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E-Commerce in China: Price and Service Competition

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ABSTRACT

Currently, the majority of Chinese online consumers paid more attention to price and service quality. This paper studied the Price and Service competition in E-commerce of China. A price game within two online business companies is used in this paper. This study shows that the product's utility to a customer has a great influence on decision making of the two online business companies. As the product's utility to a customer varies, the two companies may compete or not. This paper will help US companies to get some knowledge about China Market and to avoid failures.

Keywords

Delivery time; price; service capacity; linear city model

INTRODUCTION

The population of the Internet users in China has been more than 500 million (CNNIC, 2012). In 2011, the estimated total money spent on online purchases in China was 127 billion US dollars (800 billion RMB). Currently, E-commerce market in China, especially B2C, is very competitive. Currently research about E-commerce in China is limited. However, the huge E-commerce market in China deserves more and more research works from the western academia.

Doing business in China is different from in the U.S (Efendioglu & Yip, 2004). We need to study E-commerce development in China and understand Chinese customers' habits. The failures of EBay and BestBuy already indicated that US E-commerce models and experiences could not be totally copied and applied to China Market. EBay totally dominate C2C market in China before 2006. However, since 2006, EBay has been defeated by Taobao.com. Now, Taobao.com has occupied more than 95% of C2C market shares in China. Several clues already predicted the failure of EBay in China. None of EBay senior managers working in China can speak Chinese or understand Chinese habits. They didn't want to understand the preferences of Chinese consumers. They don't know that EBay is not a famous brand in China. They didn't know how to attract and serve Chinese consumers. At the same time, BestBuy and HomeDepot have closed their all stores in China, which announced their failures.

B2C companies are battling for the market in large cities such as Beijing, Shanghai and Shenzhen, for several reasons. First, the online shopping already is well accepted by the consumers in those large cities. Second, the IT infrastructure in these large cities is better than that in small or medium cities. Third, shipping cost will be lower in these large cities. Fourth, many young people bear high working pressure and don't have time to do shopping in local stores. They prefer to buy online.

Chinese online consumers, especially China's youth, care about price and service quality, but the price only is not the most important factor affecting the purchase decision making of Chinese consumers. More and more Chinese online consumers would like to pay more to receive better service (Wang, Yao, & Huang, 2007). For a pure online B2C business company, the lowest price may not be a good idea to attract consumers. The lowest price benefits the consumers, but in the same time the lowest price shrinks the company's marginal profit. Chinese B2C companies already try to use the better service quality to replace the lowest price strategy. Today, more and more Chinese consumers love fast delivery services offered by online stores. Sometime, they even prefer to pay more to receive fast delivery services.

In traditional industries, the price and yield always are the focus of competition among companies. Usually researchers assume that each production of products is identical. However, besides price and yield, there are some other differences. In 1929, Hotelling (1929) established a price competition model of two companies within a linear city, which is the famous

linear-city model. Hotelling assumed that the two companies have different locations in a linear city and in order to get the product, consumers should not only pay the price but also have transportation expenses. In the current E-commerce, consumers care about the price and the delivery time. In fact, geographical differences of online stores do have some influence on customers' purchase choices. In this paper, based on the Hotelling model, we study a price game between leader-follower online stores with two different delivery time guarantees.

This research will explore the following questions:

- How can an online business company maximize its profit in one large city?
- Which factors will affect the company's and customers' decision making?
- How can American companies know more about China Market?

LITERATURE REVIEW

Research results related to this paper mainly have two aspects: one is about the price, service capacity and delivery time guarantee competition; the other is about the service price and capacity decision with varied locations of service providers.

On the first aspect, Chen & Wan (2003) studied the price game of two make-to-order firms with different service capacity. Their research indicates that a firm with higher service capacity or lower per unit operation cost could take a relatively larger market share with premium prices. Chen & Wan (2005) also studied the service price and service capacity competition of two make-to-order firms with a fixed market capacity. Their research proves the existence of Nash equilibrium and shows that in the equilibrium, the number of firms operating in a market depends on the capacity of the market and the duopoly Nash equilibrium is socially optimal if and only if there is one firm operating in the equilibrium.

So (2000) studied the service price and service delivery time guarantee competition among firms with demands sensitive to both price and delivery time guarantees. His research indicated that firms will exploit their distinctive firm characteristics to differentiate their services. Assuming all other factors being equal, the high capacity firms provide better time guarantees, while firms with lower operating costs offer lower prices, and the differentiation becomes more acute as demands become more time-sensitive.

Zhang, Tan, & Dey (2009) studied the service price competition between two web service providers offering functionally the same web services with service level guarantees. Their study shows that in the long term, the two providers intend to choose different service levels and service prices. However, in the shorter term, they may incline to the similar service levels and service prices. Fan, Kumar, & Whinston (2009) studied the service price and software quality short-term and long-term competition between two software service providers (SaaS: software as a service, SWS: shrink-wrap software) with the different service time guarantee. Keskinocak, Pekgun, & Griffin (2006) analyzed the service price and lead-time competition among two firms under centralized decision making and decentralized decision making.

On the second aspect, Dobson & Stavroulaki (2006) developed a model of simultaneous price, location and capacity decisions of a service provider with time-sensitive customers uniformly distributing on a linear city. They worked out the optimal solution with the consideration of the shipping delay.

Kwasnica & Stavroulaki (2008) studied the service capacity and location competition between the two service providers who can choose their location on a linear city. Their study indicates that unless the cost of service capacity obtained is particularly low, two service providers will choose a limited service capacity and focus on the location competition. When the market capacity is large, the two service providers will not compete and service the customers closer to their own facilities while the market demand is small, two service providers will compete for some customers.

Saidi-Mehrabad, Teimory, & Pahlavani (2010) studied the influences of the customer behaviors on the market shares of multiple service providers. They assumed that when customers face with a congested facility, they may be balking, reneging and veering. Their study shows that a provider with higher service capacity can occupy a higher market share. If the balking ratio is high, the market share of all the providers will be reduced. Price volatility will not have great impact on the market share of each service provider.

Model Formulation and Analysis

In this research, we assume that two online stores (SP1, SP2) are located at both ends of a straight line with length l and the customers are time-sensitive and uniformly distribute on a linear city (see Figure 1). We propose a price game of leader-follower service providers with two different delivery time guarantees. Each customer has no preference for either online store except on the shipping fee. The distance between the customer and SP1 is x .

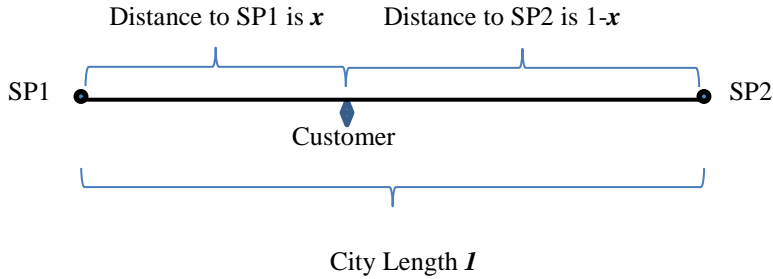


Figure 1 Linear-City Model

This research has three assumptions.

For either online store, the service system is M/M/1 type. Each online store aims to maximize its profit and each customer wants to maximize his/her utility.

All customer’s reservation payment and the per unit time waiting cost are the same. The two online stores are located at the two ends of a straight line of a linear city.

The two different delivery time guarantee are s_H, s_L ($s_H > s_L, s_H$ or s_L). s_H is the standard shipping and s_L is the expedited shipping. The two online stores must ensure that the probability of meeting the delivery time guarantee for either online store must be at least α (α can be 0.95 or 0.98). Neither of the two online stores can dominate the entire market in the city.

Table 1 Notations

λ_i	customer order arrive rate of Online Store i	$i=1,2$
μ_i	delivery rate of Online Store i	$i=1,2$
p_i	Price of Online Store i	$i=1,2$
γ_i	the unit operation cost of Online Store i representing the efficiency of an online store	$i=1,2$
s_i	delivery time guarantee ($i = H, L$ and $s_H > s_L$)	
$g(x)$	the function of shipping fee, x is the distance	
c	the unit capacity cost	
π_i	per unit time profit of Online Store i	$i=1,2$
v	the product’s utility to a customer	
c_0	per unit time waiting cost of customer	
l	per unit distance arrival rate	
a	per unit shipping fee	

In this paper, we write the customer’s net utility function as:

$$U = v - c_0s_j - g(x) - p_i \quad (j = H, L; i = 1,2)$$

Only when it satisfies $U \geq 0$, a customer could choose the service. Otherwise, they will not choose it. We denote the function of transportation cost as: $g(x) = ax$, where x is the distance between a customer's mailing address and an online store's warehouse, and a is the per unit shipping fee.

In this research, we adopt M/M/1 queuing system, which represents the queue length in a system with a single server, where arrivals are determined by a Poisson process and job service times have an exponential distribution.

The requirement that the probability of meeting the time guarantee for each online store must be at least α can be written as follows(So 2000):

$$1 - e^{-(\mu-\lambda)s_j} \geq \alpha \quad (j = H, L) \quad (1)$$

We assume that SP1 is the leader and SP2 is the follower. Based on the optimal price and the delivery guarantee of SP1, SP2 draw its own optimal solutions. If each online store cannot occupy the entire market, then in equilibrium there must exist a point (denote as A, the distance from A to SP1 is denoted as x and then the distance from A to SP2 is $1-x$). Then we can draw an equation as follows:

$$v - c_0s_{j1} - ax - p_1 = v - c_0s_{j2} - ax - p_2 \quad (j_1, j_2 = H, L) \quad (2)$$

From equation (2), we can find the value of x , then we can obtain the mean arrival rate.

$$\lambda_1 = l \frac{c_0(s_{j2} - s_{j1}) + a + p_2 - p_1}{2a}, \quad \lambda_2 = l \left(\frac{1}{2} - \frac{c_0(s_{j2} - s_{j1}) + p_2 - p_1}{2a} \right)$$

SP1, as the leader, can choose s_L or s_H , and formulate the optimal service price. SP2, as the follower, can choose its price to have a significant impact on the equilibrium solution and the profit of SP1. So SP1 need to analyze the response of SP2 when it chooses a different delivery time guarantee. Therefore, we have two cases.

Case 1: SP1 chooses s_L

Based on the above analysis, the optimization problem of SP2 can be written as:

$$\max_{p_2, \mu_2} \pi_2 = (p_2 - \gamma_2)\lambda_2 - c\mu_2 \quad (3)$$

$$\text{st.} \begin{cases} 1 - e^{-(\mu_2 - \lambda_2)s_j} \geq \alpha & (4) \\ v - c_0s_L - ax - p_1 = v - c_0s_j - a(1-x) - p_2 & (5) \\ v - c_0s_j - a(1-x) - p_2 \geq 0 & (6) \end{cases}$$

Simplifying (4), we obtain:

$$\mu_2 \geq \frac{k}{s_j} + \lambda_2, \quad k = -\ln(1 - \alpha), \quad j = H, L \quad (7)$$

We do not consider inequality constraint (6) and when $\pi_2(p_2, \mu_2, j)$ is optimal, constraint (7) must be binding. So we have:

$$\mu_2 = \frac{k}{s_j} + \lambda_2, \quad k = -\ln(1 - \alpha), \quad j = H, L \quad (8)$$

Proof : If there is an optimal solution (p_2^*, μ_2^*, j^*) which make constraint (7) to be strict inequality, then reducing μ_2^* can increase the π_2^* . So (p_2^*, μ_2^*, j^*) is not the optimal solution. So when $\pi_2(p_2, \mu_2)$ is at optimality, constraint (7) must

be binding.

As s_j is either s_L or s_H , we can regard s_j as a constant. When we get the solution, we substitute s_L and s_H into $\pi_2(s_j)$ and have a comparison. So we can get the optimal delivery time guarantee.

Substituting (5) and (8) into (3), we obtain:

$$\max \pi(p_2) = (p_2 - \gamma_2 - c) \left(\frac{1}{2} - \frac{p_2 - p_1 + c_0(s_j - s_L)}{2a} \right) l - c \frac{k}{s_j} \quad (9)$$

It is not difficult to get the solution of $\pi(p_2)$:

$$p_2^* = \frac{a + p_1 + \gamma_2 + c - c_0(s_j - s_L)}{2}, \mu_2^* = \frac{k}{s_j} + \lambda_2 \Bigg|_{p_2=p_2^*} \quad j = H, L$$

As for SP1, its optimization problem can be expressed as:

$$\max_{p_1, \mu_1} \pi_1 = (p_1 - \gamma_1) \lambda_1(p_1) - c \mu_1 \quad (10)$$

$$s.t \quad \left\{ \begin{array}{l} 1 - e^{-(\mu_1 - \lambda_1)s_L} \geq \alpha \quad (11) \\ v - c_0 s_L - ax - p_1 = v - c_0 s_j - a(1-x) - p_2 \quad (12) \\ v - c_0 s_L - ax - p_1 \geq 0 \quad (13) \end{array} \right.$$

For the same method above-mentioned, we can obtain:

$$\max \pi(p_1) = (p_1 - \gamma_1 - c) \left(\frac{p_2 - p_1 + c_0(s_j - s_L) + a}{2a} \right) l - c \frac{k}{s_L} \quad (14)$$

Substituting p_2^* into (14), we obtain:

$$p_1^* = \frac{3a + \gamma_1 + \gamma_2 + 2c + c_0(s_j - s_L)}{2} \quad j = H, L \quad (15)$$

$$x = \frac{\gamma_2 - \gamma_1 + 3a + c_0(s_j - s_L)}{8a}, \mu_1^* = \frac{k}{s_L} + \lambda_1 \Bigg|_{p_1=p_1^*} \quad (16)$$

Substituting (15) into p_2^* , we obtain:

$$p_2^* = \frac{5a + \gamma_1 + 3\gamma_2 + 4c - c_0(s_j - s_L)}{4} \quad j = H, L$$

Substituting (15) and (16) into (13) which is equal to (6), we can obtain:

$$v - c_0 s_L - ax - p_1 = v - c_0 s_L - \frac{5\gamma_2 + 3\gamma_1 + 15a + 8c + 5c_0(s_j - s_L)}{8} \quad (17)$$

Denoting

$$v_1 = \frac{5\gamma_2 + 3\gamma_1 + 15a + 8c}{8} + c_0 s_L, v_2 = \frac{5\gamma_2 + 3\gamma_1 + 15a + 8c + 5c_0(s_H - s_L)}{8} + c_0 s_L, \text{ then we have:}$$

- ❖ If $v \leq v_1$, the utility of customers on the boundary point is negative, which means (17) is negative. If the two online stores are local monopoly, they don't need to compete with each other. The optimization problem of SP1 can be written as:

$$\begin{aligned} \max_{p_1, \mu_1} \pi_1 &= (p_1 - \gamma_1)\lambda_1 - c\mu_1 \\ \text{st. } \begin{cases} 1 - e^{-(\mu_1 - \lambda_1)s_L} \geq \alpha \\ v - c_0 s_L - ax_1 - p_1 = 0 \end{cases} \end{aligned}$$

It is not difficult to get the optimal solution:

$$\hat{p}_1 = \frac{v - c_0 s_L + \gamma_1 + c}{2}, \hat{\mu}_1 = \frac{k}{s} + \lambda_1 \Big|_{p_1 = \hat{p}_1}.$$

In the same method, we can get $\hat{p}_2, \hat{\mu}_2$. In order to make sure that the two online stores are in local monopoly, their make shares should be no more than 1. Denoting the market shares of the two online stores as x_1^*, x_2^* , we have $x_1^* + x_2^* \leq 1$, $x_1^* \geq 0, x_2^* \geq 0$. We can obtain:

$$v \leq a + c + \frac{c_0 s_L + \gamma_1 + \gamma_2 + c_0 s_j}{2} \quad j = H, L.$$

- When SP2 chooses S_L , denoting $v_M = a + c + c_0 s_L + \frac{\gamma_1 + \gamma_2}{2}$.

- If $v_M \geq v_1$, then when $v < v_1$, the two online stores are in local monopoly.

The optimal per unit time profit of SP1 and SP2:

$$\pi_1^L = \frac{(v - c_0 s_L - \gamma_1 - c)^2 l}{4a} - \frac{ck}{s_L}, \pi_2^L = \frac{(v - c_0 s_L - \gamma_2 - c)^2 l}{4a} - \frac{ck}{s_L}.$$

- If $v_M < v_1$, then when $v \leq v_M$, the two online stores are in local monopoly.
- When $v_M < v < v_1$, the two online stores are not in local monopoly. There is no Nash equilibrium

- When SP2 chooses S_H , then denoting $v_M = a + c + \frac{c_0 s_L + c_0 s_H + \gamma_1 + \gamma_2}{2}$.

- If $v_M \geq v_1$, then when $v < v_1$, they are in local monopoly.
- If $v_M < v_1$, then when $v \leq v_M$, they are in local monopoly
- When $v_M < v < v_1$, there is no Nash equilibrium.

So from the above analysis, we can see that when the product's utility to a customer is small, the market capacity is large enough for them to realize local monopoly. So the two online stores can choose their optimal solution without considering the choice of the other. The optimal \hat{p}_1, \hat{p}_2 are increasing in v . The profits of two providers are decreasing in the unit service capacity cost and the unit operation cost.

- ❖ If $v_1 \leq v < v_2$
- When SP2 chooses S_L , the optimal solutions are (p_1^*, μ_1^*) and (p_2^*, μ_2^*) and their respective per unit time profits are as follows:

$$\pi_1^L = \frac{(3a + \gamma_2 - \gamma_1)^2 l}{16a} - \frac{ck}{s_L}, \quad \pi_2^L = \frac{(5a + \gamma_1 - \gamma_2)^2 l}{32a} - \frac{ck}{s_L}.$$

- When SP2 chooses S_H

If it satisfies $x_1^* + x_2^* \leq 1$, then the optimal solutions are $(\hat{p}_1, \hat{\mu}_1)$ and $(\hat{p}_2, \hat{\mu}_2)$ and their respective per unit time profits are as follows:

$$\pi_1^H = \frac{(v - c_0 s_L - \gamma_1 - c)^2 l}{4a} - \frac{ck}{s_L}, \quad \pi_2^H = \frac{(v - c_0 s_H - \gamma_2 - c)^2 l}{4a} - \frac{ck}{s_H}.$$

$$\text{From } x_1^* + x_2^* \leq 1, \text{ we can obtain } v \leq a + c + \frac{c_0 s_L + c_0 s_H + \gamma_1 + \gamma_2}{2a}.$$

Denoting $v_N = a + c + \frac{c_0 s_L + c_0 s_H + \gamma_1 + \gamma_2}{2a}$, then we have as follows.

If $v_N \leq v_1$, then when $v_1 \leq v < v_2$, there is no Nash equilibrium

If $v_N \geq v_2$, then when $v_1 \leq v < v_2$, they are in local monopoly.

If $v_1 < v_N < v_2$, then when $v_1 \leq v < v_N$, they are in local monopoly; when $v_N \leq v < v_1$, there is no Nash equilibrium.

SP2 as the follower should compare the profits in these situations and choose the right delivery time guarantee.

- ❖ If $v \geq v_2$, p_1^*, p_2^* are the optimal service prices of SP1 and SP2. The per unit time profits are:

$$\pi_1 = \frac{(3a + \gamma_2 - \gamma_1 + c_0(s_j - s_L))^2 l}{16a} - \frac{ck}{s_L}, \quad \pi_2 = \max\left(\frac{(5a + \gamma_1 - \gamma_2 - c_0(s_j - s_L))^2 l}{32a} - \frac{ck}{s_j}, j = H, L\right)$$

In this case, the two online stores compete with each other for some customers and each customer can get positive utility. From the expression of π_2 , we can see that if γ_i, a, c_0 are unchanged, the delivery time guarantee of SP2 depends on service capacity cost. If the service capacity cost is relatively large, SP2 will choose s_H . Otherwise, he will choose s_L . From the expression of π_2 , we can observe that when SP2 chooses s_H , the per unit time profit of is relatively larger. This means that choosing relatively higher delivery time guarantee of SP2 is conducive to SP1. As for SP2, his choice of delivery time guarantee depends on the specific parameter values. From the expression of p_1^*, p_2^* , we can see that p_1^* is increasing in s_j and p_2^* is decreasing in s_j . In order to compare the profits of the two online stores, we assume that SP2 also chooses s_L and $\gamma_1 = \gamma_2$. We can obtain:

$$p_2^* = 3a/2, \quad p_1^* = 5a/4, \quad x = 3/8, \quad \pi_1 - \pi_2 = -7al/32.$$

Obviously, SP2 occupies a relatively large market share with a lower service price and get higher profit. From this, we can see that when the conditions are the same, the follower SP2 can obtain a second-move advantage and its per unit time profit is on less than the profit when it choose the same delivery time guarantee with SP1.

Case 2: SP1 chooses S_H

The process is similar with the situation when SP1 choose S_H . Denoting

$$v_3 = \frac{5\gamma_2 + 3\gamma_1 + 15a + 8c + 5c_0(s_L - s_H)}{8} + c_0s_H, \quad v_4 = \frac{(5\gamma_2 + 3\gamma_1 + 15a + 8c)}{8} + c_0s_H, \text{ the analysis is the same.}$$

A NUMERICAL EXAMPLE AND DISCUSSION

Given the parameters $\gamma_1 = \gamma_2 = 0.5$, $a = 0.3$, $c = 0.2$, $c_0 = 0.5$, $s_H = 4.4$, $s_L = 3.6$, $l = 4.5$, $k = -\log 0.05$. Then we compare the prices and optimal profits of the two online stores when they choose different delivery time guarantees.

(1) When the two online store are in local monopoly, their optimal service price are the same due to the same the unit operation cost. When they are in competition, the optimal service price and the equilibrium point (denote as x) are provided in Table1.

Table 2 The price p_1^*, p_2^* and equilibrium point x

(p_1, p_2, x)	s_L (SP2)	s_H (SP2)
s_L (SP1)	(1.15, 1.08, 0.38)	(1.35, 0.97, 0.54)
s_H (SP1)	(0.95, 1.175, 0.21)	(1.15, 1.08, 0.38)

From Table 2, we can see that SP2 as the follower can occupy a relatively large market share with a lower service price if they choose the same delivery time guarantee. SP1 chooses s_L

(2) The profit comparison

1) When SP1 and SP2 both choose s_L

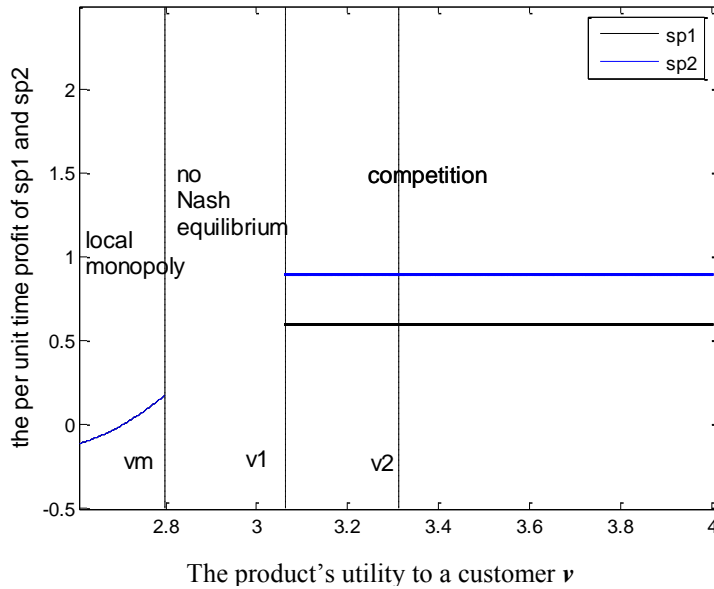


Figure 2 The per unit time profit of SP1 and SP2 when they both choose s_L

From Figure 2, we can see that if $v \leq v_m$, they are in local monopoly. Since all the values of parameters are the same, they have the same profit. If $v_m < v < v_1$, they may be in competition or in constrained monopoly; if $v \geq v_1$, they are sure in competition.

(2) When SP1 chooses S_L and SP2 choose S_H .

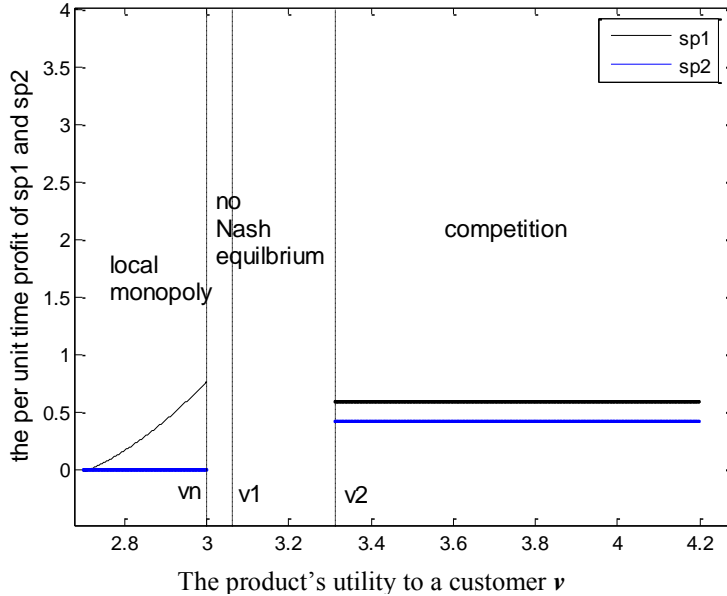


Figure 3 The per unit time profit of SP1 and SP2 when SP1 chooses S_L and SP2 chooses S_L

From Figure 3, we can see $v_n \leq v_1$. So when $v \leq v_n$, they are in local monopoly. The profit of SP2 is zero, because the delivery time is large and the product's utility to a customer is relatively small. No customer could choose to accept the service. If $v_n < v < v_2$, there is no Nash equilibrium. If $v \geq v_2$, they are sure in competition.

From Figures 2 and 3, we can find that when the product's utility to a customer is small, the two online stores are in local monopoly. If SP1 chooses S_L , S_L is the better choice to SP2. When the two online store are in competition, SP2 can obtain more profits.

When SP1 and SP2 both choose S_H or SP1 chooses S_H with SP1 choosing S_L , the situations are similar with the above two figures. We know that SP2 can find its optimal service price, service capacity and delivery time guarantee after it knows the decision of SP1. However, as for SP1, he should study the product's utility to a customer, market capacity and other parameters and the optimal response of SP2 when he chooses delivery time guarantee and make his choice.

CONCLUSIONS

In this paper, we studied the price game of leader-follower online stores with two different delivery time guarantee constraints and changeable service capacity. The contribution of our work is to consider the spatial difference of the two service providers and two types of service delivery time guarantees constraint. We mainly analyze the problem that how the leader-follower online stores choose the delivery time guarantee and pricing the service in order to attain maximum profit. Our research shows that if the number of potential customers is fixed, when the product's utility to a customer is smaller, the two online stores are both local monopoly. With the increase of the product's utility to a customer, the delivery time guarantee choices of the two online stores have a significant influence on their condition(compete or not). Besides this, there is no Nash equilibrium in some cases.

When the product's utility to a customer is large, no matter which delivery time guarantee they choose, they will compete for some customers. When the two online stores compete with each other, the follower has the second-move advantage. If the per unit service cost and the service capacity cost are the same, the per unit time profit of SP2 is higher than the per unit time profit of SP1. SP2 can draw its optimal solution after he knows the decision of SP1. However, as for SP1, he should study the product's utility to a customer, market capacity and other parameters and the optimal response of SP2 when he chooses different delivery time guarantee. Then he can make his best decision.

E-commerce market in China is unbelievable huge than what we think. Western companies need to study and explore the characteristics and preferences of China online consumers. Ignoring the online purchase habit difference between Chinese consumers and American consumers will result in unavoidable failure in China e-commerce market.

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