

## Research Article

### The Dualism of Asymmetric Information in Agricultural Insurance

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**Abstract:** Asymmetric information objectively exists in the insurance market, especially in agricultural insurance, which has a great impact on the insurance contract and market operation. This paper designs two game models to analyse the dualism of asymmetric information in agricultural insurance and its reasons of forming. We find that, the particularity of agricultural production, the agricultural risk diversification and the benefits' spillover of the agricultural insurance are the main causes of asymmetric information. Therefore, this paper puts forward that establishment of appropriate agricultural insurance mode, optimization of insurance policy design and increasing investment in science and technology, increasing farmers' insurance consciousness and establishing supervision system

**Keywords:** Agricultural insurance, asymmetric information, dualism, game model

#### INTRODUCTION

Asymmetric information means the differences of owning information in the quality and quantity between trade both parties. It is easy to cause two kinds of behavior: one is adverse selection; another is moral hazard. Adverse selection refers that one party uses its' information advantage to make the contract on their own. It often appears before the contract is signed. In contrast, after the contract is signed, moral hazard occurs because one party is difficult to monitor the behavior of the other party, which makes the risk increase.

Much of the literature has been inquiries into whether asymmetric information prevails in particular insurance markets. Akerlof proved that the applicant has complete information advantage than the insurer in the health insurance market in 1970. And Rothschild and Stiglitz (1976) explained the existence of market equilibrium in the insurance market with asymmetric information. Because of asymmetric information, there are two equilibriums, concentrated equilibrium and separate equilibrium. Scholars have adopted the "conditional correlation" approach illustrated in, in which the presence of information asymmetry implies that. Conditional on risk classification, the risk outcome is positively correlated with insurance coverage (Chiappori *et al.*, 2006). Therefore, insurance market is a typical information asymmetry market (Mark and Helen, 1993), especially in agricultural insurance, due to the particularity of the subject matter of insurance (living plants and animals) and the complexity of agricultural risk, the information asymmetry problem is more serious (Michael *et al.*, 2006). To effectively deal

with asymmetric information, many scholars put forward different views, such as establishing an effective system of agricultural insurance (Cao and Zhan, 2009), implementation of area yield insurance (Feng and Su, 2009), design variety of insurance contract and reasonably determining the insurance rate and so on (Chen, 2010).

According to the theory of information economics, asymmetric information exists in both parties of the transaction. It is called dualism of the information asymmetry. Dualism of the information asymmetry is more outstanding in agriculture insurance market (Tong, 2011). It intensifies the contradiction between supply and demand and hinders the healthy development of agricultural insurance. This paper studies dualism of asymmetric information in agriculture insurance extends empirical study about the optimization of insurance policy design and analyses the behavior of the insurer and the insured in agricultural insurance market by game models. This study aims to provide technical support for the theoretical works and to provide scientific and reasonable precaution strategies against asymmetric information in agricultural insurance.

#### MATERIALS AND METHODS

In this section, we discuss the concrete manifestation of asymmetric information in agricultural insurance from two different angles of view: the policyholder and the insurer. Based on some theoretical hypothesis, two game models are designed to illustrate market characteristics of agricultural insurance. One

Table 1: Static game of incomplete information

	High-risk farmer ( $\theta$ )		Low-risk farmer ( $1-\theta$ )	
Public holder/Insurer	To Insure ( $a$ )	Not To Insure ( $1-a$ )	To Insure ( $b$ )	Not To Insure ( $1-b$ )
To Check ( $q$ )	$[\omega\delta+f-C, -\omega\delta-f-d]$	$[-C, -d]$	$[\omega\delta-C, -\omega\delta]$	$[-C, p_L d]$
Not To Check ( $1-q$ )	$[\omega\delta-d, -\omega\delta]$	$[0, -d]$	$[\omega\delta-p_L d, \omega\delta]$	$[0, -p_L d]$

model aims for adverse selection, another for psychological risk and moral hazard.

**Adverse selection of farmers:** Usually, the potential policy-holder has more information about the subject matter of insurance than the insurer, such as the risk and loss information of land, climate, crops, livestock and poultry, while the insurer who wants to get this information must pay higher price. The problem of adverse selection exists especially with new farmers whose risk type is completely unknown to the insurer (Cohen, 2005). Thus, the insurer determines insurance rate mainly on the basis of the average loss probability and the expected losses of the agricultural risk. So lots of high-risk farmers would enter agricultural insurance market, while low-risk farmers refuse to buy insurance. The result is that high-risk farmer “drives” the low-risk type out of insurance market. Thus it would increasingly keep the insurer’s loss ratio constantly rising and if the insurer continuously increases the insurance premium, it would lead to wider adverse selection market.

**Model construction:** We assume the insurer is risk neutral, the policy-holder is risk aversion, the value of the subject matter is  $\omega$ , insurance rate  $\delta$ , so insurance premium is  $\omega\delta$ . There are two types of farmer in the market, high-risk farmer and low-risk farmer. We consider the probability of high-risk farmer in the agricultural insurance market is  $\theta$  while the probability of low risk is  $1-\theta$ . Because of incomplete information, the insurer doesn't know who is high-risk policy-holder or low-risk. So if wants to obtain more information about the subject matter of insurance, the insurer must pay checking expenses  $C$ . When the insurer finds the policy-holder does not truthfully inform the fact of the subject matter, the insured not only could not obtain insurance indemnity, but also pay economic punishment  $f$ . For simplicity, we assume that the probability of high-risk policy-holder that is in insurance accident during the insurance period is  $1$ , the probability of low-risk is  $p_L(p_L < 1)$ . Once insurance accident occurs, the insured would get insurance indemnity  $d$ . So the farmer has strategy set {to insure, not to insure}, the probability of a high-risk insured is  $a$ , the low-risk insured is  $b$ , The insurer has strategy set {to check, not to check}, the probability of check is  $q$ .

According to the above assumptions, the game model of agricultural insurance market is built in Table 1. There are two digital in brackets; the former is the insurer’s benefits, the latter represents policy-holder’s benefits.

In the agricultural insurance market,  $\theta, a, b$  and the other variables remain the same, according to the

equilibrium principle, when the insurer chooses to check ( $q = 1$ ) or not to check ( $q = 0$ ), the expected revenue should make no difference, EV represents expected revenue of the insurer.

$$EV(1, \theta, a, b) = \theta[a(\omega\delta + f - C - (1-a)C] + (1-\theta)[b(\omega\delta - C - p_L d) - (1-b)C] \quad (1)$$

$$EV(0, \theta, a, b) = \theta[a(\omega\delta - d)] + (1-\theta)[b(\omega\delta - p_L d)] \quad (2)$$

$$EV(1, \theta, a, b) = EV(1, \theta, a, b) \quad (3)$$

$$a^* = \frac{C}{\theta(f + d)} \quad (4)$$

Solving Eq. (1), (2), (3) for a yield  $a^*$ , from Eq. (4), the insured probability of high-risk farmer is directly proportional to the insurer's checking expenses  $C$  and is inversely proportional to policy-holder's economic punishment  $f$ . That means that the higher the checking expenses are, the lower the checking probability is and then more farmers of high-risk occur in the insurance market, leading to more serious policy-holder’s adverse selection problem.

**Psychological risk and moral hazard of farmers:** In agricultural insurance market, the farmers’ psychological risk is mainly displayed in the following two aspects: First, the insured produces mental relaxation after signing a policy. For example, two equal levels of plots are planted with the same crops. If seeding, cultivating pattern and timing of fertilization is different; the harvest of two plots is quite different. It shows that insurable interest in agricultural insurance is a kind of expected benefits and it depends largely on the behavior of the individuals. Farmers often neglect the management of the subject matter of insurance because of having them insured and they abandon originally effective risk control measures in planting (breeding) process, which will directly increase the occurrence of risk accident and damages. Second, the insured produces psychological risk when insurance accident happens. Most farmers think that insurance means obtaining compensation in the future, so when insurance accident happens, the insured is not willing to waste human and material resources to take positive remedial measures, but lets the disaster spread and then lodges a claim with the insurance company.

Moral hazard means the insured or beneficiary intentionally makes the accident on purpose, defrauding of the insurance amount. It is a kind of artificial hazard, for example, the insured deliberately setting fire to

Table 2: Game model after signing insurance contract

Public holder/Insurer	To Abide by Insurance Contract ( $\beta$ )	Not To Abide ( $1-\beta$ )
To Check ( $q$ )	$[\omega\delta - C - p_L d, -\omega\delta - C_1]$	$[\omega\delta - C + f, -\omega\delta - p_H d]$
Not To Check ( $1-q$ )	$[\omega\delta - p_L d, -\omega\delta - C_1]$	$[\omega\delta - p_H d, -\omega\delta]$

cause losses in fire insurance and in life-insurance, policy-holder or beneficiary intentionally murders the insured. These phenomena are more serious in agricultural insurance. Such as the cattle beyond the coverage suddenly falls ill before the expiration and according to insurance clause, the insurer generally cannot bear the medical expenses until livestock is disabled or dead. So many farmers don't take cattle to see veterinaries, but managed to kill livestock to earn insurance money.

**Model construction:** We assume the probability that insurance accidents occur goes up to  $p_H$ . If the policy-holder abides by an insurance contract, the cost  $C_1$  would be paid for taking action to prevent the accident and  $p_H$  would be reduced to  $p_L$ . The probability that the policy-holder abides by an insurance contract is  $\beta$ .  $EU$  represents the expected revenue of the policy-holder. The game model of the insurer and the policy-holder after signing an insurance contract is built, as showed in Table 2.

$$E(V) = \beta q(\omega\delta - C - p_L d) + (1-\beta)q(\omega\delta - C + f) + \beta(1-q)(\omega\delta - p_L d) + (1-\beta)(1-q)(\omega\delta - p_H d) \quad (5)$$

$$\beta^* = \frac{f + p_H d - C}{f + p_H d}$$

$$E(U) = \beta q(-\omega\delta - C_1) + (1-\beta)q(-\omega\delta - p_H d) + \beta(1-q)(-\omega\delta - C_1) + (1-\beta)(1-q)(-\omega\delta) \quad (6)$$

$$q^* = \frac{C_1}{p_H d}$$

$$EV(\beta^*, q^*) = \omega\delta - (1-\beta)(p_H - p_L)d - p_L d \quad (7)$$

$$\omega\delta = (1-\beta)(p_H - p_L)d + p_L d \quad (8)$$

When  $\frac{\partial E(V)}{\partial q} = 0$  and  $\frac{\partial E(U)}{\partial \beta} = 0$ , we could solve (5),(6) to yields  $\beta^*$  and  $q^*$ , then add  $\beta^*, q^*$  to (5) yields (7). If  $EV(\beta^*, q^*) < 0$ , the insurer would refuse to cover, so the minimum revenue that the insurer could acceptable is  $EV(\beta^*, q^*) = 0$ , yields (8). We can infer that after the establishment of an insurance contract, because of the existence of psychological risks and moral hazard, the insurance rate that the insurer could accept consists of two parts: the first part is average expectation losses rate; the second part is the additional losses rate caused by the policy-holder not complying with the insurance contract.

**Adverse selection and moral hazard of the insurer:**

Asymmetric information mutually exists for the insurer and the policy-holder in the insurance market. Most people think that information hiding comes from the policy-holder, but in fact, for both parties, each party has their information superiority than others, that is, their private information. As far as the insurer, as the provider of insurance is concerned, the price, the characteristics, the scope of protection and ensure a degree of insurance products are the insurer's private information. Because farmers are lack of insurance knowledge, lots of insured farmers blindly sign the bill when they do not fully understand the content of the insurance contract. It raises the adverse selection problem of the insurer. On the other hand, as the operators of insurance, the insurer is very familiar with various claims procedures and affairs about the insurance, while the insured farmers cannot easily understand relevant regulations and procedures. Therefore, the following may occur in the claims process: first, the insurer may be produced some phenomena in the business activities, such as "to insure easily, to claim difficultly, to receive money quickly and to refund slowly"; Second, the insurer is not strictly fulfill the obligation of reparations. Reparations procedures are too complicated and it takes a lot of time, so many insured farmers are difficult to get compensation from the insurer, it is moral hazard of the insurer. Adverse selection and ethical hazard of the insurer directly or indirectly damage the economic interests of the insured, decreasing the enthusiasm of the farmer to purchase insurance and then continuously reduces the actual demand of agricultural insurance.

**RESULTS AND DISCUSSION**

**Establish suitable business pattern for agricultural insurance:**

In this study, we put forward the insurance cooperative mode with government support and commercial insurance company involved. Based on an incentive system provided by government, this mode combines benefits between insurance company and farmers, thereby effectively reducing adverse selection and moral hazard happened.

First of all, the government function in this mode has been orientated in three aspects: the provider of agricultural insurance system, the provider of financial subsidies and the superintendent of agricultural insurance. On the one hand, government needs to provide funds and institutional support for the smooth operation of insurance cooperatives mode; On the other hand, government should supervise the insurance business, check whether the financial subsidies is allocated in place or not.

Secondly, agricultural insurance cooperative is the main body of the insurance business. Insurance cooperative is a kind of insurance organization which

means some persons have the same insurance needs commonly organize and manage an insurance business. From the international point of view, agricultural insurance cooperative is a common mode in some European countries, such as Germany and France; it is even to be the main organizational form in these countries engaged in agricultural insurance. Agricultural insurance cooperative engages in original insurance, its flexibility is high and policy holder has the dual identity, the benefit of the members is highly consistent.

Finally, in addition to the support of government and the establishment of reasonable organization, engaging in agricultural insurance needs professional management technology and management personnel to support. Obviously, it is a defect in agricultural insurance cooperative in the short term. But commercial insurance could solve this problem. Commercial insurance participate in the management of agricultural insurance cooperative is the effective method. Commercial insurance company has advanced insurance technology and professional insurance talents; especially they have rich experience on insurance pricing, determination of insurance amount, insurance claims, risk management and financial accounting, etc. These advantage could save cost of operation and solve the technical barriers of insurance cooperative engaged in agricultural insurance.

**Optimization insurance policy design:** At first, designing multi-level insurance rate system. In theory, every policy-holder of different risk levels should have different insurance rate. However, due to technical problems in the insurance, it is difficult to achieve in practice, which can easily lead to adverse selection. But at least we can design multi-level insurance contracts to meet the needs of the different policy-holder. The agricultural insurance market should be divided into different insurance branch area according to the regional climate, geographical terrain, crop average harvest and the average loss probability and so on. Each region has a base rate. On this basis, the insurance rate system will be set in a number of grades, according to their level of risk to select different levels of rates. This could promote low-risk farmer to take part in insurance positively and then reduce adverse selection behavior.

The second, setting earnest money in insurance policy. Eq. (4) in above Section tells us that if the economic punishment clause of dishonest is added in the insurance contract, the punishment is greater and the probability that high-risk farmers occur would be fewer, thus reducing the adverse selection problem. Therefore, the economic punishment is an effective way to suppress adverse selection, so earnest money should be added in the guarantees clause of insurance contracts.

Policy-holder should pay insurance premiums and earnest money at first. If insurance accident does not

happen or happen but there are no adverse selection behaviors in the period of insurance, the insurer returns earnest money and deposit interest to the insured. Otherwise, as the economic punishment, the insurer not only does not compensate for the losses of the insured, but does not return earnest money and deposit interest.

**Establishing information screening mechanism and risk assessment system:** On the one hand, various information technologies should be used to information screening of farmers and the subject matter insured. The development of information technology is most convenient for the community, such as the relevant information of goods in the supermarket can be achieved through bar code scanning. So in the agricultural insurance, such technology can also be used to check whether poultry which died and injured are the insurance mark or not. Thus, it could effectively prevent farmers' moral risk. On the other hand, through Global Navigation Satellite System (GNSS), Radio Sonde (RS), Geographic Information System (GIS) and other high and new technology, which comprehensively utilize space information technology, computer technology and modern communication network technology, the insurer could carry out early warning and process monitoring for agricultural drought, floods, cold frost disasters and other natural disasters. Based on these systems, agricultural insurance institutions could get disaster information in time and effectively avoid moral risk of the policy-holder when a disaster occurs.

**Enhancing farmers' integrity awareness:** In the long run, to fundamentally solve asymmetric information of farmers, it is important for farmers to establish the honest consciousness. Because the proper insurance propaganda will guide consumers have a positive consumption idea, so it is the first step for farmers. In practice, insurance propaganda has been carried out for many years, but mainly in the city, not in rural areas. And to some extent, insurance is a fresh thing for farmers. Because the information channel which farmers have been very narrow, farmers don't understand the knowledge of insurance, whose insurance awareness is relatively weak. In recent years, although more and more commercial insurance companies have increased agricultural insurance propaganda, but as a result of the publicity is not standardized as well as short-term behavior, lack of long-term mechanism and so on, the awareness of farmers' moral integrity does not obviously improved. Therefore, to strengthen the propaganda and popularization of agricultural insurance knowledge, that is the effective way to enhance farmers's awareness of integrity.

**Establishing the effective agricultural insurance supervision and management system:** At present, there is a coexistence of various organization forms in

the agricultural insurance market. Insurance business model is still in the exploratory period and the law is also brewing. Therefore, to establish an effective supervision system plays an important role in the healthy and rapid development of global agricultural insurance market. Especially to prevent asymmetric information in agricultural insurance, the development of the supervision system should focus on the following two aspects:

The first is the supervision of the insured. The government should try to use the power of rural grassroots organizations, such as agro technical station, the village committee and so on, in which the staff is familiar with agriculture, farmers, rural area. They can establish agricultural insurance intermediary organizations, which provide the information could be used to prevent the insured farmers from adverse selection and moral hazard.

The second is the supervision of the insurer. The insurer should be required to actively expand agricultural insurance business and design the policy clause easy to understand. And the department of insurance supervision should protect customer interests as far as possible. At the same time, the insurance supervision departments should strengthen the supervision of credit status of the insurer that means any insurer may not take the hard sell of agricultural insurance, not cheat the insured and insurance claims rejected. Through the strict supervision and good insurance cultural construction, farmers' potential insurance demand will be changed into reality.

### CONCLUSION

According to game models designed in this study, the concrete manifestation and reason forming could be analyzed in depth. And then some precautionary strategies of asymmetric information could be put forward in scientific and reasonable. Therefore, it has very important theoretical and practical value to develop agricultural insurance.

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