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The Effects of Micro Credit and Transactions of Farmland Management Right on Diversification of Disaster Risk in China

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Synopsis

Rural China suffers a lot from the natural disasters while there is no adequate disaster risk insurance supply for Chinese farmers. On the other hand, the microcredit provided by Rural Credit Cooperatives has been popularized in rural China and the law enacted in 2002 guarantees the transaction of the farmland management right among rural households. This study focuses on the effect of the two new institutions on the disaster risk diversification in rural China. The model inclusive of the Rural Credit Cooperative, the private financing sectors and the farmers is formulated to investigate the optimal combination of the microcredit and the private loan in the liquid farmland management right market, which decreases the total amount of the risk premium in the society. It is found that the liquidation of the farmland management right results in decrease in the variance of risks among farmers, and the private financing provided by the traders who have long-term relationship with the farmers mitigates the moral hazard. It is finally concluded that integration of the microcredit, the private loan and the liquid farmland management right improves the social welfare by diversifying the risk and supplying the necessary agricultural loan.

Keywords: rural China, disaster risk finance, Rural Credit Cooperatives, microcredit, farmland management right

1. Introduction

Unfortunately but really, China suffers a lot from the natural disasters. China View (2005) shows more than 70% cities, half population, 75% industrial and agricultural production are exposed to serious meteorologic, geological and oceanic disasters. For example, as in Tao et al. (2005), in 20th century, there are more than 600 earthquakes that were stronger than M6 in China. And more than 600 thousand people died. In recent 10 years, the Chinese annual average disaster losses are 100 billion RMB. That amount is the third biggest of the world, following the losses in Japan and in U.S. (China View, 2005, Li, 2005). On the other hand, Chinese, especially farmers, are less of insurance consciousness and many kinds of huge disaster risk are not insured. The sufferers are supported mainly by the national almsgiving, social contribution and self-rescuer.

In 1978, agricultural reforms are implemented, which abolished the system of people's communes and made farmers operate agricultural production individually. Since this amendment, the production efficiency has been improved remarkably. Additionally the rural enterprises in villages and towns of China become more and more active in absorbing the excessive work forces and capital in rural China (Wei,2000). Moreover, in 1996, the reform of rural financial system made Chinese Rural Credit Cooperatives (RCCs), a main function of which are to supply farmers with necessary loan for agricultural production, more independent of supervision by the Agricultural Bank of China. Namely RCCs became the cooperatives that make their own management decisions

(Kawahara, 2005a). They put into practice the individual and group-lending microcredit loan in 1996, which have gradually been popularized in 2000s. The loan size is from 8000 to 10000 RMB in developed areas and from 3000 to 5000 RMB in undeveloped areas, while the interest rates are decided by each RCC considering they should be close to the basic interest rate given by People's Bank of China. The contract time term is one year in most of the cases. In the end of 2002, 93% of RCCs are operating the microcredit loan, and more than 20% rural households have made use of it. In the case where the bigger loan is demanded, group-lending is available with the loan group consisting of 3-5 rural households, who mutually help and monitor each other to repay the loan (Kawahara, 2005a). Diffusion of the microcredit has changed the composition of the financial market in the agricultural area. For example, Yan (2002) points out that, in 1998, only 21% of farmers' loan came from the agricultural banks and RCCs, who seemed to be less positive in providing credit, while 74% of farmers' loan was from the private financing sectors. However, according to a survey in certain areas of rural China by Kawahara (2005a), the amount of the loan from the agricultural banks and RCCs is almost equal to that from the private sectors during 2001-2002. Availability of the formal loan operated by the agricultural banks and RCCs are increasing, while the private loan including informal lending by the business partners like traders still play an important role in the financial supply of rural China.

Before 1980s, the main land utilization system in rural China is agricultural cooperation and land communization. Since 1978, the state has been encouraging and popularizing the contractual management system in respect of land in the rural areas. Under the contractual management system, farmers get the farmland management right while the collective still owns the farmland. Farmers can make their own decisions on agricultural production and marketing. And since 1990s, the state has been encouraging the circulation of the right to the farmland contractual management, which is effected according to the law, on a voluntary basis and with the compensation (Kawahara, 2005b, National People's Congress, 2002, Baidu, 2007). For the purposes of stabilizing and improving the two-tier management system that combines centralized and decentralized management on the basis of the household contractual management, granting to the peasants long-term and guaranteed the land-use right, safeguarding the legitimate rights and interests of the parties to the land contracts in the rural areas, and promoting the development of the agriculture and rural economy and social stability in the countryside, the "Law of the People's Republic of China on Land Contract in Rural Areas" was adopted at the 29th Meeting of the Standing Committee of the Ninth National People's Congress of the People's Republic of China on August 29, 2002 and hereby promulgated and went into effect as of March 1, 2003 (National People's Congress, 2002).

Considering the recent institutional movement above, it must be true that the RCCs' microcredit loan has improved the farmers' ability of risk financing, although the following questions still remain as unsettled;

1) Why have RCCs supplied not enough credit to farmers but "micro" credit?

2) How does the coexistence of RCCs and private financing sectors in current rural financial market is characterized? Why do RCCs not completely dominate the market in spite of their devastating advantage in risk pooling over the private sectors?

3) What kind of effect does the liquidation of the farmland management right have on the disaster risk management in the agricultural areas?

As the view point of the study, we focus on RCCs' limited ability to control farmers' moral hazard in the disaster risk management, which is caused by the following factors;

1) There is information asymmetry between farmers and RCCs because RCCs are connected to the member farmers only through the financial transaction, saving and borrowing, that is different from the agricultural co-operative system in Japan that has integrated co-operative relationship with the member farmers.

2) Farmlands can not serve as collateral for the loan because they belong to the collective. Farmers are also limited to use their houses as guarantee.

3) Guarantor system is not very effective. It is also costly for RCCs to monitor debtor and his guarantor's economic condition.

This study develops the risk management models in the agricultural villages of China to describe the following structures;

1) The circulation of the right to farmland contractual management will make the risk exposure more homogeneous among the farmers.

2) For that reason, the ability of the RCCs and the private financing sectors to manage the risk is increased,

resulting in decrease in the risk premium included in the interest of the loan.

3) Moreover, by involving the private financing sectors as the stakeholder, who can monitor the farmers' condition with low cost due to long-term relationship, the farmers are less motivated to go into moral hazard in risk mitigation.

The rest of this paper will be arranged as follows; in Section 2, we analyze the effect of the liquidation of the farmland management right on the risk diversification by a simple model without RCCs, which will contribute as the preparation for the following model. In Section 3, we incorporate the RCC into the model to investigate the respective role of the RCC and private financing sectors in disaster risk management. In Section 4, we conclude the results and note the remained issues that should be tackled in future.

2. The Liquidation of the Farmland Management Right and Diversification of Disaster Risk

2.1 Assumptions

We let L be the total farmland of rural China. μ is the probability of the disaster that will cause unsuccessful crop. If the crop is unsuccessful, farmers will get nothing from cultivating. For the reason of simplification, the number of farmers is standardized to 1. Farmers are heterogenous only with respect to the initial endowment of wealth, θ, that is distributed from 0 to Θ, with the density function, $f(\theta)$. The size of the farmland cultivated by the farmer with the endowment, θ, is represented by $l(\theta)$. The assumptions above are followed by

$$\int_0^{\Theta} \theta f(\theta) d\theta \equiv \bar{\theta}, \quad \int_0^{\Theta} l(\theta) f(\theta) d\theta = L, \qquad (1)$$

where $\bar{\theta}$ is the mean of θ. We assume that the farmland management rights are uniformly distributed before transaction, that is $l(\theta) = L$. The farming of land *l* costs αl at the beginning of farming period, where α is the input for unit farmland cultivating. Accordingly each farmer's initial wealth does not necessarily cover his costs. So he needs the loan that amounts $\alpha l - \theta$. In Case I and Case II of this session, we do not consider the RCCs and the microcredit, and assume that all the loan is provided by the private sectors through interlinked transactions, in which two parties trade in at least two markets on the condition that the terms of all such trades are jointly determined (Bell, 1988). The market interlinkage generally provides a way of partially circumventing incomplete or non-existent markets in the developing societies (Bardhan, 1999). Now, we suppose the local traders as private financing sectors in the model, who respectively have long-term relationship with a farmer as each client, and therefore know the farmer's condition and behavior well. We further assume that traders are homogeneous, competing with one another in the market, and moreover, each trader has one farmer as his partner, respectively. Hence the local traders not only buy agricultural products from the farmers but, before production, supply them with private financing service such as loan.

According to the above assumption, the farmer with θ gets the loan, $m(\theta) = \alpha l - \theta$, from the trader with a contract that he will pay back the loan with interest after the successful crop. Then, if the successful crop comes as wish, the farmland l will have production l and the farmer can sell all the production by the price p without any difficulty. Therefore the farmer gets income, pl, from which he repays the loan to the trader with the interest payment, Ω, that includes the risk premium. If the crop fails, the farmer and the businessman will get nothing back. Assuming that the trader is risk averse, the market competition implies that the trader's expected utility equals to 0, and Ω satisfies the following equation like

$$(1-\mu)\cdot u(\Omega) + \mu \cdot u(-m) = 0, \qquad (2)$$

where $u(\cdot)$ represents the trader's utility function that has the properties like $u'(\cdot) > 0$, $u''(\cdot) < 0$. The

first term of the left hand side of (2) is the contingent utility of the trader if the crop is successful while the second term corresponds to the case that the crop fails. It is found that Ω depends on the probability of disaster, μ, and the loan size, m. Applying the implicit function theorem on (2), we have

$$\frac{\partial\Omega(\mu,m)}{\partial m}>0,\frac{\partial^2\Omega(\mu,m)}{\partial m^2}>0, \qquad (3)$$

that is, the interest with risk premium is convex with respect to the loan size, *m*. Hereafter, for simplification, we call $\Omega(\mu,m)$ as "risk premium" and represent it by $\Omega(m)$.

2.2 Case I: Risk diversification in private financial market

In Case I , we assume as the benchmark case that the farmland management right can not be transacted, namely, the size of the land is given by $l(\theta)=L$ for any θ. Hence the loan that the farmer gets from the trader is $m(\theta)=\alpha L-\theta$. Assuming that the farmer is risk neutral, the expected utility of the farmer in Case I is represented by

$$W^I(\theta)=(1-\mu)\{(p-\alpha)L-\Omega(m(\theta))\}-\mu\theta. \quad (4)$$

Since the traders' welfare is zero in the competitive market, we can evaluate the social welfare by integrating farmers' expected utility like

$$\begin{aligned} SW^I &= \int_0^{\Theta} W^I(\theta)f(\theta)d\theta \\ &= (1-\mu)(p-\alpha)L-\mu\bar{\theta}-(1-\mu)\int_0^{\Theta}\Omega(m(\theta))f(\theta)d\theta, \end{aligned} \qquad (5)$$

where $\bar{\theta}$ represents the mean of θ. The first and second terms of the final line of (5) mean the total expected profit of the society, while the third term represents the aggregated risk premium farmers pay to the traders if the crop is successful. It implies that the reduction of the aggregated risk premium can improve the social welfare.

2.3 Case II: Private financial market and transaction of the farmland management right

In case II, we assume that there are transactions of the farmland management right. The loan that the farmer with wealth θ gets from the trader is $m(\theta)=\alpha l(\theta)-\theta$. The expected utility of the farmer is

$$W^{II}(\theta)=(1-\mu)\{(p-\alpha)l(\theta)-\Omega(m(\theta))\}-\mu\theta, \quad (6)$$

where $l(\theta)$ is now an endogenous variable. Since there is no externality in the market, the market equilibrium is equivalent to the social optimum. Therefore we introduce the solution in the social optimization with respect to the allocations of the farmland management right as follows.

$$\max_{l(\theta)(0\le\theta\le\Theta)} \quad SW^{II}=\int_0^{\Theta}W^{II}(\theta)f(\theta)d\theta, \quad (7a)$$

$$\text{subject to} \quad \int_0^{\Theta}l(\theta)f(\theta)d\theta=L. \quad (7b)$$

The optimal solutions in the problem above can be attained in the market where each farmer individually maximizes his own expected utility by exchanging the farmland management right and making loan contract with the trader. The optimal allocation of the farmland management right is characterized by

$$l^{**}(\theta)=\frac{\theta-\bar{\theta}}{\alpha}+L \qquad (0\le\theta\le\Theta). \qquad (8)$$

The optimal size of the farmland the farmer cultivates is proportional to his wealth, θ, which is followed by

$$m(\theta)=\alpha l^{**}(\theta)-\theta=\alpha L-\bar{\theta}\equiv m^{**}, \qquad (9)$$

namely, the amount of the loan is identical among the farmers. As a result, the equilibrium expected utility of the farmer is given by

$$W^{II}(\theta) = \left\{(1-\mu)\left(\frac{p}{\alpha}-1\right)-\mu\right\}\theta + (1-\mu)\left\{\left(\frac{p}{\alpha}-1\right)m^{**}-\Omega^{**}\right\}, \quad (10)$$

where $\Omega^{**} = \Omega(m^{**})$ and it is uniform among the farmers. The expected utility is in proportion to the farmer's wealth, θ, that is different from $W^{I}(\theta)$ given by (4). The maximized social welfare is identified as follows:

$$SW^{II} = (1-\mu)(p-\alpha)L - \mu\bar{\theta} - (1-\mu)\Omega^{**}. \quad (11)$$

Compared with SW^{I} given by (5), we find that SW^{II} is maximized by minimizing the aggregated risk premium. Considering that m^{**} is the mean of $m(\theta)$, and the convexity of the risk premium function, $\Omega(m)$, clarified in (3), we find, based on Jensen's Inequality, that

$$\Omega^{**} \le \int_0^{\Theta} \Omega(m(\theta)) f(\theta) d\theta . \quad (12)$$

This model assumes a linear system with respect to the farmers' risk neutral preference and production technology in agriculture, other than risk premium defined by the risk averse preference of the trader. Hence the difference in the social welfare is reflected by the aggregated risk premium, and the maximization of the social welfare with respect to $l(\theta)$ is equivalent to the minimization of the aggregated risk premium with respect to $m(\theta)$. Owing to the convexity of $\Omega(m)$, every farmer's Ω is equalized by $m(\theta) = m^{**}$ at the optimum, namely, farmers' disaster risks are leveled off in the market.

3. Farmers' Incentive for disaster Mitigation and Roles of Rural Credit Cooperatives and Private Financing Sectors

3.1 Assumptions

In the preceding section, we investigated the effect of liquidation of the farmland management right on redistribution of risks in the society. In this section we are concerned with how the functions of the private financing sectors and RCCs can be effectively coordinated in the disaster risk management scheme in rural China.

In the model of this section, we expand the model in two ways; the RCC that provides the microcredit to the farmers and the practice of risk mitigation by the farmers are introduced, while for simplification we assume that there are only two farmers (i =1,2) in the society, who are the members of the same RCC and whose initial endowments are θ_1 and θ_2 respectively. In Case III we introduce the social optimal solution, and in Case IV we describe the market equilibrium where we investigate how the moral hazard of the farmers caused by the information limitation of RCCs can be controlled.

In Case III, we assume that the RCC provides the loan ϕ_1 and ϕ_2 to farmer 1 and 2 respectively. We further assume that the farmers' disaster risks are identical and independent. If farmer i's crop is successful, the RCC will get the loan back with interest payment, $\tilde{\Omega}_i$ (i =1,2), that includes risk premium. Each farmer demands the loan from the trader by the amount of $m_i = \alpha l_i - \theta_i - \phi_i$ (i =1,2), which covers the shortfall of monetary resource. On the other hand the farmers can mitigate the losses in the state of disaster by the mitigation behavior before the event. We suppose that by investing e_i, farmer i gets the

harvest $\zeta(e_i)$ in the state of disaster. We call e_i by "effort", and assume that the unit of e_i is given by labor, or equivalently, time. The function $\zeta(\cdot)$ has the properties like $\zeta'(\cdot)>0, \zeta''(\cdot)<0$. Moreover we assume that ζ is divided into $\varepsilon_R\zeta$, $\varepsilon_Q\zeta$ and $(1-\varepsilon_R-\varepsilon_Q)\zeta$ for the RCC, the trader and the farmer respectively. ε_R and ε_Q are assumed to be constant and positive parameter, and their sum is less than unity. The expected utilities of the RCC and the trader are represented by $W_R(\cdot)$ and $W_Q(\cdot)$ that satisfy

$$\begin{aligned} &W_R(\phi_1,\phi_2,\tilde{\Omega}_1,\tilde{\Omega}_2,e_1,e_2) \\ &=(1-\mu)^2\cdot U(\textstyle\sum_i\tilde{\Omega}_i) \\ &+\mu(1-\mu)\textstyle\sum_{i,j(i\neq j)}U(-\phi_i+\varepsilon_R\cdot\zeta(e_i)+\tilde{\Omega}_j) \\ &+\mu^2\cdot U(\textstyle\sum_i\{-\phi_i+\varepsilon_R\cdot\zeta(e_i)\}), \end{aligned} \tag{13a}$$

$$\begin{aligned} &W_Q(\phi_i,\Omega_i,e_i)=(1-\mu)\cdot u(\Omega_i) \\ &\quad+\mu\cdot u(-m_i+\varepsilon_Q\cdot\zeta(e_i)) \quad (i=1,2), \end{aligned} \tag{13b}$$

where $U(\cdot)$ represents the RCC's utility function that has the properties like $U'(\cdot)>0$, $U''(\cdot)<0$.

3.2 Case III: Social optimal allocation of disaster risk

The social optimal problem is represented as follows;

$$\begin{aligned} &\max_{l_i,e_i,\phi_i,\tilde{\Omega}_i,\Omega_i\,(i=1,2)} \quad SW^{III}=\sum_i W_i^{III} \\ &=\sum_i\Big[(1-\mu)\{(p-\alpha)l_i-\tilde{\Omega}_i-\Omega_i\} \\ &\quad+\mu(1-\varepsilon_R-\varepsilon_Q)\zeta(e_i)-\mu\theta_i-e_i\Big], \end{aligned} \tag{14a}$$

subject to

$$l_1+l_2=L \tag{14b}$$

$$W_R(\phi_1,\phi_2,\tilde{\Omega}_1,\tilde{\Omega}_2,e_1,e_2)=0 \tag{14c}$$

$$W_Q(\phi_i,\Omega_i,e_i)=0 \qquad (i=1,2) \tag{14d}$$

The constraint (14c) comes from a supposition that the RCC does not enjoy any surplus for achievement of the public purpose, while the constraint (14d) is caused by the market competition among the traders. We have the following results;

$$l_1=\frac{L}{2}+\frac{\theta_1-\theta_2}{2\alpha}, \qquad l_2=\frac{L}{2}-\frac{\theta_1-\theta_2}{2\alpha}, \tag{15a}$$

$$\phi_1=\phi_2\equiv\phi^*, \tilde{\Omega}_1=\tilde{\Omega}_2\equiv\tilde{\Omega}^*(\phi_1,\phi_2,e_1,e_2), \tag{15b}$$

$$m_1=m_2=\frac{\alpha L-\theta_1-\theta_2}{2}-\phi^*\equiv m^*, \tag{15c}$$

$$\Omega_1=\Omega_2\equiv\Omega^*(m_i,e_i) \quad (i=1,2), \tag{15d}$$

$$e_1=e_2\equiv e^*, \tag{15e}$$

where ϕ^* and e^* are determined by the following conditions;

$$2\tilde{\Omega}^*_{\phi_i}(\phi^*,\phi^*,e^*,e^*)-\Omega^*_{m_i}(m^*,e^*)=0, \tag{16a}$$

$$\begin{aligned} &-(1-\mu)\left\{\tilde{\Omega}^*_{e_i}(\phi^*,\phi^*,e^*,e^*)+\Omega^*_{e_i}(m^*,e^*)\right\} \\ &\quad+\mu\left(1-\varepsilon_R-\varepsilon_Q\right)\zeta'(e^*)=1, \end{aligned} \tag{16b}$$

where subscripts on $\tilde{\Omega}^*(\cdot)$ and $\Omega^*(\cdot)$ mean partial derivative with respect to corresponding variables. We find that the RCC would like to supply individual farmer with the same loan and ask for the same risk premium, besides the private loan is also identical between the farmers. Finally the level of the farmers' effort for disaster mitigation is equalized in the social optimal situation.

3.3 Case IV: Market allocation of disaster risk

In case III, we considered the problem where the social planner determined all the variables in the

society so as to maximize the sum of expected utilities as the objective function. Accordingly there was no problem caused by information asymmetry. In Case IV, we consider the individual optimization by the farmer *i* who can induce the moral hazard that he may devote less effort than the social optimal effort, e^*.

We suppose that the farmers are given disaster education with some instruction manual at the beginning, and they are required to devote e^* level of effort. On the other hand, the RCC has limited information on the farmers' situations, and provides the social optimal size of the microcredit $(\phi^*, \tilde{\Omega}^*)$, and does not behave strategically. Note that ϕ^* is given by (15b) in Case III and $\tilde{\Omega}^* = \tilde{\Omega}^*(\phi^*, \phi^*, e^*, e^*)$. On the contrary, each farmer behaves in the market so as to maximize his expected utility with respect to the size of the farmland management right and the mitigation effort. Accordingly there may be some difference between e_i $(i = 1, 2)$ and e^*. Now we suppose that the trader monitors each farmer's behavior without any cost and discovers this difference. He seeks the farmer a penalty for deviation from the optimal mitigation effort by the amount of $Z(e_i) \equiv \gamma \cdot (e^* - e_i)$ $(i = 1, 2)$, which is proportional to the level of the moral hazard. γ is assumed to be a constant coefficient decided by the trader, and as is assumed on the effort, the units of the penalty is given by labor or time. The following is the event-sequence in Case IV.

1) The farmers are instructed by the public sector to devote e^* for the mitigation.

2) The RCC gives the farmers the microcredit $(\phi^*, \tilde{\Omega}^*)$ where $\tilde{\Omega}^* = \tilde{\Omega}^*(\phi^*, \phi^*, e^*, e^*)$.

3) The trader announces the risk premium function, $\Omega^\circ(\cdot)$, which is defined more precisely later, and the penalty coefficient, γ.

4) The farmer *i* transacts the farmland management right, l_i, in the market, makes private loan contract, and determines the level of effort, e_i. $(i = 1, 2)$.

5) The market of the farmland management right reaches the equilibrium.

6) The trader discovers the moral hazard and seeks the penalty.

7) Disaster occurs or not.

8) The farmers get crop and make repayment to the RCC and the trader.

The expected utility of the RCC and the trader is given by $W_R(\phi^*, \phi^*, \tilde{\Omega}^*, \tilde{\Omega}_2^*, e_1, e_2)$ and

$$W_Q^\circ(\phi_i, \Omega_i^\circ, e_i, \gamma) = (1-\mu) \cdot u(\Omega_i^\circ + \gamma \cdot (e^* - e_i)) + \mu \cdot u(-m_i + \varepsilon_Q \cdot \zeta(e_i) + \gamma \cdot (e^* - e_i)) \quad (i = 1, 2) \quad ,(17)$$

where the penalty collected is added to the trader's income. Since the traders are competitive, $W_Q^\circ(\phi_i, \Omega_i^\circ, e_i, \gamma) = 0$, followed by the risk premium function, $\Omega_i^\circ = \Omega_i^\circ(\phi_i, e_i, \gamma)$. The optimization problem of the farmer i $(i = 1, 2)$ is represented as follows;

$$\max_{l_i, e_i} \quad W^{IV}$$

$$= (1-\mu)\{(p-\alpha) l_i - \tilde{\Omega}_i^* - \Omega^\circ(m_i, e_i, \gamma)\} + \mu(1 - \varepsilon_R - \varepsilon_Q)\zeta(e_i) - \mu\theta_i^\circ - e_i - \gamma \cdot (e^* - e_i) \quad (18a)$$

subject to

$$\theta_i^\circ = \theta_i + q \cdot (\frac{L}{2} - l_i), \quad (18b)$$

$$m_i = \alpha l_i - \theta_i^\circ - \phi^* = (\alpha + q) \cdot l_i - (\theta_i + \frac{qL}{2}) - \phi^* \quad (18c)$$

where q is the price of the farmland management

right in the market, and θ_i° is the wealth after the transaction of the right. The loan from the trader is determined by (18c). We have the first order conditions with respect to l_i and e_i like

$$(1-\mu)\left\{p-\alpha-(\alpha+q)\Omega_{m_i}^\circ(m_i,e_i,\gamma)\right\}+\mu q=0 \quad (19a)$$

$$-(1-\mu)\Omega_{e_i}^\circ(m_i,e_i,\gamma)+\mu\left(1-\varepsilon_R-\varepsilon_Q\right)\varsigma'(e_i)+\gamma=1 \quad (19b)$$

The market equilibrium condition is given by

$$l_1+l_2=L. \quad (20)$$

Now, we find that, if the trader sets the value of penalty coefficient, γ, at

$$\gamma^\circ=-(1-\mu)\tilde{\Omega}_{e_i}^*(\phi^*,\phi^*,e^*,e^*), \quad (21)$$

the farmers' choices and the market equilibrium result in

$$e_1=e_2=e^*, \quad m_1=m_2=m^*, \quad (22a)$$

$$l_1=\frac{L}{2}+\frac{\theta_1-\theta_2}{2\alpha+2q^\circ}, \quad l_2=\frac{L}{2}-\frac{\theta_1-\theta_2}{2\alpha+2q^\circ}, \quad (22b)$$

$$(1-\mu)\left\{p-\alpha-(\alpha+q^\circ)\Omega_{m_i}^\circ(m^*,e^*,\gamma^\circ)\right\}+\mu q^\circ=0 \quad (22c)$$

where q° is the equilibrium price of the farmland management right. In summary, γ being set at γ° like (21), the first order condition for the farmer *i*, that is identified by (19b), becomes equivalent to the social optimal condition (16b). Moreover, by transacting the farmland management right in the market, the size of the private loan is equalized between the farmers and, furthermore, identical to the social optimal level. Hence, with the optimal risk management scheme, we finally have

$$SW^{IV}=\sum_i W_i^{IV}=SW^{III}, \quad (23)$$

namely, the social optimal welfare is achieved in the decentralized market.

4. Conclusions

So far, we have developed the risk management models in the agricultural villages of China to investigate the effective coordination between the RCC and the private financial sectors in the liquid market on the farmland management right. The circulation of the farmland management right makes the farmers' loan and disaster mitigation effort more homogeneous in equilibrium, that increases the ability of the RCCs and the private financial sectors to pool the risks, resulting in decrease in the risk premium included in the interest of the loan. Moreover, by making use of the private financing sectors' monitoring ability, farmers are less motivated to go into the moral hazard in disaster risk mitigation. In that sense, the microcredit system that leaves some roles for private financial sectors and the liquidation of the farmland management right complementarily work in the risk financing.

As for the future work, we should investigate more circumstantially practical conditions of the inter-linkage market. Moreover we should take into account RCCs' operational strategy and interaction with the farmers; the cooperative characteristics of RCCs, the farmers' motivation for contributing in RCCs' sustainability, for example. We are also concerned about the rural enterprises' ability to absorb the capital and surplus work force and try to involve the rural enterprises into the risk financing model in rural China.

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中国における小額信用貸付と農地の経営権の流動化が災害リスクファイナンスに与える影響に関する一考察

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要　旨

本研究では中国の農村地域を対象に，1996年の農村金融体制改革を契機に導入された小額信用貸付と，2002年に制定された「農村土地請負法」に基づいた農地経営権の流動化に着目した農民の災害リスクファイナンスモデルを定式化した．分析によって，農地の経営権の流動化を通じて，農村信用社と民間金融の補完的効果が向上し，農村金融全体のリスクプレミアムが減少することが示された。

キーワード: 中国農村地域，災害リスクファイナンス，農村信用社，小額信用貸付，農地経営権