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Income Uncertainty, Risk Coping Mechanism and Farmer Production & Management Decision: An Empirical Study from Sichuan Province

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Abstract: With an absence ex-post income risk coping mechanisms such as risk pooling in social networks and inter-temporal consumption smoothing mechanism, Chinese farmers depend heavily on ex-ante mechanisms to cope with income risk. Based on survey data collected on 1063 peasant households in Sichuan province, this paper tests how ex-ante risk coping mechanisms affect farmers' behavior and welfare. The result indicates that: the conservative production strategy and the diversified strategy play the most important role in farmers' reducing income fluctuations; but it causes the low efficiency and widens the income gap between the poor and the rich.
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1. Introduction

The rural reform in late 1970s has not only provided farmers with production and operational independence, but also made them the subjects to undertake risks. As the mode of agricultural production and farming operation is special, farmers have to face the impact of multiple risks. To address the fluctuations in income resulted from various risks, farmers can make use of formal and informal risk mechanisms to deal with income risks. Formal risk response mechanisms mean that the formal system arrangements for risk management, mainly including the modern social security and commercial insurance; informal risk coping mechanisms mean that risk aversion measures other than the formal coping mechanisms, mainly including the risk pooling in the social network, inter-temporal consumption smoothing and all approaches taken by farmers in the production process to avoid the risk. At present, the development of formal risk coping mechanisms focusing on the modern social security and commercial insurance is generally at a low level in rural areas. Therefore, in the context of the basic lack of formal risk coping mechanism, farmers rely largely on informal risk aversion mechanisms to cope with income fluctuations. In terms of the time income risk happens, informal risk response mechanisms can be divided into ex-ante risk coping mechanism and ex-post risk coping mechanism. The former refers to risk prevention measures that farmers take in the course of production before the income risk occurs, mainly including the conservative strategies of production and management and diverse production strategies; the latter means risk coping measures that farmers take after the occurrence of income risks, mainly including the risk pooling in social networks and inter-temporal consumption smoothing. Under conditions that the credit market and insurance market develop adequately, the ex-post risk response mechanism will not bring economic efficiency losses and thus become a relatively ideal method of risk management. Unfortunately, farmers are subject to multiple limits in the use of ex-post risk response mechanism to deal with income fluctuation, which makes the mechanism functionally limited. Therefore, a rational farmer has to take preventive measures to avoid the risk before the occurrence. However, the ex-ante mechanism will bring many

negative results, such as inhibiting innovation in agricultural production; reducing the degree of specialization of farmers' production and hindering the constant increase of economic efficiency. Even worse, once the ex-ante mechanism can not resist the impact of income risks, farmers would be forced to be directly exposed to risks, thus passively suffering the adverse consequences resulted from income reduction, such as giving up the children's educational opportunities, lowering the standard of living, delaying the treatment of diseases, and sale of productive assets, etc. which would obviously undermine farmers' long-term productive efficiency. As poor farmers are more easily exposed to the risk directly, they are more easily caught in the conditions of long-term low efficiency, which will lead to a vicious cycle of poverty and widen the gap between the rich and the poor. Currently, it is of great significance to understand the risk response measure taken by farmers spontaneously and its impact on production and operation, in order to help farmers cope with risks at lower cost and thus increase agricultural productivity and welfare level of farmers.

The research on farmers risk coping mechanisms makes a very important field in development economics. Based on foreign scholars' research, it is found that after the occurrence of future income risk, farmers in developing countries will adopt the risk pooling in social networks and inter-temporal consumption smoothing to cope with income fluctuations. Bardhan and Udry [1] discovered that the risk pooling in social networks and inter-temporal consumption smoothing is a traditional way for farmers to lessen the income fluctuation. Farmers can share in income risk of each other through income transfers and swap credits characterized by state contingent in the social network with geographical and blood relationship as the bridge; inter-temporal consumption smoothing is applied to deal with risks mainly by achieving the inter-temporal transfer of income with the savings and loans in the financial market. Nevertheless, according to the research made by Fafchamps [2], it is found that ex-post risk coping mechanisms are limited in multiple ways. The main problem facing the risk pooling within the social network lies where the social network size is limited, and where its internal problems in implementation are against the information. Rosenzweig and Wolpin [3] discovered that inter-temporal consumption smoothing is often subject to the limit of less developed financial market. For this reason, even if farmers take the foregoing ex-post risk coping mechanisms to deal with income risks, the effect is limited. In case that the income smoothing conducted after the crisis is functionally limited, farmers in developing countries will take precautionary measures to avoid the income risk before it occurs. The ex-ante risk coping mechanisms take the main form of the conservative production strategy and diversified strategy, which refers to that farmers may diversify the sources of income as much as possible, as long as the different sources of income are not perfectly correlated, and the combination of these sources will reduce the total income risk. The conservative production strategy means that farmers take part in the low-risk and low-return production activities as possible as practically. Relative to ex-post risk management mechanisms, the ex-ante risk reaction mechanism depends on farmers' own choice, subject to smaller external constraints, and thus can help farmers to avoid the income risk to a certain extent. However, the ex-ante risk coping mechanism reduces the degree of agricultural specialization, delays the progress of agricultural technology, thus leading to a decline in productive efficiency and income. Morduch [4] discovered that farmers who have adopted the ex-ante mechanism have to measure between reduced income and risk, which is the main factor limiting the ex-ante mechanism.

There are also a number of scholars who studied the risk response mechanisms adopted by farmers. The research by Chen and Ding [5] shows that Chinese farmers, like other farmers in developing countries, deal with income risks through risk pooling and inter-temporal consumption smoothing in the social network; their research also discuss the impact of the social capital of rural households on risk pooling in the social network. In the empirical research made by Luo [6] on the relationship between health risks and consumer behavior in poverty-stricken areas, the relation between risk response mechanisms and farmers consumption smoothing is discussed. He inspected the relation between health risks and consumption fluctuation, and thus proved that farmers have a very strong consumption smoothing capacity. Fan and Yuan [7] conducted a research on the effect of the urban-rural income risk on consumption of durable goods, and found that durable goods consumption of rural residents are more sensitive than urban residents to income risks; in the research, it is pointed out that it is of great importance to establish the rural social security system to improve the welfare level of farmers. Gan and Xu Lixin [8] made a rigorous research on consumption insurance, and the research examined the impact of risk response mechanisms on farmers' ability of consumption smoothing through the introduction of cross variable. And Ma and Bai [9] tested the effect of the ex-post risk response mechanism on income fluctuations of farmers by use of survey data of Shaanxi farmers. The results show that the risk co-ordination and inter-temporal consumption smoothing mechanism in the social network play a part in addressing the income risk for farmers to some extent.

There has been some research that mainly shows whether or to what extent there are in a variety of ex-post risk response mechanisms in rural areas of China; however, the research failed to conduct a careful survey on the ex-ante risk coping mechanisms that farmers generally adopt and was in lack of systematical analysis of the relationship between the risk response mechanisms and the production and operation of farmers. In addition, there has been some research centering on standard analysis in case of failure to make a rigorous empirical test on how various risk response mechanisms play the role in mitigation of farmers' income fluctuations. To overcome the above-mentioned shortcomings, the paper uses the survey data based farmers in Sichuan, and seeks to investigate more fully the various mechanisms adopted by the farmers to respond to fluctuations in income and their effect on production and management decisions of farmers. Through such investigation, this paper attempts to explain: what role different risk response mechanisms play in easing the income fluctuation? What methods the farmers prefer to avoid risks, what factors prevent the farmers from the choice of risk avoidance mechanism? And what the impact of the risk coping measures the farmers choose to take on their production and life would be?

2. Theoretical hypothesis

Investigation shows that farmers of Sichuan mainly take a variety of informal risk coping mechanisms to deal with the income risk. However, the use of these mechanisms by the farmers to ease the income risk is faced with various constraints, of which the size determines the degree of implementation of various risk response mechanisms.

Farmers can deal with the income risk through the risk pooling in the social network. Studies made by Du [10] show that the role of village social network with geography relation as the link is gradually weakening. The primary social network for a rural family is a network of relatives and friends composed by blood relationship, marriage relationship, and no relationship. Such network of relatives and friends is the basis for farmers in China to realize the risk pooling in the social network. At the same time, how the risk pooling in the network of relatives and friends is achieved is subject to such factors as scale, closeness and support capacity, etc.. Farmer's network of relatives and friends is limited in size, which limits the function of the risk pooling mechanism based on the size of the network of relatives and friends. The network of close relatives and friends ensures constrained opportunistic behavior of farmers and overcome information and implementation problems. However, in the process of transition to marketization, the traditional ethical ideas in rural areas are gradually fading away, and the closeness of the network of friends and relatives is continuously decreasing, which will cause a negative effect to the risk pooling in the network of relatives and friends. Members of the network depend largely on the income of other members in terms of the amount of transfer payment that they can receive in the event of risks. Yet, Members of the network share the homogeneity in the economic status so that capacity of support of other members is limited. In case of any income risk, the total amount of transfer payments that farmers can get from relatives and friends is often very small. Based on the foregoing analysis, Hypothesis 1 is proposed that: effects of the risk pooling in the social network depend on the size, closeness and support capacity of the network of relatives and friends. Although the risk pooling in the network of friends and relatives can help farmers respond to income fluctuation to a certain extent, it is another case in rural areas. In the process of marketization of the rural areas, the mobility of the population never stops growing, alternative of the market to features of the network of relatives and friends keeps deepening with the traditional ethical concepts increasingly weakened. Such factors play down the feature of the risk pooling in the social network, thus become functionally limited while helping farmers cope with the role income risk.

Farmers can also deal with the income risk through inter-temporal consumption smoothing mechanism, that is, asset accumulation and credit. The research conducted by Hang and Shen [11] shows that the important purpose for savings of farmers is to prevent uncertainty. Wan [12] discovered that the income level of farmers in China will economically and statistically make a significant impact on the rate of savings. Recent results from Wang [13] indicate that the saving rate of rural population grows with the increase in the income level of farmers. However, the actual low-level income of farmers led to generally low rate of savings, thus limiting their capacity to smooth the fluctuation in income by assets accumulation. From the perspective of credit, the source of loans for farmers includes formal and informal credit markets. As the four major state-owned banks are gradually seceding from rural credit markets, it is mostly the rural credit association who provides loans to farmers in the rural formal credit market. But, Sheng [14] discover that in recent years, loan behavior of rural credit cooperatives has presented obvious non-agricultural trend, and the number of loans available to farmers is very limited. In the informal credit market, a severe shortage of development exists in the private credit market and informal lenders in rural areas

remains illegal or strictly restricted by laws, thus restraining the possibilities that farmers obtain loans from the private credit market. According to the above analysis, Hypothesis 2 is proposed that: the income level of farmers and the availability of loans from formal and informal credit markets determine the effect of the inter-temporal consumption smoothing mechanism. But due to farmers' current income level and constraints from credit markets, the inter-temporal consumption smoothing mechanism plays a limited role.

Often in a "deep-enough-to-reach- neck" state, farmers in developing countries tend to avoid the risk in a stronger sense that common economic entities do. In the basic lack of formal risk management mechanisms and under the conditions that the ex-post risk response mechanism is so much restricted, they have to rely more on the ex-ante mechanism to avoid the income risk and make careful arrangements for production activities to stabilize the income. Usually, farmers insist on applying conservative agricultural technologies while keeping very cautious in use of new technologies that may potentially increase the profit; farmers often tend to choose those low yielding crops that can defend any adverse changes in the weather and cultivate a variety of crops in the land of small scale. Unfortunately, the ex-ante mechanism will cause negative results. First, the ex-ante mechanism will reduce the initiative of farmers to use new technology, so that farmers diversify the low-efficiency operation on the land of small size, thus reducing the efficiency of agricultural production. Second, the ex-ante mechanism will widen income gaps. As well-off farmers give less considerations to risks in obtaining income, their degree of specialization will be higher and will hold a more positive attitude to new technologies and new market opportunities and produce higher production and operation efficiency. For poor farmers, the situation is just the opposite. Such a mechanism would make repeated effects so as to widen the income gap. Finally, once the ex-ante mechanism fails to cope with income risk, farmers may fall into the poverty-stricken trap, causing a vicious cycle of poverty. Based on the above-said analysis, Hypothesis 3 is proposed that: in the lack of formal risk management mechanisms, against the background of restricted ex-post risk response mechanism, farmers will make use of ex-ante mechanisms to avoid the income risk, which will result in the loss of efficiency and equity.

3. Data collection and variable selection

3.1. Data source

The data in this study comes from the questionnaire of "farmers' income risk" project made by the discussion group in the rural areas in Sichuan from July to September 2009. The author conducted two pre-surveys to ensure that the questionnaire can be understood and accepted by farmers. The formal investigation was made in 9 counties and 81 villages in northeastern, middle and southern Sichuan. 15 farmers were randomly selected from each of the villages for the investigation. In this survey, 1220 copies of the questionnaire were sent out, of which 1129 copies were actually regained in total, as part of the questionnaire were invalid, 1,063 copies of valid questionnaires were eventually obtained, and the rate of valid questionnaires was 88%.

3.2. Variable selection

In this study, the independent variable is the degree of the income fluctuation as farmers face the risk, that is, the change in the normal income caused by risk factors. The ideal method to measure the income fluctuation is to review the change in the actual income of farmers via time-series data. However, taking into account the difficulties in and costs of directly asking farmers the time-series income, this study is designed to measure the income fluctuation of farmers with the subjective experience in enduring the income risk. Specifically, the head of a household is required to describe the fluctuation in their normal income in the event of relatively more serious risks (the loss is about one third of the normal annual income) based on their experience with "basically unchanged" and "significantly lowered".

Explanatory variables in this study are mainly divided into three categories: Category I covers the ex-ante risk response mechanism variables, such as, conservative production strategy (measured by the attitude to treat new technologies and new varieties), diversified strategy (measured by the attitude to simultaneous cultivation or feeding of a variety of agricultural products); Category II is the ex-post inter-temporal consumption smoothing variables, including: degree of development of the formal credit market (measured by the level of difficulty in the access to

loans from credit unions or banks), the informal credit market development (measured by the level of difficulty in the access to private loans), average household income (total household income divided by population of family); Category III is the ex-post risk pooling in social network, including the breadth variable of the social network (measured with the number of friends and relatives), support capacity of the network of friends and family (measured with the number of relatively well-off families among relatives and friends) and the closeness variable of social network (measured by the status of contact with relatives and friends).

Additionally, we have conducted control on the formal risk response mechanism variables and the farmer family characteristics variables. The formal risk response mechanism includes: level of development of commercial insurance markets and level of difficulty in the access to government relief. Farmer family characteristics variables include: the number of population of a family, the age of heads of households (average age of male and female heads of households), the educational background of the heads (average educational level of male and female heads of households), the size of per capita cultivated land area and traits of the heads of households. Among them, traits of the heads of households refer to how the heads of the households are optimistic, and are measured with how often the heads consider external accidents. As the optimism level of heads of the households will affect their subjective experience in consumption fluctuations, analysis errors caused by the adoption of subjective experience index in this paper can be reduced by controlling the character traits of the heads of the households.

Table 1 Explanation, Assignment and Distribution of Variables

Variable name	Variable explanation	**Variable assignment**
Explained variable	—	—
I fluctuation	income fluctuation in case of income loss(dichotomous variable)	0= basically unchanged(21.4%) 1= significantly lowered(78.6%)
Formal risk coping mechanism variable	—	—
CI restrict	level of the difficulty in the access to commercial insurance compensation	1= very difficult(19.5%) 2= relatively difficult(40%) 3= common(26.5%) 4= relatively easy (10.2%) 5= easy(3.8%)
GR restrict	level of the difficulty in the access to governmental relief	1= very difficult(31.4%) 2= relatively difficult(36.3%) 3= common(24.3%) 4= relatively easy(6.2%) 5= easy(1.8%)
Risk pooling in social network variable	—	—
SN scale	number of relatives and friends	1= very few(2.0%) 2= relatively few(8.4%) 3= common(45.5%) 4= relatively many(27.2%) 5= quite many(16.9%)
SN income	number of well-off family among relatives and friends	1= a few(51.1%) 2= common(43.8%) 3= many(5.1%)
SN quality	status of contact with relatives and friends	1= very bad (5.7%) 2= relatively bad(6.4%) 3= common(31.5%) 4= relatively good(41.2) 5= very good(15.2%)
inter-temporal consumption smoothing mechanism variable	—	—
FC restrict	level of the difficulty in the access to loans from the formal credit market	1= very difficult(30.2%) 2= relatively difficult(46.5%) 3= common(15.6%) 4= relatively easy(6.9%) 5= very easy(0.8%)
IC restrict	level of the difficulty in the access to loans from the informal credit market	1= very difficult(13.4%) 2= relatively difficult(29.1%) 3= common(37.7%) 4= relatively easy (14.7%) 5= very easy(5.1%)
H income	average income level of a family	(ten thousand Yuan)
Ex-ante risk coping mechanism variable	—	—
CP strategy	attitude to the adoption of new technologies and varieties	1= always (3.8%) 2= very often (8.3%) 3= cautious(53.6%) 4= seldom(26.2%) 5= never(8.1%)
DP strategy	attitude to simultaneous cultivation or	1= always(41.8%) 2= very often(31.6%) 3= cautious(11.3%)

	feeding of a variety of agricultural products	4= seldom(8.2%) 5= never(7.1%)
Family characteristic variable	—	—
Character	whether often consider the future potential accidents or not	1= over often(15.3%) 2= sometimes (49.4%) 3= seldom (25.6%) 4= never(9.7%)
Age	age of the head of a household	(years old)
H population	number of population of a family	(person)
Land	per capita cultivated land	(mu)
Leader	whether the family has any rural cadre or not	0= no(90.1%) 1= yes(9.9%)
Education	educational background of the head of a household	(year)

Note: The percentage included in brackets is that of each assignment accounts for of all the samples.

4. Model Selection and Estimation Method

Dependent variables of this study are dichotomous variables, and regression analysis is conducted by use of dichotomous logistic method. The explanatory variables in this study are mostly ordered categorical variables, for such variables, one method to deal with them is to change each multi-category qualitative variable into a number of dichotomous qualitative variables. However, data in this study is derived from the questionnaire and most of the explanatory variables are ordered categorical variables, in case they are changed into a number of dichotomous qualitative variables, there will be too many final variables, which is not conducive to a clear explanation. Another method set out in the Social Science Research to deal with ordered categorical variables is to give each option of variables a certain value and use the variables as continuous ones. The model this approach describes is relatively simple and easy to explain. However, this approach requires assignment to be the same with the actual size as much as possible, to avoid bias caused by improper assignment. As the questionnaire of this study is designed to classify the ordered categorical variables in details, and attention has been paid to the distance set option so as to avoid improper assignment, this paper adopts the latter method for analysis. For assignment of each specific variable, see Table 1. To conduct the analysis, this paper adopts the quantitative analysis model as follows:

$$LN(p_i/1-p_i)=\alpha_0+\alpha_1 X_i+\alpha_2 Y_i+\alpha_3 Z_i+\alpha_4 W_i+\alpha_5 C_i+\varepsilon_i$$

Of which , p_i indicates the probability of significantly reduced income, $1-p_i$ indicates that the probability that income does not significantly reduce, and $p_i/(1-p_i)$ indicates the odds ratio of significantly reduced income, that is, the probability of significantly reduced income divided by the basically unchanged income. α_0 is a constant. X_i indicates the set of ex-ante risk response mechanisms, Y_i indicates the set of risk pooling mechanisms in social networks, Z_i indicates the set of inter-temporal consumption smoothing mechanism variable, W_i indicates the set of formal risk response mechanism variables, and C_i indicates the set of family characteristics variables. $\alpha_1, \alpha_2, \alpha_3, \alpha_4$ and α_5 are respectively the sets of corresponding variables. ε_i is a random error term.

5. Results and Analysis

In this study, stata9.0 software is adopted for logit regression analysis, and of 1063 effective samples, there are in total 1018 samples included in regression process. Results from the measurement test are shown in Table 2. In the process of the measurement test, in order to understand the robustness of the results and under the constant control of family characteristics, variables of formal risk response mechanism, risk pooling mechanism in social network, inter-temporal consumption smoothing mechanism and ex-ante risk response mechanism are included in turn, so that model 1, model 2, model 3 and model 4 are respectively worked out; finally, all the explanatory variables are included into the regression analysis process to obtain Model 5. Measurement test results show that the test results included in each group of explanatory variables and including all the explanatory variables, in terms of the variables this paper is concerning about, are of no significant difference in both the size of coefficients or statistical

significance. It can be seen that in the main variables this paper is to investigate make robust impact on explanatory variables. To simplify the analysis, the following analysis is conducted mainly based on model 5.

In order to avoid the potential heteroscedasticity, the standard error in the table is the robust standard error, and the corresponding p value is also calculated according to the robust standard error. For convenience of comparison of the level of the role of each independent variable, standardized disposal is conducted regression coefficients on model 5. The specific approach is: regression coefficient and corresponding standard deviation of the independent variables multiplied and then divided by the standard deviation of logistic distribution. The main independent variable of the econometric model in this paper is the continuous classified variable in the formed of subjective assignment. One obvious fact is that if these explanatory variables are assigned with different methods, the standard deviation will be different, and the partial effect will be certainly different; thus, here is comparison of the relative role of the independent variables, the ideal method is to conduct standardized disposal of the regression coefficients rather than to calculate the partial effect. The analysis below will be carried out mainly according to standardized regression coefficients.

Table 2 Results of Measurement Test (model 1-5)

Explained variable I fluctuation	Model 1 B	Model 2 B	Model 3 B	Model 4 B	Model 5 B	Model 5 Exp(B)	Standardized regression coefficient
CI restrict	-0.076 (0.079)	—	—	—	-0.049 (0.095)	0.952 (0.083)	-0.025
GR restrict	0.297 (0.299)	—	—	—	-0.283 (0.271)	0.751 (0.216)	-0.134
SN scale	—	-0.257** (0.112)	—	—	-0.259*** (0.113)	0.772*** (0.085)	-0.161
SN income	—	-0.477*** (0.129)	—	—	-0.338*** (0.153)	0.713*** (0.105)	-0.128
SN quality	—	0.109 (0.121)	—	—	0.116 (0.125)	1.123 (0.137)	0.062
FC restrict	—	—	0.047 (0.089)	—	0.047 (0.088)	1.048 (0.087)	0.023
IC restrict	—	—	-0.172** (0.080)	—	-0.233** (0.09)	0.792** (0.076)	-0.101
H income	—	—	-1.107*** (0.399)	—	-0.911** (0.401)	0.402** (0.107)	-0.147
CP strategy	—	—	—	-0.381*** (0.072)	-0.392*** (0.052)	0.676*** (0.068)	-0.191
DP strategy	—	—	—	-0.341*** (0.067)	-0.323*** (0.063)	0.724*** (0.073)	-0.168
Character	-0.387*** (0.099)	-0.363*** (0.080)	-0.384*** (0.077)	-0.378*** (0.074)	-0.373*** (0.082)	0.689*** (0.072)	-0.18
Age	-0.018 (0.019)	-0.025 (0.018)	-0.028 (0.023)	-0.023 (0.020)	-0.028 (0.022)	0.972 (0.013)	-0.051
H population	-0.050 (0.071)	-0.051 (0.071)	-0.097 (0.083)	-0.066 (0.078)	-0.086 (0.083)	0.918 (0.076)	-0.07
Land	-0.236*** (0.081)	-0.207*** (0.067)	-0.194*** (0.069)	-0.212*** (0.079)	-0.201*** (0.071)	0.818*** (0.060)	-0.132
Leader	-0.320* (0.137)	-0.289 (0.270)	-0.221 (0.252)	-0.218 (0.263)	-0.118 (0.247)	0.889 (0.211)	-0.019

Education	-0.047 （0.038）	-0.034 （0.036）	-0.045 （0.050）	-0.042 （0.048）	-0.048 （0.056）	0.953 （0.026）	-0.032
Constants	4.386*** （0.636）	4.900*** （0.696）	4.718*** （0.656）	4.820*** （0.677）	6.121*** （0.762）	—	—
Log pseudo-likelihood	-477.2	-478.3	-485.7	-487.2		-459.4	
Wald Chi-square	53.48***	49.44***	48.52***	49.51***		70.93***	
Pseudo R^2	0.056	0.055	0.050	0.049		0.083	

Note: (1) *, ** and *** indicate noticeable at the statistical levels of 10%, 5% and 1% respectively; (2) What are included in brackets are robust standard errors.The impact of various independent variables is analyzed based on the regression results in case farmers face income risk, as follows.

5.1. Effect of the formal risk coping mechanism

Regression analysis findings show that the degree of development of the commercial insurance market makes no significant effect on income fluctuations as farmers face the income risk. This is because the income of farmers in Sichuan is still mainly from agriculture, but due to the synergy of agricultural insurance and serious asymmetry of information, insurance companies hold a negative attitude to the provision of agricultural insurance services. Government relief does not significantly affect the income fluctuation. Although the Government has implemented in rural areas such measures as social assistance and rural subsistence allowances in recent years, the intensity and scope of implementation is limited, therefore, the way to help farmers cope with income risk is insignificant. Survey data shows that farmers' number of choosing the formal risk aversion mechanism accounts for only 6.4% of the total choice, much lower than the choice ratio of other types of risk aversion mechanisms. This indicates that in case farmers respond to the income risk, the formal risk aversion mechanism goes a little way.

5.2. Effect of the risk pooling mechanism in social networks

The size of relatives group has significant negative impacts on the income fluctuation in case farmers face the income risk; the odds ratio is 0.772, which indicates that the change in the number of relatives and friends of one class can decrease the odds ratio of income fluctuations 0.228 times (here, the odds ratio specifically means: the probability of significantly lowered consumption divided by that of basically unchanged consumption, below is the same); and the absolute value of standardized regression coefficients is quite large (0.161). This indicates that in rural areas of Sichuan, the network of relatives and friends plays an important role in alleviating income fluctuations. The negative effect of the number of wealthy families in the network of relatives and friends on income fluctuations is very significant; the odds ratio is 0.713, indicating that every one-level increase on the number of wealthy families in the network of relatives and friends will decrease the odds ratio over 0.287 times; the absolute value of standardized regression coefficient is relatively larger (0.128), which shows that the effect of the network of relatives and friends depends not only on the size but also on the support capability determined by the level of income of relatives and friends. The impact of closeness of the interaction in the friends and relatives group on fluctuations in income is not indistinctive, possibly because there is in fact a little difference in the closeness of the interaction within the relatives and friends group, not enough to make effect on the risk pooling in the social network, so as to bring a small impact on income fluctuations. Seen from overall, the effect of the network of relatives and friends on mitigation of fluctuations in the income of farmers depends on the size of the network and the support capability determined by the level of income of relatives and friends. However, the risk pooling in the social networks lacks of enforcement mechanisms; with the continuous deepening of the rural market, the constraints from traditional ethical ideas in rural areas have increasingly weakened, the closeness of the network of friends and relatives has gradually declined. These factors determine the limited role of the risk co-ordination mechanism in social networks. Survey data shows that farmers' rate of choosing the risk pooling mechanism in social networks accounts for only 15.9% of the total choice, much lower than that of choosing the ex-ante risk

aversion mechanism and that of choosing the inter-temporal consumption smoothing and only higher than that of choosing the formal risk aversion mechanism. From the foregoing analysis, Hypothesis 1 is confirmed.

5.3. Effect of inter-temporal consumption smoothing mechanism

The constraints of loans from the formal credit market to income fluctuations are not significant, indicating that the effect of formal loans on farmer's income risks is not significant. Currently, loans from main formal credit cooperatives of Sichuan rural areas are generally limited to production, negative to issue consumer loans; on the other hand, procedures for loans from credit unions loans are complicated, with long application period, thus it is difficult to help farmers cope with the income risk. These factors will influence the farmers' dealing with the income risk through the formal credit. Reduced constraints of the informal credit market loans have a very significant negative impact on farmers' income fluctuation; the odds ratio is 0.792, indicating every one-level decrease on the constraints of informal loans will reduce the odds ratio of the income fluctuation 0.208 times. This shows that the development of the informal lending market plays a positive role in fluctuations in income of farmers. It is found based on a survey that there are mainly two reasons why private credit market plays a larger role than the formal credit market does, which are: on the one hand, lenders are in rural communities and are provided with more full information to accurately issue loans based on the economic strength of farmers, thus to avoid losses on bad debts; on the other hand, private credit procedures are simple, which is helpful for farmers to cope with the income risk in a timely manner. However, the absolute value of standardized regression coefficient is relatively small (0.101), which means that the role of the informal credit market is relatively limited, mainly because farmers' loans in the informal credit market are generally controlled within a low limit due to higher interest of private loans. Average family income level plays a significant part in income fluctuation and the odds ratio is 0.402, indicating that a rise of 10,000 Yuan in annual income of a family can decrease the odds ratio of fluctuations in income 0.598 times; the absolute value of standardized regression coefficient is relatively large (0.147). It shows the farmers' assets accumulation level reflected by the average family income level should play a rather significant role in the income risk. Overall, the inter-temporal consumption smoothing mechanism makes a relatively important effect on aversion of income risks. However, with generally low rate of savings of farmers, the savings is restricted in terms of flows in the formal credit market and it costs much to employ the informal private credit market. For this reason, the role of the inter-temporal consumption smoothing mechanism is relatively limited. Survey data shows that farmers' rate of choosing the inter-temporal consumption smoothing mechanism accounts for only 35.3% of the total choice, much lower than that of choosing the ex-ante risk aversion mechanism and higher than that of choosing the risk pooling mechanism in social networks mechanism. From the foregoing analysis, Hypothesis 2 is confirmed.

5.4. Effect of the ex-ante risk coping mechanism

Conservative production strategies have a significant impact on income fluctuation; the odds ratio is 0.676, indicating that one-level increase in subjective attitude to the introduction of new technologies and new varieties will decrease the odds ratio of income fluctuation over 0.324 times; the absolute value of standardized regression coefficient is relatively large (0.191). Diversified operation also has a very significant effect on the response of rural households to income fluctuation; the odds ratio is 0.724, which shows that one-level increase in subjective attitude to simultaneous cultivation or feeding of a variety of agricultural products will increase the odds ratio of 0.276 times; the absolute value of regression coefficients is relatively large (0.168). According to the above analysis, in the absence of the formal risk aversion mechanism and in the context that the ex-post risk aversion mechanism is very limited, farmers have to take measures to avoid the income risk before it occurs. It is found that well-off farmers adopt less ex-ante mechanisms than farmers do to deal with the risk. This is because the wealthy ones tend to have more physical and financial assets, which in itself is conducive to their self-insurance, and, more assets mean more possibility to provide collateral to lenders, or to be used as the signal conveying its operation. This makes more access to loans. As a result, as the less wealthy give consideration to risk issues during obtaining income, the higher the degree of specialization will be, the more positive the attitude to new technologies and new market opportunities is, the higher the production and management efficiency will be achieved. For the poor, it is another case. Such a mechanism would play a role repeatedly so that the income gap continuously widens. Obviously, the more the farmers are in lack of the ex-post risk mechanism, the more evident the widening of such difference is. And more

importantly, the lower the income level of farmers is, the more they are likely to adopt theex-ante risk aversion measures. And this will lead to a vicious circle of poverty. Survey data shows that farmers who have low income are apt to adopt theex-ante mechanism to cope with the income fluctuation. The number that farmers choose theex-ante risk response mechanism to cope with the income fluctuation accounts for 42.4% of the total choice, the highest among the percentage of various risk aversion measures, which proves the conclusion reached by Dercon. In summery, Hypothesis 3 is confirmed.

5.5. *Effect of family characteristics variable*

The regression analysis results show that the degree of farmers' optimism has a significant effect on the farmers income fluctuation, and the odds ratio is 0.689, which means that each one-level increase in the degree of farmers' optimism causes a reduce in the income fluctuation by 0.311; the absolute value of regression coefficients is relatively large (0.180). This indicates that subjective factors do have influence on the income fluctuation perceived by farmers, and that the variable has effectively controlled the subjective factors. The number of agricultural land plays a significant and positive part in income fluctuation, and the odds ratio is 0.818, meaning that a one-mu increase in per capita cultivated land of a family will reduce the odds ratio of income fluctuations 0.182 times. The absolute value of regression coefficients is relatively large (0.132) and this shows that the agricultural land plays an important role in helping farmers cope with the income risk, functioning as insurance for farmers. Regression analysis results also show that the older farmers, bigger family size, the higher level of educational background and the position of rural cadre provide farmers more ability to cope with the income risk, but these effects are not significant.

Finally, two concerns about the above models are: (1) whether the income level may be related to the social networks and the degree of difficulty in borrowing and lending? (2) Whether the variables in the above models used to reflect the personality characteristics of the head of a household (how often farmers consider the future accidents) reflect the time preference, and thus make effects on the consumption smoothing mechanism? From the measurement models we try to get rid of the income and the variables used to reflect the characteristics of the head of a household, and work out two new models respectively. Measurement results of the new model show that, the removal of the two variables has made some influence on the size and p value of the coefficient of related explanatory variables to a low extent. The main conclusions made through the foregoing analysis still stand. These facts further prove that conclusions reached under the model 5 are robust. Moreover, the absolute value of likelihood function log (Log pseudo-likelihood) of two new models becomes bigger, this means that the value of the likelihood function becomes smaller and the degree of fitting turns worse. This shows that the income variables and variables of personality characteristics of the head of a household have an independent role in explaining the fluctuations in income of farmers.

6. Conclusion and Suggestion

Based on the above-mentioned analysis, following conclusions may be drawn up: (1) as the formal risk aversion mechanism has little effect, farmers adopt multiple informal ways to avoid the income risk in three types of forms, including the risk pooling in the social network, inter-temporal consumption smoothing andex-ante risk response measures;(2) ex-post risk aversion mechanism may to some extent facilitate farmers to cope with the income risk; however, the mechanism is functionally limited due to a variety of constraints. (3) Against the background of the lack of formal risk response mechanism and that the ex-post risk response mechanism is functionally limited, farmers have to rely on the ex-ante risk response mechanism to deal with the income risk, or are forced to bear the results from the income risk after the occurrence of the risk, which will cause the reduction of the efficiency of agricultural production and operation and the vicious circle of poverty. For the long term, the ex-ante risk aversion mechanism chosen at large by farmers is not conducive to the stable increase of their income and the continuous development of rural economy. Therefore, it is of great significance to provide farmers with assistance to address the income risk in better methods.

Based on the above conclusions, some policy advices are brought forward as follows. First, constantly increase the social capital for farmers to meet the market economy so as to strengthen the ability of farmers to cope with the income risk and reduce the frangibility of farmers; second, improve rural financial services, reduce constraints for

farmer credits, and enhance the ability of farmers to handle the income risk through the inter-temporal consumption smoothing; at last, further improve the standard of the rural social security and help the poor farmers maintain the basic living standards; provide the enterprises that are engaged in rural insurance service with subsidies granted for policy considerations and reasonable profits; decrease the level of agricultural insurance premium and increase the rate of participation of farmers in insurance.

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