The Optimal Contract for Land Trusteeship

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Abstract. Land trusteeship, as a new management mode to realize large-scale and intensive land management, has been paid more and more attention by the government and scholars. This paper develops a model to study the optimal contract of land trusteeship via principal-agent theory which is based on Tirole's (2006) entrepreneur model, and the model is numerically simulated. Theory and numerical simulation suggests that the optimal share ratio of agricultural service enterprises is positively correlated with the probability of successful land trusteeship during the due diligence work of agricultural service enterprises and the possible high net income per acre of land. The expected income of 1 acre of land , the probability of successful land trusteeship in due diligence of agricultural service enterprises and the effort degree of agricultural service enterprises in successful trusteeship have positive effect on the existence of the optimal contract; The land trusteeship fee, the expected necessary income of farmers, the private income of agricultural service enterprises, and the share ratio of agricultural service enterprises have negative effects on the existence of the optimal contract.

Keywords: Land trusteeship，Contract，principal-agent

1 Introduction

In the report of the 19th National Congress of the Communist Party of China, General Secretary Xi Jinping proposed the rural revitalization strategy for the first time in response to the issues of “Three rural”, and pointed out that the rural revitalization strategy is a fundamental solution to solve the problems of“Three rural”, promoting agricultural development, rural prosperity, and increasing farmers' income.

However, due to the widespread problem of scattered and small-scale land management plots in rural areas of China, the adoption of advanced agricultural production technologies such as "scale based technology" has been severely restricted, resulting in low agricultural output, poor quality of agricultural products, and a lack of competitiveness in the market. This production mode of small-scale peasant economy not only affects the improvement of agricultural technology, but also hinders the process of agricultural modernization and restricts the rapid development of rural economy. Accelerating the construction of a new agricultural management system and promoting

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innovation in agricultural management methods has become an urgent problem that needs to be solved in China. [1]

Land trusteeship is a new form of management in which large grain farmers, professional cooperatives, leading enterprises, supply and marketing cooperatives, and other trusteeship entities, in accordance with the needs of farmers, implement unified management, service, and operations of their responsible fields, while adhering to the unchanged responsibility system for family coalition production, unchanged land use rights, unchanged farmers 'operators, and unchanged peasants' beneficiary subjects. Through unified land trusteeship, the scattered land is concentrated and managed to promote the transformation of agricultural production methods, facilitating the realization of large-scale and mechanized agricultural production, improving agricultural production efficiency, and promoting rural economic development. [2] In addition, land trusteeship is also supported by the central policies. The Central Document No. 1 has repeatedly proposed supporting and supporting new agricultural business entities and new agricultural service entities.[3]

However, farmers entrust their land to agricultural service enterprises such as large grain growers, professional cooperatives, leading enterprises, supply and marketing cooperatives, etc. The principal-agent relationship is formed between farmers and agricultural service enterprises through signing trusteeship contracts. However, due to information asymmetry, some bad agricultural service enterprises have opportunistic behaviors and damage farmers' rights and interests by means of unloading responsibilities, which seriously affects farmers' enthusiasm for trusteeship, hindering the development of land trusteeship.[4]This dereliction of responsibility by agricultural service enterprises can be avoided through appropriate contracts. As long as a reasonable incentive mechanism is set up to ensure that the benefits of due diligence by agricultural service companies are no less than the benefits of dereliction of responsibility, they will work diligently. This not only enhances the work enthusiasm of agricultural service enterprises, but also enhances the trusteeship enthusiasm of entrusted farmers.

This paper uses the moral hazard model of asymmetric information (Tirole, 2006) to establish a principal-agent model between agricultural service enterprises and trusteeship farmers to analyze the main factors affecting land trusteeship, and study the optimal contract of land trusteeship.[5] The basic insight is that farmers entrust their land to agricultural service enterprises (custodians), as the level of effort of agricultural service enterprises cannot be observed, The trusteeship farmers face agency problems caused by asymmetric information. Agricultural service enterprises may take some opportunism behavior after the event to damage the interests of trusteeship farmers, which seriously affects the enthusiasm of farmers for trusteeship land, affects the stability of trusteeship contracts, and hinders the process of agricultural modernization.[6] To change this phenomenon, agricultural service enterprises must be encouraged not to take opportunism behavior after the event. This must enable agricultural service enterprises to obtain enough share in the final land income under the condition of hard work.

Therefore, a reasonable trusteeship contract should not only motivate agricultural service enterprises to fulfill their duties, but also ensure that the trusteeship farmers receive their expected necessary income, otherwise farmers will not choose to trust the land. Based on this, this paper establishes a principal-agent model between agricultural

service enterprises and trusteeship farmers, and studies the main factors affecting farmers' trusteeship land through equilibrium analysis, so as to design reasonable land trusteeship contracts. Finally, some policy suggestions are given to improve farmers' trust initiative.

2 Model

2.1 Fundamental Assumption

(1)Participants: Agricultural service enterprises and entrusted farmers. There is asymmetric information between agricultural service enterprises and entrusted farmers. The effort degree of agricultural service enterprises is the private information of agricultural service enterprises, and the entrusted farmers cannot observe the effort degree of agricultural service enterprises, but can only see the final income of the land.

(2) Each acre of land may generate high net income R_H ,or low net income R_L .When each acre of land receives high net income R_H ,it is called successful land trusteeship; When each acre of land receives low net income R_L ,it is called failed land trusteeship. The maximum difference in net income per acre of land $\Delta R = R_H - R_L > 0$.

(3) The expected necessary net income of entrusted farmers for each acre of land is R_0, and only when the net income of entrusted land is no less than R_0, the farmers will entrust the land to the agricultural service enterprises.

(4) The trusteeship fee of 1 acre of land entrusted by farmers is C_0 (the trusteeship fee here only includes the labor fee of agricultural service enterprises, excluding the cost of seeds, fertilizers and other means of production).

(5) When the entrusted land gets a high net income, it can ensure that the entrusted farmers get their expected necessary net income. When the entrusted land gets a low net income, the entrusted farmers cannot get their expected necessary net income. Whether the entrusted land earns high or low net income, the trusteeship cost of agricultural service enterprises can be guaranteed. That is: $R_H > R_0 + C_0 > R_L > C_0$

(6) The probability of success of land trusteeship is affected by the degree of effort of agricultural service enterprises, but the degree of effort of agricultural service enterprises is not observable. If agricultural service enterprises fulfills its duties, the probability of success of land trusteeship is P_H, the agricultural service enterprise has no private benefits; If the agricultural service enterprise shirks its responsibility, the probability of success of land trusteeship is P_L, the agricultural service enterprise receives private income B, which $\Delta P = P_H - P_L > 0$, represents the degree of effort of the agricultural service enterprise when the trusteeship is successful. The larger ΔP the higher degree of effort of the agricultural service enterprise when the trusteeship is successful.

(7) The expected return of the land while agricultural service enterprises fulfill their duties is greater than the sum of the expected return on the land and it's private income while agricultural service enterprises discharge their responsibilities. That is:

$$P_H R_H + (1 - P_H) R_L > P_L R_H + (1 - P_L) R_L + B$$

(8) Both agricultural service enterprises and entrusted farmers are risk neutral.

(9) Agricultural service enterprises have the pricing power of trusteeship contracts to maximize their own interests; Trusteeship farmers can only choose trusteeship or not trusteeship.

2.2 Contract Analysis

Even if the private income is included the expected income of the trusteeship land is not more than the expected income when the agricultural service enterprises do their due diligence if the agricultural service enterprises discharge their responsibilities. Only by incentivizing agricultural service enterprises to work diligently can land trusteeship have social efficiency. So the contract design must leave enough incentives for agricultural service enterprises to fulfill their duties. It is assumed that when the land trusteeship is successful, the agricultural service enterprise can not only receive the trusteeship fee C_0, but also get the share of the residual net income, and the share ratio is r. The proportion obtained by the entrusted farmers is (1-r) of the remaining net income in addition to the trusteeship expenses. When the land trusteeship fails, the agricultural enterprises can only get the trusteeship cost, and the trusteeship farmers get all the remaining net income. Therefore, the income of agricultural service enterprises must meet the incentive constraint:

$$P_H[(R_H - C_0)r + C_0] + (1 - P_H)C_0 \geq P_L[(R_H - C_0)r + C_0] + (1 - P_L)C_0 + B \quad (1)$$

The equation (1) reduces to: $\Delta P(R_H - C_0)r \geq B$ (2)

The entrusted farmers will participate in land trusteeship only if their expected income is no less than their expected necessary income. The contract design must also meet the participation constraint of the trusteeship farmers, that is:

$$P_H(R_H - C_0)(1 - r) + (1 - P_H)(R_L - C_0) \geq R_0 \quad (3)$$

According to equation (3):

$$P_H[(R_H - C_0)r + C_0] + (1 - P_H)C_0 \leq P_H R_H + (1 - P_H)R_L - R_0 \quad (4)$$

2.3 Optimization Model

Although agricultural service enterprises have the pricing power of contracts, due to the competition of the land trusteeship market, the land trusteeship fee can only be

uniformly priced according to the market conditions, and agricultural service enterprises have bargaining power only in the proportion of the remaining net income. Agricultural service enterprises can choose the appropriate share ratio to maximize their own benefits. Therefore, the optimal model for this problem is:

$$\begin{cases} \max_{r} \ P_H[(R_H - C_0)r + C_0] + (1 - P_H)C_0 \\ s.t \qquad \Delta P(R_H - C_0)r \geq B \\ \qquad\quad P_H[(R_H - C_0)r + C_0] + (1 - P_H)C_0 \leq P_H R_H + (1 - P_H)R_L - R_0 \end{cases} \tag{5}$$

2.4 Equilibrium Analysis

The solution of the optimization problem above is:

$$r^* = \frac{P_H \Delta R + R_L - C_0 - R_0}{P_H(R_H - C_0)}$$

Where the necessary condition of the existence of optimal solution is:

$$C_0 \leq P_H R_H + (1 - P_H)R_L - R_0 - \frac{P_H B}{\Delta P} = \overline{R^H} - R_0 - \frac{P_H B}{\Delta P} \tag{6}$$

In which $\overline{R^H} = P_H R_H + (1 - P_H)R_L$ represents the expected net income of 1 acre of land when the agricultural service enterprise performs due diligence.

As can be seen from the solution results of the optimization model, the optimal payment contract for agricultural service enterprises engaged in land trusteeship service is: when the trusteeship is successful, the proportion of the remaining net income obtained by the agricultural service enterprise is $r^* = (P_H \Delta R + R_L - C_0 - R_0)/[P_H(R_H - C_0)]$,the proportion of remaining net income obtained by the entrusted farmer is $1 - r^*$, the condition of the existence of optimal solution is the custody fee $C_0 \leq \overline{R^H} - R_0 - P_H B / \Delta P$.The condition of the existence of optimal solution is influenced by the land trusteeship fee C_0, the expected income of 1 acre of land when the agricultural service enterprise performs due diligence $\overline{R^H}$, the expected necessary net income of entrusted farmers for each acre of land R_0, the probability of successful land trusteeship when the agricultural service enterprise performs due diligence P_H, the private income of the agricultural service enterprise when it shirks its responsibility B, and the degree of effort of the agricultural service enterprise when the trusteeship is successful ΔP. And the lower the cost of land trusteeship, the easier it is for optimal contract to exist; The higher the expected net income of

1 acre of land during the due diligence work of agricultural service enterprises, the easier the optimal contract to exist; The lower the expected necessary net income of entrusted farmers for each acre of land, the easier the optimal contract to exist; The lower the private income of agricultural service enterprise when it shirks its responsibility, the easier it is for optimal contract to exist; The higher the level of effort of the agricultural service enterprise during successful trusteeship, the easier it is for optimal contract to exist.

3 Numerical Simulation

In this section, we study the influence of the main influencing factors of land trusteeship on the optimal contract through numerical simulation. We set the parameters: R_H=1000，R_L=600，C_0=120，R_0=600, give figure 1 about the relationship between the share ratio of the residual net income r and the probability of successful land trusteeship during the due diligence work of agricultural service enterprises P_H; we set the parameters: R_L=600，C_0=120，R_0=600, P_H=0.8， give figure 2 about the relationship between the share ratio of the residual net income r and the possible high net income per acre of land R_H.

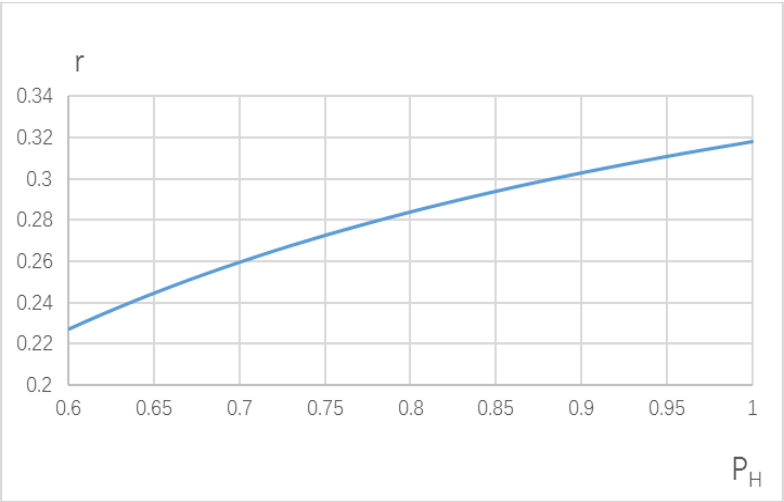

Fig. 1. Share ratio and the probability of successful land trusteeship

Figure 1 and Figure 2 show that the share ratio of the residual net income r decreases with the probability of successful land trusteeship when the agricultural service enterprise performs due diligence P_H and the possible high net income per acre of land R_H.Agricultural service enterprises need to improve their work skills and enthusiasm in order to obtain higher profits from land trusteeship services. By increasing the probability of successful land trusteeship during the due diligence work of agricultural service enterprises and the high net income that may be obtained per acre of land, they can improve their own earnings.

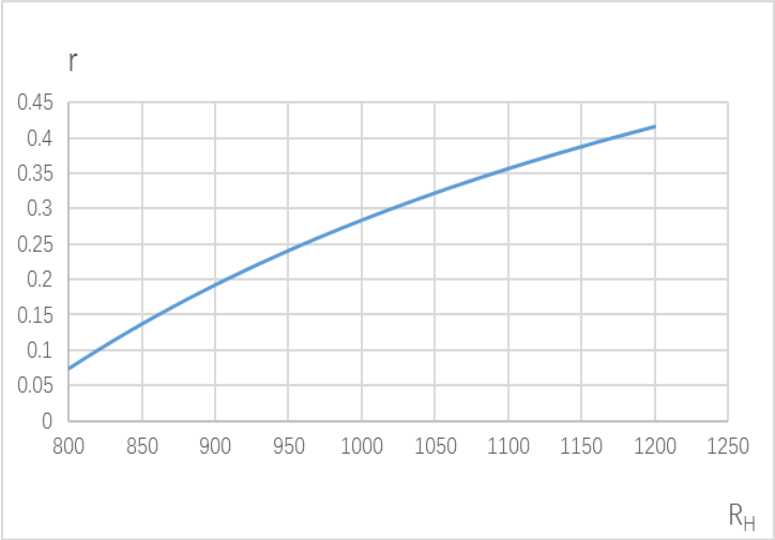

Fig. 2. Share ratio and high net income

4 Conclusion

It can be seen from the analysis in the above part that the optimal contract of land trusteeship service for agricultural service enterprises is: when the trusteeship is successful, the proportion of the remaining net income obtained by the agricultural service enterprises is $r^* = (P_H \Delta R + R_L - C_0 - R_0)/[P_H(R_H - C_0)]$, the proportion of the remaining net income obtained by the entrusted farmers is $1 - r^*$. When the optimal contract is established, the entrusted farmers only receive their expected necessary net income R_0 from per acre of land, the agricultural service enterprises get all the excess income. In this way, not only the participation of farmers is guaranteed, but also the agricultural service enterprises get the maximum benefits.

The optimal share ratio of agricultural service enterprises is positively correlated with the probability of successful land trusteeship during the due diligence work of agricultural service enterprises and the possible high net income per acre of land. The main factors that affect the establishment of the contract are: land custody fee, the expected income of 1 acre of land when agricultural service enterprises fulfill their duties, the expected necessary net income of entrusted farmers for each acre of land, the probability of successful land trusteeship when agricultural service enterprises fulfill their duties, the private income of agricultural service enterprises when it shirks its responsibility, the effort degree of the agricultural service enterprise when the land trusteeship is successful, and the share proportion of the agricultural service enterprise when the land trusteeship is successful. Among them, the expected return on 1 acre of land during the due diligence work of agricultural service enterprises, the probability of successful

land trusteeship during the due diligence work of agricultural service enterprises, and the degree of effort of the agricultural service enterprise when the trusteeship is successful have a positive impact on the establishment of contracts; The other three factors have a negative impact on the establishment of the contract.

5 Suggestions

To take the road of socialist rural revitalization with Chinese characteristics, it is necessary to solve the problems of "three rural areas". As an important means to solve the problems of agriculture, rural areas, and farmers, "land trusteeship" operates continuously, stably, and healthily in order to better serve rural revitalization. In this way, in addition to making a reasonable trusteeship contract to ensure the benefits of both parties, it is also necessary to find ways to improve the agricultural work skills of agricultural service enterprises, in order to improve the probability of successful land trusteeship and the income of land upon successful trusteeship, so as to enhance the working enthusiasm of agricultural service enterprises and the willingness of farmers to trusteeship, and promote the achievement of the contract. Only by effectively ensuring the rights and interests of farmers can they be willing to entrust their land to agricultural service enterprises, so that Chinese agriculture can achieve large-scale operation, some modern agricultural technologies can be promoted, and agricultural production efficiency can be improved. Agricultural revitalization can better assist rural revitalization.

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