

Game theory research on the “lemon” problem of the e-commerce market

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Abstract—“Lemon” problem is a concrete manifestation of information asymmetry. In the e-commerce market, due to its unique and open character, the problem is even worse than the traditional market, restricting the development of the e-commerce market. This paper analyzes the reasons for the “lemon” problem in the e-commerce market, using the game theory to discuss how to solve this problem, finally get the specific approaches from multi-angles.

Keywords-E-commerce, “lemon” problem, information asymmetry, game

I. INTRODUCTION

“Lemon” is the appellation of “old car” and “defective car” in American spoken language. After George Akerlof’s research on the “lemon” problem, “lemon” became the name of low-quality goods, “lemon market” is interpreted as “flawed market”. As the e-commerce market has low barriers to entry, low management costs and an easy way to get information, it offers equal opportunities to all market participants. However, due to the virtual character of network, “lemon” problem on the Internet actually be strengthened. Therefore, “lemon” phenomenon deserves study and become a hot issue in recent years. This paper contraposes the means of network transactions, using the game theory as a tool to study how to effectively improve the “lemon” phenomenon of online shopping.

II. ANALYSIS OF “LEMON” PROBLEM IN THE E-COMMERCE MARKET

In the e-commerce market, the advanced information technology allows the costs of information release and information acquisition to continue to reduce. But the virtual character of network transactions makes it more difficult for the consumers to judge the average quality of the network products through the quality of the probability distribution. This phenomenon leads to a consequence that in order to pursue the maximization of self-interest the seller conceals the true information. We assume that the seller gets a unit of positive income by being honest, and two units of income by being dishonest. So the optimal choice for seller is deceiving. If the consumer has rational expectations, the consumer will get zero unit of utility value by choosing mistrust. On the contrary, the consumer will lose one unit value. Finally the result of Nash Equilibrium is mistrust and cheating.

III. CAUSE ANALYSIS OF “LEMON” PROBLEM IN THE E-COMMERCE MARKET

(1) Buyers. The powerful search function allows the buyer to get a lot of quality information in a very short time. Also the excessive choices make it difficult for buyers to decide. In the e-commerce market, the lack of quality information makes it hard for buyers to make an accurate judgment, which in turn enhances the uncertainty of the quality.

(2) Sellers. As the e-commerce market has low barriers to entry, reputation constraint based on the long-term trading on seller fraud will become weak. Opportunity cost of this behavior is low, and speculation enhanced. Sellers get competitive advantage through taking the non-price competition means and use information asymmetry between sellers and buyers to reduce costs.

(3) Commodity. The commodity of the e-commerce market is divided into two kinds: tangible products and intangible products. Tangible product show through pictures, text and sound, buyers can’t confirm the real quality. Intangible products such as software, digital information and so on, are mostly experience products and disposable products with unpredictable quality.

(4) Market. The most important feature of the e-commerce market is virtual character, which makes the product quality hard to measure. As product delivery and payment process are implemented through the network, it is difficult to achieve the promise of replacement or return as traditional market.

IV. GAME THEORY RESEARCH ON HOW TO SOLVE THE “LEMON” PROBLEM IN THE E-COMMERCE MARKET

A. Assumed conditions

1) There are only two kinds of products in the market: good one and bad one. The value for buyers is G and B respectively.

2) Buyers purchase only good quality goods, so regardless of the quality of the goods, sellers sell it as the good one. The price is P and the cost of disguise is C.

3) The proportion of the two types is p_g and p_b .

Therefore, transaction process in the e-commerce market can use Figure 1 to represent.

According to the above assumed conditions, when $P > C$, $G > P > B$, the positive choices of buyers and sellers have a certain risk, conservative choice may lose the opportunity of the potential benefits.

B. *Balanced type*

Divide market equilibrium into the following four types based on differences in the efficiency:

- 1) Market completely fails: no commodities traded
- 2) Market close to failure: good quality commodities as well as a small part of the poor quality commodities have entered the market, buyers purchase in a certain probability.
- 3) Market partially succeeds: all commodities regardless of good or bad quality enter the market and buyers buy all commodities regardless of their quality.
- 4) Market completely succeeds: the good ones are sold; the bad ones quit the market.

C. *Perfect Bayesian equilibrium of the model*

- 1) The equilibrium of market completely fails

Buyers estimate sellers choose to sell the poor quality products according to their experience. The judgment is $p(g/s)=0$, $p(b/s)=1$.

- buyers do not buy
- sellers do not sell
- buyers' judgment is $p(g/s)=0$, $p(b/s)=1$

Expected revenue of buyers is $0 \times (G-P) + 1 \times (B-P) = B-P < 0$, choosing not to buy is the best. When buyers do not buy, the benefit sellers can get is 0 or $-C$ with sellers selling the good ones or the bad ones. Both results are not better than choosing not to sell, so no selling is the wise choice.

- 2) The equilibrium of market close to failure

This kind of equilibrium must meet two conditions: $P > C$ and $p(g/s)(G-P) + p(b/s)(B-P) < 0$. The numerical example is set as follows. Assume $G=300$, $B=0$, $P=200$, $C=100$, $p_g=p_b=0.5$. $P=200 > C=100$, sellers owning poor quality goods have the desire to sell. Expected revenue of buyers is $p(g/s)(G-P) + p(b/s)(B-P) = 0.5 \times (300-200) + 0.5 \times (0-200) = -50 < 0$, the buyers lose.

- buyers choose to buy or not to buy at a probability of 0.5
- sellers choose to sell the good ones, and choose to sell or not to sell the bad ones at a probability of 0.5
- buyers' judgment is $p(g/s)=2/3$, $p(b/s)=1/3$

$p_g=p_b=0.5$, $p(s/g)=1$, $p(s/b)=0.5$. The conditional probability of selling good quality products is:

$$p(g/s) = \frac{p_g \times p(s/g)}{p_g \times p(s/g) + p_b \times p(s/b)} = \frac{0.5 \times 1}{0.5 \times 1 + 0.5 \times 0.5} = 2/3$$

The expected revenue of buying is :

$$p(g/s)(G-P) + p(b/s)(B-P) = 2/3 \times 100 + 1/3 \times (-200) = 0$$

As buyers choose to buy or not to buy at a probability of 0.5, the expected revenue of selling good quality products is $0.5 \times 200 + 0.5 \times 0 = 100 > 0$, so sellers choose to sell. On the contrary, the expected revenue of sellers is $0.5 \times 100 + 0.5 \times (-100) = 0$

This kind of equilibrium is not an ideal market conditions. The expected revenue of buying is zero and sellers owning good quality products only can sell the goods at a probability of 0.5.

- 3) The equilibrium of market partially succeed

Assume p_b is small. Buyers believe that good quality products accounted for the majority and $P > C$.

- buyers buy all commodities regardless of their quality
- sellers sell all commodities regardless of their quality
- buyers' judgment is $p(g/s)=p_g$, $p(b/s)=p_b$

The expected revenue of buying is $p_g(G-P) + p_b(B-P) > 0$, choosing to buy is the best.

As buyers buy all commodities regardless of their quality, sellers' benefit is P or $(P-C)$, both are greater than zero, sellers will choose to sell.

- 4) The equilibrium of market completely succeed

Presume $P < C$, sellers choose to sell good quality products.

- buyers buy all commodities regardless of their quality
- sellers only choose to sell good quality products
- buyers' judgment is $p(g/s)=1$, $p(b/s)=0$

When sellers choose to sell, the expected revenue of buying is $1 \times (G-P) + 0 \times (B-P) = G-P > 0$, choosing to buy is the best. As the quality is good, the expected revenue of sellers is $P > 0$. Otherwise, the revenue is $P-C < 0$.

D. *Sum-up of the type of market*

According to the game theory discussion above, summarize the conclusions in Figure 2 below.

The dotted line in the figure divides the coordinate into several regions. In the right side of the line, only good quality products can be sold and the market completely succeeds. In the upper-left, the market partially succeed, all commodities regardless of their quality are being sold and bought. In the lower-left, the market closes to failure or completely fails. If we do not take a mixed strategy, the market will completely fails.

V. SUGGESTIONS

1) Buyers' point of view. First, create a virtual community, master as much information as possible. Then complain about cheating. It can not only protect their own interests, but also help to change information asymmetries, and restrain the behavior of people who occupy the larger amount of information.

2) Sellers' point of view. Improve the quality of products and support services, promise that the low-quality products can be returned and implement brand marketing strategies. The key point is either sellers sell low-quality products cannot provide similar information, or the cost of these measures is much higher than the cost of sellers who sell high-quality products.

3) The standpoint of commodities. The products in electronic auction market are mainly search products. How to achieve the distinction between non-defective products and inferior-quality products is the key to solve the "lemon" problem.

4) The standpoint of markets. In order to make the market achieve orderly development, the market management department should boycott the low-quality products or counterfeit products enter, they should act as the mediating role of the quality assessment. The intervention of

quality assessment intermediary will increase transaction costs, but it can improve the reliability of the quality.

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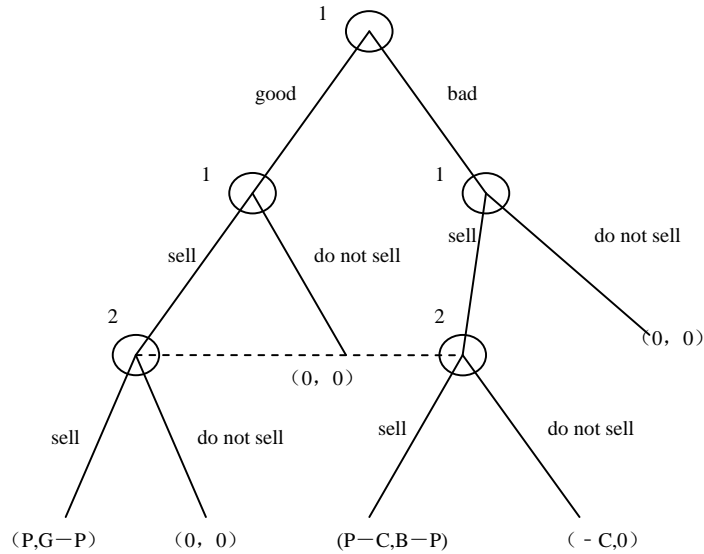


Figure 1. Single price of e-commerce transactions

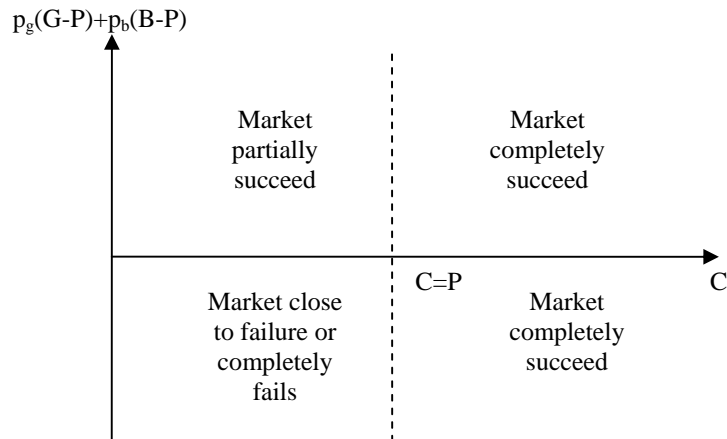


Figure 2. The solution of single price of e-commerce transactions