International Journal of Management Science
Vol 13, No 1, May 2007

Online Channel Strategies of Hybrid Firms and Social Cost*

Sumi Cho

Researcher, IT Economy Research Team, Electronics and Telecommunications Research Institute
161 Gajeon-dong, Yuseong-gu, Daejeon, 305-350, South Korea

Sang-Ho Lee**

Associate Professor, Department of Economics, Chonnam National University,
300, Yongbong-Dong, Bukgu, Gwangju, 500-757, South Korea

(Received Apr. 2006; Revised Aug. 2006; Accepted Jan. 2007)

ABSTRACT

We consider the product differentiation model of online channel competition and examine the strategies of hybrid firms in terms of efficiency. After measuring the social cost of online business strategies, we show that (i) online channel of hybrid firm under blockaded entry may increase the social cost if the firms' delivery cost is sufficiently smaller than the consumer's transportation cost, and (ii) online competition under free entry may increase the social cost if the firms' delivery cost is sufficiently larger than the consumer's transportation cost. Finally, we discuss the strategic incentive of hybrid firms to reduce delivery cost and investigate the effect of the Internet maturity on the social cost.

Keywords: Online Channel, Offline Transaction, Transportation Cost, Delivery Cost, Internet Maturity

---

* The earlier version of this paper was presented at the 2006 International Conference on Business and Information (Singapore) and the seminar at Chonnam National University (Korea), Fudan University (China), and Singapore Management University (Singapore) with the title of "Online Business Competition and Social Cost in a Differentiated Goods Market." We are grateful to the seminar participants and anonymous referees for their constructive suggestions.

** Corresponding author, Email: sangho@chonnam.ac.kr

1. Introduction

Internet ignites new market opportunities through online business. Online business offers consumers greater benefits of increased information gathering and lower transaction costs, which yields a wider set of choices than those available in traditional offline business. While new online firms such as Amazon.com appear in the electronic commerce (e-commerce) market, there is also growing trend in introducing new online channel into offline channel through the form of hybrid business such as BarnesandNobles.com. These two entities now compete in more efficient ways of multiple channels strategies to create new markets.

Recent business economics research on e-commerce has been conducted in a variety of fields. Weisman [17] and Kauffman and Walden [10], for instance, reviewed and organized main research issues related to the Internet economy. Some research has examined the possibility that online business will lead to firms engaging in fierce price competition, thus enhancing the competitive environment for product transactions. Bakos [2], Lynch and Ariely [13], and Harrington [8] analyzed the relation between search costs and product prices in e-commerce market using a simple economic model. In addition, some research on price competition and business behaviors in e-commerce market has been conducted through empirical approaches. See, for example, Bailey [1], Liang and Huang [12], Brynjolfsson and Smith [3], and Chun and Kim [5] for the empirical analysis of the product prices between online and offline purchases. Cho *et al.* [4], Zettelmeyer [18] and Dumans [6] considered the relative efficiency between transaction costs and access cost or delivery costs, examining the strategic game model between online firms and offline firms. Finally, Goolsbee [7], Shy [14], and Lee [11] investigated the revenue change in the government and discussed e-commerce taxation.

While much has been researched on the conduct of business-to-consumer and business-to-business e-commerce markets, competitive process that transforms offline firms and online firms into hybrid firms has not been extensively examined. In addition, few researches have conducted the efficiency issues of online business and the social cost of online channel strategies. For instance, from the viewpoint of society, how the introduction of online channel by offline firms with the form of hybrid channels affects the competitive environment compared to pure online channel competition? This paper reexamine the work of Chun and Kim [5] and Lee [11], who utilize the canonical Hotelling [9]'s linear city model to analyze an online business competition under the coexistence equilibrium between online and offline firms. In particular, we examine the competition effects of the online channel strategies by hybrid firms and measure the social cost of online business competition. Compared to the case of pure online competition, we show that the introduction of online channel by hybrid firm under blockaded entry may increase the social cost if the firms' delivery cost of online channel is sufficiently smaller than the consumer's transportation cost through offline channel. We also show that online competition by hybrid firms under free entry may increase the social cost if the firms' delivery cost is sufficiently larger than the consumer's transportation cost. Finally, we examine the incentive of hybrid firms to reduce delivery cost and evaluate the effect of delivery cost on the social cost. For a dynamic analysis, we also incorporate the Internet maturity into the model and investigate how the degree of online access affects the social cost of online competition.

This paper is organized as follows: Section 2 provides a basic product differentiation model of pure online competition using the linear city model. Section 3 considers two mixed cases where offline firms introduce the online channel with the strategies of hybrid business. The first case is a blockaded entry model where the asymmetric competition between offline firms occurs, while the second case is a free entry model where symmetric competition between hybrid firms occurs. We quantify the competition equilibrium of each case to compare the social costs. Section 4 discusses the strategic incentive of hybrid firms and incorporates the Internet maturity into the basic model. The conclusion is provided in the final section.

2. Pure Online Competition

In the linear city model, there is a unit length where consumers are uniformly distributed along this interval. There are two conventional offline firms at either ends of the unit line. They sell the same product and compete against each other with zero marginal cost. We denote the price of the offline firm A is p_f^A, which is located at point 0, while P_f^B is for the offline firm B located at point 1.

Each consumer is indexed by $x \in [0, 1]$ and x is a location from the origin. Consumers who buy one unit of the product from the offline firms should pay the price and transportation cost of τ per unit of distance. In particular, a consumer located at some point x has to pay transportation cost of τx for shopping at firm A, or $\tau(1-x)$ for shopping at firm B. Then, we can define the total payment of a consumer located at point x by $P_f^A + \tau x$ if a consumer purchases from the offline firm A, while $P_f^B + \tau(1-x)$ if she buys from the offline firm B.

On the other hand, a pure online firm, which has no physical location, sells the same goods as the offline firms. The price of the online firm is denoted by p_n and the production cost is also zero.[1] Assuming that every consumer at each location point can access to the Internet, consumers may buy goods from the offline firms or the online firm.[2] If the consumer purchases the good from the online firm, irrespective of the location of the consumer, she incurs no costs,[3] i.e., she needs to pay the price of the online product, p_n, which is set by an online firm. However, since the online firm should deliver the product that is ordered through the online channel, it incurs the delivery cost of d per consumer.

Let x_A (or x_B) denote the consumer who is indifferent to whether she purchases from an online firm or an offline firm A (or firm B). Then, we have

$$x_A = \frac{p_n - p_f^A}{\tau}. \tag{1}$$

and

$$x_B = 1 - \frac{p_n - p_f^B}{\tau}. \tag{2}$$

The analysis will be focused on the coexistence equilibrium, where the online and offline firms sell the product in the equilibrium, i.e., $0 < x_A < x_B < 1$ and earning non-negative profits. Then, it is assumed that $\tau > d$. It implies that the delivery cost

---

1 In order to focus on the relative magnitude between transportation cost and delivery cost, we assume that the cost of the online channel is the same as that of the offline channel. For a discussion on production cost of online channel in an e-commerce market, see for example, Lynch and Ariely [13] and Chun and Kim [5] among others.

2 In the analysis, we will focus on the market-covered case where consumers in the market should buy one good from an online firm or one of two offline firms. In section 4, we will incorporate the maturity of Internet access and extend the analysis.

3 Strader and Shaw [15] discussed transaction costs in e-commerce. However, for an analytic simplicity, any risk in online transaction is not considered in the model.

of the firms is sufficiently smaller than the transportation cost of the consumers. In other words, the transportation cost of the organized firms should be less than that of individual consumers because of the economies of scale/scope during the transportation process.

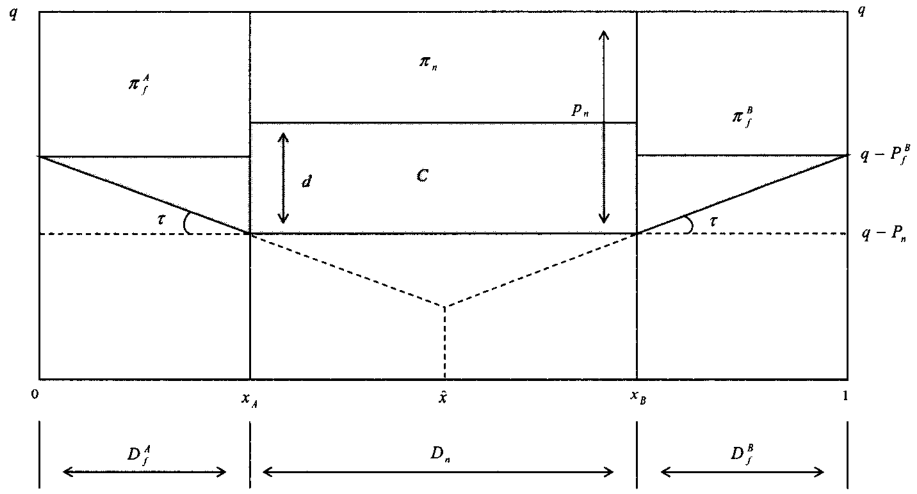

Figure 1. pure online competition

In the coexistence equilibrium, which is depicted in Figure 1, the demand functions for each firm are given by:

$$D_f^A = x_A = \frac{p_n - p_f^A}{\tau}, \tag{3}$$

$$D_f^B = 1 - x_B = \frac{p_n - p_f^B}{\tau}, \tag{4}$$

$$D_n = x_B - x_A = \frac{\tau - (2p_n - p_f^A - p_f^B)}{\tau}, \tag{5}$$

where $D_f^A + D_f^B + D_n = 1$.

Then, we can define the profit functions of the offline firms as $\pi_f^i = p_f^i D_f^i$, $i = A, B$, and that of the online firm as $\pi_n = (p_n - d)D_n$. In a coexistence and symmetric equilibrium, the first-order conditions yield the following equilibrium prices:

$$p_f^* = \frac{\tau + 2d}{6} \text{ and } p_n^* = \frac{\tau + 2d}{3}, \tag{6}$$

where $p_f^A = p_f^B = p_f^*$ and $p_n^* > p_f^* > 0$. Notice that the online firm can set a higher price than the offline firms in the model.[4]

The market demands in equilibrium are given by:

$$D_f^* = D_f^A = D_f^B = \frac{\tau + 2d}{6\tau} \text{ and } D_n^* = \frac{2\tau - 2d}{3\tau}, \tag{7}$$

where $D_n^* > D_f^*$ if $\tau > 2d$.

Finally, using the equilibrium prices in (6) and equilibrium demands in (7), the social cost, which is defined the sum of transportation cost and the delivery cost, can be obtained from the hatched area in Figure 1.

$$C^* = \frac{\tau^2 + 28\tau d - 20d^2}{36\tau}. \tag{8}$$

3. Mixed Online Competition

We now consider the two types of mixed hybrid firm competition where offline firms introduce the online channel into pure online competition. The first one is the blockaded entry model where one of two offline firms introduces new online channel to compete against the other pure offline firm while the other firm doesn't enter the e-commerce market. Thus the blockaded entry case is for the asymmetric online business competition between two offline firms. The second case is the free entry model where both offline firms introduce new online channels together and compete with prices, and thus it is for the symmetric online business competition.

3.1 Blockaded Entry: Asymmetric Competition

Assume that offline firm A introduces a new online channel to compete against the other offline firm B. Then, the profit function of firm A will be written as $\pi_A =$

---

4 Several studies in the analysis of prices competition between offline firms and online firms yield conflicting results depending on the consumer's search costs and product characteristics. See the discussion in Chun and Kim [5].

$p_f^A D_f^A + (p_n - d)D_n$ and that of firm B will be $\pi_B = p_f^A D_f^B$. The first-order condition under the coexistence equilibrium between two firms gives the following equilibrium prices:

$$p_f^{A**} = \frac{4\tau + d}{6}, \quad p_f^{B**} = \frac{\tau + d}{3}, \quad p_n^{**} = \frac{2\tau + 2d}{3}, \tag{9}$$

where $p_n^{**} > p_f^{A**} > p_f^{B**} > 0$. Note that the equilibrium prices after introducing online channel by offline firm A might increase, compared with those of online competition in (6), i.e., $p_f^{A**} > p_f^*$, $p_f^{B**} > p_f^*$, and $p_n^{**} > p_n^*$ for all τ. This implies that the hybrid firm under blockaded entry can lessen price competition between multiple channels.

The market demands in equilibrium are given by:

$$D_f^{A**} = \frac{d}{2\tau}, \quad D_f^{B**} = \frac{\tau + d}{3\tau}, \quad D_n^{**} = \frac{4\tau - 5d}{6\tau}. \tag{10}$$

where $D_f^{B**} > D_f^{A**} > 0$. This demonstrates that firm A will set the higher offline price compared to that of firm B, thus the market demand of the offline channel for firm A will be lower than that of firm B. Notice also that the market size of the online channel in (10) is less than that in (7), i.e., $D_n^{**} < D_n^*$. This implies that the offline firm can reduce online transactions by introducing an online channel, thus lessening price competition. However, the demand of the competitor offline firm B is increasing, i.e., $D_f^{B**} > D_f^*$.

Finally, the social cost of blockaded entry case is calculated as follows:

$$C^{**} = \frac{4\tau^2 + 56\tau d - 47d^2}{72\tau}. \tag{11}$$

3.2 Free Entry: Symmetric Competition

We next consider the other case where both offline firms introduce new online business into the offline channels. We assume that they compete in an online market with the form of Bertrand price competition. Then, the profit function of the hybrid firm will then be written as $\pi_i = p_f^i D_f^i + (p_n^i - d)D_n^i$, $i = A, B$. However, Bertrand price competition yields that $p_n^i = d$ in equilibrium. Then, using the demands functions in (3) and (4), in a symmetric equilibrium, we have the following equilibrium prices:

$$\hat{p}_f = \hat{p}_f^A = \hat{p}_f^B = \frac{d}{2}, \quad \hat{p}_n = \hat{p}_n^A = \hat{p}_n^B = d. \tag{12}$$

Notice that $\hat{p}_f < p_f^*$ and $\hat{p}_n < p_n^*$. It implies that the equilibrium prices in the free entry case decrease compared with pure online competition in (6). This result assures that consumer surplus will increase after the introduction of online channel.[5]

The market demands in equilibrium are given by $\hat{D}_f = d/2\tau$ and $\hat{D}_n = (\tau - d)/\tau$. Notice also that $\hat{D}_f < D_f^*$ and $\hat{D}_n > D_n^*$. It implies that because of fierce price competition, the online market demand will increase under the free entry equilibrium.

Finally, the social cost of symmetric online channel competition is calculated as follows:

$$\hat{C} = \frac{4\tau d - 3d^2}{4\tau}. \tag{13}$$

4. Discussion and Extension

4.1 Discussion: Comparison of Social Cost

We show that online channel strategies of hybrid firms will not yield the least social cost of online competitions. Comparing the results of social cost among the three alternatives, we have the following relationship:

$$C^{**} < C^* < \hat{C} \quad \text{if} \quad d > 0.536\tau$$
$$C^* < C^{**} < \hat{C} \quad \text{if} \quad 0.286\tau < d < 0.536\tau$$
$$C^* < \hat{C} < C^{**} \quad \text{if} \quad 0.143\tau < d < 0.286\tau$$
$$\hat{C} < C^* < C^{**} \quad \text{if} \quad 0 < d < 0.143\tau$$

Notice that the social cost under free entry is not always the least. In particular, its social cost is the biggest among the three alternative models when $d > 0.286\tau$, and

[5] Notice that market demand will be increasing if the competition price is low. However, under the market-covered assumption, this demand increasing effect caused by lowering

it is the smallest only if $0 < d < 0.143\tau$ where delivery cost is sufficiently smaller than transportation cost. In addition, the social cost under blockaded entry is the biggest when $0 < d < 0.286\tau$ and it is the smallest only if $d > 0.536\tau$ where delivery cost is sufficiently larger than transportation cost. Therefore, the social costs in online competition depend on the relative size between delivery cost and transaction cost. In particular, if the delivery cost is sufficiently larger or sufficiently smaller than transportation cost, pure online competition yields the least social cost in an e-commerce market competition.

We now consider the strategic incentive of hybrid firms and its effects on the social cost. First, to understand the strategic incentive of hybrid firm, we first need to compare its profit level in the three alternatives. Then, we can show that the profit of hybrid firm under blockaded entry is the highest among the three alternatives. That is, offline firm will try to extend online channel to be a hybrid firm, i.e., $\pi^{A^{**}} > \pi^{*} + \pi_{n}^{*}$, and block the entry of the other online firms, i.e., $\pi^{A^{**}} > \hat{\pi}_{A}$. In this sense, it will prefer to be Stackelberg leader in the online market competition to enjoy the first-mover advantage. Therefore, it will hire some strategic behaviors such as increasing switching cost of consumers to lock them in and/or reducing delivery cost to get competitive advantage of online channel.[6]

gIn evaluating the effect of reducing delivery cost on the social cost, we have the following relations:

$$\frac{\partial C^{*}}{\partial d} \gtreqless 0 \quad \text{if} \quad \text{d} \lesseqgtr 0.7\tau$$
$$\frac{\partial C^{**}}{\partial d} \gtreqless 0 \quad \text{if} \quad \text{d} \lesseqgtr 0.596\tau$$
$$\frac{\partial C^{\wedge}}{\partial d} \gtreqless 0 \quad \text{if} \quad \text{d} \lesseqgtr 0.67\tau$$

It implies that there is a peak point where the social cost is the highest in each competition case. Using these relationships, we can draw the social cost function responding on the delivery cost in Figure 2.

---

prices is ignored in our model.

6 Shy[14] and Varian, et al[16] examine several important roles of switching cost and the lock-in effect in the economics of information technology.

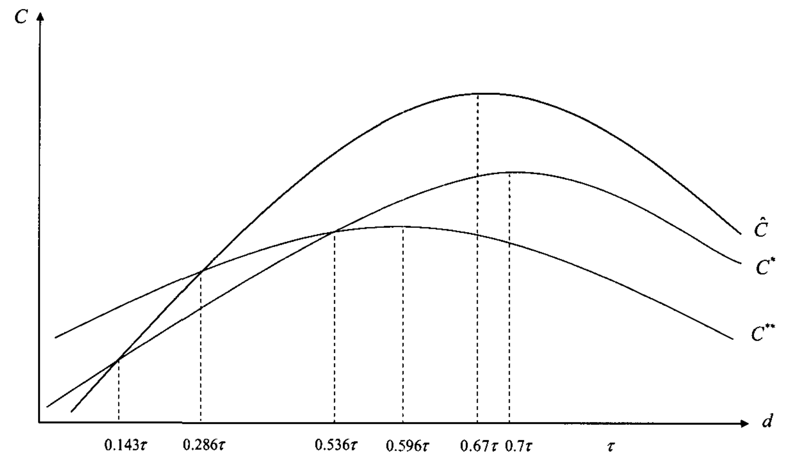

Figure 2. delivery cost and social cost

A few remarks are in order. First, even though the social cost of blockaded entry is the least when $d > 0.536\tau$, the social cost is decreasing in d when $d > 0.596\tau$. Thus, if the hybrid firm under blockaded entry hires efficient logistic system and thus reduces delivery cost when $0.596\tau < d < \tau$, the social cost will increase. Only when $0.536\tau < d < 0.596\tau$, the reduction of delivery cost will be beneficial to the society.

Second, even though the social cost increases when the delivery cost decreases when $d < 0.536\tau$, the social cost of blockaded entry is the not least. In particular, its social cost is the highest when $d < 0.286\tau$. Therefore, when the delivery cost decreases, the socially efficient region for the blockaded entry is $0.536\tau < d < 0.596\tau$. It represents that the possibility that mixed competition between online firms and hybrid firms yields better outcome for society is very low under the situation of decreasing delivery cost.

4.2 Extension: Internet Maturity and Social Costs

We extend the basic model into the case where the Internet maturity is incorporated. We assume that only m ($0 < m < 1$) fraction of consumers at each location point has access to the Internet, while others ($1-m$) do not have access to the Internet. Thus, m denotes the mature rate of online shopping. Then, a consumer with access to Internet may buy the good from the offline firms or from online firm. If the consumer purchases the good from the online firm, irrespective of the location of the consumer, she incurs no costs.

On the other hand, when the consumer cannot access Internet, we will denote $\hat{x}$ as the consumer who is indifferent to whether she purchases from offline firm A or firm B. Then, for comparison purpose, we can derive an indifferent consumer with the location of $\hat{x} = \frac{p_f^B - p_f^A + \tau}{2\tau}$ (See Figure 1).

4.2.1 Pure online competition

In the coexistence equilibrium, the demand functions for each firm are given by:

$$D_f^A = mx_A + (1-m)\hat{x} = \frac{2m(p_n - p_f^A) + (1-m)(p_f^B - p_f^A + \tau)}{2\tau}, \tag{14}$$

$$D_f^B = m(1-x_B) + (1-m)(1-\hat{x}) = \frac{2m(p_n - p_f^B) + (1-m)(p_f^A - p_f^B + \tau)}{2\tau}, \tag{15}$$

$$D_n = m(x_B - x_A) = \frac{m\tau - m(2p_n - p_f^A - p_f^B)}{\tau}. \tag{16}$$

where $D_f^A + D_f^B + D_n = 1$.

Then, using the similar procedure with the previous section, we have the following symmetric equilibrium prices:

$$p_f^* = \frac{(2-m)\tau + 2md}{2(2m+1)}, \text{ and } p_n^* = \frac{(3+m)\tau + 2(1+3m)d}{4(2m+1)}.$$

This gives $p_n^* - p_f^* = \frac{2(1+m)d - (1-3m)\tau}{4(2m+1)}$. Notice that $p_n^* \geq p_f^*$ if $m \geq \frac{\tau - 2d}{3\tau + 2d}$ and $p_n^* \leq p_f^*$ if $m \leq \frac{\tau - 2d}{3\tau + 2d}$. Therefore, the online firm can set a higher price than the offline firms in the model.[6] This implies that when the maturity of Internet access is high, an online firm might set higher prices than offline firms.

We can get the equilibrium results of $\hat{x} = \frac{1}{2}$, $x_A = 1 - x_B = \frac{p_n^* - p_f^*}{\tau} =$

[6] Several studies in the analysis of prices between offline firms and online firms yield conflicting results on the price differences. For example, according to the survey of Korea Information Society Development Institute, the price of 44% in the total online shopping malls is the differences. For example, according to the survey of KISDI, the price of 44% in the total online shopping malls are the same as offline prices, while 33% are lower and 23% are higher than offline prices.

$\frac{(3m-1)\tau+2(1+m)d}{4(2m+1)\tau}$, and $x_B - x_A = 1-\frac{2(1+m)d-(1-3m)\tau}{2(1+2m)\tau}$ m and the social cost of pure online competition from Figure 3.

$$C^* = (1-m)(V+W+Y+Z)+m(V+W+X+Y)$$

where, $V+W+Y+Z=\frac{\tau\hat{x}}{2}=\frac{\tau}{4}$, $V+W=(p_n^*-p_f^*)x_A=\frac{[(3m-1)\tau+2(1+m)d]^2}{16(2m+1)^2\tau}$, and

$$X+Y=d(x_B-x_A)=d[1-\frac{(3m-1)\tau+2(1+m)d}{2(2m+1)\tau}].$$

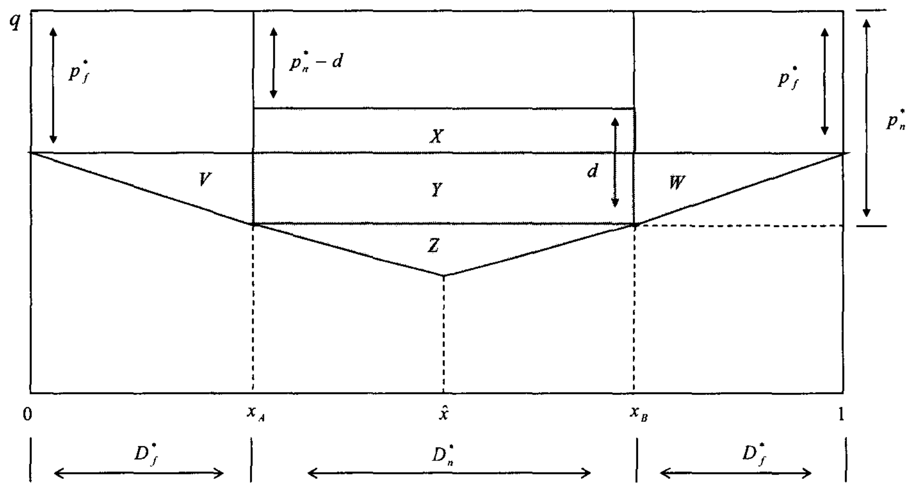

Figure 3. Internet maturity and social cost of pure online competition

4.2.2 Blockaded entry competition

Using the same procedures, we have the following equilibrium prices in a coexistence equilibrium under blockaded entry:

$$p_f^{A**} = \frac{(3+m)\tau+(2-m)d+(1-m^2)}{3(1+m)},$$

$$p_f^{B**} = \frac{(3-m)\tau+2(2-m)d}{3(1+m)},$$

$$p_n^{**} = \frac{m[2(3+m)\tau+2(2-m)d+(1-m^2)]+3(1+m)d}{6m(1+m)}.$$

Notice that $p_f^{A**} > p_f^{B**} > p_f^*$ and $p_n^{**} > p_n^*$. Thus, it still holds that the hybrid firm under blockaded entry can lessen price competition and thus consumer surplus will decrease.

Then, we have $\hat{x} = \frac{1}{2} - \frac{2m\tau - (2-m)d + (1-m^2)}{6(1+m)\tau}$, $x_A = \frac{p_n^{**} - p_f^{A**}}{\tau} = \frac{3(1+m)d - m(1-m^2)}{6m(1+m)\tau}$, and $1 - x_B = \frac{p_n^{**} - p_f^{B**}}{\tau} = \frac{m[4m\tau - 2(2-m)d + (1-m^2)] + 3(1+m)d}{6m(1+m)\tau}$. These results give us the social cost of mixed competition under blockaded entry from Figure 4.

$$C^{**} = (1-m)(V + Y_1 + Z_1 + W + Y_2 + Z_2) + m(V + W + X_1 + X_2 + Y_1 + Y_2)$$

where $V + Y_1 + Z_1 = \frac{\tau\hat{x}^2}{2} = \frac{\tau}{2}[\frac{1}{2} + \frac{(2-m)d - 2m\tau - (1-m^2)}{6(1+m)\tau}]^2$,

$$W + Y_2 + Z_2 = \frac{\tau(1-\hat{x})^2}{2} = \frac{\tau}{2}[\frac{1}{2} - \frac{(2-m)d - 2m\tau - (1-m^2)}{6(1+m)\tau}]^2,$$

$$V + W = \frac{\tau}{2}(x_A^2 + (1-x_B)^2)$$

$$= \frac{[3(1+m)d - m(1-m^2)]^2}{72m^2(1+m)^2\tau} + \frac{[m(4m\tau - 2(2-m)d + (1-m^2)) + 3(1+m)d]^2}{72m^2(1+m)^2\tau},$$

$$X_1 + X_2 + Y_1 + Y_2 = d(x_B - x_A) = d[1 - \frac{4m^2\tau + 2(3+m+m^2)d}{6m(1+m)\tau}].$$

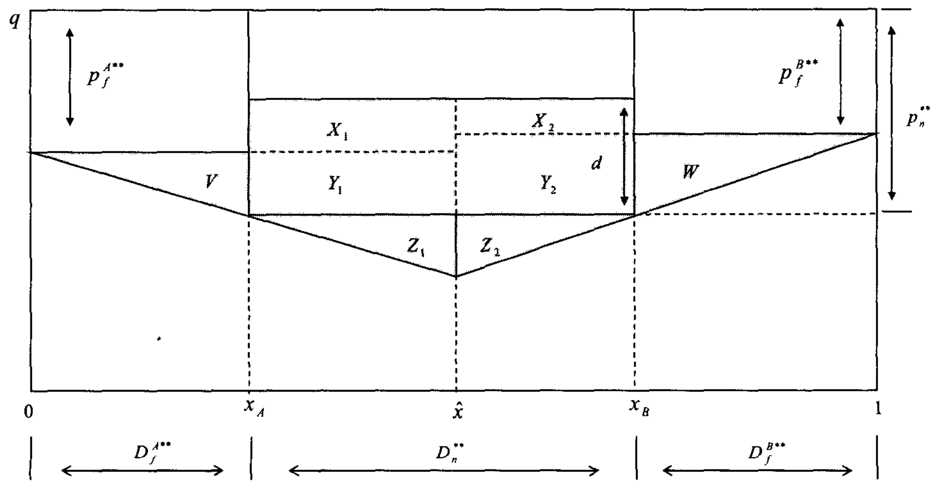

Figure 4. social cost of blockaded entry

4.2.3 Free entry competition

Using the same argument of Bertrand price competition, we have the symmetric equilibrium prices: $\hat{p}_f = \hat{p}_f^A = \hat{p}_f^B = \frac{(1-m)\tau+2md}{(1+3m)}$ and $\hat{p}_n = \hat{p}_n^A = \hat{p}_n^B = d$. Notice that $\hat{p}_f \geq \hat{p}_n$ if $m \geq \frac{\tau-d}{\tau+d}$ and $\hat{p}_f \leq \hat{p}_n$ if $m \leq \frac{\tau-d}{\tau+d}$. In addition, $\hat{p}_n < p_n^*$ and $\hat{p}_f \leq p_f^*$ if $m(2d-\tau) \leq 3\tau - 2d$ and $\hat{p}_f \geq p_f^*$ if $m(2d-\tau) \geq 3\tau - 2d$.

Then, we have $\hat{x} = \frac{1}{2}$ and $x_A = 1 - x_B = \frac{p_n^* - p_f^*}{\tau} = \frac{(1+m)d-(1-m)\tau}{(1+3m)\tau}$. Using the market demand in equilibrium gives the social cost under free entry from Figure 5.

$$\hat{C} = (1-m)(V+W+Y+Z) + m(V+W+X+Y)$$

where $V+W+Y+Z = \frac{\tau\hat{x}}{2} = \frac{\tau}{4}$,

$$V+W = \tau x_A^2 = \frac{[(1+m)d-(1-m)\tau]^2}{(1+3m)^2\tau},$$

$$X+Y = d(x_B - x_A) = d[1 - \frac{2(1+m)d-2(1-m)\tau}{(1+3m)\tau}].$$

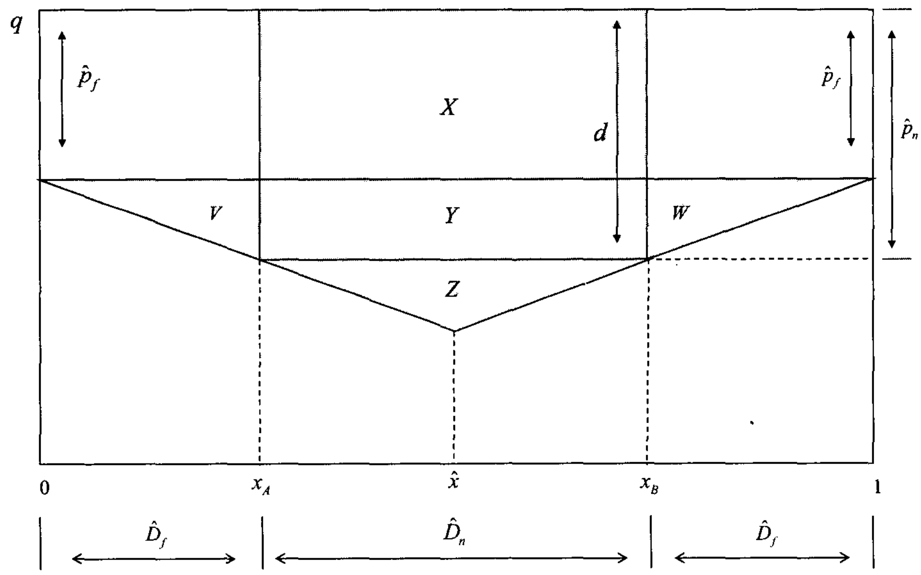

Figure 5. social cost of free entry

4.2.4 *Comparison of social cost*

We will investigate the social costs with m. For the convenience of comparison under the situation of coexistence equilibrium, we will show an example where $\tau = 12 > d = 1$ and measure the social costs of C^*, C^{**} and $\hat{C}$. Then, from the numerical results in Table 1 and Figure 6, a few remarks are in order.

First, the social cost is decreasing in online access rate m. In particular, the decreasing rate of free entry case is the highest and thus, as Internet matures and offline transportation cost is sufficiently larger than online delivery cost, the social cost of free entry case is the least. In other words, the symmetric competition effect is beneficial to the society when the online access matures sufficiently.

Table 1. Numerical Example

m	C^*	C^{**}	$\hat{C}$
0.1	2.835	2.826	3.388
0.2	2.617	2.603	3.234
0.3	2.390	2.426	2.936
0.4	2.169	2.264	2.607
0.5	1.959	2.111	2.285
0.6	1.760	1.962	1.980
0.7	1.573	1.817	1.693
0.8	1.395	1.673	1.426
0.9	1.226	1.531	1.174
1.0	1.065	1.390	0.938

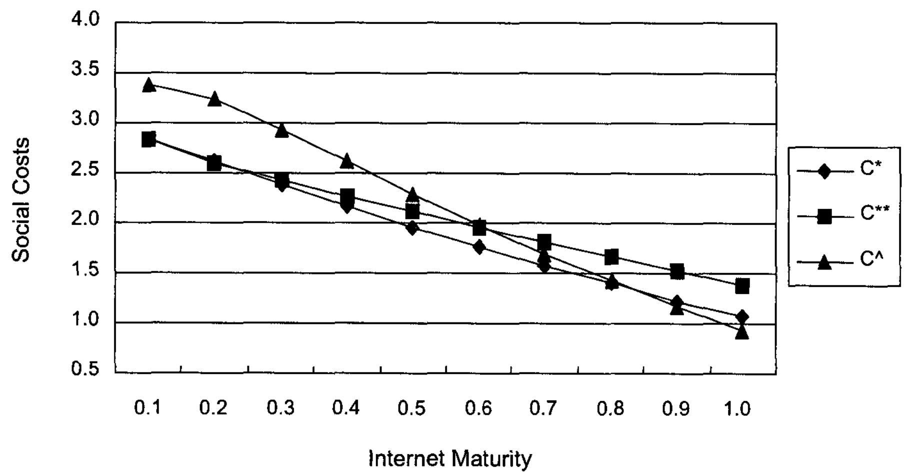

Figure 6. The Comparison of Social Costs

Second, the social costs depend on the competition pattern. In particular, the social cost of free entry case is not always the least. For example, when $m < 0.6$, the social cost of symmetric online competition of free entry case is the largest among the three scenarios. But, when $m > 0.6$, asymmetric online competition of blockaded entry case yields the largest social costs. However, when internet maturity is sufficiently low, i.e., $m < 0.2$, the social cost of pure online competition is larger than that of asymmetric online competition. Therefore, it is important to expand online business into offline business with the evaluation of Internet maturity and online competition pattern.

5. Conclusion

This paper considered a simple linear city model that analyzes the competition strategy of online channels by hybrid firms, and examined the equilibrium outcome where offline firms compete with online business under the form of a hybrid firm. We measured the social cost of online business competition and demonstrated that, compared to the case of pure online competition, the introduction of online channels by offline merchants with the form of hybrid channels may increase the social cost. In particular, we have shown that (i) online channel of hybrid firm under blockaded entry may increase the social cost if the firms' delivery cost is sufficiently smaller than the consumer's transportation cost, and (ii) online competition under free entry may increase the social cost if the firms' delivery cost is sufficiently larger than the consumer's transportation cost.

We also examined the strategic incentive of hybrid firms to evaluate the effect of delivery cost on the society, and found out that the hybrid firm will plan to enjoy the first-mover advantage as a Stackelberg leader. In particular, we have shown that (i) when delivery cost is sufficiently larger than transportation cost, the social cost of blockaded entry is the least but the social cost is decreasing in delivery cost, and (ii) when delivery cost is sufficiently smaller than transportation cost, the social cost is increasing in delivery cost but the social cost of blockaded entry is not the least. It indicates that the possibility that mixed competition between online firms and hybrid firms yields better outcome for society is very low under the strategic situation of decreasing delivery cost.

Finally, we extended the analysis into the case where the Internet maturity is incorporated and demonstrated that, compared to the case of pure online competition, the introduction of online channels by hybrid merchants might reduce welfare as the Internet matured.

For the future research, interlinking strategies between network effect of online channel and lock-in effect of offline channel should be incorporated. The other challenging attempt is to examine the strategic incentive of hybrid firm in choosing location by considering cost saving effect of multiple channels and complementary effect of online channels from advertising and online experiences. Finally, another interesting issue is to explain how the model analyzed can be generally applied to other hybrid channel competition with different forms of hybrid firms in various market structures since most of the firms in these days have already transformed into the hybrid firms by any means.

References

[1] Bailey, J. P., *Intermediation and electronic markets: aggregation and pricing in Internet commerce,* Technology, Management and Policy, MIT, Cambridge, 1998.

[2] Bakos, J. Y., "Reducing buyer search costs: implications for electronic marketplaces," *Management Science* 43, 12 (1997), 1613-1630.

[3] Brynjolfsson, E. and M. Smith, "Frictionless commerce? a comparison of Internet and conventional firms," *Management Science* 46, 4 (2000), 563-85.

[4] Cho, H. R., J. S. Yu, C. N. Cha, and S. G. Lim, "Analysis of pricing and efficiency control strategy between online and offline marketing channels," *Journal of the Korean Institute of Industrial Engineers* 27, 2 (2001), 181-189.

[5] Chun, S. H. and J. C. Kim, "Pricing strategies in B2C electronic commerce: analytical and empirical approaches," *Decision Support System* 40, 2 (2005), 375-388.

[6] Dumans, M. E., "Competition between on line retailers and traditional shops," CREST-LEI 2002-30, 2002.

[7] Goolsbee, A., "In a world without borders: the impact of taxes on internet commerce," *Quarterly Journal of Economics* 115, 2 (2000), 561-76.

[8] Harrington, J. E., "Comment on reducing buyer search costs: implications for electronic marketplaces," *Management Science* 47, 12 (2001), 1727-1731.

[9] Hotelling, H., "Stability in competition," *Economic Journal* 39 (1929), 41-57.

[10] Kauffman, R. and E. A. Walden, "Economics and electronic commerce: survey and directions for research," *International Journal of Electronic Commerce* 5, 4 (2001), 5-116.

[11] Lee, S. H., "Price competition between online and offline firms in an e-commerce market and discriminatory taxation," *Hitotshubashi Journal of Economics* 47, 1 (2006), 37-49.

[12] Liang, T. P. and J. S. Huang, "An empirical study on business acceptance of products in electronic markets: a transaction cost model," *Decision Support Systems* 24 (1998), 29-43.

[13] Lynch, J. G. and J. D. Ariely, "Wine online: search costs and competition on price, quality and distribution," *Marketing Science* 19, 1 (2000), 83-103.

[14] Shy, Oz, *The Economics of Network Industries.* The Cambridge University Press, 2001.

[15] Strader, T. J. and M. J. Shaw, "Characteristics of electronic markets," *Decision Support System* 21 (1997), 185-198.

[16] Varian, H. R., J. Farrell, and C. Shapiro, *The Economics of information technology: an introduction*, Cambridge University Press, 2004.

[17] Weisman, A. E., *The Internet economy: access, taxes, and market structure*, Brookings Institution Press, 2000.

[18] Zettelmeyer, F., "Expanding to the Internet: pricing and communications strategies when firms compete on multiple channels," *Journal of Marketing Research* 37 (2000), 292-308.