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The Farmers Behavior in Agricultural Insurance under the Von·Neuman-Morgenstern Utility Model

WANG Qing-song*

College of Humanities and Social Sciences of Northeast Forestry University, Harbin, 150040, China

Abstract

Agricultural insurance is an important component in the system of agriculture and the rural economy and plays an important role in the stability of rural society. Farmers as an important actor in agricultural insurance, the analysis of their economic behavior has important significance. Based on the basic assumptions of economics, this paper analyzes characteristics of farmer behavior in agricultural insurance and the factors affecting their behavior. Then using Von·Norman—Morgenstern Utility Model to analyze the risk preferences of individual farmer. The research result is that under the present stage, agricultural insurance behavior is influenced by many factors. In the voluntary insurance and nor a certain amount of subsidy, the vast majority of farmers would not choose insurance and the demand of agricultural insurance can only be regarded as a potential demand rather than effective demand. It needs joint work to ensure the farmer to attend the agricultural insurance.

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1. INTRODUCTION

Agricultural insurance is an important component in the system of agriculture and the rural economy and plays an important role in the stability of rural society. Farmers as an important actor in agricultural insurance, the analysis of their economic behavior has important significance. Foreign agricultural insurance system, developed from a variety of risk insurance to all risks insurance, from the production insurance to income insurance, it has formed a very complete system in theory and practice research. In recent years, foreign studies on agricultural insurance system mainly include the following areas: agriculture insurance actuarial techniques such as agriculture insurance Crate-making, the quantitative analysis of agricultural production distribution in technologies and micro-aspects; the quantitative analysis in asymmetric information theory to the agricultural insurance rate, such as moral hazard and adverse selection; the relationship between agricultural insurance and the ecological environment.

In 1982, with the rehabilitation of the agricultural insurance, it began a gradual emphasis on agricultural insurance in domestic, research content mainly include: the agricultural insurance nature (Guo Xiaohang, 1986; Li

* Wang Qing-song. Tel.: 0451-82192352; E-mail address: dearwangqingsong@126.com
Jun, 1996; Liu Jingsheng, 2000; Du Guozhu, Wang Guojun, 2003); agricultural insurance system, the formulation of policies and regulations and the exploration of development strategies (Wang Yuxian, 1990; Du Guozhu, 1997); the interaction study between agricultural insurance agents, including farmers, agriculture, insurance companies, and the government (Long Wenjun, 2004) and so on. In summary, most studies focused on the agricultural insurance system, models of agricultural insurance and so on, while there is little research have been carried out on the change of farmer's behavior under agricultural insurance system.

Model helps to have an abstract and intuitive understanding in economic phenomena and enhance analytical rigor. Von Neuman---Morgenstern Utility Model had analyzed an insurance problems, especially analyzed the insured individual consumer’s behavior and consider that a single rational consumer those who are risk averse in the insurance. It has played an important reference for this study. In view of the comprehensive and systematic studies of agricultural insurance agents are rare, based on the basic assumptions of economics, this paper analyzes characteristics of farmer behavior in agricultural insurance and the factors affecting their behavior. Then using Von Neuman---Morgenstern Utility Model to analyze the risk preferences of individual farmer, and tries to reveal the effective ways to increase the insurance rate.

2. MODEL

2.1. Von Neuman---Morgenstern Utility Model and Methods

The expected utility and effectiveness of expectation are the two frequently used concepts in the analysis of consumer behavior when it exist risk. Here use of expected utility function to determine farmers’ risk behaviors.

2.1.1. Expected utility

As in determining conditions the aim of consumer behavior is to maximize the utility, under uncertainty conditions consumer behavior is also aimed at the greatest effectiveness. However, in uncertainty, because consumers do not know in advance what the results will happen, so he was just in advance to make the best decisions to maximize his expected utility. To this end, economists established the concept of expected utility.

For an insurance policy of the farmers: \( I = \left( p \cdot (1 - p), w_1, w_2 \right) \); the expected utility function of the insurance as follows: \( E \{ U \left( p \cdot (1 - p), w_1, w_2 \right) \} = pU \cdot w_1 - (1 - p) U \cdot w_2 \)

Where, \( w_1 \) and \( w_2 \), refers the amount of household wealth when the risk occur and does not occur, \( p \) and \( 1-p \) respectively refers to the probability of the occurrence rate of \( w_1 \) and \( w_2 \). The expected utility function can be abbreviated as follows:

\[
E[U(w_1, w_2)] = pU(w_1) + (1 - p) U(w_2) \tag{1}
\]

From the above equation, it can be seen farmers’ expected utility function is that all the results he may get of the weighted average of the utility under conditions of uncertainty. As the establishment of expected utility function, the analysis of risk-taking behavior, on the faced of uncertainty condition, it becomes the analysis of farmers behavior of pursuit expected utility maximization.

2.1.2. Effectiveness of expectation

For an insurance policy \( I = \left( p \cdot (1 - p), w_1, w_2 \right) \), the expected value of insurance is: \( pw_1 + (1 - p)w_2 \). We can see from this value, insurance expectations are the weighted average of the amount of wealth owned by farmers under the different results in the insured. Accordingly, the effectiveness of the insurance expected as: \( U \left( pw_1 + (1 - p)w_2 \right) \).
2.1.3. Farmer's attitude towards risk

With an uncertain outcome for the same things, farmers’ attitude towards risk is not the same, so that their respective acts of choice may differ. According to the attitude towards risk, economists divide the farmers into three categories: risk adverse, risk enthusiasts and risk neutral. Risk attitude of these three criteria for judging are as follows:

Take farmers faced with an insurance policy as an example to analyze. Assumed in the no-risk conditions (under the conditions of not buy insurance), the amount of money wealth farmers can held is equal to the expected value of insurance, that is . If a farmer think that in the absence of risk to hold a set amount of money the utility of wealth is greater than the risk expected utility under the conditions of insurance, namely: , then the farmer is a risk adverse. If a consumer who feels that in the no-risk conditions, to hold a set amount of money the utility of wealth under the conditions of the insurance risk is less than the expected utility, namely: , then this farmer is a risk enthusiasts. If a farmer regard that under the condition that in the absence of risk to hold a set amount of money the utility of wealth is equal to the risk insured under the conditions of expected utility, namely: , then this farmer is a risk neutral.

2.2. Simulate farmers’ insurance behavior

In order to reduce of potential losses under the risk, the majority of farmers as risk averse would purchase insurance. The following model is to analyze the decision-making behavior of farmers purchase insurance under the risk situation in pursuit of expected utility maximization.

Assumptions: refers a farmer's initial farmland wealth, he faces the risk of natural disasters, and the probability of natural disasters is , the loss . To reduce their losses from natural disasters, the farmers would choose to purchase insurance, then after the occurrence of natural disasters, the insurance company will pay him compensation , but he must be pay the insurance fee in advance to the insurance company, where, for the purchase of insurance per yuan of expenditure. So, how the farmers to choose the optimal amount of insurance to obtain the maximum expected utility?

First of all, from the farmer's own perspective, under the conditions of insurance, the behavior that farmers maximize their expected utility can be mathematically described as:

Where: refers to monetary wealth owned by farmers in the event of future natural disasters after insured, refers to monetary wealth owned by farmers when natural disasters do not occur after insured.

The first-order conditions that farmers’ expected utility maximization are:

That is:

Again from the perspective of insurance companies, in case of natural disasters occur, the revenue of insurance companies is ; if not occur, the revenue is . Assumed that the cost of insurance is zero, then the insurance company's expected profit is: .

Assume that industry as a perfectly competitive industry, each insurance company's long-term profit is zero, so: .

This means that , namely: in this model, insurance companies prescribe that the purchase price per unit of is equal to the probability occurrence of natural disasters . That is, the greater (or smaller) the is, the higher (or lower) the is.

Finally, substituting into a conditional first-order, there is:


In the last equation, eliminate \( x \) and \((1-x)\) items available:

\[
U'(w - 1 + (1 - x)q) = U'(w - xq)
\]

(5)

As a result, the conclusions can be drawn as following: First, the best insurance number that farmers choose, who are risk averse, should be making the marginal utility of money wealth when the natural disasters do occur is equal to the wealth of natural disasters do not occur. Second, we can also get: \( w - 1 + (1 - x)q = w - xq \). This means that \( I = q \). It shows that, as a risk averse, farmers choose the optimal amount of insurance should be equal to all the loss of money wealth that he might suffer. In other words, the optimal insurance is full insurance. In this way, regardless of whether the natural disasters occur or not, he has to maintain its own money wealth \((w-xq)\).

2.3. Brief summary

Each farmer’s risk attitude can be divided into three types: risk adverse, risk neutral, risk enthusiasts. Prudent person would prefer to choose a smaller income and output bias; they would abandon some of the possible gains while reducing the probability of loss. The amount of the loss income risk aversion is used to reduce maybe the risk outcome. Have such a tendency, producers willing to participate in activities exist risks, but must be reciprocated in any kind. From the theory analysis, to individual farmers, in order to realize their expectations of the largest insurance, the best way is to insured their own farmland or livestock or forest land, regardless of whether the occurrence of natural disasters, he is determine to maintain their access to a certain amount of monetary wealth.

3. CONCLUSION

According to Von • Neuman—Morgenstern utility model, we can concluded that farmers who are risk adverse individual, if make a comparison of this conclusion with the analysis of behavior in front, we find that, for the majority of farmers in our country, their behavior differ from the theoretical analysis results. Because farmers’ behavior of agricultural insurance affected by many factors, in the voluntary insurance not under the conditions of certain subsidies, farmers are mostly unable to select insurance, agricultural insurance can only be regarded as a potential demand rather than effective demand. Therefore, the farmers to purchase agricultural insurance, subject to affordability constraints. At the same time, farmers are also affected by agricultural insurance act itself, the expected benefits of agriculture and the expected return of agricultural insurance constraint. To stimulate farmers’ agricultural insurance act, we should taken into account of many factors, such as the role of government, insurance companies and the role of farmers itself.

4. References