. But farmers' expected utility has been decreased because of farmers' disability on affecting RCCs' management. That will hold farmers back from

getting to understand RCCs' new operation mechanism.

[4] After the institutional reformation, with the efficient participation in RCCs' management, farmers' disaster mitigation effort, RCCs' sustainability and farmers' long-run utility will be increased at the same time. Because under this situation, with comprehensive knowledge about RCCs' operation and efficient participation in RCCs' management, farmers get to know their disaster mitigation effort will affect RCCs' post-disaster sustainability and their own long-run benefit. Furthermore, with full ability to decide loan allocation ratio, farmers can and would like to reach adequate investment strategy to maximize RCCs' profit rate and their own long-term utility.

[5] To get farmers perfect information about RCCs' operation (to make farmers do adequate disaster mitigation effort) is firmly related with to get farmers full ability to participate in RCCs' management (to maximize RCCs' profit rate). We cannot separate them and try to finish the former job individually. Because without ability to participate in RCCs' management, farmers' long-run expected utility will be decreased because of being involved in RCCs' new operation mechanism. Under that situation, after knowing RCCs' economic environment correctly, farmers will not like to follow the reformation process of RCCs.

[6] At the beginning of RCCs' reformation, because of being used to pre-reformation operation mechanism under which farmers cannot represent their opinion on RCCs' management, some RCCs will not like to follow the reformation decision of the central government very well. In other words, RCCs only introduce the post-reformation decision making system in which farmers can represent and practise their opinion with some certain probability. And this probability will decide farmers' real expected utility after reformation (from the view point of the central government) and farmers' acceptance on RCCs' reformation. Farmers will compare the benefit after reformation with their original one. They will continue to support reformation if the former is bigger, vice versa. So our principal job is to make the probability of RCCs' to introduce the post-reformation decision

making system in which farmers can represent and practise their opinion as high as possible. The possible way could be carrying out some efficient communication mechanism that will make it easier for farmers to get RCCs' information and represent their opinion to RCCs' staff. One optional method is the legislation and supervision from the government to RCCs with the participation motivation from the government to farmers.

[7] With the rise of the variance of the return from risky investment, RCCs' efficient management about financial risk (deciding the loan allocation between safe and risky investment) becomes more and more important. Correspondingly, farmers' will ask for more and more ability or opportunity to participate in RCCs' management and allocate less and less loan to risky investment.

[8] With efficient participation and supervision from farmers on RCCs' financial risk management, maintaining RCCs' main job of supporting agriculture, RCCs can make use of capital market to improve the sustainability while making farmers' long-run benefit free from the financial risk.

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小額信用貸付の持続性と農民の長期的利益の改善：中国農村信用社の制度改革に着目して

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要 旨

2000年の中国農村信用社の制度改革によって農村信用社は行政からより独立に運営が行えるようになったが、その一

方で運営の持続可能性に関する問題が発生している。原因は非効率的な管理体制に加えて、農民が新しい農村信用社の経済状況について無知であり、持続可能性を考慮しながら災害時にもローンを返済できるように防災努力を十分に行わないことによる。本研究では、農民が農村信用社の経済状況を正確に把握してローンの返済のための防災努力を行うとともに、農村信用社の金融リスク管理の意思決定に参加することにより、農村信用社の持続可能性と農民の長期的利益がともに改善されることを示す。

キーワード: 農村信用社, 持続性, 防災, 金融リスク管理