

Retraction

Retracted: The Equilibrium Mechanism of Interest Distribution in Farmland Transfer: Based on the Perspective of the Three-Party Game

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This article has been retracted by Hindawi following an investigation undertaken by the publisher [1]. This investigation has uncovered evidence of one or more of the following indicators of systematic manipulation of the publication process:

- (1) Discrepancies in scope
- (2) Discrepancies in the description of the research reported
- (3) Discrepancies between the availability of data and the research described
- (4) Inappropriate citations
- (5) Incoherent, meaningless and/or irrelevant content included in the article
- (6) Peer-review manipulation

The presence of these indicators undermines our confidence in the integrity of the article's content and we cannot, therefore, vouch for its reliability. Please note that this notice is intended solely to alert readers that the content of this article is unreliable. We have not investigated whether authors were aware of or involved in the systematic manipulation of the publication process.

Wiley and Hindawi regrets that the usual quality checks did not identify these issues before publication and have since put additional measures in place to safeguard research integrity.

We wish to credit our own Research Integrity and Research Publishing teams and anonymous and named external researchers and research integrity experts for contributing to this investigation.

The corresponding author, as the representative of all authors, has been given the opportunity to register their agreement or disagreement to this retraction. We have kept a record of any response received.

References

- [1] H. Li and X. Zhang, "The Equilibrium Mechanism of Interest Distribution in Farmland Transfer: Based on the Perspective of the Three-Party Game," *Discrete Dynamics in Nature and Society*, vol. 2021, Article ID 7912554, 12 pages, 2021.

Research Article

The Equilibrium Mechanism of Interest Distribution in Farmland Transfer: Based on the Perspective of the Three-Party Game

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The purpose of the paper is to study how the interests of farmland transfer be distributed among the government, contractors, and farmland transferees. The process of the paper is to analyze the evolutionary stability strategies of the government, contractors, and farmland transferees by building a three-party evolutionary game model; in order to identify the equilibrium point of the three-party evolutionary game, an example of interest distribution in a village in Anhui Province is used to analyze and simulate the three-party evolutionary game. The conclusions of the paper are as follows: the combination of a one-party subsidy, transferring farmland, and grain production is the ideal equilibrium result in the three-party game; farmland transfer rent is the a crucial factor of interest balance among the three parties; only if the farmland transfer rental price is larger than the sum of the contractor's self-farming incomes and subsidies and lower than the grain income of the transferee can the three parties realize the equilibrium of interest distribution. The suggestions of the paper are that the government should carry out the system of "retirement allowance" and transform "subsidy" to "allowance" to protect the interests of contractors, and the government should promote farmland transfer and encourage grain production by controlling the fluctuation range of farmland transfer rent.

1. Introduction

The introduction of a third right, a land management right which is transferable from peasants to outsiders, has enabled a huge land assembly movement, affecting millions of small holdings [1]. There are four kinds of basic interests in farmland transfer in China: grain outputs, agricultural subsidies, farmland transfer rents, and agricultural profits. There are three basic parties that participate in the interest distribution of farmland transfer: the government, the contractors (the peasants who sign a contract with the government to obtain the management rights of the farmland. If they transfer out the farmland, they are also called transferors) and the transferees (who transfer farmland from the contractors). Therefore, there are three basic contradictory relationships: the relationship between the government and the contractors, the relationship between the contractors and the transferees, and the relationship

between the government and the transferees. Between the government and the contractors, if the government cancel the subsidies for the contractors, the contractors would refuse to transfer farmland. Between the contractors and the transferees, if the rent of farmland transfer is high, the transferees will not transfer in farmland or engage in "nongrain" business to obtain great profits. Between the government and the transferees, if the government does not subsidize the transferees' grain production, the transferees will engage in "nongrain" business.

In the interest distribution of farmland transfer, the government, the contractors, and the transferees all want to maximize their own interests and engage with each other. What kind of strategy do the three parties of farmland transfer adopt to participate in interest distribution? To what extent is a balanced interest distribution achieved? What is the impact on the farmland transfer and the interest distribution? Regarding these three problems, this paper uses evolutionary

game theory to study the strategic behavior of the three parties in the game, analyzes the evolutionary stability strategy of the three parties, and determines the equilibrium point of the three parties' interest game. Based on the value of the interest distribution in a village in Anhui Province, evolution simulation is carried out using MATLAB. On this basis, the policy implications of this paper are revealed. From our research, the final state of interest distribution among three parties in farmland transfer can be better predicted, and the reference for the decision-making of the government, the contractors, and the transferees can be provided.

2. Literature Review

Regarding the interest distribution of farmland transfer in China, scholars focus on studying in which ways farmland transfer parties participate in the interest distribution of farmland transfer and the income status of farmers after such transfer.

Subsidies are the important interest of farmland transfer. Subsidies are the main means for the government to regulate grain production and farmers' incomes. The existing research examines the income effect of subsidies from three aspects: the effect causing increases in grain production, farmers' income, and rent. Regarding subsidies on increasing grain production, most scholars suggest that subsidies significantly increase grain production [2, 3], but some scholars argue that the effect of subsidies on grain production has declined [4, 5], indicating that we must find another way to increase grain production. Regarding farmers' income, scholars generally believe that subsidies promote an increase in this [6], and, now, agricultural subsidies have evolved into an income subsidy for farmers [7]. In regard to the increase in rental price caused by subsidies, scholars suggest that the existing agricultural subsidies strengthen farmers' understanding of contractual rights and farmland as welfare [8], facilitate subsidy involution development, and cause an increase in the rental price of farmland transfer.

The rent of farmland transfer is the core interest of farmland transfer. The rent of farmland transfer is the price of farmland transfer, which is the most fundamental means for contractors to obtain the interest distribution of farmland transfer. Studies on the rent of farmland transfer in China can be divided into two stages. The first stage occurred around 2010, and it mainly focuses on why the rent of farmland transfer is low, the damage to farmers' interests, and the poor transfer of farmland. Scholars study the formation mechanism, components, pricing model, and influencing factors of farmland transfer rent, respectively. Some scholars' studies show that 30% to 50% of the land that has been transferred does not receive any rent, in terms of both the number of land parcels and the land area [9]. The purposes of the research are to improve the rent of farmland transfer, protect farmers' interests, and promote the transfer of farmland. In the second stage, which occurred around 2017, due to the rapid rise in farmland transfer rental price, scholars began to study the causes of high farmland transfer rental prices and its impact on grain production. Based on these studies, turning subsidies into absolute land rent [10],

overcapitalization of farmland [11–13], preference for farmland of industrial and commercial capital [14], farmland prices illusion of contractors, profit illusion of transferees, and farmers' expected prices [15] cause an abnormal increase in farmland transfer rental prices.

The transferee's profit is the new interest created by farmland transfer, which is the fundamental goal of the transferee's lease of farmland and the fundamental means for the transferee to participate in the interest distribution of farmland transfer. The existing studies examine how the profit of transferees can be improved from the perspective of the scale operation and government subsidies. Off-farm employment and part-time employment can significantly affect the scale of land transfer of farmers [16, 17]. Some scholars' studies show that the larger the leased area of farmland, the larger the operation scale, the higher the profit [18–20], the more obvious the income effect, and the more possible income of transferees' [21]. In relation to government subsidies, scholars generally believe that subsidies are the most effective policy tools to promote the transfer of farmland and improve the income of transferees. They successively put forward secondary financial subsidies to transferees [22], direct agricultural subsidies to transferees, land transfer price subsidies [23], classified subsidies, and land transfer subsidies [24].

The income distribution effect of farmland transfer has two distinct conclusions. One conclusion is that farmland transfer will lead to income inequality. Farmland transfer is conducive to an increase in income in rural high-income groups, thus widening the income gap of farmers [25], and collective transfer of farmland aggravates the income gap. Another conclusion is that farmland transfer will narrow the rural income gap and reduce income inequality [26, 27]. Farmland has little effect on reducing rural income inequality, so policy makers need to encourage poor farmers to transfer out farmland [28]; in areas with underdeveloped economy and low income of land units, farmland transfer improves income distribution [29].

In all of these studies, scholars focus on the means and ways of farmland transfer parties to participate in the distribution of farmland transfer interests, for example, the subsidy between the government and farmers, the rent of farmland transfer between the transferors and transferees, the subsidy between the government and transferees, or the income distribution effect after farmland transfer. However, there is no research on the contradictory relationship between the participants and the interaction between the means of distribution. Although some authors proposed the use of the game theory method to study the interest distribution of farmland transfer [30], there is no practical method to follow. Some authors also calculated the distribution relationship of subsidies between the transferees and transferors [31, 32] but only calculated the division of a certain interest between the two parties. These studies ignore the three basic participants in the transfer of farmland, namely, the government, contractors, and the transferees, who use strategic behavior to distribute the interests generated from the transfer of farmland. This paper attempts to supplement this research gap. Using the tripartite evolutionary game, it reveals the interest objectives, the coping

strategies, and the game equilibrium of the participants in the farmland transfer, and it better predicts the final interest distribution state of the three parties in the farmland transfer, so as to provide reference for decision-making of the government, contractors, and the transferees.

3. Analysis Framework and Model Construction

3.1. Analysis Framework. This paper studies the game relationship in the interest distribution of farmland transfer under the framework of three parties: the government, contractors, and the transferees (represented by G , O , and L , respectively). The analysis framework is shown in Figure 1.

In Figure 1, \longrightarrow represents the interest distribution of farmland transfer. There are four kinds of interests in farmland transfer: grain output, agricultural subsidies, agricultural profits, and the rent of the farmland transfer. Through agricultural subsidies, the government can stimulate farmland transfer and obtain stable grain production. By transferring in farmlands, the transferees can expand their farmland scale, the transferees' subsidies, and agricultural profits. Through the supply of farmland, the contractors obtain the direct agricultural subsidies and the rent of farmland transfer.

In Figure 1, \iff represents the relationship of contradictions and the game of interests. There are three basic participants in the interest distribution in the farmland transfer: the government, the contractors, and the transferees. Therefore, there are three basic contradictions. The first is the contradiction and the interest game between the government and the contractors. The government decides the ownership of direct agricultural subsidies, and the contractors decide whether to transfer the farmland. The second is the contradiction and the interest game between the government and the transferees. The government decides whether to provide agricultural subsidies to the transferees, and the transferees decide whether to engage in grain production. The third is the contradiction and the interest game between the contractors and the transferees. The contractors supply the farmlands, and the transferees pay the farmland transfer rent. The level of farmland transfer rent directly determines whether the contractors transfer out the farmlands or not, and this also determines the level of the transferees' net profit.

The three participants are rational individuals, pursuing the maximization of their own interests. The government's goal is to achieve grain security and maximize grain production with the least agricultural subsidies. The goal of the contractor is to maximize their own utilities and obtain both government subsidies and farmland transfer rent. The goal of the transferees is to maximize profits, pay less rent, and obtain more government subsidies. Regarding the interest distribution of farmland transfer, the three parties contradict are interdependent of each other. The strategic behavior of one party inevitably leads to the strategic reaction of the other two parties, and one party's maximization of interests inevitably affects the maximization of the interests of the other two parties. Finally, there is a satisfactory equilibrium

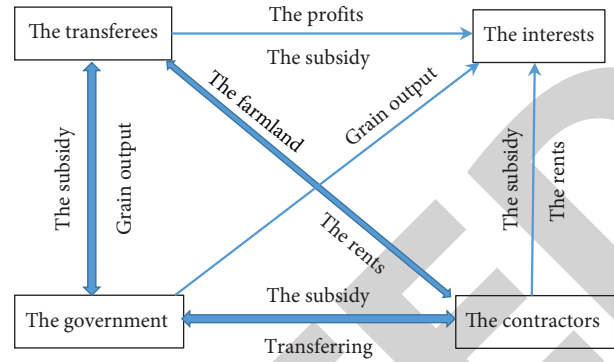


FIGURE 1: The research framework of interest distribution in farmland transfer.

solution among the three parties, which is the combination of the evolutionary stable strategies of the three parties.

3.2. Model Construction. In the three-party evolutionary game, the strategy set of the government is $A = \{a_1, a_2\}$, where a_1 stands for "one-party subsidy"; that is, the subsidies are only given to the transferees; a_2 stands for "two-party subsidy," which gives subsidies to both the transferees and the contractors. R_G is the government's grain output when the contractors farm themselves; bR_G ($b \geq 1$) is the government's grain output when the transferees choose "grain production." If the transferees choose "nongrain production," the government's grain output is 0. The government's expenditure is the direct agricultural subsidies of the contractors S_L and agricultural subsidies of the transferees S_O . The strategy set of the transferees is $C = \{c_1, c_2\}$, where c_1 stands for "grain production"; if the transferees can maximize their profits, they will engage in grain production; otherwise, they will engage in nongrain production. c_2 stands for "nongrain"; if the transferees transfer farmlands in and engage in grain production, the grain profit is R_O and the net profit of grain production is $R_O - T$ after the rent T of farmland transfer is paid to the contractors. The net profit of nongrain is $a(R_O - T)$, where a is a nongrain gain coefficient. If the transferees engage in "grain production," there are subsidies S_O from the government, while if they engage in "nongrain production," there is no government subsidy S_O . The strategy set of the contractors is $B = \{b_1, b_2\}$, where b_1 stands for "transferring farmland" and b_2 stands for "nontransferring farmland." The income of the contractors from self-farming is R_L , and the contractors obtain direct agricultural subsidies S_L from the government. If the farmland is transferred, the contractors gain the rent of farmland transfer T . The payment matrix of the three-party game among the government, the transferees, and the contractors is constructed, as shown in Tables 1 and 2.

An explanation of the payoff matrix is that the first figure of the array in the table is the government's payoff, the second is the transferee's payoff, and the third is the contractor's payoff. If the contractors do not transfer farmland, the transferees have no income, and the payoff is 0; under the one-party subsidy of the government, the contractors can obtain the subsidy S_L even if they do not transfer farmland.

TABLE 1: The matrix of three-party payoff under government one-party subsidy.

		Contractors	
		Transferring farmland	Nontransferring farmland
Transferees	Grain production	$bR_G - S_O, S_O + R_O - T, T$	$R_G - S_L, 0, S_L + R_L$
	Nongrain production	$0, a(R_O - T), T$	$S_L, 0, S_L$

TABLE 2: The matrix of three-party payoff under government two-party subsidy.

		Contractors	
		Transferring farmland	Nontransferring farmland
Transferees	Grain production	$bR_G - S_O - S_L, R_O + S_O - T, S_L + T$	$R_G - S_L, 0, S_L + R_L$
	Nongrain production	$-S_L, a(R_O - T), S_L + T$	$-S_L, 0, S_L$

4. Model Analysis

Assuming that the probability of the government's one-party subsidy strategy is x ($x \in [0, 1]$), then the probability of the government's two-party subsidy strategy is $1 - x$. The probability of the contractors' transferring farmland strategy is y ($y \in [0, 1]$), and the probability of the contractors' non-transferring farmland strategy is $1 - y$. The probability of the transferees' grain production strategy is z ($z \in [0, 1]$), and the probability of the transferees' nongrain production strategy is $1 - z$. Thus, the dynamic equation of the government, the contractors, and the transferees can be calculated.

The replicated dynamic equation of the government is as follows.

According to Tables 1 and 2, we calculated the expected payoff of the "one-party subsidy" strategy U_{G_1} . The expected payoff of the "two-party subsidy" strategy U_{G_2} and the average expected payoff \bar{U}_G are as follows:

$$U_{G_1} = yz(bR_G - S_O) + y(1 - z) \times 0 + (1 - y)z(R_G - S_L) + (1 - y)(1 - z)(-S_L), \quad (1)$$

$$U_{G_2} = yz(bR_G - S_O - S_L) + y(1 - z)(-S_L) + (1 - y)z(R_G - S_L) + (1 - y)(1 - z)(-S_L), \quad (2)$$

$$\bar{U}_G = xU_{G_1} + (1 - x)U_{G_2}, \quad (3)$$

$$F(x) = \frac{dx}{dt} = x(U_{G_1} - \bar{U}_G) = x(1 - x)yS_L. \quad (4)$$

In the same way, the replicated dynamic equation of the contractors and the transferees can be obtained:

$$F(y) = \frac{dy}{dt} = y(1 - y)(T - zR_L - xS_L), \quad (5)$$

$$F(z) = \frac{dz}{dt} = z(1 - z)y[S_O - (a - 1)(R_O - T)]. \quad (6)$$

According to the differential equation law of the evolutionary stability strategy, (4)–(6) are simultaneously established to obtain the differential equations for the replicating power system of the government, the contractors, and the transferees:

$$\begin{cases} F(x) = x(1 - x)yS_L, \\ F(y) = y(1 - y)(T - zR_L - xS_L), \\ F(z) = z(1 - z)y[S_O - (a - 1)(R_O - T)]. \end{cases} \quad (7)$$

Using the system of differential equation (7), the Jacobian matrix J is constructed:

$$J = \begin{bmatrix} (1 - 2x)yS_L & x(1 - x)S_L & 0 \\ -y(1 - y)S_L & (1 - 2y) \cdot (T - zR_L - xS_L) & -y(1 - y)R_L \\ 0 & z(1 - z) \cdot [S_O - (a - 1)(R_O - T)] & (1 - 2z)y \cdot [S_O - (a - 1)(R_O - T)] \end{bmatrix}. \quad (8)$$

Letting $F(x) = F(y) = F(z)$, eight stable local equilibrium points composed of (x, y, z) are obtained: $E_1(0, 0, 0)$, $E_2(0, 0, 1)$, $E_3(0, 1, 0)$, $E_4(0, 1, 1)$, $E_5(1, 0, 0)$, $E_6(1, 0, 1)$, $E_7(1, 1, 0)$, and $E_8(1, 1, 1)$. Substituting the values of the eight local equilibrium points into (8), the eigenvalues of the Jacobian matrix of each local equilibrium point are calculated. The eigenvalues of the

Jacobian matrix of the eight equilibrium points are listed in Table 3.

According to the eigenvalues of the Jacobian matrix of the differential equation, we can judge the global stability of the eight stable local equilibrium points. If and only if all the eigenvalues of the Jacobian matrix are not positive [33, 34],

TABLE 3: The eigenvalues of the Jacobian matrix.

Equilibrium	Eigenvalues λ_1	Eigenvalues λ_2	Eigenvalues λ_3
$E_1 (0, 0, 0)$	0	T	0
$E_2 (0, 0, 1)$	0	$T - R_L$	0
$E_3 (0, 1, 0)$	S_L	$-T$	$S_O - (a - 1)$ $(R_O - T)$
$E_4 (0, 1, 1)$	S_L	$-(T - R_L)$	$-[S_O - (a - 1)$ $(R_O - T)]$
$E_5 (1, 0, 0)$	0	$T - S_L$	0
$E_6 (1, 0, 1)$	0	$T - R_L - S_L$	0
$E_7 (1, 1, 0)$	$-S_L$	$-(T - S_L)$	$S_O - (a - 1)$ $(R_O - T)$
$E_8 (1, 1, 1)$	$-S_L$	$-(T - R_L - S_L)$	$-[S_O - (a - 1)$ $(R_O - T)]$

the equilibrium point is the evolutionary stable strategy (ESS) equilibrium point of the system. Clearly, the global stability of the equilibrium point depends on the values of the farmland transfer rent (T), the income of self-farming (R_L), the direct agricultural subsidy for contractors (S_L), the increased profit of nongrain ($(a - 1)(R_O - T)$), the agricultural subsidies for transferees (S_O), and the interrelationship among them. The contractors have already gained subsidies S_L from the government, as China has implemented direct agricultural subsidies for many years. Moreover, the rent level of farmland transfer is significantly higher than the subsidy of contractors. If the rent is lower than the income of self-farming, the contractors will farm by themselves and gain income from self-farming. In order to analyze the sign of eigenvalues corresponding to different equilibrium points conveniently, and without losing generality, we assume that $T > 0$, $T - R_L > 0$, $S_L > 0$, and $T - S_L > 0$. There are many complex parameters in the model, and four situations are discussed for the stability strategy of the evolutionary game, as shown in Tables 4 and 5.

In the first case, $T - R_L - S_L > 0$, $S_O - (a - 1)(R_O - T) > 0$, that is, the case in which the rent of farmland transfer is greater than the sum of the contractors' self-farming income and the agricultural subsidies, the transferees' subsidies are greater than the increased profit of nongrain. It can be observed that only $E_8 (1, 1, 1)$ is the evolutionary stable strategy equilibrium point. In the second case, $T - R_L - S_L > 0$, $S_O - (a - 1)(R_O - T) < 0$, that is, the case in which the rent of farmland transfer is greater than the sum of the contractors' self-farming income and the agricultural subsidies, the transferees' subsidies are less than the increased profit of nongrain, and $E_7 (1, 1, 0)$ is the evolutionary stable strategy equilibrium point. In the third case, $T - R_L - S_L < 0$, $S_O - (a - 1)(R_O - T) < 0$, that is, the case in which the rent of farmland transfer is less than the sum of the contractors' self-farming income and the agricultural subsidies, the transferees' subsidies are greater than the increased profit of non-grain, and there is no evolutionary stable strategy equilibrium point. In the fourth case, $T - R_L - S_L < 0$, $S_O - (a - 1)(R_O - T) > 0$, that is, the case in which the rent of farmland transfer is less than the sum of the contractors' self-farming income and the agricultural subsidies, the transferees' subsidies are less than the increased

profit of nongrain, and $E_7 (1, 1, 0)$ is the evolutionary stable strategy equilibrium point.

Therefore, there are only two evolutionary stable strategy equilibrium points in the tripartite game among the government, the contractors, and the transferees regarding the interest distribution of farmland transfer, namely, $E_7 (1, 1, 0)$ and $E_8 (1, 1, 1)$. The evolutionary stability strategies they correspond to are one-party subsidy, transferring farmland, and nongrain production and one-party subsidy, transferring farmland, and grain production, respectively. $E_8 (1, 1, 1)$, one-party subsidy, transferring farmland, and grain production, is an ideal result of evolutionary stable strategy equilibrium.

Based on the above analysis, the rent of farmland transfer is the crucial determine factor of tripartite interest distribution. Only if the rent of farmland transfer is greater than the sum of the contractors' self-farming income and the agricultural subsidies will the contractors transfer out farmlands. Only if the contractors transfer out farmlands can the government implement the one-party subsidy policy on transferees. For the transferees, if the rent of farmland transfer is equal to the transferees' grain income, they can engage in grain production only by relying on their subsidies from the government.

Therefore, the reasonable range of farmland transfer rent is $R_L + S_L < T < R_O$; that is, the three parties can realize the balance of interest distribution only if the rent of farmland transfer is greater than the sum of the contractors' self-farming income and the agricultural subsidies and less than the grain income of the transferees. There is one question that's worth discussing, if the income of nongrain production is greater than the sum of government subsidy and grain production income, that is, $S_O - (a - 1)(R_O - T) < 0$, $E_7 (1, 1, 0)$ is the evolutionary stable strategy equilibrium point. The point $E_7 (1, 1, 0)$ cannot adjust to the evolutionary equilibrium point of $E_8 (1, 1, 1)$ through the government subsidies. This indicates that part of farmland must be used for nongrain production to meet the strong demand for nongrain products.

5. Case Analysis

5.1. Equilibrium Point of Interest Distribution. This paper empirically analyzes the distribution of interests among the government, the contractors, and the transferees in the case of 4300 mu (1 mu = 1/15 Ha) farmland transfer in a village in Anhui Province.

The village is located in the northeast, about 240 kilometers of Hefei city, the capital of Anhui Province. It is located in the watershed between Yangtze River and Huaihe River and has a hilly landform, with a drop of about 20 meters. The village has a population of more than 4000 people, and young and strong workers commute to the cities for work. Most of the villagers are left-behind old people and children, and the labor force is mainly composed of males in their 50s. The whole farmlands of the village have more than 18,500 mu, and they are relatively barren and highly dependent on chemical fertilizers; farmland is mainly irrigated by water stored in ponds. The crops grow twice a year,

TABLE 4: Eigenvalues and stability.

Equilibrium	Case 1				Case 2			
	λ_1	λ_2	λ_3	Stability	λ_1	λ_2	λ_3	Stability
$E_1 (0, 0, 0)$	0	+	0	Unstable	0	+	0	Unstable
$E_2 (0, 0, 1)$	0	+	0	Unstable	0	+	0	Unstable
$E_3 (0, 1, 0)$	+	-	+	Unstable	+	-	-	Unstable
$E_4 (0, 1, 1)$	+	-	-	Unstable	+	-	+	Unstable
$E_5 (1, 0, 0)$	0	+	0	Unstable	0	+	0	Unstable
$E_6 (1, 0, 1)$	0	+	0	Unstable	0	+	0	Unstable
$E_7 (1, 1, 0)$	-	-	+	Unstable	-	-	-	Evolutionary stability strategies (ESS)
$E_8 (1, 1, 1)$	-	-	-	Evolutionary stability strategies (ESS)	-	-	+	Unstable

TABLE 5: Eigenvalues and stability.

Equilibrium	Case 3				Case 4			
	λ_1	λ_2	λ_3	Stability	λ_1	λ_2	λ_3	Stability
$E_1 (0, 0, 0)$	0	+	0	Unstable	0	+	0	Unstable
$E_2 (0, 0, 1)$	0	+	0	Unstable	0	+	0	Unstable
$E_3 (0, 1, 0)$	+	-	+	Unstable	+	-	+	Unstable
$E_4 (0, 1, 1)$	+	-	-	Unstable	+	-	-	Unstable
$E_5 (1, 0, 0)$	0	+	0	Unstable	0	+	0	Unstable
$E_6 (1, 0, 1)$	0	-	0	Unstable	0	+	0	Unstable
$E_7 (1, 1, 0)$	-	-	+	Unstable	-	-	-	Evolutionary stability strategies (ESS)
$E_8 (1, 1, 1)$	-	+	-	Unstable	-	+	+	Unstable

mainly rice, wheat, and rapeseed. Rice is harvested in autumn, rapeseed is harvested in spring, and rice is planted in paddy fields, while wheat or rapeseed are planted in irrigated and sloping fields.

Before transferring, the direct agricultural subsidies given to the contractors by the government is CNY 97.5 per mu, which is rounded up to CNY 100. The transferees gained a production reward of CNY 100 per mu from the government after transferring in 4300 mu farmlands. The crops in the village grow twice a year, with wheat harvested in spring and rice harvested in autumn, and the net income per mu is CNY 250–1000. Income is assumed to be evenly distributed over 4300 mu farmlands; the grain income of the contractors before the transfer is $(1000 + 250)/2 = 625$. 4300 mu farmlands are all transferred to the transferees, and the grain income of the transferees should be no less than CNY 1000 per mu. The farmland transfer rent is CNY 800 per mu. If the contractors are engaged in grain production, the grain output value of that obtained by the government is $R_G = (650 + 850/2) + (850 + 1250/2) = 1800$. If the transferees are engaged in grain production, the grain output value obtained by the government is $bR_G = 850 + 1250 = 2100$. Because the transferees have not used the farmland for nongrain production in the past three years, let $a = 1$; that is, the increased profit of nongrain is 0. These parameters are listed in Table 6.

Substituting the above values into Table 3, the Jacobian eigenvalues of the village in Anhui province are obtained, as shown in Table 7.

According to the criterion of the equilibrium point based on global stability, $E_8 (1, 1, 1)$ is the evolutionary stable strategy equilibrium point; that is, one-party subsidy, transferring farmland, and grain production represent the

TABLE 6: List of village parameter values.

R_G	R_L	R_O	T	a	b
1800	625	1000	800	1	1.17

stable strategic combination among the government, the contractors, and the transferees. At present, the interest distribution of farmland transfer in the village is in an unstable state, because the government’s “two-party subsidy” policy is not the government’s evolutionary stability strategy, and the government tends to implement the policy of “one-party subsidy”; that is, the trend of government’s policy is to abolish direct agricultural subsidies for contractors and retain or increase subsidies for transferees.

Some phenomena in the survey can also prove the unstable state of interest distribution in the village. First, the rent of farmland transfer continues to fall and dropped twice in the past three years, from CNY 960 to CNY 900 and finally to CNY 800 at present. Second, the rent of farmland transfer is different in the village. In addition to the rent of farmland transfer (CNY 800), the rent of farmland transferred privately among the contractors costs only CNY 200–300. Third, two transferees were replaced in the past three years because they were unable to pay their rent. Finally, the transferees consider the possibility of nongrain production, but they give up because of the government restrictions and the selection of nongrain varieties.

5.2. Simulation Analysis. The initial value of x is calculated by the ratio of the area of transferees’ farmland actually subsidized by the government to the area of transferred farmlands, $x = 0.6$. The initial value of y is calculated by the

TABLE 7: Eigenvalues of the Jacobian matrix in the village.

Equilibrium	Eigenvalues λ_1	Eigenvalues λ_2	Eigenvalues λ_3
$E_1 (0, 0, 0)$	0	800	0
$E_2 (0, 0, 1)$	0	175	0
$E_3 (0, 1, 0)$	100	-800	100
$E_4 (0, 1, 1)$	100	-175	-100
$E_5 (1, 0, 0)$	0	700	0
$E_6 (1, 0, 1)$	0	75	0
$E_7 (1, 1, 0)$	-100	-700	100
$E_8 (1, 1, 1)$	-100	-75	-100

ratio of the area of actually transferred farmland of the contractors to the area of the whole contractors' farmlands, $y=0.4$. The initial value of z is calculated by the ratio of the area of farmland with grain actually planted by the transferees to the area of the transferred farmland, $z=0.7$. Substituting the above parameters into (7), MATLAB evolution simulation is as shown in Figure 2(d). Figure 2(d) shows that the government will eventually abolish the subsidies for the contractors and only subsidize the transferees. Next, we used Matlab2018b simulation technology to demonstrate the impact of farmland transfer rent, the farmland transfer motivation of contractors, and the evolutionary power of the transferees, respectively.

5.2.1. The Impact of Farmland Transfer Rent on the Evolutionary Stability Strategy of the Three Parties. According to Table 3, there are three critical value points of farmland transfer rent $T: S_L, R_L,$ and $R_L + S_L$. Combined with this case, the farmland transfer rent is divided into four intervals: $(0, 100), (100, 625), (625, 725),$ and $(725, 1000)$. T is 70, 550, 670, and 800, respectively, and other parameters remain unchanged, demonstrating the influence of the change in T on the tripartite evolutionary stability strategy.

In Figure 2(a), because the rent is too low, the contractors quickly give up transferring farmlands, and, as a result, it is difficult for the government and the transferees to implement the strategy of "one-party subsidy" and "grain production," respectively; the three parties cannot reach the combination equilibrium of the evolutionary stable strategy, and Figure 2(b) is similar to Figure 2(a). In Figure 2(c), with the substantial increase in farmland transfer rental price, the contractor's enthusiasm for transferring farmland rises, and the transferred farmland also rapidly increases; however, with the increase in the probability of the "one-party subsidy" implemented by the government, the contractors begin to reduce the rate of farmland transfer. If the government implements the "one-party subsidy" completely, the contractors finally give up transferring farmlands and return to the strategy of "nontransferring farmland." If the rent of farmland transfer is greater than the sum of contractors' self-farming income and the agricultural subsidies, high rental prices will encourage contractors to transfer out farmland quickly. Thus, the contractors transfer out farmland completely at the fastest speed, and the government and the transferees evolve to 1 (i.e., the strategy of "one-party

subsidy" and "grain production") at roughly the same speed, far lower than the farmland transferring speed of the contractors, which shows that it is a long evolution process for the government to cancel the agricultural subsidies for contractors.

5.2.2. Analysis on the Farmland Transfer Motivation of the Contractors. The farmland transfer decision-making of the contractors is affected by many factors; it is also the basis of the optimal strategic choice of the government and the transferees. Therefore, it is necessary to conduct a specific analysis of the motivation of contractors in farmland transfer. According to the differential equation rule of the evolutionary stability strategy, the partial derivative of y from (5) is

$$\frac{dF}{dy} = (1 - 2y)(T - zR_L - xS_L). \quad (9)$$

Letting $dF(y)/dy = 0$, the critical value of x is $\theta_x = T - zR_L/S_L$. If $x = \theta_x$, then all values of y are stable. If $x < \theta_x$, $dF(y)/dy|_{y=1} < 0$, then $y = 1$ is the evolutionary stable strategy. Thus, the lower the probability of the government choosing "one-party subsidy," the higher the probability of the contractors choosing "transferring farmland." Finally, the strategy of "transferring farmland" is stable. As shown in Figure 3, θ_x divides the cube into V_a and V_b parts, which represent the probability of "transferring farmland" and "nontransferring farmland," respectively. If $z = 0$, $x = T/S_L$; if $z = 1$, $x = T - R_L/S_L$, then $V_a = 2T - R_L/2S_L$. In V_a , if $x < \theta_x$, y converges to 1; the volume of V_a , which represents the contractor's strategy of "transferring farmland," is larger.

V_a is used to represent the probability value of the contractor's choice of the "transferring farmland" strategy. Then, the transferring farmland possibility of contractors depends on the farmland transfer rent (T), the income of self-farming (R_L), the subsidy for contractors (S_L), and their interrelationship. Combined with this case, the relationship of farmland transfer rent (T), the income of self-farming (R_L), and the subsidy for contractors (S_L) with the probability value of the contractors choosing "transferring farmland" V_a separately can be calculated, as shown in Figure 4.

Figure 4(a) shows that the higher the rent of farmland transfer, the greater the farmland transfer motivation of the contractors. Figure 4(b) shows that the higher the income of the contractors' self-farming, the less motivation that contractors have regarding farmland transfer. Figure 4(c) shows that the higher the subsidy of the contractors is, the less motivation the contractors have regarding farmland transfer. It can be seen from the figure that the existing CNY 100 subsidies for the contractors have a little effect on farmland transfer. In order to promote the transfer of farmland, the role of farmland transfer rent must offset or even exceed the counteraction of self-farming income and subsidies. Therefore, the rent of farmland transfer is the only driving force for the transfer of farmland.

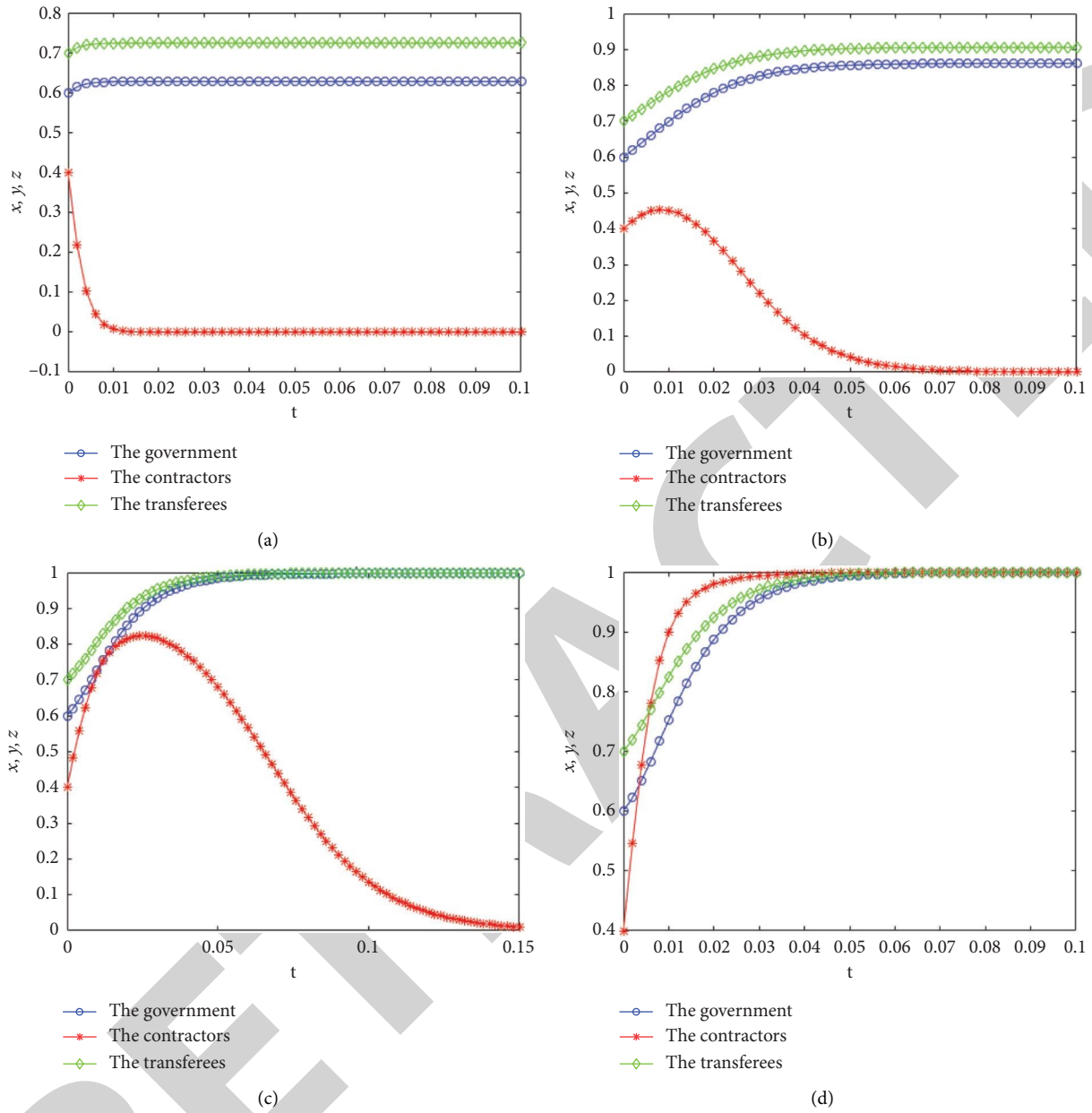


FIGURE 2: The impact of farmland transfer rent on the three-party evolutionary stability strategy. (a) $T=70$ The ESS of three parties, (b) $T=550$ The ESS of three parties, (c) $T=670$ The ESS of three parties, and (d) $T=800$ The ESS of three parties.

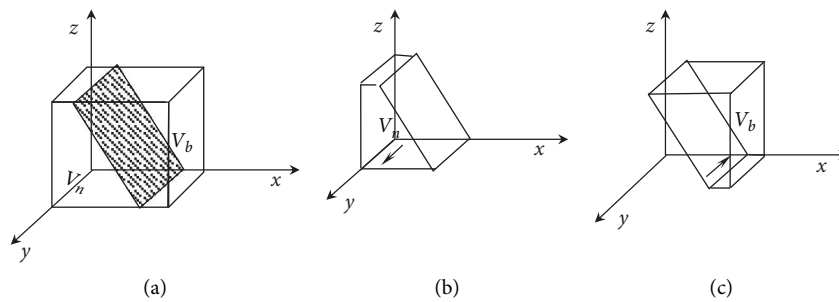


FIGURE 3: The probability of farmland transfer of contract households. (a) $x = \theta_x$, (b) $x < \theta_x$, and (c) $x > \theta_x$.

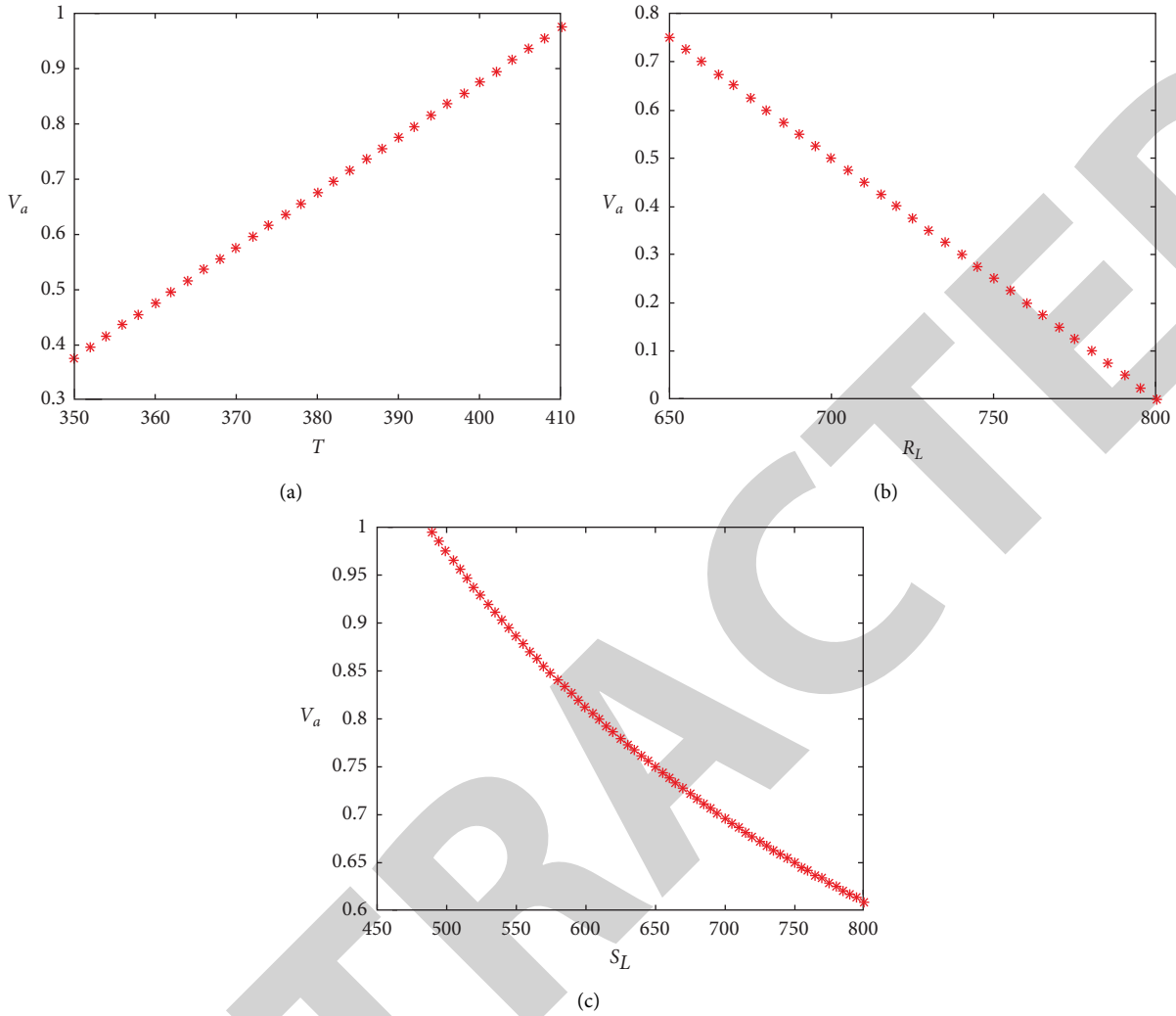


FIGURE 4: The relationship among the probability of “transferring farmland” strategy by the contractors (V_a) and farmland transfer rent T , self-farming income (R_L), and contractor subsidies (S_L). (a) The relationship between V_a and T , (b) the relationship between V_a and R_L , and (c) the relationship between V_a and S_L .

5.2.3. Analysis of the Transferees’ Driving Force for Grain Production. There are two core factors that affect the grain production of the transferees: the increased profit of non-grain production and the rent of farmland transfer. The partial derivative of from (6) is

$$\frac{dF(z)}{dz} = (1 - 2z)y[S_O - (a - 1)(R_O - T)]. \quad (10)$$

According to (10), there are critical values for the coefficient of the increased profit of nongrain production a and the rent of farmland transfer T . It will have a significant impact on the transferees’ evolutionary stability strategy if a or T is above or below those critical values.

The critical value of the coefficient a is $\theta_a = S_O + R_O - T/R_O - T$. If $a < \theta_a$, the transferees will engage in grain production; if $a > \theta_a$, the transferees will engage in nongrain production. Combined with the case $\theta_a = 1.5$, other parameter values remain unchanged. a is 1.2 or 2; the evolutionary stability strategy of the transferees is shown in

Figure 5(a). The critical value of farmland transfer rent T is $\theta_T = (a - 1)R_O - S_O/a - 1$. If $T > \theta_T$, the transferees can only maintain profits and rents by engaging in nongrain production; if $T < \theta_T$, the transferees can abide to government policies and engage in grain production. Combined with this case, the parameter values other than a and T remain unchanged; therefore, $a = \theta_a = 1.5$ and $\theta_T = 600$. T is 500 or 700, and the evolutionary stability strategy of the transferees is as shown in Figure 5(b).

Figure 5(a) shows that if a is below the critical value of 1.5, z converges to 1; that is, the transferees will choose the strategy of “grain production.” If a is above the critical value of 1.5, z converges to 0; that is, the transferees will choose the strategy of “nongrain production.” Figure 5(b) shows that if the farmland transfer rent T is below the critical value 600, z converges to 1; if the farmland transfer rent T is above the critical value of 600, z converges to 0. Therefore, if a and T are below the critical values θ_a and θ_T , the transferees will engage in grain production, and if a and T are above the critical

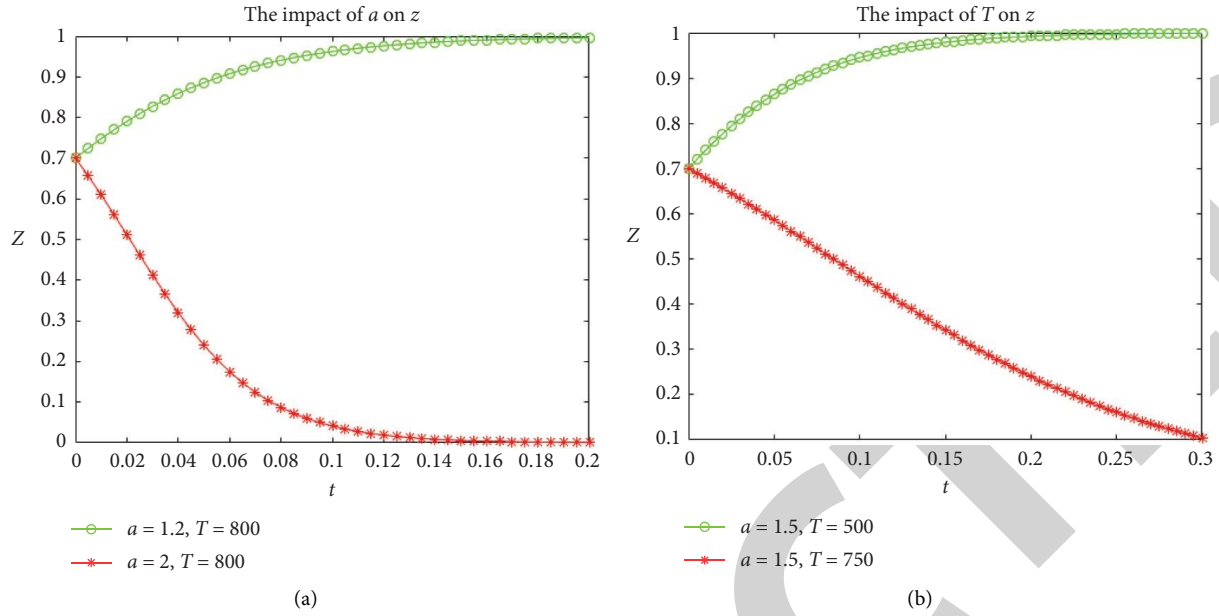


FIGURE 5: The impact of nongrain income and farmland transfer rent on z . (a) The impact of nongrain income and (b) the impact of farmland transfer rent.

values θ_a and θ_T , the transferees will engage in nongrain production. When $a = \theta_a$ or $T = \theta_T$, the transferees' income from grain production is equal to income from nongrain production, the transferees choose grain or nongrain production according to their preferences or random decision.

6. Conclusion and Policy Implication

This study shows that there is an ideal equilibrium result among the three parties, and the subsidy for transferees is the evolutionary stability strategy of the government. Regarding interest distribution in farmland transfer, there is an ideal equilibrium result in the interest game among the government, the contractors, and the transferees: one-party subsidy, transferring farmland, and grain production. The premise is that the rent of farmland transfer is greater than the sum of the contractors' self-farming income and the agricultural subsidies. In the tripartite evolutionary game, this is an evolution stable strategy of the government to subsidize grain production for transferees, which means that the government will give up subsidies for both the contractors and the transferees, only subsidizing the transferees. This is an unexpected result of the tripartite game, as it overturns the original assumption that the government must implement the policy of two-party subsidies.

There is a reasonable fluctuation range of farmland transfer rent, and grain production of transferees depends not only on the rent of farmland transfer but also on the profit of nongrain production. The rent of farmland transfer is the most basic means for contractors to obtain the interest distribution of farmland transfer, and it is the only driving force for contractors to transfer farmland. The farmland can be transferred smoothly only if the rent of farmland transfer is greater than the sum of the contractors' self-farming income and the agricultural subsidies. The rent of farmland

transfer is also the key factor to determine the grain production of the transferees without considering the factor of the increased profit of nongrain production. The transferees will have no grain production profit if the rent of farmland transfer is higher than their grain income. Therefore, the reasonable range of farmland transfer rent is between the sum of the contractors' self-farming income and agricultural subsidies and the grain income of the transferees, that is, $R_L + S_L < T < R_O$. Another determinant of grain production is the transferees' profits of nongrain production. If the increased profit of nongrain is less than the transferees' subsidies, the transferees will engage in grain production. Therefore, in order to encourage the transferees to engage in grain production, it is necessary to ensure their profits. Properly controlling the rent of farmland transfer and increasing the grain production subsidies for transferees can effectively curb their nongrain impulse.

Based on the above conclusions, this paper has two policy implications. First is implementing the system of "retirement allowance." The evolution model shows that the government will eventually abolish the direct agricultural subsidies for contractors. In order to protect the interests of farmers and maintain social stability, it is suggested that the direct agricultural subsidies should be transferred from the agricultural department to the social security department. It also shows that land productivity protection subsidies should be converted into "retirement allowance." The allowance should be given to the contractors in a fixed way, which makes it a special allowance representing a solution to the worries of those who retired from farmland operations. Secondly, the rent of farmland transfer should be reasonably controlled. The evolution model shows that the reasonable range of farmland transfer rent is between the sum of the contractors' self-farming income and agricultural subsidies and the grain income of the transferees. Within this range,

farmland can be transferred smoothly, and the transferees can engage in grain production securely. It is obvious that the rent of farmland transfer, which is often more than CNY 1000, cannot come from the profit of grain production; it must come from nongrain or nonagricultural production, which is bound to have a potentially negative impact on grain security. Therefore, it is suggested that the government should appropriately regulate the rent of farmland transfer and return it to its reasonable fluctuation range.

Data Availability

The data used to support the findings of this study are available from the corresponding author upon request.

Conflicts of Interest

The authors declare that they have no conflicts of interest regarding the publication of this paper.

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