Game Analysis of Interests Coordination between Grain Production and the Development of Animal Husbandry

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Abstract In order to promote the common development of grain production and animal husbandry, and achieve the optimal comprehensive benefit of the entire system of grain production and the development of animal husbandry, we use the method of game theory to research the relations between grain production and the development of animal husbandry, from the perspective of interests cointegration. In accordance with the internal relations between stakeholders in grain production and the development of animal husbandry, we focus on researching the interests-sharing game behavior of the government and planting subject collectives, the planting subject collectives and planting subject individuals, the breeding subject and planting subject. The results show that there is inequality between various stakeholders, and they seek not only the price-based benefit, but also some intangible interests difficult to calculate and quantify.

Key words Grain production, Development of animal husbandry, Interests cointegration, Game analysis

1 Introduction

Grain production provides the material basis for improvement in people's living standards, and plays a significant role in ensuring national food security. At the same time, with the improvement in people's living standards, residents' dietary structure has also experienced changes; the residents' food consumption gradually shifts to the pursuit of nutrition structure and the demand for meat, eggs and milk is increasing; animal husbandry develops by leaps and bounds. However, affected by the scarcity of resources, the problem of resources allocation, the problem of grain production and the development scale of animal husbandry have become increasingly prominent. The study on the relations between grain production and the development of animal husbandry, is of important significance to the construction of commercial grain bases in China and the development of animal husbandry.

Sun Delin (1996) believes that the contradiction between the development of animal husbandry and insufficient food supply will long exist; according to the law of changes in coordination between grain production and animal husbandry production, he puts forward the dialectical relationship of coordinated development between grain production and animal husbandry production using cycle theory[1]. Wang Baodong and Shi Jichao (2008) believe that feed grain will become the first major item of food consumption in China, and China's food security is closely related to animal husbandry. They suggest that we should balance the relations between food security and animal husbandry, and develop suitable animal husbandry on the basis of food security[2]. Huang Jikun, and Qiu Huanguang (2009) believe that the development of fuel ethanol will cause rise in the prices of agricultural products, thereby producing a tremendous negative effect on the development of animal husbandry[3].

Sun Liping (2006) believes that in the era of interests polarization and interests game, any specific economic and social affair can be the interest; thereupon a number of followers of interests are generated, and they want to share part of the interests, and carry out interests game.

In the process of current social political and economic development, when the government promulgates one policy, all stakeholders will show different attitudes based on self-interest; take the actions and measures that express their own interests based on the current political framework[4]. The stakeholders in the system of grain production and the development of animal husbandry, include the government, planting subject, breeding subject, and the middleman linking planting subject and breeding subject. They become the sharers of system interests, and conduct game in the process of sharing interests[5]. The planting subject includes the planting subject collectives (such as cooperatives, agricultural associations, *etc.*), and the planting subject individuals (general planting farmers). Likewise, the breeding subject includes the breeding subject collectives (such as breeding and processing integration enterprises, cooperatives, *etc.*), and the breeding subject individuals (general breeding farmers).

From the perspective of interests cointegration, this article researches the relations between grain production and the development of animal husbandry, and analyzes the game process of benefit-sharing between all stakeholders in the system of grain production and the development of animal husbandry, in order to provide recommendations for establishing long-term stable reciprocal relationship between grain produc-

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tion and the development of animal husbandry, ultimately achieving comprehensive benefits optimization of the system. The " coordination" here means the act of causing different parts to function together efficiently in terms of literal meaning.

2 The setting of the study scope and condition assumptions

Interests and income are two different concepts. In the *Modern Chinese Dictionary*, interests generally refer to the benefits, such as material benefits, personal benefits, and collective benefits. Income refers to the profit from production or commerce. In terms of the explanation in the *Modern Chinese Dictionary*, interests are greater than income.

The " coordination" in " interests coordination" is to change the original situation to adapt to the objective environment and requirements, and play a greater role. " Coordination" is a state of harmony after rationally distributing the interests in all parts.

In addition to the specific benefits generated by the prices, the joint development of grain production and animal husbandry, can produce other unexpected benefits, such as stable social environment and sound ecological environment. In turn, using interests to reconcile the conflict between grain production and the development of animal husbandry, will reduce instable factors, and increase stability, conducive to the stability and further development of the food-livestock system.

The process of game between the stakeholders is actually the process of bargaining. Let the two parties of game be A and B, the process of game is as follows:

Assuming that A first makes a price S_1, if B accepts the offer, then the deal is reached; if B rejects the offer, then B makes a price S_2, and the deal is reached after A accepts the offer; if A rejects the offer, then A makes a price S_3, and the deal is reached after B accepts the offer; contrarily, B makes a price, …… the rest may be deduced by analogy, until the two parties reach an agreement or a party abandons the negotiation and quits, then the game is over.

Due to the time value of negotiation and capital, for each additional game, the interests of both parties will suffer a loss, and let the loss coefficient be $\lambda(0<\lambda<1)$. Let the interests of two parties in the i-th bargaining be A_i and B_i, respectively, there is a functional relationship between A and B: $A = f(B)$ (Fig. 1). Assuming that A and B do not clearly know the each other's interests, let be the degree of understanding of each other's interests $(0<\Delta<1)$, and one simple incomplete information game is established.

3 Game analysis process

3.1 Game between the government and planting subject collectives The game between the government and the grain planting subject is divided into two categories: one category is the game on the types of crop planted in the farmland; the other is the game on expropriating land for development of animal husbandry.

Due to the existence of the loss coefficient, for each additional game, the interests of both sides may be reduced to some extent. The government, as the special participation subject, is mandatory, and we set the game times as three.

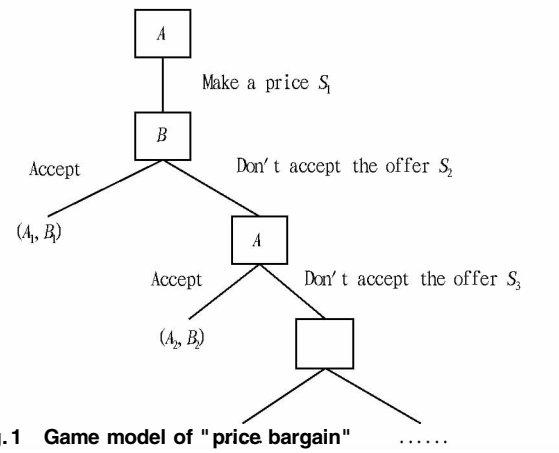

Fig. 1 Game model of "price bargain"

In general, the government, as the macro guide, will have some development instructions for the regional grain production, such as the types of crop planted and the planting area. For example, Heilongjiang Province is China's main soybean producing area. On the one hand, the local land and natural conditions are suitable for the development of this crop; on the other hand, the local government also has development support policies.

After the survey, research and analysis, if the government finds that the benefit from the cultivation of crop B is much greater than that from the cultivation of crop A (if it is transformed successfully, the benefit of crop B will be w higher than that of crop A), it will require the farmers to grow this crop. At the same time, there is also the risk of losses arising from unsuccessful transformation, thus the game between the government and planting subject collectives appears.

The specific game analysis is as follows.

(i) The first round of the game. The government formulates preferential policy f_1 to encourage the planting subject collectives to cultivate crop B. The government obtains interests at S_1, and the planting subject obtains interests at $W\text{-}s_1$. The planting subject considers the costs and risks of transformation, and compares them with the interests $W\text{-}S_1$ that may be produced. The strategy combination is (accept, reject). If it is accepted, the game is over; on the contrary, it will enter into the next round of game.

(ii) The second round of the game. The planting subject requires the preferential policy f_2 to be better than f_1. The government's interests are S_2, and the planting subject collectives' interests are $W\text{-}S_2$. The government's strategy combination is (accept, reject). Like the first round, after comparing the transformation costs and interests, if it is accepted, the game is over; on the contrary, it will enter into the next round of game.

(iii) The third round of the game. The government will introduce preferential police f_3 (f_3 better than f_2). The government interests are S_3, the planting subject collectives' interests are $W - S_3$. In order to facilitate agreement as soon as possi-

ble, the program introduced by the government is attractive enough, so that the planting subject collectives accept this program, then the game is over; if the planting subject collectives do not accept it, the program of planting new crop will end, and the game miscarries.

There is another case. The development of large-scale animal husbandry needs to occupy a large area of land, which requires the approval of expropriation of some land that can be originally used for development of crop farming; once the land acquisition program is reached, the representative of the national interests – the government, and the representative of rural collective interests – grass-roots cadres in rural areas, will be in the game on the land compensation scheme, and the game behavior of both sides is based on bargaining.

Assuming that the value of the negotiation object is W, the government and planting subject collectives will conduct game on the land compensation scheme. First, the government introduces the distribution program, and the planting subject collectives' strategy combination is (accept, reject); if the planting subject collectives reject the program, they will introduce another program, and the government's strategy combination is (accept, reject)…….

The government makes a choice based on the actual situation, and limits the game process, namely limiting the game process to proceed in the third time at most; the program introduced by the government in the third round is mandatory to some extent, and the planting subject collectives must accept the program.

The game process is as follows.

(i) The first round of the game. The government's program: the government's interests are S_1, and the planting subject collectives' interests are W-S_1; the planting subject collectives choose to accept or reject, and if accepting, the interests of both sides are S_1 and W-S_1, respectively, then the game is over; contrarily, it will enter the next round of the game.

(ii) The second round of the game. The planting subject collectives require the government's interests to be S_2, and their own interests to be W-S_2. The government chooses to accept or reject, and if accepting, the interests of both sides are λS_2 and $\lambda(W\text{-}S_2)$, respectively, then the game is over; contrarily, it will enter the next round of the game.

(iii) The third round of the game. The government puts forth the interests of both sides at $\lambda_2 S_3$ and $\lambda_2(W - S_3)$, respectively. This is the last round of the game, and the planting subject collectives must accept. Fig. 2 can be used for showing the above three stages of game.

The third round of the game program is mandatory, which is the key point of this game. The interests distribution program proposed by the government must be accepted. For each additional round of game, the interests of both sides will partly suffer a loss, and too long time of negotiation is unfavorable to both sides. Offering the compensation that the farmers can accept as soon as possible is beneficial to both sides.

In this game process, the government has double identity of the participant (economic man) and manager (administrative man), determining whether the land is expropriated. The status of the government and the status of planting subject collectives are unequal; the game space of planting subject collectives lies in the compensation standard of land requisition, and this standard is limited to the national laws. When the two sides can not reach an agreement on compensation standard of land requisition, there may be conflicts between the two[63].

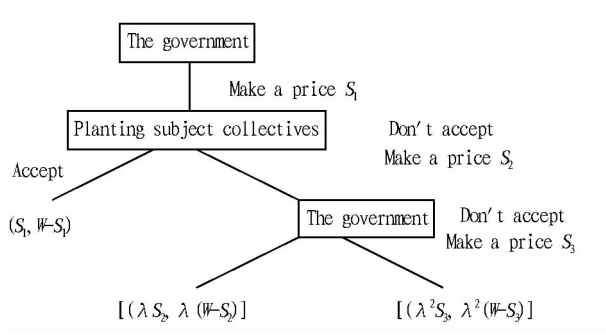

Fig. 2 Three stages of game between the government and planting subject collectives

3.2 Game between planting subject collectives and planting subject individuals After the government and planting subject collectives carry out the initial allocation of land requisition interests, then it is the secondary distribution game process of land requisition interests between holders of right to ownership of land-planting subject collectives and holders of land use rights-planting subject individuals.

In the process of land ownership transfer, due to consistency in interests, an interest group is formed between planting subject individuals. The rural grass-roots cadres, as the agent of planting subject collectives, have the dual identity of planting subject representatives and the government representatives in fact, becoming a relatively independent special interest subject at this point. For their own interests, they may accept the land requisition program with less compensation for the interests of planting subject collectives; they may use power to withhold compensation for the land requisition (of course this is illegal), causing losses on the interests of planting subject individuals.

In the process of interests game between two sides, the planting subject collectives predominate. First of all, they have information superiority, and the land requisition is the whole process and content of negotiation between them (as representatives of planting subject individuals) and the government. In the second place, as the representatives of planting subject individuals, when they negotiate with the government, the government often gives the greatest degree of support.

3.3 Game between the government and breeding subject Land is regarded as a scarce resource. Especially in China as a country with a large population, the land must first meet the demand for grain ration, and be used for producing grain; for the limited land that can be used not only for grain production, the state has a set of strict rules. For the land used for the development of large-scale breeding, the investment subjects need to need to go through the government approval, using a higher price to purchase the right to use. The government and

breeding subject possess complementary resources. The government has the organizational resources, and the breeding subject has the economic resources. There is Nash equilibrium in the interests game between the two.

From the bargaining game analysis in the previous paragraphs, we know that the government's offer is not based on wild speculations, because this is likely to cause failure of the negotiation and frequent game is likely to lead to considerable losses of profits. In addition, the economic interests generated from the development of animal husbandry are higher than the economic interests generated from grain production, which can promote the development of other local industries, and also help to highlight the government performance. At the same time, the breeding subject will not make a high price, because this may be unprofitable. The game between the government and breeding subject is a typical bargaining game, and an incomplete information game. The selection strategy of the government and breeding subject is (compromise, non-compromise). Assuming that the maximum interests of them under non-compromise are W_1 and W_2, respectively; the interests of them under compromise are W_1 and W_2, respectively. Based on the above analysis, we know that the two sides can not achieve the maximum interests at the same time; in the process of game, the two sides concede mutually (a kind of compromise), and finally reach agreement, then the game is over. The interests matrix is shown in Table 1.

Table 1 Interests game between the government and breeding subject

		Breeding subject	
		Compromise	Don't compromise
The government	Compromise	(W, W_2)	(0, W_2)
	Don't compromise	(W_1, 0)	(0, 0)

3.4 Game between breeding subject and planting subject

From the perspective of industry chain, grain production provides feed for animal husbandry breeding. At the same time, after being processed, some livestock byproducts can be used by grain production. In addition to the pure income sharing relationship between the two on the basis of price, there are still other types of interests game, for example, after the livestock breeding develops rapidly to form a certain scale, the enterprises will be attracted to invest in the construction of animal products processing enterprises. Meanwhile, some funds will be attracted for grain production and processing; the convergence of capital and human resources generates a chain effect, driving the development of local agriculture, animal husbandry, service industry, and construction, and generating additional interests. There is game in the distribution of interests between grain production and the development of animal husbandry.

4 Analysis based on game results

First of all, in the process of grain production transformation and land requisition, the opportunities for the state, planting subject collectives, and planting subject individuals to obtain interests are not even, and there are some inequalities. In the process of grain production, the government acts as a leading role, guiding the farming practices of planting subject and putting forward feasible suggestions. The planting subject individuals lack perspicacious market insight, with strong mentality of blind conformity, and they are often in a weak position when in the game with the government, whose bargaining power is weak. In addition, due to the existence of the government's rent-seeking behavior and potency collective's control over the collective land, the planting subject often only get a small cake when in interests game.

Secondly, the goal constantly pursued by the members of interests system not only includes the benefit based on price, but also includes some intangible benefits difficult to calculate and quantify. Coordination is to conduct rational allocation of interests between the stakeholders to reach a relatively stable state, and it is the manifestation of synergy target of grain production and the development of animal husbandry.

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