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Analysis of Business Competitive Cooperation Relationship Based on Game Theory

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Abstract
Based on the electronic businesses on the E-commerce platform as the research subject, this paper establishes the incomplete information static game model, to carry out the game analysis on the behavior between the businesses involved in the transaction, so as to make suggestion to establish and perfect the trust mechanism of E-commerce. The game behavior between the businesses is fundamental the game in

pricing, this paper makes game research on the pricing strategies of the different businesses that sell the same product but have different reputation, so as to obtain the conclusion that a less reputable business will offer their product at a relatively lower price to compensate for their lack of Credibility.
Key words: CREDIBILITY MECHANISM, GAME THEORY, INCOMPLETE INFORMATION STATIC GAME MODEL, BUSINESS COMPETITION

1. Introduction

With the rapid spreading and popularization of the Internet in China, more and more people are involved with the Internet, where there are an increasing number of people who participate in the online shopping. According to the news from China Electronic Commerce Research Center on November 9, 2012, the market research institute eMarketer recently published a report of "China's E-commerce: A Blooming Developing Market", which showed that in 2012 China's online shopping users reached 220 million, B2C market reached $ 107.5 billion, with a year-on-year increase of 94.1% [1]. Thus, China's B2C E-commerce is developing rapidly day to day, which has also brought positive energy for the fast development of China's economy. B2C E-commerce in China was launched relatively late, and also had relatively a lot of emerging issues in the rapid development process, among which the issue of businesses was the most prominent. In China, most of the E-commerce businesses still rely on the provider of the E-commerce platform, because for most businesses, the cost to establish an E-commerce website is relatively high, let alone the varieties of post-maintenance, therefore, relying on the existing E-commerce platform can part of the cost for the construction of the website, and also can make use of the existing reputation of the E-commerce platform. Therefore, for China's current situation of E-commerce, the research on the businesses that rely on E-commerce platform is very necessary [2].

The current research on the competitive cooperation relationship issue of the businesses on the electronic platform can be divided into two aspects: On the one hand, mainly focus on increasing the Credibility of the E-commerce merchant through technical means, such as the security authentication, privacy issues, web performance etc. incurred by technology; on the other hand, primarily focus on the social factors, and consider the factors that affect the competitive cooperation of businesses are multifaceted, in addition to the technical factor, the code of ethics , laws and regulations, business reputation, etc. can largely affect the consumption behavior of the customers in the businesses, and some scholars even combine the risk and Credibility to analyze the relationship between the businesses. Gefen et al made use of data mining theory to elaborate the important role of the complete degree and credibility of the information of the businesses in the business competition, and considered that the Credibility played a significant role; and carried out testing with the simulation system [3]; Hassanein et al studied the influence of humanized website design on businesses, and discussed the impact of product parameters, considered that the user-friendly website design can establish the Credibility for the physical products, while cannot establish Credibility for graphics products [4]; Pauline et al took B2B as the main investigation subject, and made a qualitative research on the cooperation risk of the businesses, pointing out that the enhancement of cooperation would reduce the risks and the transaction costs [5-6]; Nir et al put forward a model based on fuzzy theory for the business competitive cooperation relationship [7-8], pointing out that the strategy of a business will affect the strategy of many businesses; Sulin et al specified the intermediary in the E-commerce as a trusted third party, and made analysis on the trading behavior of the traders with the application of the game theory [9-10]. Currently there are relatively many empirical studies on the competitive cooperation relationship of businesses on the E-commerce platform, by means of experimental economics to study the business behavior patterns, due to the different participants, thus leading to the different research on the different models of E-commerce, and more research is focuses on the research of the Credibility issues of B2C (Business to Customer) E-commerce model, while has little studies on the B2B (Business to Business) model.

This paper discussed the choices and decisions an E-commerce business would make in different circumstances of different Credibility and cost. Whether the business would take advantage of the Credibility to deceive customers, or choose to carry out the reasonably priced Credibility transactions so to achieve the long-term interests. On the basis of the rational analysis on the nature of the game between E-commerce businesses, an incomplete information static game model was established to show that under certain conditions, both parties in the transaction game would g of the long-term benefits, and would adhere

to fair competition; the businesses with relatively lower Credibility, would use low prices to make up for their disadvantage in terms of Credibility, while businesses with high Credibility would not deliberately offer very low price to have malignant competition with other merchants, but rather offer a reasonable price according to their own cost of high reputation. Finally, conclusions and recommendations were put forward on how to improve the Credibility of businesses give up the short-term interests so as to achieve the maximization.

2. Game Theory and B2C E-commerce

Game theory is a theory that studies the parties involved in a variety of game situations and their rational behavior choice; and also a theory about how competitor adopts the optimal strategy and behavior according to the game circumstances and the change of competitors. Why can game theory produce such a huge impact in the field of economics? And how can it develop a new method in economic analysis and form another economic research paradigm as opposed to the (random) general equilibrium theory? This is probably also attributable to the origin of the game theory and the strategic thinking that it contains. Game theory is essentially a kind of theory of play, given the game's specific rules (information structure), the game participants must repeatedly try to figure out the psychological and possible actions of the other participants in order to win the game, and make the decision and adjustment to their own behavior on this basis, which is the process of make strategy or countermeasures. For this reason, "Game Theory" is generally referred to as "Countermeasure Theory" or "Play Theory." In addition, the game plot of the game theory is generally derived from people's real lives, which is the abstraction and conceptualization of the living environment, therefore, the result of game is not just the performance of victory or defeat of game, but rather the condensation of the life philosophy, which provides a unique perspective for people to profoundly understand and accurately grasp the various social economic phenomenon, and also has the practical significance for the development of social rules and economic policies.

It is very effective to analyze how the decisions between businesses affect each other through the game theory. First of all, from the perspective of the relationship between businesses, the level of Credibility when conducting E-commerce transactions, or that of the Credibility of the entire E-commerce market is a result of the mutual game between different trading subjects; the decision options of the trading subjects affect each other, if all trading subjects chose to carry out transaction with good faith in the end after a series of decision options, then we say that the result of this game is (credibility, integrity), then the E-commerce market has a relatively high Credibility; when the game result is that both the transaction parties get the maximum benefit when choosing (fraud, cheating), then the E-commerce market has a relatively low Credibility. This mechanism formed by Credibility is for the different subjects of transaction involved in every aspect, by analyzing how the decision-making of the transaction subject influences that of the other subjects, to make targeted suggestions on the current Credibility mechanism of the E-commerce market in China.

3. Research on the Relationship between Businesses Based on Game Theory

This section sets up a game model between E-commerce merchants and solves the equilibrium state mainly for the strategic choice in respect of pricing of the E-commerce merchants in selling the unified merchandise, through the discussion on the result of equilibrium, to draw a series of conclusions.

3.1 The Essence of Game between Businesses

It seems that only buyers and sellers participate in the process of E-commerce transactions, however, in fact, throughout the course of the entire transaction, all of the E-commerce businesses unintentionally participate in the process of each transaction. Because for a merchant that presents in the same E-commerce platform and sell the same product, before the merchant publish product information, he is bound to do research on the information about the product released by other merchants and gain experiences or lessons, as guidance for his own information release.

After the merchant publishes his product information, what he considers next is how to make his own product information show in the most front in the search page (when customers do not actively choose the sorting keyword), only in the relatively front position that the product appears, can it be possible to obtain more page view, so that it will have more potential customers. The only thing that the merchant can control by their own wish in the order of the appearance here is the price, because sometimes customers will choose the price for the order o f ranking. While the price will indirectly affect the sales, sales are also often chosen as the keyword for ranking by customers. So for merchants that participate in the E-commerce transactions, how to set a reasonable price is the first step to get the deal.

Therefore, the game between the E-commerce businesses is mainly: how each E-commerce business sets a price for their best interest according to their

own circumstances.

3.2 Incomplete Information Static Game Model Construction and Solution

The game behavior between businesses is mainly how businesses offer a most profitable commodity price to customers based on their own cost, we assume that the E-commerce businesses offer price for the same commodity at the same time. As the credibility of various E-commerce businesses is different, the cost of credibility for selling the same product is not the same, however, the E-commerce merchants can directly see each other's credibility. Here we assume that when E-commerce businesses sell commodities, the fixed costs and operating costs for one transaction is the same constant C, and the only difference is the cost of credibility, as represented by c_r^i, which only the buyer knows, but all sellers know c_r^i taken independently from the uniformly distributed function at the interval Φ_i. Therefore, as for one E-commerce transaction, it can be regarded as an incomplete information static game.

(1) Game between only two businesses

When only two sellers play the game, we do not consider the scenario that the two businesses offer the same price, but only consider the scenario that the businesses offer different prices, and the customers will make transaction with the business that offers the relatively lower price.

Use Φ_i to represent the profit of a merchant i in an operating period, the unit cost $c_i, c_i = C + c_r^{ii}, c_i$ is a strictly increasing function, and the sales price $p_i, p_i(c_i)$ is a strictly increasing differentiable function, in a similar way, p_i is a strictly increasing differentiable function of c_r^i, i.e., $p_i = p_i(c_r^i)$, the function equilibrium pricing strategy is $p = p^*(c_r)$, then the E-commerce business i's profit function is

$$\Phi_i = (p - c_i)\,\mathrm{Prob}(p_i > p) \tag{1}$$

Prob (.) represents the probability of $p - c_i$, in which p_i is the online price offer of sellers j. The first item $p - c_i$ of the profit function is the net income of the seller in the case of a given transaction, and the second item Prob (.) is the probability of the transaction.

Based on symmetry, $p_i = p^*(c_r^i)$, so:

$$\begin{aligned}\mathrm{Prob}(p_i > p) &= 1 - \mathrm{Prob}(p_i > p) = 1 - \mathrm{Prob}\{p^*(c_r^i) \le p\} \\ &= 1 - \mathrm{Prob}\{c_r^i \le p^{n-1}(p) = \varphi(p)\} \\ &= 1 - \varphi(p)\end{aligned} \tag{2}$$

Where $\varphi(p) = p^{*-1}(p)$ is the inverse function of p^*, that is, when the seller chooses the price offer p is their cost $\varphi(p)$, as c_r^i is a uniformly distributed function in $[0,1]$, accordingly the characteristics of the uniformly distributed function $\mathrm{Prob}\{c_r^i \le p\} = p$. Thus, the problem encountered by seller i is:

$$\max \Phi_i = (p - c_i)\,\mathrm{Prob}(p_i > p) \tag{3}$$

$$= (p - c_i)(1 - \varphi(p)) \tag{4}$$

The optimization condition of the first-order is:

$$1 - \varphi(p) - (p - c_i)\varphi^n(p) = 0 \tag{5}$$

If p^* is the seller i's best strategy, then $\varphi(p) = c_r$. Solve the differential equation to obtain:

$$p^* = \frac{1 + 2c + c_r}{2} \tag{6}$$

$$p^* - c_i = \frac{1 - c_r}{2} \tag{7}$$

Because c_r is independently obtained from the uniformly distributed function defined in the interval $[0,1]$, namely, the seller's price is always higher than the cost.

(2) Game between n sellers

Similarly, we can get the profit function of seller i for one transaction:

$$\Phi_i = (p - c_i)\prod_{j \ne i}\mathrm{Prob}(p_i > p) \tag{8}$$

$$= (p - c_i)\left[1 - \varphi(p)\right]^{n-1}$$

Optimization of the first-order condition to get:

$$\left[1 - \varphi(p)\right]^{n-1} - (p - c_i)(n-1)\left[1 - \varphi(p)\right]^{n-2}\varphi^n(p) = 0 \tag{9}$$

As in the balanced situation $\varphi(p) = c$, simplify and solve the equation (5-9) to get

$$p^* = \frac{2n-1}{2n-2}c_r + \frac{1}{2n-2} + C \tag{10}$$

$$\text{i.e. } p^* = \frac{2n-1}{2n-2}c_r + \frac{1}{2n-2} + C \tag{11}$$

$$p^* - c_i = \frac{1 - c_r}{2n-2} \tag{12}$$

(3) Conclusion

Conclusion 1: As can be obtained from equation 10, each online seller's price is higher than their own cost, but the price is influenced by the quantity of sellers, and the increase in the quantity of sellers will reduce their price offer.

Conclusion 2: As can be obtained from equation 11, due to the seller i's price offer $p^* - c_i$ is a strictly increasing function of its credibility cost, the seller with relatively low credibility will offer a relatively low price, so that the price advantage will make up for their lack of credibility.

Conclusion 3: As obtained from equation 12, the difference p^*-c_i between the equilibrium price offer and the cost will decrease with the increase of the credibility cost, that is, with the increase of credibility, its impact on the price offer is getting smaller and smaller.

4. Simulation Experiment

Take $a=8$, $b=1$, $c=2$, $u_1=u_2=0.0082$, take initial value $q_{1.0}=2.7$, $q_{2.0}=0.3$, changes in yield and profit of the two producers determined by the system, respectively, as shown in shown in Figure 1a and 1b.

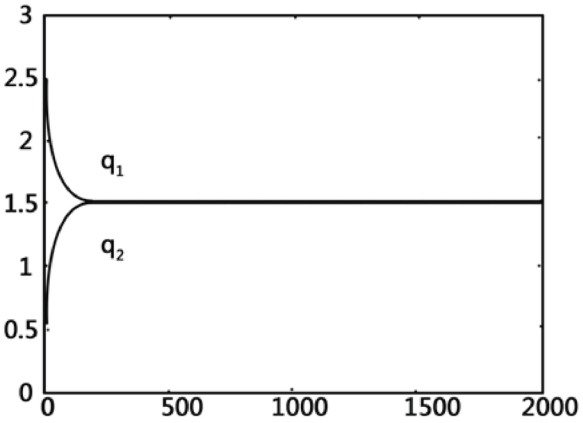

Figure 1(a). Chart of changes in supplies($b=1$)

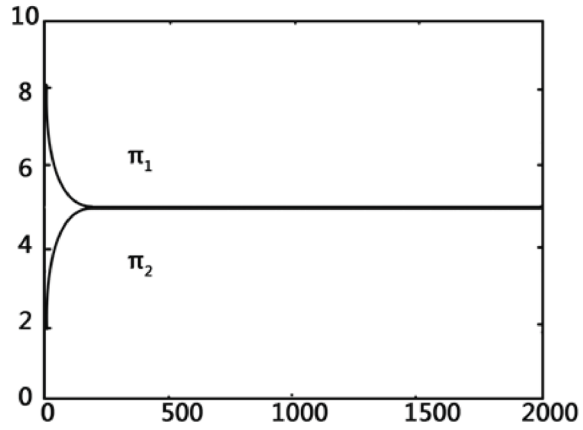

Figure 1(b). Chart of changes in profit($b=1$)

If you only change the value of the system parameters b, take $b=1.02$, while the remaining parameters and initial value unchanged ($a=8$, $c=2$, $u_1=u_2=0.0082$, $q_{2.0}=0.3$, $q_{2.0}=0.3$), the corresponding changes in yield and profit are shown in Figures 2a and 2b.

From the above numerical analysis points, it can be seen that different values of the system parameters, stability of the system is different. Figure 1 illustrates the competition between businesses are stable, but when the value of the parameter b occurs small changes, business competition relations is changed

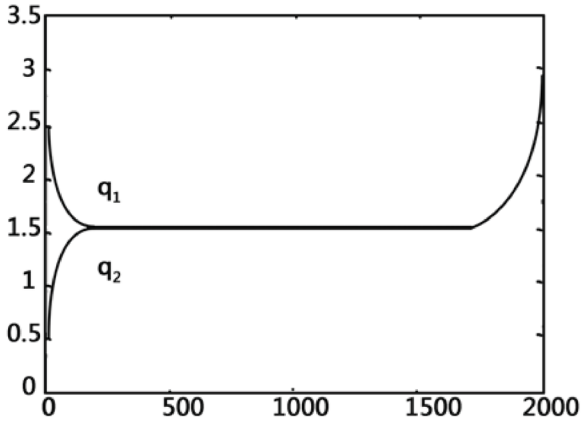

Figure 2(a). Chart of changes in supplies($b=1.02$)

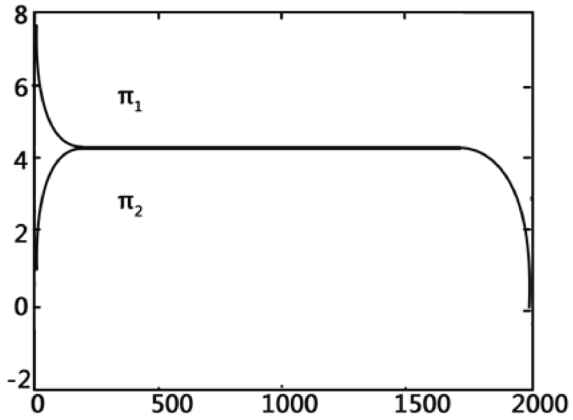

Figure 2(b). Chart of changes in profit(1.02)

from stable (Figure 1) to unstable (Figure 2). And Figure 2 also reflects the business's sales volume and profits not only can not be stabilized to a Pareto optimal steady state, and ultimately vicious competition phenomenon occurs- the competition cost of both sides are limitlessly increased (Fig. 2a) and the amount of profit tends to be zero (Figure 2b).

5. Suggestions for the Businesses on the E-commerce Platform to Improve Credibility

(1). From the conclusions we can see that the number of the E-commerce merchants will affect the price offer of the merchants on the commodity, at the same time the characteristics of the network without geographical restrictions can meet the requirement of sufficient quantity of online sellers, therefore, we can increase the number of sellers in the network from the following aspects. Reduce the threshold to entry, under the condition to ensure the business has complete basic qualification materials, the threshold for businesses to enter the online market can be reduced, such as lowering the minimum registration capital. Thus many businesses that have the idea but cannot afford to enter the business can also get into the E-commerce market, so as to achieve disguised

increase in the competitiveness between E-commerce businesses.

(2). For some commodities, relevant standards shall be developed to prevent the phenomenon of disguised deception brought about by the malicious competition. Allow the customers to be aware of the situation, and not make blind transaction simply because of the low price offered by a merchant. In particular, some commodities with relatively clear standard, such as mobile phones, computers and other digital products, as many customers do not have very professional knowledge for these products, sometimes a merchant may make use of it and sell to the customers same products but with different quality. As the same product with different quality is relatively lower in the selling price, the merchant makes use of this price advantage to carry out unconventional transaction, and obtain all kinds of benefits.

(3). Cost reduction is the relentless pursuit of all businesses including E-commerce businesses, for all E-commerce businesses, the biggest difference is that of the credibility cost, as the cost of the online seller we mentioned earlier, for online sellers the cumulative reputation cost is the most important, because before many customers carry out transaction, they are generally most concerned about the reputation of a business. Therefore, to regulate the credibility rating criteria of sellers should not be merely based on the turnover and customer reviews as the credibility rating criteria. It requires the establishment of a more perfect credibility rating evaluation system, which requires the relevant E-commerce sector authority to develop a more rational credibility evaluation system. At the same time, in order to strengthen these characteristics of the online sellers, there should be should be premium policy on the taxation and management fee for the sellers that have reached a certain level of trading volume, accumulated a certain degree of credibility, and sustained in the network for a certain length of time.

(4). Since the amplitude of variation of the equilibrium price of commodities reduces with the increase of the commodity costs (which to some extent represents the value of the commodity) C, in which such cost includes the cost of credibility, that is to say, the advantages of E-commerce seller's reputation will decrease with the increase of credibility. Therefore, we should introduce relevant policies to avoid the occurrence of this phenomenon, which will influence the enthusiasm of the E-commerce merchants with high credibility. This is also to stimulate E-commerce businesses to pay more serious attention.

6. Conclusion

The game behavior businesses between businesses is fundamentally the game in respect of pricing, through the game research on the pricing strategy between businesses that sell the same product but have different credibility, it can be drawn that a business with less credibility will offer a relatively lower price to compensate for the lack of their credibility. Because unlike the traditional trade, for online trade, online reputation is also a hidden cost, and it will affect the pricing of the product. The cost of the product sold by businesses with high reputation will be high, high cost of reputable selling products will be high, so the product price offer will be relatively high; also drawn the conclusion that it is not strictly increasing between the amount of increase in product price and the increase in the rating of credibility rating, but with the continued increase of credibility, the amplitude of price increase will be smaller and smaller. When customers select and purchase commodities, they should pay particular attention to the businesses with high credibility but low price, because these businesses with high credibility are likely to have obtained these commodities through irregular means, and are very likely to provide poor quality products.

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A Meta-analysis of the Relationship between Organizational Improvisation and Performance

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