E C O N O M I C S B U L L E T I N

Wholesale Price Discrimination between High Street Retailers and Online Retailers

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Abstract

We analyze wholesale pricing and retail pricing when a monopolistic manufacturer sells its product to a high street retailer and an online electronic retailer, which have different selling qualities and marginal selling costs. We observe that (1) the wholesale price for an online electronic retailer is higher than that for a high street retailer if an online electronic retailer's selling cost advantage is greater than its selling quality disadvantage for all consumers buying products, and (2) the retail price of the e-retailer is necessarily lower than that of the c-retailer independent of conditions.

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1. Introduction

"Manufacturers, including Sony, are charging shopping websites wholesale prices between 10 and 15 per cent higher than their prices to high street stores, the trade group that represents online sellers says. The rises mean that e-retailers will find it difficult to carry on undercutting prices in the high street." (The Times, November 15, 2005.)

The above newspaper article reported wholesale price discrimination of manufacturers between conventional high street retailers (referred to hereafter as c-retailers) and online electronic retailers (referred to hereafter as e-retailers). It is seemingly surprising that manufacturers set higher wholesale prices for e-retailers which would sell products at lower price than c-retailer. However, on careful consideration, it would not be surprising that manufacturers set different wholesale prices for c-retailers and e-retailers, because the environment for sale, including marginal selling costs, market area, target consumers, etc., differ between c-retailers and e-retailers. The present study investigates wholesale pricing decisions of a monopolistic manufacturer when the manufacturer sells its products to two different types of retailers: a c-retailer and an e-retailer.

The issue of wholesale price discrimination is identical with that of third-degree price discrimination in intermediate good markets, which was analyzed by Katz (1987), DeGraba (1990), and Yoshida (2000) as fundamental theoretical study. Their studies assumed a two stage game in which a monopolistic upstream firm first decides the price for oligopolistic downstream firms on the intermediate goods markets and then downstream firms decides the quantity to sell on the final goods markets, based on the price given by a upstream firm. As the result, they showed that a monopolistic upstream firm charges different prices to different downstream firms and prohibiting this price discrimination might improve social welfare. Yet more recent studies considered that a upstream firm charge a two-part tariff to downstream firms, and considered that downstream firms having a symmetric demand function are engaged in price competition (O'Brien and Shaffer (1994), Caprice (2006), and Rey and Tirole (2007)).

On the other hand, most studies regarding competition between c-retailers and e-retailers assumed that c-retailers and e-retailers have an asymmetric demand function respectively and are engaged in price competition, because c-retailers and e-retailers have different market areas[1] and different selling methods[2], and, as described in the above quoted article, e-retailers appear to sell at prices below those of c-retailers. Balasubramanian (1998), Bouckaert (2000), and Nakayama (2003, 2007) assumed that while the market area of c-retailers is limited near their stores, e-retailers do not require specific areas, and they used the price competition model with horizontal (geographical) differentiation. Chiang *et al.* (2003) assumed that e-retailers are inferior to c-retailers regarding selling quality based on the result of Kacen *et al.* (2002) where the willingness to pay for a product sold by an e-retailer is lower than that for an identical product sold by c-retailers, and they used the price competition model with vertical (product quality) differentiation.

[1]Market area of c-retailers is limited near their stores, while e-retailers do not require specific areas.

[2]C-retailers sell products through face-to-face, while e-retailers sell products through web site.

We follow Chiang *et al.* (2003) to model competition between c-retailers and e-retailers, that is, we use the price competition model with horizontal vertical differentiation, and we assume the following: (1) consumers are heterogeneous in the valuation of products, (2) the valuation that each consumer places on a product are spread uniformly, and (3) when consumers buy a product from an e-retailer, the valuation is discounted at a constant rate. Moreover, selling costs between c-retailers and e-retailers would be different by different selling methods, and thus we assume that c-retailers and e-retailers incur different marginal selling costs respectively. Under these assumptions, we consider a two stage game in which at first stage, a monopolistic manufacturer decides the wholesale price for a c-retailer and an e-retailer, and at second stage, based on the wholesale price given by a manufacturer, a c-retailer and an e-retailer decide the retail prices respectively.

By solving this game, we show the following results: in regard to retail pricing, the retail price of the e-retailer is necessarily lower than that of the c-retailer independent of conditions. On the other hand, in regard to wholesale pricing, the wholesale price for the e-retailer is higher than that for the c-retailer when the e-retailer's selling cost advantage (which means c-retailer's selling cost minus e-retailer's selling cost) is greater than the e-retailer's selling quality disadvantage (which means a valuation discount when a consumer buy a product from e-retailer) for all consumers.

The present paper is organized as follows. Section 2 derives wholesale and retail pricing when a monopolistic manufacturer sells its products to a c-retailer and an e-retailer. Section 3 presents the concluding remarks.

2. Wholesale and retail pricing by a manufacturer, a c-retailer, and an e-retailer

We consider the case in which one monopolistic manufacturer sells its product to one c-retailer and one e-retailer. The monopolist manufacturer can offer each retailer different wholesale prices.[3] w_c denotes the wholesale price for the c-retailer, and w_e denotes the wholesale price for the e-retailer. The manufacturer incurs the constant marginal product cost, denoted by c_m, and the c-retailer and e-retailer incur constant marginal selling costs, denoted as c_c and c_e, respectively. As a result, the profits for each retailer are determined by

$$\begin{aligned} \pi_c &= (p_c - w_c - c_c)D_c(p_c, p_e), \\ \pi_e &= (p_e - w_e - c_e)D_e(p_c, p_e), \end{aligned}$$

where $D_c(p_c, p_e)$ and $D_e(p_c, p_e)$ are demand functions of each retailer, and the manufacturer's profit is determined by

$$\pi_m = (w_c - c_m)D_c(p_c, p_e) + (w_e - c_m)D_e(p_c, p_e). \quad (1)$$

[3]We assume that the manufacturer does not permit retailers to buy and sell the manufacturer's products from other retailers.

The manufacturer acts as a Stackelberg price leader. In other words, in the first stage, the manufacturer sets the wholesale prices for the c-retailer and the e-retailer, and then in the second stage, the c-retailer and the e-retailer choose the respectively retail prices based on the wholesale prices.

Before beginning the analysis of wholesale pricing and retail pricing, we need to formulate demand functions of each retailer, and thus, we analyze the product choice of consumers between the e-retailers and the c-retailers. When consumers buy a product from an e-retailer, they select a product based on a virtual description of the product, using text, graphics, or symbols in a web page catalog and have no information regarding the feel, taste, or smell of the product. Therefore, consumers buying a product from an e-retailer would be more likely to make a poor product choice as compared to a consumer buying a product from a c-retailer[4]. If a consumer is granted a refund for such a product, the consumer incurs the cost to return the product (which includes transportation costs, restocking fees, shipping charges, etc.). Thus, risk-averse consumers would estimate the value of a product sold by an e-retailer to be lower than a product sold by a c-retailer even if the e-retailer and the c-retailer sell the same product. An empirical study by Kacen et al. (2002) also showed that consumers evaluate e-retailers lower than c-retailers with respect to "uncertainty about receiving the correct item", "charges for shipping and handling", and "exchange-refund policy for returns", as a result, the willingness to pay for a product sold by an e-retailer is lower than that for a product sold by c-retailers. Thus, we assume that the customer's reservation price for a product sold by an e-retailer is discounted below the customer's reservation price, v, for a product sold by a c-retailer and is denoted by θv ($0 < \theta < 1$. Here, θ is given exogenously). Moreover, in order to prevent each retailer from not entering this market, we assume that $c_c + c_m < 1$ and $c_e + c_m < \theta$. When the e-retailer offers the product at price p_e, the net consumer surplus is $\theta v - p_e$ by buying the product from the e-retailer. If this surplus is greater than 0 (i.e., $\theta v - p_e > 0$), a consumer might buy the product from the e-retailer. However, a consumer can buy the product not only from the e-retailer but also from the c-retailer. Thus, if the surplus derived from the e-retailer is greater than 0 and equal to or greater than the surplus derived from the c-retailer (i.e., $\theta v - p_e \geq v - p_c$), a consumer would buy from the e-retailer and the consumer would obtain a surplus of $\theta v - p_e$. Conversely, if the surplus derived from the c-retailer is greater than 0 (i.e., $v - p_c > 0$) and larger than the surplus derived from the e-retailer, a consumer would buy from the c-retailer and would obtain a surplus of $v - p_c$.[5] Therefore, the demand function of each retailer are

$$D_c(p_c, p_e) = \begin{cases} 1 - p_c & \text{if } p_c < p_e/\theta, \\ 1 - \dfrac{p_c - p_e}{1 - \theta} & \text{if } p_e/\theta \leq p_c \leq (1-\theta) + p_e, \\ 0 & \text{if } p_c > (1-\theta) + p_e, \end{cases}$$

[4]We implicitly assume that consumers incur a large search cost each when they visit either c-retailer or e-retailer. Therefore, we assume that consumers will not buy a product from e-retailer after they see a real product from c-retailer.

[5]If both the surplus derived from the c-retailer and the surplus derived from the e-retailer are equal to or less than 0, we assume that the consumer would not buy the product and would obtain a zero surplus.

$$D_e(p_c, p_e) = \begin{cases} 0 & \text{if } p_c < p_e/\theta, \\ \dfrac{\theta p_c - p_e}{\theta(1-\theta)} & \text{if } p_e/\theta \leq p_c \leq (1-\theta) + p_e, \\ 1 - \dfrac{p_e}{\theta} & \text{if } p_c > (1-\theta) + p_e. \end{cases}$$

Figure 1 illustrates the surplus derived from each firm. If the demands of both retailers is more than 0, consumers that estimate a product to be of high quality will buy the product from the c-retailer, and consumers that estimate a product to be of lower quality will buy the product from the e-retailer. When the value that consumers place on the product is lower, the absolute discounted reservation price for the e-retailer's product is smaller, and the consumers' choice is affected by the retail price more than product quality.

Since we formulated demand functions, we derive the equilibrium. We first assume the case of equilibrium in which both the c-retailer and the e-retailer have a positive demand. The profits for each retailer are determined by

$$\pi_c = (p_c - w_c - c_c)\left[1 - \frac{p_c - p_e}{1-\theta}\right], \tag{2}$$

$$\pi_e = (p_e - w_e - c_e)\left[\frac{\theta p_c - p_e}{\theta(1-\theta)}\right]. \tag{3}$$

In the second stage, the c-retailer and the e-retailer determine their prices so as to maximize their profits based on the wholesale prices. The first-order conditions of (2) and (3) with respect to the retail price give the retail price equilibrium as follows[6]:

$$p_c^* = 1 - \frac{2(1 - w_c - c_c) + (\theta - w_e - c_e)}{4 - \theta} \tag{4}$$

$$p_e^* = \theta - \frac{\theta(1 - w_c - c_c) + 2(\theta - w_e - c_e)}{4 - \theta} \tag{5}$$

The demands of the c-retailer and the e-retailer in this retail price equilibrium are given as:

$$D_c = \frac{(2-\theta)(1 - w_c - c_c) - (\theta - w_e - c_e)}{(1-\theta)(4-\theta)} \tag{6}$$

$$D_e = \frac{-\theta(1 - w_c - c_c) + (2-\theta)(\theta - w_e - c_e)}{\theta(1-\theta)(4-\theta)} \tag{7}$$

In the first stage, the manufacturer determines the best wholesale prices for the c-retailer and the e-retailer in order to maximize the manufacturer's profit. Since the manufacturer anticipates the retail price equilibrium in the second stage, the first-order conditions of (1) subject to (4), (5), (6), and (7) give the best wholesale prices to maximize the manufacturer's profit as follows[7]:

$$w_c^*|_{D_c>0, D_e>0} = c_m + \delta_c/2, \;\; w_e^*|_{D_c>0, D_e>0} = c_m + \delta_e/2.$$

[6]The second-order conditions are satisfied.

[7]The second-order conditions are satisfied.

where δ_c denotes $1 - c_c - c_m$ and δ_e denotes $\theta - c_e - c_m$.

This wholesale price for the c-retailer (e-retailer) is the same as the best wholesale price of the manufacturer that sells its product to only the e-retailer. In other words, the manufacturer decides the wholesale price for the c-retailer (e-retailer) as if there were only one c-retailer (e-retailer) in the retail market. Note, however, that we assume that both the c-retailer and the e-retailer have a positive demand. The wholesale prices must then satisfy

$$(2-\theta)\delta_c > \delta_e \text{ and } \theta\delta_c < (2-\theta)\delta_e, \tag{8}$$

Next, we assume the case of equilibrium in which the e-retailer does not have a positive demand. The necessary condition for the existence of this equilibrium is that the e-retailer cannot obtain a positive demand even if the e-retailer charges only its marginal cost plus the wholesale price for the e-retailer (which equals $c_e + w_e$). Then, the c-retailer would select its price so that the e-retailer cannot obtain a positive demand even if the retail price of the e-retailer is $c_e + w_e$. Thus, the best response price of the c-retailer based on the wholesale price is $p_c^* = \min[(1+c_c+w_c)/2, (c_e+w_e)/\theta]$, which depends on c_e and w_e if w_e is sufficiently small. When the e-retailer cannot obtain a positive demand, the demand of the c-retailer is $1 - p_c$, and the profit of the manufacturer is $\pi_m = (w_c - c_m)(1 - p_c)$. Thus, the profit of the manufacturer would increase by decreasing the wholesale price for the e-retailer without decreasing the wholesale price for the c-retailer. Then, the manufacturer would decide the wholesale price for the e-retailer so as to satisfy the requirement that the right-hand side of (7) be equal to zero. In other words,

$$\frac{-\theta(1 - w_c - c_c) + (2-\theta)(\theta - w_e - c_e)}{\theta(1-\theta)(4-\theta)} = 0. \tag{9}$$

Because $\pi_m = (w_c - c_m)(1 - p_c)$, the best wholesale price for the c-retailer to maximize the manufacturer's profit is $w_c^*|_{D_e=0} = c_m + \delta_c/2$, and by substituting w_c^* into (9) we derive the best wholesale price for the e-retailer as

$$w_e^*|_{D_e=0} = c_m + \delta_e - \theta\delta_c/2(2-\theta) \leq w_e^*|_{D_c>0, D_e>0}.$$

Finally, we assume the case of equilibrium in which the e-retailer does not have a positive demand. We can derive the retail and wholesale prices in the equilibrium, as well as in the equilibrium in which the e-retailer does not obtain a positive demand. Thus, the best wholesale price for an e-retailer to maximize the manufacturer's profit is $w_e^*|_{D_c=0} = c_m + \delta_e/2$, and the best wholesale price for a c-retailer is

$$w_c^*|_{D_c=0} = c_m + \delta_c - \delta_e/2(2-\theta) \leq w_c^*|_{D_c>0, D_e>0}.$$

Moreover, we can easily see that $\pi_c|_{w_c=w_c^*, w_e=w_e^*} \geq \pi_c|_{D_c=0, w_e=w_e^*}$ and $\pi_e|_{w_c=w_c^*, w_e=w_e^*} \geq$

$\pi_e|_{D_e=0,w_c=w_c^*}$. Therefore, the wholesale price in equilibrium is as follows:

$$w_c^* = \begin{cases} c_m + \delta_c/2, & \text{if } (2-\theta)\delta_c > \delta_e, \\ c_m + \delta_c - \delta_e/2(2-\theta), & \text{if } (2-\theta)\delta_c \leq \delta_e, \end{cases} \tag{10}$$

$$w_e^* = \begin{cases} c_m + \delta_e/2, & \text{if } \theta\delta_c < (2-\theta)\delta_e, \\ c_m + \delta_e - \theta\delta_c/2(2-\theta), & \text{if } \theta\delta_c \geq (2-\theta)\delta_e. \end{cases} \tag{11}$$

From (10) and (11), $w_c^* < w_e^*$ if and only if $\delta_c < \delta_e$, and $w_c^* > w_e^*$ if and only if $\delta_c > \delta_e$. Let us define the partial welfare for the consumer as the difference between the net surplus of the consumer and the product and selling costs for the product that the consumer buys. δ_c (δ_e) implies the partial welfare for the consumer evaluating the product at the maximum when the consumer buys the product from the c-retailer (e-retailer). Therefore, $\delta_c < \delta_e$ implies that the partial welfare for the consumer evaluating the product at the maximum is improved by buying the product from the e-retailer rather than the c-retailer[8], and the larger the difference between δ_c and δ_e, the more the partial welfare is improved. Moreover, if and only if $\delta_c < \delta_e$, $v - c_c - c_m < \theta v - c_e - c_m$ for $0 \leq v \leq 1$, which implies that all of the partial welfares for each consumer are improved by buying the product from the e-retailer rather than the c-retailer. Thus, when $\delta_c < \delta_e$ is satisfied, it is the most desirable from a social welfare point of view that all consumers buy the product from the e-retailer, and we say that the e-retailer is *strictly efficient*. Summarizing this discussion, we obtain the following proposition.

Proposition 1

When the e-retailer is strictly efficient, the wholesale price for the e-retailer is higher than that for the c-retailer, and vice versa. When the e-retailer is not strictly efficient, the wholesale price for the e-retailer is lower than that for the c-retailer, and vice versa.

When the e-retailer is strictly efficient and some consumers buy the product from the c-retailer, the wholesale pricing of the manufacturer in the equilibrium is not desired for social welfare, because the partial welfare for the consumer is improved by buying the product from the e-retailer rather than the c-retailer.

Moreover we obtain the following proposition with regard to the retail pricing in equilibrium.

Proposition 2

In equilibrium, if both retailers obtain a positive demand, the retail price of the c-retailer is higher than that of the e-retailer, that is,

$$p_c^*(w_c^*, w_e^*) > p_e^*(w_c^*, w_e^*).$$

[8]Since $\delta_e - \delta_c = (c_c - c_e) - (1-\theta)$, another implication of $\delta_c < \delta_e$ is that the e-retailer's selling cost advantage for the consumer evaluating the product at the maximum is greater than the e-retailer's selling quality disadvantage for the consumer.

Proof: Since $0 < \theta < 1$, $D_e(p_c, p_e) = 0$ when $p_c \leq p_e$. Therefore, if both retailers get a positive demand in equilibrium, $p_c^* > p_e^*$ must be satisfied. Q.E.D.

When the e-retailer is strictly efficient, the wholesale price for the e-retailer is higher than that for the c-retailer, but the retail price of the e-retailer is lower than that of the c-retailer. Since consumers conclude that the e-retailer's selling quality is lower than the c-retailer's selling quality, the e-retailer has no way to survive in the market other than quoting lower prices than the c-retailer whether the wholesale price for e-retailer is high or low.

3. Concluding remarks

We analyzed the wholesale and retail pricing for a c-retailer and an e-retailer that differ with respect to the selling quality and marginal selling cost. As a result, we found the following. In regard to retail pricing, the retail price of the e-retailer is necessarily lower than that of the c-retailer independent of conditions. In regard to wholesale pricing, when the e-retailer is strictly efficient, the wholesale price for the e-retailer is higher than that for the c-retailer, and vice versa. When the e-retailer is not strictly efficient, the wholesale price for the e-retailer is lower than that for the c-retailer, and vice versa.

The newspaper article mentioned in the introduction reports that the wholesale price for e-retailers is 10 to 15 percent higher than that for c-retailers. Judging from this report and the result of the present paper, we conclude that e-retailers are strictly efficient. The online retailing would be excellent in cost performance, insomuch that price cutting to make up for selling quality disadvantage would become no problem. Therefore, the manufacturer would exploit the additional profits of online retailers, and thus, the wholesale price for online retailers would become higher than that for high street retailers.

When the e-retailer is strictly efficient, social welfare is improved by buying the product from the e-retailer rather than the c-retailer. Therefore, the wholesale price discrimination in which the c-retailer is favored is not desired for social welfare, and forbidding the wholesale price discrimination might be desirable. However, forbidding the wholesale price discrimination shuts out the c-retailer that is inefficient from the market through price competition, and strengthens the monopolistic power of the e-retailer, and as a result, social welfare might worsen. Whether forbidding the wholesale price discrimination is desirable is left for future research.

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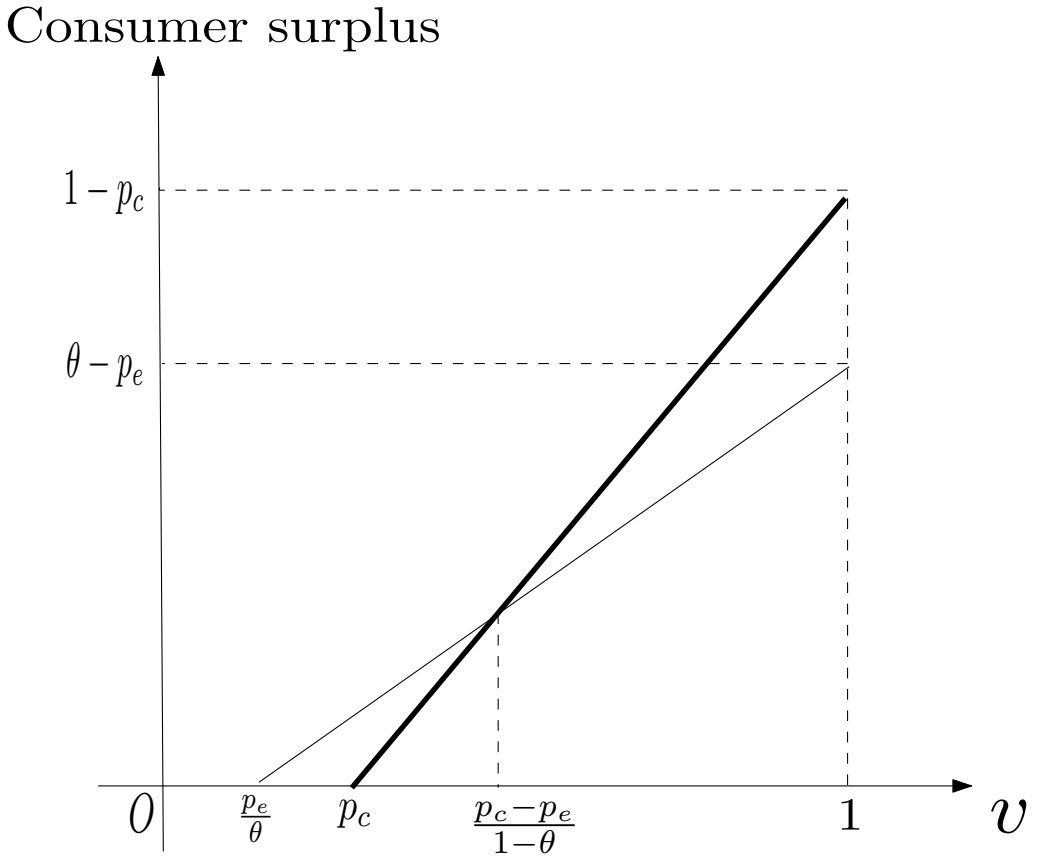

Figure 1: Consumer surplus (bold line: consumer buys the product from a c-retailer, thin line: consumer buys the product from an e-retailer)