

# Analysis about Bargaining on Game Theory

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**Abstract-** in the real trading business, both of the parties are located at opposite end of the game, including cooperative and competition. Sometimes they played games to search for self interest, sometimes for survival. Both of the parties tend to fight with each other to maximize their own interests, in the bargaining game, how to gradually display the resources in their hands at the proper time and then force the other one make concessions, then earn more interests. It has been a core question of Game Theory. At the angle of the government, they care more about how to maximize the social utility. Sometimes in order to ensure the continuous growth of the economic, the Government will play a role help to make moves intervention, and take appropriate measures to promote economic growth.

**Keywords-** Game theory; dynamic game theory; bargaining; government intervention

## 1. Introduction

From the side of application of science, Game Theory is defined as: It's a kind of Theory based on the information analysis and the ability of judgment, to research the behavioral interactions and their mutual balance between multiple decision-making bodies, and how to maximize their interests and utility. The government intervention refers government makes intervention and regulation over the market, to make up the defects and insufficient of the market mechanism. They mainly limit the monopoly and unfair competition through the legal means, the policy of tax and subsidy to help to regulate, or merging related enterprise to make the externality "internalization"; providing public goods and the public services to people; establishing completed market economic-system; correcting market information asymmetry; adjusting income distribution, maintaining the social justice; ironing economic fluctuation and maintaining macroeconomic stable.

In the real life, both of the parties pursuit their own interests and utility, it always break the transaction and directly lead to it can't maximization the social utility. And it's the proper time and very valuable using the Game Theory to solve how to reach the game equilibrium point of the utility maximization and to improve the social utility.

## 2. Bargaining in the real life

Let's beginning from the real life, discussing about how players make strategies. In the Game, each player has a practical complete action to choose, and it is not a

stage program of action, but of the entire operation of a program, a viable throughout the whole planning a program of action, called a strategy of the player.

For example, in the most real simulation shopping, we set A is a buyer, and B is a seller. The seller B has given a price of  $\beta$ , and it's higher than A's psychological price of  $\alpha$ . In order to achieve this transaction, they played a game to reach an intermediate price of  $\gamma$ , where the seller B is willing to sell and the buyer A also willing to purchase. Generally the buyer A will take lobbying rhetoric: (1) the buyer A won't agree with this high price given by the seller B; (2) the buyer A is very fond of this article sold by the seller B, and A is so willing to pay for it; (3) but if the seller B stick on selling on this high price, A will buy it in another shop. Corresponding, the seller B generally will take lobbying rhetoric: (1) the seller B will try to make the buyer A trust that it 's a loss if sell at price of  $\alpha$ , even fabricated bid  $\theta (\theta > \alpha)$ ; (2) try to lobbying the buyer A the article is so suitable for A and have a good quality; (3) the seller B will give out a warning that the price in lowest in the market; (4) the sellers point puerile and designer, the puerile often prone to compromise, and pay more attention on the final success of the transaction, but the designer often won't participate bargaining game, the care more about the status reflected on price.

## 3. Analysis about Bargaining on Game Theory

As mentioned above, there is no end if we just discuss about this bargaining from the player's mind, I'll calculate it via mathematical means.

Opportunity cost of bargaining: assume that the players reach final transaction at price of  $\gamma$  ( $\alpha \leq \gamma \leq \beta$ );

The buyer A will pay more for a single article is:

$$Pa = \gamma - \alpha$$

The seller B will take more for a single article is:

$$Pb = \beta - \gamma$$

Here we will temporarily ignore the time cost over the bargaining, if they reach the finally transaction, the sense of accomplishment for selling and the sense of joy for buying are far beyond the time cost over bargaining. In order to simplify the model we will ignore the time cost when the transaction is successful.

Assume that the buyer A's tolerance for the higher price is  $\Omega_a$ , and the seller B's tolerance for the lower price is  $\Omega_b$ , and then we can calculate the opportunity cost produced in this game.

The opportunity cost over the buyer A is:

$$Ca = Pa * \Omega_a = (\gamma - \alpha) * \Omega_a$$

The opportunity cost over the seller B is:

$$Cb = Pb * \Omega_b = (\beta - \gamma) * \Omega_b$$

In the game, we try to build the game matrix according to their utilities, and try to find out the balanced point based on the principle of Nash Equilibrium. First let's analyze the utility of the buyer and the seller in various game results.

On the worst condition, they break the transaction because the can't reach a proper medium price during this game, both of them have spent same time on bargaining, the time cost is  $\zeta$ , their utility is:

$$(-\zeta, -\zeta)$$

If the finally reach a price  $\gamma$  and make a transaction successfully, the opportunity of the buyer A and the seller B is  $Ca$  and  $Cb$ , the sense of joy for buying of the buyer A is  $\delta_a$ , the sense of accomplishment for selling of the seller B is  $\delta_b$ , their utility is:

$$(\delta_a - (\gamma - \alpha) * \Omega_a, \delta_b - (\beta - \gamma) * \Omega_b)$$

Now let's defined the utility for the whole society (this game) is  $\Pi$ , here:

$$\Pi = \Pi_a + \Pi_b$$

It is obvious, if they break the transaction,

$$\Pi = -2\zeta, \Pi < 0$$

It is meaningless for discuss the maximization of  $\Pi$ . If they reach the transaction successfully, the utility for the whole society is:

$$\Pi = \delta_a + \delta_b - (\gamma - \alpha) * \Omega_a - (\beta - \gamma) * \Omega_b \quad (1)$$

Let's derivate on  $\Omega_a$  over equation (1):

$$\Pi(\Omega_a)' = \alpha - \gamma \quad (2)$$

Let's derivate on  $\Omega_b$  over equation (1):

$$\Pi(\Omega_b)' = \gamma - \beta \quad (3)$$

Let's derivate on  $\gamma$  over equation (1):

$$\Pi(\gamma)' = \Omega_a - \Omega_b \quad (4)$$

There are three solutions for maximize the social utility: (1)  $\alpha = \gamma$ , they reach the transaction at the price of the buyer A's expected psychological price and the buyer A gain all of the surplus value utility.

$$\Pi = \delta_a + \delta_b - (\beta - \alpha) * \Omega_b$$

(2)  $\gamma = \beta$ , they reach the transaction at the price of the seller B's expected psychological price, and the seller B gain all of the surplus value utility.

$$\Pi = \delta_a + \delta_b - (\beta - \alpha) * \Omega_a$$

(3)  $\Omega_a = \Omega_b$ , it means that the buyer A and the seller B have the same tolerance for the difference price from their psychological price, whether it is the buyer A buy the article at lower one dollar or the seller B sell the article at higher one dollar, the marginal utility is same. Then no matter whom have obtain the more utility, the whole social utility will always be the same and at the maximum value.

#### 4. Qualitative analysis on several results of the bargaining

Although the government should no step in market economy, but sometimes the correct prediction and appropriate management is good to promote the economic growth. Let's temporarily take no account of the negative effect brought by the government intervention, only discuss how to maximize the utility of the whole society, and give advices from different angles over the above three aspects.

(1)  $\alpha = \gamma$ , when the social utility is maximization they should reach the transaction at the buyer A's psychological price, but the government needs to take some measures to ensure the final transaction will take place at the buyer A's psychological price on  $\alpha$ , because the buyer A will gain all the surplus value and the seller B will lose all of it. Such as limit the rights of the seller, the seller must agree with the buyer A's requirement price  $\alpha$ , or the seller B can just price his article according to the consumers' purchase intention. Apparently there is nobody willing to play the role of the seller in the market economy. The seller B get his income from one hand is  $(\beta - \alpha)$ , the other hand is that the wages come from the government, or the government will hire some merchants or personnel to serve the people in these career. It's a kind of consume as need, obviously the society haven't reached this condition.

Under this condition, the government will give out some subsidies to the seller B, such as if the seller B sell the article with a discount to his psychological price  $\beta$ , then the government will give the seller B certain compensation or tax cuts or other measures, to make up the seller B's psychological gap. Then the buyer A have obtained whole the social utility in this transaction, and that the seller B get from the government is a kind of loss of the social utility.

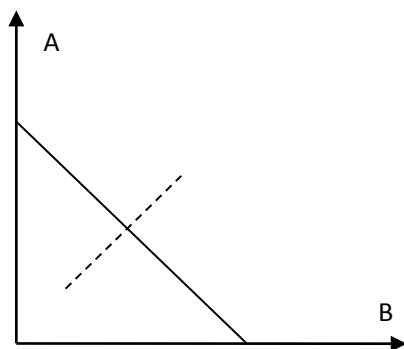
(2)  $\gamma = \beta$  when the social utility is maximization they should reach the transaction at the seller B's psychological price, but the government needs to take some measures to ensure the final transaction will take place at the seller B's psychological price on  $\beta$ , such as limit the rights of the buyer's, when the seller B sell the article at the price of  $\beta$ , the buyer can't bargain it. Then the seller will gain all the surplus value and the buyer will lose all of it. This is typical kind of monopoly; the seller can specify the price and the buyer can't bargain it. In the long period of economic development, the monopoly is not conducive to economic advance and development, but

at this paper's view, the monopoly does really maximize the whole social utility.

At the angle of the buyer A, his own utility is completely deprived of, and the buyer A will buy the item sold by the seller B in addition to living in the long run, in the rest of time the buyer A won't buy the article sold by the seller B, then the market economic will shrink. Sometimes the government will sacrifice some of the utility, in order to ensure the long operation of the social and economic order.

(3)  $\Omega_a = \Omega_b$ , it means that the utility damaged by one marginal dollar to the seller B is equal to the utility produced by one marginal dollar to the buyer A, that's to say the whole social utility summation is constant, it is distributed between the buyer A and the seller B.

It's basically conforms to the social reality, in the real life, the price of an article in a period of time is stable, that's means one marginal dollar will produce the same opportunity cost to both of the buyer A and the seller B ( $P * \Omega_a / \Omega_b$ ), both of them will maximize their utility in the game to get more.



**Figure 1:** the utility distribution between the buyer A and the seller B when  $\Omega_a = \Omega_b$

The game between the buyer A and the seller B result that, the equilibrium point moves along the dotted line in the graph, then the utility will change, but the whole social utility is still same.

## 5. Conclusions

Market economy is produced from the highly developed commercial economy and constantly improvement is a highly developed stage of the commercial economy. Western traditional economic theory says that, the market is the only way to allocate resource in a market economy. The social resources change as the market price, the supply and demand relationship, then flow to the best benefits of the economic sector; the market operated by an invisible hand, the government plays the role of a watchman and doesn't disturb the market. But the practice shows that the defects of the laissez-faire market economy are obvious, especially after a few times of economic crisis, the economic theory which just completely relies on the free market regulation won't work. The market failure will appear when it's inefficient or no efficiency on allocation on resources.

In the long process of the development of the market economy running, market failure happens often. One of the main reasons is that the government doesn't predict to market behavior and running track correctly, there are

some errors of the results when making money and other policies. The results of market failure are: lack of public products; restrict competition; unfair distribution of income and wealth; economic growth can't keep sustain and stable.

In bargaining game, every rational person wants to maximize their own interests, and play game based on this. The government should give appropriate intervention to ensure the effective and sustainable operation of the whole social economic. What's the most important thing before this for the government is observing and predicting the market well. Then help to achieve the maximization of the whole social utility.

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## Vitae



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