Farmers' Agricultural Catastrophe Insurance Demand Analysis and Behavior Research

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Abstract. The frequency of agricultural catastrophe in China is very high, and the loss is gigantic. However, the agricultural catastrophe insurance lags behind. Basing on the behavioral economics, this paper analyzes the supply and demand of agricultural catastrophe insurance in China. We surveyed the attitude of agricultural catastrophe insurance about farmers by multistage sampling, and the survey covered 1355 farmers in 28 provinces. Furthermore, we analyzed the risk perception and behavior on multi-logistic model. According to the analysis, most farmers accept agricultural catastrophe insurance, and the government's policy induction can effectively promote the change of attitudes about farmers.

Introduction

Agriculture is a high-risk and weak industry, and it is extremely vulnerable to huge losses from disaster risks. In 2014, Shenzhen took the lead in implementing comprehensive catastrophe insurance. In 2017, Shanghai successively launched typhoon catastrophe index insurance. If the government enforces through policy, is the farmer willing to accept it? This paper analyzes the supply subject and demand behavior of agricultural catastrophe insurance.

Literature Review

Attribute Consensus of Agricultural Catastrophe Insurance

Agricultural catastrophes are not only uncertain in their low frequency, but also high in losses and large in scale (TL Murlid haran, 2003. Li Dalei et al., 2009). With the contingency of the catastrophe risk concept, management methods and tools, the catastrophe insurability has reached a consensus (Xie Jiazhi, etc, 2011). Agricultural catastrophe insurance is a quasi-public goods (Huang Yingjun, 2014).

Analysis Supply and Demand of Agricultural Catastrophe Insurance

(Miranda & Glauber, 2007) The systemic risk of agricultural catastrophe insurance is about 10 times ordinary insurance, resulting in lack of supply. At present, China’s agricultural catastrophe insurance mainly due to factors such as low income of farmers, lack of awareness and external environment (Zhao Yanni, 2013).

Behavior Analysis of Agricultural Catastrophe Insurance

The behavior of agricultural catastrophe insurance entities is restricted by many factors. Fuzzy aversion and moral hazard, bias, technological progress and market competition are affecting insurance companies. However, dominating government compensation leads to farmers’ dependence, and fortunate psychology leads to irrational decision-making. Fortunately, government policy support to increase demand.
Survey of Supply and Demand Based on Farmers' Perspective

Basic Information of Farmers

The paper chose to survey by multistage sampling, taking into account the principle of the eastern, central and western regions of China. The scope of the survey covered 651 villages in 28 different provinces. The final valid questionnaire is 1355(Table 1), and the effective rate is 90.3%.

The survey was mainly male, accounting for 63.5%. The age is mostly 30-50 years old, accounting for 89.3%, and the most age group is concentrated in 40-50 years old. Cultural education is mainly junior high school education, accounting for 42.7%. The population size of the family is mainly 4 people, accounting for 39.3%. Most of them are 3-5 people, accounting for 82.2%. The survey statistics of household annual income show that 57.6% income is at the middle-to-low level of 1-3 million yuan. According to the types of agriculture, the proportion of farmers engaged in planting is up to 73.7%. The scale of farmer production shows that the decentralized operation of farmers is more common, among which 663 households with 5 acres or less account for 48.9%.

Table 1. Basic characteristics of survey sample farmers.

| Types                          | Option          | Sample | Ratio | Types                          | Option          | Sample | Ratio |
|-------------------------------|-----------------|--------|-------|-------------------------------|-----------------|--------|-------|
| gender                        | Male            | 860    | 63.5% | Family year                   | Less than 10,000 yuan | 161    | 11.9% |
|                               | Female          | 495    | 36.5% | Total revenue                 | 10,000-20,000 yuan | 225    | 16.6% |
|                               | Under 30 years  | 370    | 27.3% |                              | 20000-30000 yuan  | 394    | 29.1% |
|                               | 30-40 years old | 404    | 29.8% |                              | 30000-40000 yuan  | 437    | 32.3% |
|                               | 40—50 years old | 436    | 32.2% |                              | More than 40,000 yuan | 138    | 10.2% |
|                               | Over 50 years   | 145    | 10.7% | The proportion of agricultural income | 20% — 50% | 486    | 35.9% |
| culture degree                | Elementary school and below | 353 | 26.1% |                              | 50% — 80% | 271    | 20.0% |
|                               | junior high school | 578 | 42.7% |                              | More than 80% | 105    | 7.7%  |
|                               | High school and secondary school | 226 | 16.7% |                              | 0 — 5 acres | 663    | 48.9% |
|                               | College         | 113    | 8.3%  | Land area                     | 5 — 10 acres | 350    | 25.8% |
|                               | Undergraduate and above | 85  | 6.3%  |                              | 10 — 15 acres | 201    | 14.8% |
|                               | 1 person        | 35     | 2.6%  |                              | 15 — 25 acres | 78     | 5.8%  |
| family Total population       | 2 persons       | 72     | 5.3%  |                              | 20 — 25 acres | 19     | 1.4%  |
|                               | 3 persons       | 316    | 23.3% |                              | More than 25 acres | 24     | 1.8%  |
|                               | 4 persons       | 532    | 39.3% | Mainly engaged in Agricultural types | crop farming forestry | 998    | 73.7% |
|                               | 5 persons       | 265    | 19.6% |                              | Animal husbandry Fishery | 125    | 9.2%  |
|                               | above 6 persons | 135    | 10.0% |                              |                      | 89     | 6.6%  |
Risk Management Services and Behavior Choices of Government

Table 2. Agricultural catastrophe prevention and post-disaster relief in local government.

| Types                               | Option       | Samples | Ratio  | Types                               | Option         | Samples | Ratio  |
|-------------------------------------|--------------|---------|--------|-------------------------------------|----------------|---------|--------|
| Local related Department            | comprehensive| 165     | 12.2%  | Local related                       | Within 12 hours| 236     | 17.4%  |
| Department                          | part         | 513     | 37.9%  | Disaster                            | Within 24 hours| 313     | 23.1%  |
| catastrophe                         | Rarely       | 402     | 29.7%  | relief operation                    | Within 48 hours| 396     | 29.2%  |
| Preventive work                     | never        | 275     | 20.3%  | speed                               | After 48 hours | 410     | 30.3%  |

Table 2 statistics reflect the agricultural catastrophe prevention and disaster relief services of local government departments. 79.7% of the farmers reflect that relevant government have taken preventive measures. 20.3% of the farmers reflect that relevant government have never done it. On the other hand, the survey shows that 17.4% government relief disaster within 12 hours. 23.1% government is within 24 hours. 30.3% government is after 48 hours. The statistics show that the overall disaster relief rate of the government is not timely enough in the farmers' perceptions.

Company's Insurance Services and Behavior Choices

(Table 3) The survey shows that China's agricultural insurance has not full covered, and this paper analyzes the insurance service status and behavior evaluation of insurance companies. Among the 952 households, 55.8% of farmers did not purchase agricultural insurance. With agricultural insurance meeting the demand, 52.8% of the households considered unsatisfied. The quality of insure service evaluation is different, and 52.7% of households evaluated it is general.

| Types                                       | Option       | Samples | Ratio  | Types                                       | Option         | Samples | Ratio  |
|---------------------------------------------|--------------|---------|--------|---------------------------------------------|----------------|---------|--------|
| Purchase the number of agricultural insurance| 0            | 531     | 55.8%  | Evaluation                                  | Good           | 36      | 3.8%   |
|                                            | 1-3          | 315     | 33.1%  | The service of the local insurance company  | Better         | 223     | 23.4%  |
|                                            | 4-5          | 50      | 5.3%   |                                             | Generally       | 502     | 52.7%  |
|                                            | above 5      | 56      | 5.9%   |                                             | Poor           | 191     | 20.1%  |
| The current agricultural insurance can meet you| complete    | 159     | 16.7%  |                                             |                |         |        |
|                                            | No           | 503     | 52.8%  |                                             |                |         |        |

The Measurement Model and Empirical Test

Model Selection

This paper studies the farmers' satisfaction with agricultural disaster compensation as a dependent variable and studies how the independent variables (influencing factors) affect the farmers' willingness. Because the dependent variables are complete satisfactory(cs), more satisfactory(ms), general satisfactory(gs) and complete dissatisfactory(ns). Therefore, this paper chooses to establish an ordered multi-logistic regression model to analyze farmers' satisfaction with agricultural disaster compensation. Basic on the relevant research, farmers' satisfaction with agricultural disaster compensation is mainly affected by four aspects.

\[
\log \frac{it(p_{satis = cs})}{1 - (p_{satis = cs})} = -\alpha + \sum_{i=1}^{n} \beta_i X_i + \varepsilon 
\]  

\[
\log \frac{it(p_{satis = ms})}{1 - (p_{satis = ms})} = -\alpha + \sum_{i=1}^{n} \beta_i X_i + \varepsilon 
\]
\[ \log \left( p_{\text{satis}} \right) = \log \left( \frac{p_{\text{satis}}}{1-p_{\text{satis}}} \right) = -\alpha_3 + \sum_{i=1}^{n} \beta X_i + \epsilon \] (3)

In the above (1) (2) (3) formula, it is a random disturbance item. In this paper, the influence factor is set to 12 independent variables, so n is 12.

Variable Assignment and Description

According to the research hypothesis and analysis of this paper, representative variables are selected for analysis. (1) Dependent hypothesis. Farmers’ satisfaction with agricultural disaster compensation is divided into four situations: ns.gs.ms.cs. The dependent variables are taken as “1”, “2”, “3” and “4” respectively. (2) Independent variables. Referring to the relevant research literature and survey data of relevant farmers’ subsidies, the satisfaction of farmers’ compensation for agriculture is affected by individual factors and external factors. The selection, meaning and assignment of specific variables are shown in Table 4.

| Variable Name                  | Code   | Definition Description and Variable Type                          | Variable Assignment |
|--------------------------------|--------|------------------------------------------------------------------|---------------------|
| Satisfaction with disaster compensation | satisfy | Ordered categorical variable                                      | Very satisfied=1     |
|                                |        |                                                                  | General = 3          |
|                                |        |                                                                  | Totally dissatisfied = 4 |
|                                | sex    | Disordered categorical variable                                   | Female=0             |
|                                |        |                                                                  | Under 30 years old = 1 |
|                                |        |                                                                  | 30-40 years old = 2   |
|                                |        |                                                                  | 40-50 years old = 3   |
|                                |        |                                                                  | 50 years old or older = 4 |
| Farmers’ own characteristics   | age    | Ordered categorical variables (assigned by age from small to large)| Primary school and below = 1 |
|                                |        |                                                                  | Junior high school = 2 |
|                                |        |                                                                  | High school and secondary school = 3 |
|                                |        |                                                                  | High school and secondary school = 3 |
|                                |        |                                                                  | Undergraduate and above = 5 |
|                                | education | Ordered categorical variables (assigned by educational level from small to large) | Less than 10,000 (¥) = 1 |
|                                |        |                                                                  | 10,000-20,000 (¥) = 2 |
|                                |        |                                                                  | 20,000-30,000 (¥) = 3 |
|                                |        |                                                                  | 30,000-40,000 (¥) = 4 |
|                                |        |                                                                  | More than 40,000 (¥) = 5 |
|                                | Family income | Ordered categorical variables (assigned by the annual income of the family from small to large) | Very low = 1 |
|                                |        |                                                                  | Low = 2 |
|                                |        |                                                                  | Middle = 3 |
|                                |        |                                                                  | High = 4 |
|                                | Agricultural and regional characteristics Share of agriculture income | Ordered categorical variables (from small to large) | Very low = 1 |
|                                |        |                                                                  | Low = 2 |
|                                |        |                                                                  | Middle = 3 |
|                                |        |                                                                  | High = 4 |
|                                | Agricultural and regional characteristics land | Ordered categorical variables (assigned from small to large land area) | Very low = 1 |
|                                |        |                                                                  | Low = 2 |
|                                |        |                                                                  | Middle = 3 |
|                                |        |                                                                  | High = 4 |
|                                | Agricultural and regional characteristics Risk frequency | Ordered categorical variables (assigned from large to small in order of frequency of occurrence) | Never = 1 |
|                                | risk—impact | Disordered categorical variable                                  | Very frequent = 1 |
|                                |        |                                                                  | Freq = 2 |
|                                |        |                                                                  | Occassional = 3 |
|                                | prevent | Ordered categorical variables (assigned from large to small according to the development) | Never = 1 |
|                                |        |                                                                  | Have been and very comprehensive = 1 |
|                                |        |                                                                  | Have been but only part = 2 |
|                                |        |                                                                  | Almost done = 3 |
|                                | Agricultural disaster commitment and service undertake | Ordered categorical variables (with government as a reference group) | Government = 1 |
|                                |        |                                                                  | Insurance company = 2 |
|                                |        |                                                                  | Agricultural Professional Cooperative = 3 |
|                                |        |                                                                  | Other (Red Cross donation, etc.) = 4 |
|                                |        |                                                                  | Own = 5 |
|                                | Loss compensation necessary | Ordered categorical variables (ordered from large to small as necessary) | Very necessary = 1 |
|                                |        |                                                                  | Very but not urgent = 2 |
|                                |        |                                                                  | Not necessary at all = 3 |

Model Measurement Results

We use SPSS and maximum likelihood estimation method (MLE) to estimate the parameters of the model. The results of the farmers satisfaction on agricultural disaster compensation is shown in Table 5.

According to the likelihood ratio, it is 58.418 and rejects the null hypothesis. All coefficients are 0 at a significant level of 1%, so the model is acceptable.

Conclusion

Increased Supply and Demand of the Agricultural Catastrophe Insurance

The established agricultural catastrophe insurance policy system includes the government's subsidies and the technological advancement of the insurance, which increases the supply. Despite farmers having risk-aware bias, government-dependent behavior, which hinders their enthusiasm
for participation. But the government support and subsidies induce farmers to purchase agricultural catastrophe insurance.

Table 5. Logit Model of Farmers’ Compensation for Agricultural Disasters.

| Factor type                                      | Variable name                  | Regression coefficient | Standard error | Wald value |
|-------------------------------------------------|--------------------------------|------------------------|----------------|------------|
| Disaster compensation is very satisfactory=1    |                                | -1.274*                | 0.738          | 2.979      |
| Satisfactory disaster compensation = 2          |                                | 0.405                  | 0.728          | 0.310      |
| Disaster compensation is generally satisfactory = 3 |                                | 3.072***               | 0.742          | 17.128     |
| gender                                          |                                | -0.545***              | 0.179          | 9.299      |
| Farmers’ own characteristics                     | age                            | 0.132                  | 0.101          | 1.711      |
|                                                | Educational level              | 0.007                  | 0.079          | 0.008      |
|                                                | Total annual household income  | 0.310***               | 0.074          | 17.488     |
|                                                | Farmers’ own characteristics   |                        |                |            |
|                                                | age                            | 0.132                  | 0.101          | 1.711      |
|                                                | Educational level              | 0.007                  | 0.079          | 0.008      |
|                                                | The proportion of agricultural income | 0.157                | 0.100          | 2.499      |
|                                                | Land area                      | 0.011                  | 0.076          | 0.021      |
|                                                | Agricultural and regional      |                        |                |            |
|                                                | characteristics               |                        |                |            |
|                                                | The proportion of agricultural income | 0.157                | 0.100          | 2.499      |
|                                                | The proportion of agricultural income | 0.157                | 0.100          | 2.499      |
|                                                | Prevention of hidden disaster by relevant local authorities | 0.421***               | 0.096          | 19.174     |
|                                                | Agricultural disaster frequency in the past | 0.220**                | 0.112          | 3.882      |
|                                                | Wether crops have been affected by disaster or not | 0.113                | 0.186          | 0.365      |
|                                                | The main bearer of agricultural disaster losses in the past | 0.041                | 0.048          | 0.748      |
|                                                | The main bearer of agricultural disaster losses in the past | -0.200               | 0.126          | 2.529      |

Observations 524
Likelihood ratio 58.418 (P=0.0000001)
Nagelkerke $R^2$ 0.117

Note: *, **, *** respectively indicate significant levels at 10%, 5%, and 1%.

Popularizing Risk Knowledge is Benefit to Stimulate Demand

This paper shows that most of the farmers have the willingness to enhance disaster prevention awareness and knowledge, and they can actively implement remedies in the event of catastrophes. Farmers also have initially formed awareness to prevent catastrophe by purchasing insurance, but it has not formed a large scale. It shows that popularizing disaster prevention knowledge is conducive farmers to generate insurance purchase behavior. And most farmers are willing to accept compulsory purchases with low premiums.

Government Induction is Benefit to Implementation

Although there are many factors hindering the farmers’ willingness, and the relevant research also shows that agricultural catastrophe insurance is feasible, but it is inseparable from government policy. Owing to the character of quasi-public goods, government policy are the effective conditions for the agricultural catastrophe insurance. It can effectively transform the demand attitude of farmers. The survey results show that agricultural catastrophe insurance is suitable to adopt under the quasi-public goods framework.

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References

[1] T.L. Murlidharan, H. Shah. Economic Consequences of Catastrophes Triggered by Natural Hazards [M]. Blume Earthquake Engineering Center Report. No. 2003, 225-230.
[2] Li Dalei, Zhong Weizhou. Model Selection and Policy Suggestions of Agricultural Catastrophe Insurance in China [J]. Social Scientist, 2009(5): 59-62.

[3] Xie Jiazhi, Chen Li. Rational Thinking on the Insurability of Catastrophe Risk in China [J]. Insurance Research, 2011(11): 20-30.

[4] Huang Yingjun, Li Jiangyan. Game Analysis and Countermeasure Research on the Subject of Agricultural Catastrophe Insurance [J]. Exploration. 2014(1): 101-104.

[5] Mario J. Miranda, Joseph W. Glauber. Systemic Risk, Reinsurance, and the Failure of Crop Insurance Markets [J]. American Journal of Agricultural Economics. 2007, 79(2): 85~93.

[6] Zhao Yanni. Research on Agricultural Catastrophe Insurance in China [J]. Agricultural Economy. 2013 (3): 51-53.