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# Refunds and Collusion

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## Abstract

We characterize the conditions under which industry-wide agreements on refund policies weaken price competition. We identify the conditions under which joint industry profit increases with the amount of refunds promised to those consumers who cancel a reservation or return a product, as well as the conditions under which joint profit is maximized when service providers agree on providing no refunds to customers.

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## 1. Introduction

Semicollusion refers to explicit and implicit non-price agreements among brand producing firms intended to weaken price competition. For many years, researchers of Industrial Organizations have been debating for example whether research joint ventures should be allowed and to what extent they generate price increases above the competitive levels. In this paper we examine the effects of colluding on refund levels. In principle, colluding on refunds should be more alarming than ordinary semicollusive practices since refunds can be viewed as a component of the price. Under this interpretation, collusion on refunds can be viewed as full collusion rather than semicollusion. The purpose of this paper is to explore precisely the issue whether collusion on refunds is harmful to consumers, and to what degree it can substitute for direct price collusions.

In the present paper, we formally introduce *competition* into industries that either utilize advance booking systems where some consumers do not show up when the service is delivered, or retail industries where some consumers wish to return the product and obtain some refund. Our purpose is investigate whether industry-wide collusion on a joint refund policy can weaken price competition and therefore harm the consumers. Our analysis can be applied to two types of industries. First, to industries providing services like travel arrangements (airline, train, bus, hotel, car rental), or repair, maintenance, education, and so on. These industries are characterized by services that are *time dependent* and *non-storable*. This means that both buyers and sellers must commit to a certain predetermined time at which the service is set to be delivered. Therefore, service providers tend to utilize advance reservation systems as part of their business and marketing strategies. Second, our analysis applies also to retailers selling *experience goods* where some consumers discover after purchase that there are unsatisfied with the product they have fully paid for. For this reason, our model allows for multiple strategies where service providers or retailers can choose their refund policy in addition to setting prices.

In the Economics literature there are a few papers analyzing the refundability option as a means for segmenting the market or the demand. Most studies have focused on a single seller. Those studies that analyze industries with multiple sellers generally assume that prices are fixed, thus leaving firms to compete on capacity allocation only. Contributions by Gale and Holmes (1992, 1993) compare a monopolist's advance bookings with socially-optimal ones. Gale (1993) analyzes consumers who learn their preferences only after they are offered an advance purchase option. On this line, Miravete (1996) and more recently Courty and Li (2000) further investigate how consumers who learn their valuation over time can be screened via the introduction of refunds. Courty (2003) investigates resale and rationing strategies of a monopoly that can sell early to uninformed consumers or late to informed consumers. Dana (1998) also investigates market segmentation under advance booking made by price-taking firms. Finally, Ringbom and Shy (2004) analyze partial refunds set by price-taking firms.

The papers analyzing a duopoly market structure include Gale (1993) who analyzes a duopoly setting with consumers who learn their preferences over time. Macskasi (2003) analyzes duopoly with product differentiation where each consumer gets an ex ante signal of her preferred location and only then learns the true location. The present paper adds to the duopoly literature by

focusing on the incentive to (semi) collude on a joint industry-wide refund policy.

The paper is organized as follows. Section 2 sets up a basic model of service providers who compete in prices *and* the amount of refunds given to consumers who are either not satisfied with a product, or do not show up at the time when the service is scheduled to be delivered. Section 3 solves for a noncooperative equilibrium. Section 4 analyzes collusion on refund levels and its welfare consequences. Section 5 analyzes shipping and handling charges. Section 6 investigates incentives to collude when consumers view the advance reservations systems as differentiated brands (in addition or in place of viewing only the services as differentiated). Section 7 summarizes the findings of this paper.

## 2. A Model of Competition and Refunds

Consider a service industry with two imperfectly-competitive service providers, selling two differentiated products/services. The difference between the present model and other models of product differentiation is that in the present model some consumers request refunds on their booking of the service or their purchase of products.

### 2.1 Services and products: Interpreting the model

Our model can be interpreted and applied to capture two types of markets:

**Services** : Where consumers make reservations, prepay for the service, and then request (partial) refund in the event that they cancel or simply do not show up (with some probability  $1 - \sigma$ ) for the delivery of the service. Under this interpretation, consumers show up with probability  $\sigma$ .

**Products** : Where consumers fully pay for a product, but then are not satisfied with the product (with some probability  $1 - \sigma$ ) and utilize the store's refund option. Under this interpretation, there is a probability  $\sigma$  that a customer is satisfied with the product after the purchase.

The first interpretation applies to transportation services such as the airline industry, whereas the second interpretation fits general retailing business.<sup>1</sup> In order to avoid excessive writing, we will be using the service interpretation in some models and the product interpretation for others, but the reader should bear in mind that our intention is to cover both types of industries.

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<sup>1</sup>We abstract from moral hazard issues generated by excessive refunds. In our setting, the probabilities of showing up are exogenously given.

## 2.2 Service providers

There are two service providers labeled by  $j = A, B$ . Let  $p_A$  and  $p_B$  be the prices they charge for providing the service, and  $r_A$  and  $r_B$  the refund they each promise to any consumer who pays for the service but later cancels or simply does not show up. Thus, in addition to setting prices, each service provider utilizes a refund policy where each provider must inform consumers how much of the prepaid price is refundable in the event that the customer does not show up during the time when the service is delivered, or if the customer is simply unsatisfied the product.

Service providers bear two types of per-customer costs. Let  $k \geq 0$  denote the service provider's capacity production cost or the cost of making a reservation for one customer. Note that this cost could be significant if the provider does not have any alternative use (no salvage value) for an unused capacity. Alternatively, it may not exist if capacity has an immediate alternative use upon no shows of consumers. In addition, service providers bear a per-customer cost of operation which we denote by  $c \geq 0$ . The difference between the *capacity cost* and the *operation cost* is that the latter is borne only if the customer actually shows up for the service, whereas the capacity/reservation cost is borne regardless of whether the customer shows up. Finally, we assume that both service providers always buy a sufficient amount of capacity to accommodate all reservations. Abstracting from overbooking complications enables us to generalize our results to any number of consumers in the market.

## 2.3 Consumers

Consumers are differentiated along two dimensions: Location preference and probability of showing up to collect a reserved service. We assume that there are  $n_H$  consumers who show up for the delivery of the service (or are satisfied with the product) with probability  $\sigma_H$ . Similarly there are  $n_L$  consumers whose probability of showing up is  $\sigma_L$ . We assume that  $0 < \sigma_L < \sigma_H < 1$ . The  $n_H$  and  $n_L$  consumers are indexed by  $x$  ( $0 \leq x \leq 1$ ) that measures the distance (disutility) from service provider  $A$ , whereas  $(1 - x)$  measures the distance from  $B$ . Thus,  $x$  serves as the standard Hotelling index of differentiation. We assume that the (expected) utility of a consumer indexed by  $(\sigma_i, x) \in \{\sigma_H, \sigma_L\} \times [0, 1]$  is given by

$$U(\sigma_i, x) \stackrel{\text{def}}{=} \begin{cases} \sigma_i(\beta - \tau x) - p_A + (1 - \sigma_i)r_A & \text{buying service } A \\ \sigma_i[\beta - \tau(1 - x)] - p_B + (1 - \sigma_i)r_B & \text{buying service } B. \end{cases} \quad (1)$$

The parameter  $\beta$  measures consumers' basic utility from the service, and  $\tau$  measures the degree of service differentiation, which is inversely related to the degree of competition between the two service providers. That is, competition becomes more intense when  $\tau$  takes lower values. The utility function (1) reveals that the benefit  $\beta$  (net of the transportation cost) is collected only if the consumer shows up (with probability  $\sigma_i$ ). Section 6 analyzes an alternative formulation where consumers bear transportation costs by making a reservation regardless of whether they actually end up showing up at the service delivery time.

## 2.4 Profits of service providers

Let  $q_A$  and  $q_B$  denote the endogenously determined number of consumers who each book (buy) one unit of service from providers  $A$  and  $B$ , respectively. Since not all consumers end up showing up at the service delivery time (alternatively, since some consumers are not satisfied and end up returning the product) we denote by  $s_A$  and  $s_B$  the *expected* number of consumers who show up at the service delivery time. Clearly,  $0 < s_j < q_j$  for all  $j = A, B$ . Therefore, the (expected) profit of each service provider  $j$  is given by

$$\pi_j(p_j, r_j) = (p_j - k)q_j - cs_j - r_j(q_j - s_j), \quad j = A, B. \quad (2)$$

The first term measures the revenue net of the reservation cost (cost of producing the product under the second interpretation). The second term measures the operation cost borne only if consumers actually show up to be served. The last term is the expected total refunds to consumers who don't show up for the service they have paid for.

## 3. Equilibrium Prices and Refunds

Consider the following two-stage game. In Stage I, both service providers determine the refunds ( $r_A$  and  $r_B$ ) to be given to all consumers who do not show up at the service delivery time. In Stage II, both providers take refunds as given and determine the prices  $p_A$  and  $p_B$ . As we show in Proposition 3 below, a reversal of stages I and II yields identical equilibrium prices and refund levels. Thus, the chosen order of the strategic decisions is irrelevant under imperfect competition (but clearly not under collusion, as shown later in Section 4).

### 3.1 Stage II: Equilibrium prices

Suppose that both service providers are already committed to the amount of refund they give on no-shows. Formally, let  $r_A$  and  $r_B$  be given. The utility function (1) implies that a type  $i$  consumer who is indifferent between booking service  $A$  and  $B$  is determined by  $\sigma_i(\beta - \tau\hat{x}_i) - p_A + (1 - \sigma_i)r_A = \sigma_i[\beta - \tau(1 - \hat{x}_i)] - p_B + (1 - \sigma_i)r_B$ . Hence,

$$\hat{x}_i = \frac{p_B - p_A + (1 - \sigma_i)(r_A - r_B) + \sigma_i\tau}{2\sigma_i\tau} \quad \text{for each type } i = H, L. \quad (3)$$

Thus, the fractions of  $A$  and  $B$  buyers increase with the amount of refunds  $r_A$  and  $r_B$ , respectively. Clearly, this difference between the proportions  $\hat{x}_H$  and  $\hat{x}_L$  disappears when  $\sigma_L \rightarrow 1$  and  $\sigma_H \rightarrow 1$  since in this case all buyers always show up meaning that no one asks for any refund.

From (3) we can compute the number of bookings (number of customers) made with each provider, and the expected number of show-ups:

$$\begin{aligned} q_A &= n_H\hat{x}_H + n_L\hat{x}_L & q_B &= n_H(1 - \hat{x}_H) + n_L(1 - \hat{x}_L) \\ s_A &= n_H\sigma_H\hat{x}_H + n_L\sigma_L\hat{x}_L & s_B &= n_H\sigma_H(1 - \hat{x}_H) + n_L\sigma_L(1 - \hat{x}_L). \end{aligned} \quad (4)$$

Substituting (3) into (4), and then into (2), maximizing  $\pi_A$  with respect to  $p_A$ , and  $\pi_B$  with respect to  $p_B$  yields

$$p_j = k + \gamma(c + \tau) + (1 - \gamma)r_j, \quad \text{where } 0 < \gamma \stackrel{\text{def}}{=} \frac{\sigma_H \sigma_L (n_H + n_L)}{n_H \sigma_L + n_L \sigma_H} < 1, \quad (5)$$

for service providers  $j = A, B$ . Second-order conditions for maxima are easily verified by computing  $\partial^2 \pi_j / \partial p_j^2 = -(n_H \sigma_L + n_L \sigma_H) / (\sigma_H \sigma_L \tau) < 0$ . Next, observe that

$$p_B - p_A = \frac{(r_B - r_A)[n_H \sigma_L (1 - \sigma_H) + n_L \sigma_H (1 - \sigma_L)]}{n_H \sigma_L + n_L \sigma_H}.$$

Thus,

### Observation 1

*The firm committed to a higher refund ends up charging a higher price. Formally,  $p_B \geq p_A$  if and only if  $r_B \geq r_A$ .*

## 3.2 Stage I: Equilibrium refunds

In the first stage, each service provider chooses her refund level knowing how the committed level of refund will affect the equilibrium prices as given in (5). Substituting (5) for  $p_A$  and  $p_B$  into (2), and then maximizing  $\pi_A$  with respect to  $r_A$ , and  $\pi_B$  with respect to  $r_B$  yields the best-response functions  $r_A = (r_B + c + \tau)/2$  and  $r_B = (r_A + c + \tau)/2$ . Thus, refunds are strategically complements. Second-order conditions are satisfied as  $\partial^2 \pi_j / \partial r_j^2 = -n_H n_L (\sigma_H - \sigma_L)^2 / [\tau (n_H \sigma_L + n_L \sigma_H)] < 0$ . Therefore, the subgame perfect equilibrium refunds, prices, and profit levels are given by

$$r_A = r_B = c + \tau, \quad p_A = p_B = c + k + \tau, \quad \pi_A = \pi_B = \frac{\tau (n_H \sigma_H + n_L \sigma_L)}{2}. \quad (6)$$

Equation (6) implies the following proposition.

### Proposition 2

*In a subgame perfect equilibrium, the refund to customers who do not show up consists of the entire price net of the capacity cost. Formally,  $r_A = p_A - k$  and  $r_B = p_B - k$ .*

In other words, competitive refunds consist of the operation cost saving on a no-show,  $c$ , plus the duopoly price markup  $\tau$ . This implies that service providers do not make any profit on customers who cancel. Hence, all profits are extracted only from consumers who do show up for the service (or are satisfied with the product under the second interpretation given in Section 2.1).

### 3.3 Robustness to the order of decisions

Our equilibrium so far was computed under the assumption that service providers must commit to their refund policies before price competition begins. A natural question to ask at this point is whether the calculated equilibrium is robust to changes in the order of the decisions. To investigate this issue let us suppose now that both service providers first announce and commit to their prices  $p_A$  and  $p_B$ , and only later announce their refunds on no shows  $r_A$  and  $r_B$ .

We follow the same optimization as in Section 3.1, but in a reverse order. More precisely, Substituting (3) into (4), and then into (2), maximizing  $\pi_A$  with respect to  $r_A$ , and  $\pi_B$  with respect to  $r_B$ , and solving the system of the two best-response functions yields

$$r_j = \psi(p_j - k - c - \tau) + c + \tau, \quad \text{where} \quad \psi \stackrel{\text{def}}{=} \frac{n_H \sigma_L (1 - \sigma_H) + n_L \sigma_H (1 - \sigma_L)}{n_H \sigma_L (1 - \sigma_H)^2 + n_L \sigma_H (1 - \sigma_L)^2} > 1, \quad (7)$$

set by each service provider  $j = 1, 2$ . Second-order conditions are satisfied by  $\partial^2 \pi_j / \partial r_j^2 = -[n_H \sigma_L (1 - \sigma_H)^2 + n_L \sigma_H (1 - \sigma_L)^2] / (\sigma_H \sigma_L \tau) < 0$ . Notice that (7) implies that the amount of refund  $r_A$  depends only on the price  $p_A$  (and not on  $p_B$ ), and  $r_B$  depends only on  $p_B$  (and not on  $p_A$ ).

Next, substituting  $r_A$  and  $r_B$  from (7) into the profit functions, solving the two first-order conditions yield

$$p_A = p_B = c + k + \tau \quad \text{hence} \quad r_A = r_B = c + \tau. \quad (8)$$

Comparing (8) with (6) yields the following proposition.

#### Proposition 3

*In markets for differentiated services where service providers compete in prices and the amount of refunds on no-shows, the subgame perfect equilibrium outcome where both commit first on refunds and then on prices, is the same as when they first decide on prices and then on refunds.*

### 3.4 Welfare under competition

We define consumer surplus as the sum of consumers' utilities (1) evaluated at the equilibrium prices and refund levels. Formally,

$$CS \stackrel{\text{def}}{=} \sum_{i=H,L} n_i \int_0^{0.5} [\sigma_i (\beta - \tau x) - p_A + (1 - \sigma_i) r_A] dx + \sum_{i=H,L} n_i \int_{0.5}^1 \{\sigma_i [\beta - \tau(1 - x)] - p_B + (1 - \sigma_i) r_B\} dx. \quad (9)$$

Substituting the equilibrium prices and refund levels (6) into (9) yields

$$CS = \left( \beta - c - \frac{5\tau}{4} \right) (n_H \sigma_H + n_L \sigma_L) - k(n_H + n_L). \quad (10)$$



Social welfare is defined by the sum of consumer surplus (10) and aggregate industry profit (6). Therefore,

$$W \stackrel{\text{def}}{=} CS + \pi_A + \pi_B = \left( \beta - c - \frac{\tau}{4} \right) (n_H \sigma_H + n_L \sigma_L) - k(n_H + n_L). \quad (11)$$

As expected, social welfare is the sum of basic utility net of operation cost and the average transportation cost, all multiplied by the expected number of consumers who show up, minus reservation costs for the entire consumer population.

## 4. Collusion on Refund Levels

In this section we proceed with our main investigation which is to characterize the conditions under which service providers have incentives to jointly agree on either higher or lower refund levels as compared with the noncooperative levels characterized in the previous section.

Proposition 3 demonstrated that under imperfect competition the subgame-perfect equilibrium outcome is invariant with respect to the order at which decisions are made (refunds versus prices). However, as we demonstrate below, when firms are able to collude on refunds, the order of decision making does matter. For this reason, Section 4.1 analyzes collusion on refunds before price competition begins, whereas Section 4.2 analyzes collusion on refunds after service providers compete in prices.

### 4.1 Collusion on refunds in the first stage

In the second stage both service providers compete in prices, given their commitments on the amount of refunds on no-shows. The price competition equilibrium as a function of firms' refund levels was already computed in the previous section and is given in (5). Substituting (5) into (4) and (3), and both into (2) and rearranging the terms yields the following linear-quadratic semi-collusive joint profit function

$$\begin{aligned} \pi_A + \pi_B = \frac{n_H n_L (\sigma_H - \sigma_L)^2}{2(n_H \sigma_L + n_L \sigma_H)} \left\{ \frac{1}{\tau} [r_A, r_B] \begin{bmatrix} -1 & 1 \\ 1 & -1 \end{bmatrix} \begin{bmatrix} r_A \\ r_B \end{bmatrix} + [r_A, r_B] \begin{bmatrix} 1 \\ 1 \end{bmatrix} - 2c \right\} \\ + \frac{\sigma_L \sigma_H (n_H + n_L)^2 \tau}{(n_H \sigma_L + n_L \sigma_H)} \quad (12) \end{aligned}$$

Next, we observe that  $\pi_A + \pi_B$  is linear quadratic with respect to the refund levels, where the quadratic part is negative semi-definite with a maximum value of 0 along  $r_A = r_B$ , and where the linear part is upward sloping in the direction  $r_A = r_B$ .<sup>2</sup> Geometrically, the collusive profit is a ridge surface in the refunds, sloping upward in the direction  $r_A = r_B$ . Therefore, industry profit

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$${}^2 \det \nabla^2 (\pi_A + \pi_B) = 0 \text{ and } \nabla (\pi_A + \pi_B)|_{r_A=r_B} = \frac{n_H n_L (\sigma_H - \sigma_L)^2}{2(n_H \sigma_L + n_L \sigma_H)} \cdot \begin{bmatrix} 1 \\ 1 \end{bmatrix} > \mathbf{0}.$$

is maximized when the firms agree on a common refund. For any collusive refund level satisfying  $r = r_A = r_B$ , the profits are

$$\pi_A = \pi_B = \frac{n_H n_L (\sigma_H - \sigma_L)^2 (r - c) + \sigma_L \sigma_H (n_H + n_L)^2 \cdot \tau}{2(n_H \sigma_L + n_L \sigma_H)}. \quad (13)$$

Clearly, the industry profit increases with the collusive refund level  $r$ . Thus, the reader may conclude that without assuming reservation utility, service providers will agree on raising  $r$  with no bound. However, in what follows we demonstrate that this is not necessarily the case if we restrict the refund level not to exceed the price of the service.

The noncooperative equilibrium prices  $p = p_A = p_B$  corresponding to the collusive refund rate  $r$  is obtained by substituting the refund rate into equation (5). Hence,

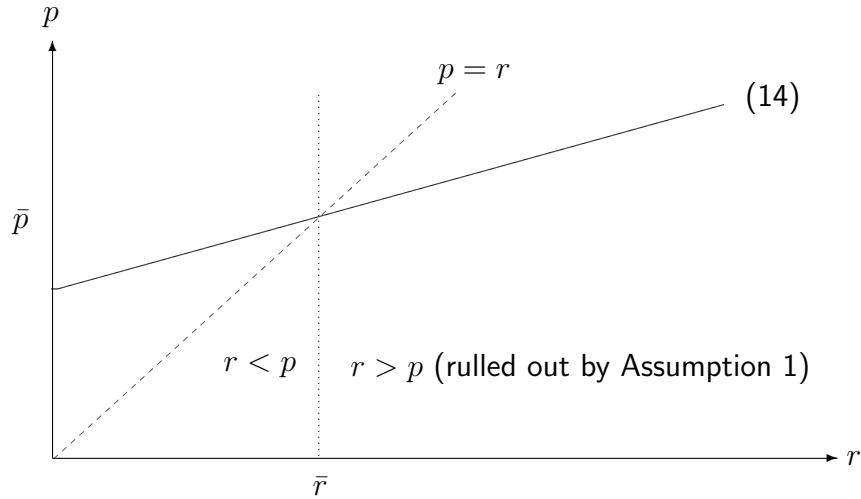
$$p = k + \gamma(c + \tau) + (1 - \gamma)r, \quad (14)$$

where the parameter  $\gamma$  is defined in (5). Comparing the equilibrium price when firms collude on  $r$  (14) to the equilibrium prices under no collusion (6), reveals that (14) is a linear combination of the marginal operation cost plus duopoly mark up *and the refund level*  $r$ . Next, industry profit (as a function of  $r$ ) can be expressed in the following transparent form

$$\pi_A + \pi_B = (n_H + n_L)[p - k - \delta c - (1 - \delta)r], \quad \text{where } 0 < \delta \stackrel{\text{def}}{=} \frac{\sigma_L n_L + \sigma_H n_H}{n_L + n_H} < 1, \quad (15)$$

is the average showing up probability in the population.

Equation (14) postulates the exact relationship between the collusive refund level and the noncooperative equilibrium price which is plotted in Figure 1. Thus, the collusive refund levels



**Figure 1:** Noncooperative equilibrium price as a function of the colluded refund levels.

are lower than the noncooperative price when the refunds are sufficiently low. In addition, the price is linearly increasing in refunds with a slope smaller than one. Therefore, there exist a

unique refund level where the prices and refunds coincide, which we denote by  $\bar{p} = \bar{r}$ , that can be solved directly from equation (14) to take the form

$$\bar{p} = \bar{r} = \frac{k}{\gamma} + c + \tau \quad (16)$$

Figure 1 shows that all refund levels exceeding  $\bar{r}$  are greater than the purchase price. At these levels, refunds can be viewed as a partial subsidy to those consumers who do not show up. We would like to rule out this “subsidy option” with the following assumption.<sup>3</sup>

**ASSUMPTION 1**

*Service providers are prohibited from offering refunds on no-shows (cancellations) larger than the price for which the service/product is sold for. Formally,  $r_j \leq p_j$  for  $j = A, B$ .*

The following proposition summarizes our results on the effects of collusion on refunds.

**Proposition 4**

*Under Assumption 1,*

- (a) *The collusive refund level and the resulting noncooperative equilibrium prices are finite, uniquely determined, and are given by (16).*
- (b) *The difference between the collusive refund and the noncooperatively-determined refund is proportional to the capacity cost parameter  $k$ .*
- (c) *If the observed refund levels exceed the sum of the operation cost and the duopoly market, that is  $r > c + \tau$ , then we know that the firms are colluding.*

Part (a) is rather remarkable, as some may argue that without assuming a reservation utility, service providers may be tempted to set  $r_A = r_B = +\infty$ , thereby artificially raising their cost before price competition begins. Here we show that under Assumption 1 firms will collude on a finite refund level.

Proposition 4(b) can be verified by subtracting the collusive refund level (16) from the noncooperative equilibrium level (6), to obtain  $k/\gamma$ . Hence, the collusive refund and the noncooperative refund levels coincide when the capacity cost is  $k = 0$ . Therefore, we can infer that collusion on a joint refund policy is more likely to be observed in industries with large capacity costs.

Proposition 4(c) proposes a method for detecting collusion on refunds by observing the full prices  $p_A$  and  $p_B$ , and then comparing prices with the marginal operation cost, the differentiation parameter, and the observed refund levels. Of course, if the refund policy is clearly observable, one can detect the collusion on refunds by comparing the observed refund levels to the imperfectly-competitive level obtained in (6).

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<sup>3</sup>Obviously, an introduction of a reservation utility could further limit the maximal feasible value of  $\bar{r}$ . However, an introduction of a reservation utility would unnecessarily complicate our model.

On the consumer side, collusion has two opposing effects on consumer welfare. First, collusion raises consumer welfare since it increases the refund in the event of a no-show. Second, higher refunds increase prices, thereby reducing consumer welfare. To compute the net effect of collusion on refunds on consumer welfare, substitute (5) into (9) as well as  $r$  for  $r_A$  and  $r_B$ , and then differentiating with respect to  $r$  yields,

$$\frac{\partial CS}{\partial r} = -\frac{n_H n_L (\sigma_H - \sigma_L)^2}{n_H \sigma_L + n_L \sigma_H} < 0. \quad (17)$$

According to (17), an increase in refunds lowers consumer welfare. Therefore,

**Proposition 5**

*Colluding on refund levels reduces consumer welfare only if the capacity cost is strictly positive. Formally, the change in consumer surplus resulting from the collusion is given by*

$$CS^{\text{collude}} - CS^{\text{compete}} = -\frac{k}{\gamma} \frac{n_H n_L (\sigma_H - \sigma_L)^2}{n_H \sigma_L + n_L \sigma_H} < 0.$$

Thus, the change in consumer surplus is equal to the loss from the price increase,  $(1/\gamma - 1)k$ , paid by consumers who show up, plus the additional refunds  $k/\gamma$  paid to consumer who do not show up. Notice that the loss in consumer surplus equals the gain in industry profits.

Finally we observe that the industry profit under the collusive refund level (16)

$$\pi_A + \pi_B = (n_H + n_L)[\delta(\bar{r} - c) - k]. \quad (18)$$

**4.2 Collusion on refunds in the Second stage**

Now consider a reversed order of decisions where service providers first compete in prices knowing that in the second stage they will collude on the amount to be refunded upon no-shows. Consider the second stage where service providers collude on mutual refund levels  $r = r_A = r_B$ , taking the prices  $p_A$  and  $p_B$  as given. Substituting (3) and (4) into (2), setting  $r = r_A = r_B$  yields  $\partial(\pi_A + \pi_B)/\partial r = n_H(\sigma_H - 1) + n_L(\sigma_L - 1) < 0$ . Hence,

**Proposition 6**

*In a market structure where firms first compete in prices and then collude on refund levels, the collusive refund level is  $r_A = r_B = 0$ . That is, no refunds will be given on no-shows.*

This result can be deducted logically considering the fact that once prices are fixed in the first stage, service providers minimize costs by refusing giving any refunds on no-shows. Thus, Proposition 6 demonstrates that once prices are fixed, strictly positive refunds can be realized only as an outcome of competition.

Clearly given prices, the collusion on no refunds reduces consumer welfare. However, it remains to investigate how equilibrium prices are affected by firms' decision on providing no

refunds. Substituting  $r_A = r_B = 0$  into (3) and (4) and then all into (2), solving  $0 = \partial\pi_j/\partial p_j$  for  $j = A, B$  yields the noncooperative equilibrium prices

$$p_A = p_B = \frac{(c + \tau)\sigma_H\sigma_L(n_H + n_L) + k(n_H\sigma_L + n_L\sigma_H)}{n_H\sigma_L + n_L\sigma_H}, \quad (19)$$

and the resulting profit levels

$$\pi_A = \pi_B = \frac{\sigma_H\sigma_L\tau(n_H + n_L)^2 - cn_Hn_L(\sigma_H - \sigma_L)^2}{2(n_H\sigma_L + n_L\sigma_H)}. \quad (20)$$

Finally, to obtain the consumer surplus when firms collude on not giving refunds, substitute  $r_A = r_B = 0$  and the equilibrium price (19) into (9) to obtain

$$CS = \frac{(n_H^2 + n_L^2)\sigma_H\sigma_L(4\beta - 5\tau) + n_Ln_H[4\beta(\sigma_H^2 + \sigma_L^2) - \tau(\sigma_H^2 + 8\sigma_H\sigma_L + \sigma_L^2)]}{4(n_H\sigma_L + n_L\sigma_H)}. \quad (21)$$

We are now ready to investigate how collusion on no-refunds affects consumers and service providers. Comparing profit levels (20) with (6), and consumer welfare (21) with (10) yields the following proposition.

**Proposition 7**

*The ability to collude on refunds after service providers compete in prices reduces their profits whereas consumer welfare is enhanced.*

The reason why firms “lose” from colluding on refund levels after the price competition stage, is that price competition is intensified when firms know that they will collude on no refunds in the second stage of the game. In other words, since noncooperative competition on refund levels in the second stage results in strictly positive refund levels, service providers set higher prices in the first stage taking into account the expected costs associated with giving refunds to consumers who do not show up. In contrast, since collusion results in an agreement on no refunds, prices competition in the first stage generates lower prices since the cost of providing refunds disappears. This suggests the question why firms want collude on refund levels at the second stage?

**Corollary 8**

*In a market structure where service providers have the option to collude on a joint refund policy after prices are determined, (a) service providers will collude on giving no refunds if prices are exogenously fixed. Otherwise, (b) if this option exists, firms will not utilize the opportunity to collude on a joint industry-wide refund policy.*

## 5. Shipping and Handling (s&h) Charges

Shipping and handling charges (as opposed to refunds) are widely observed in some industries, most notably, in all mail-order companies. Shipping and handling can be interpreted as a portion

of the price which is not refunded under any circumstance. Formally, let  $h_A$  and  $h_B$  denote these charges. The utility function (1) is now given by

$$U(\sigma_i, x) \stackrel{\text{def}}{=} \begin{cases} \sigma_i(\beta - \tau x - p_A) - h_A & \text{buying service } A \\ \sigma_i[\beta - \tau(1-x) - p_B] - h_B & \text{buying service } B, \end{cases} \quad (22)$$

for each consumer of type  $i = H, L$ . The profit functions (2) are now modified to

$$\pi_j(h_j - k)q_j + (p_j - c)s_j, \quad j = A, B, \quad (23)$$

where  $q_j$  and  $s_j$  maintain the same definitions as before (number of reservations and the number of those who show up).

### 5.1 Noncooperative equilibrium s&h charges

Consider a two-stage game where in Stage I both providers compete in s&h charges, and then in Stage II compete in prices. The computations of the present game are identical to those of Section 3 so there is no need to repeat them step-by-step. Thus, the solution to the second stage (price competition) is given by

$$p_j(h_j) = \frac{c(n_H\sigma_H + n_L\sigma_L) - h_j(n_H + n_L) + k(n_H + n_L) + \tau(n_H\sigma_H + n_L\sigma_L)}{n_H\sigma_H + n_L\sigma_L}. \quad (24)$$

Therefore, a rise in the s&h charge  $h_j$  results in a compensatory price reduction during the price competition stage. The corresponding profit levels  $\pi_j(h_j, h_\ell)$  where  $j, \ell = A, B$  as functions of given refund levels are then given by

$$\pi_j(h_j, h_\ell) = \frac{n_H n_L (\sigma_H - \sigma_L)^2 [k(h_j - h_\ell) - h_j^2 + h_j h_\ell] + \sigma_H \sigma_L \tau^2 (n_H \sigma_H + n_L \sigma_L)^2}{2 \sigma_H \sigma_L \tau (n_H \sigma_H + n_L \sigma_L)}. \quad (25)$$

Moving to the first stage, from (25), maximizing  $\pi_A$  with respect  $h_A$  and  $\pi_B$  with respect  $h_B$ , solving for the two first-order conditions, and then substituting into (24) and (25) yields

$$h_j = k, \quad p_j = c + \tau, \quad \pi_j = \frac{\tau(n_H\sigma_H + n_L\sigma_L)}{2}, \quad \text{for } j = A, B. \quad (26)$$

We summarize our results on noncooperative s&h charges with the following proposition.

#### Proposition 9

- (a) *The noncooperative equilibrium s&h charges equal the reservation cost parameter  $k$ , whereas the refundable price equals the unit operation cost and the duopoly markup. Hence,*
- (b) *The s&h and the refund noncooperative games generate identical profit levels and consumer surplus.*

Proposition 9(b) follows directly by comparing (26) with (6), and Proposition 2.

## 5.2 Collusion on s&h charges

Suppose now that both firms can agree on a common industry-wide s&h charges denoted by  $h = h_A = h_B$ , before price competition begins. In order to compute the collusive s&h charges, substitute the noncooperative equilibrium prices (24) into the profit function (25), and then setting  $h_A = h_B = h$  yields that  $\pi_A = \pi_B = (n_H\sigma_H + n_L\sigma_L)\tau/2$ , which is independent of  $h$ . Therefore,

### Proposition 10

*Profit of firms is invariant with respect to the collusive level of the s&h charge. Thus, firms will not collude on an industry-wide s&h charge.*

Proposition 10 can be explained by observing how the noncooperative price adjusts when the collusive s&h charge varies. More precisely, (24) shows that increasing  $h$  by, say, \$1 would result in a price reduction of  $(n_H\sigma_H + n_L\sigma_L)/(n_H + n_L)$  which is the expected revenue from those who show up for the service (those who are satisfied with the product under the second interpretation). Hence, the increase in the s&h revenue is exactly offset by the decline in price revenues. Incidentally, we obtain this “collusion-invariance” result also in Section 6 where we analyze consumers have preferences over reservation systems.

## 6. Preference Over Advance Reservation Systems

All the consumer utility functions analyzed so far (1) and (22) share the common assumption that consumers view the *services* provided by the two firms as differentiated. However, in some services, in particular in services where consumers must make advance reservations long before the service is provided, it seems that consumers view the *advance reservation systems* themselves as differentiated in addition or instead of viewing the services as differentiated. More precisely, let us assume that the utility function of a consumer indexed by  $(\sigma_i, x) \in \{\sigma_H, \sigma_L\} \times [0, 1]$  is now given by

$$U(\sigma_i, x) \stackrel{\text{def}}{=} \begin{cases} \sigma_i\beta - p_A + (1 - \sigma_i)r_A - \tau x & \text{book service } A \\ \sigma_i\beta - p_B + (1 - \sigma_i)r_B - \tau(1 - x), & \text{book service } B. \end{cases} \quad (27)$$

Comparing (27) with (1) reveals that now the differentiation (location) disutilities  $\tau x$  and  $\tau(1-x)$  are *not* multiplied by the showing up probabilities  $\sigma_H$  and  $\sigma_L$ . This means that this disutility is borne by consumers at the time the reservations are made and not later at the time when the services are actually delivered. Another interpretation for the utility function (27) is that consumers must travel to the place where reservations are made, or that this type of service requires two visits, one as a preliminary engagement such as a medical checkup and a second visit which involves the actual service. Under this interpretation, consumers bear (or pay) the disutility  $\tau x$  or  $\tau(1-x)$  on their first visit, but still maintain the uncertainty regarding showing up for the second visit with probabilities  $\sigma_H$  and  $\sigma_L$ .

## 6.1 Imperfect competition

The problem here is the same as in the previous sections. The solution follows the same steps as before, when we solved for the two-stage subgame-perfect equilibrium. The proportion of type  $i$  consumers who book with service provider  $A$  becomes

$$\hat{x}_i = \frac{p_B - p_A + (1 - \sigma_i)(r_A - r_B) + \tau}{2\tau}, \quad i = L, H, \quad (28)$$

which is different from the corresponding expression (3). The expected number of customers and the expected number of show-ups are the same as in (4), as well as the profit function (2). We proceed step by step as in section 3.1 by first solving for the noncooperative equilibrium prices. That is, substitute (28) into (4) and thereafter into (2) to obtain the appropriate profit functions  $\pi_A$  and  $\pi_B$ . The noncooperative equilibrium prices  $p_j$ ,  $j = A, B$ , are then given by

$$p_j = k + \tau + r_j + \delta(c - r_j), \quad (29)$$

where  $\delta$  is the average showing up probability in the population, already defined in (15). Second-order conditions are verified by observing that  $\partial^2 \pi_j / \partial p_j^2 = -(n_H + n_L) / \tau < 0$ . Next, maximizing profit using the equilibrium prices (29), we obtain the noncooperative refund levels

$$r_A = r_B = c. \quad (30)$$

The second order condition, evaluated at the equilibrium prices (29), is given by  $\partial^2 \pi_j / \partial r_j^2 = -n_H n_L (\sigma_H - \sigma_L)^2 / \tau < 0$ . Consequently, equilibrium prices, refund levels, the corresponding profits under imperfect competition are

$$r_A = r_B = c, \quad p_A = p_B = c + k + \tau, \quad \text{and} \quad \pi_A = \pi_B = \frac{\tau(n_H + n_L)}{2}. \quad (31)$$

Comparing the equilibrium in the present model (31), to the equilibrium of our benchmark model (6), we can state the following differences.

### Proposition 11

*Service providers (a) set lower refunds (b) earn higher profits, and (c) charge the same price, when consumers have preferences over the reservation systems as compared with preferences over the services only.*

Proposition 11 predicts that higher refunds are likely to be observed in industries such as car rentals where consumers have preferences over the services themselves (e.g., the specific car models rented out) and not over the reservation systems only.

## 6.2 Collusion on refunds

The analysis of collusion here follows the same steps as in Section 4.1. Substituting the prices (31) into (28) and then into (4) and thereafter into (2) we obtain

$$\pi_A + \pi_B = \frac{n_H n_L (\sigma_H - \sigma_L)^2}{2(n_H + n_L) \tau} [r_A, r_B] \begin{bmatrix} -1 & 1 \\ 1 & -1 \end{bmatrix} \begin{bmatrix} r_A \\ r_B \end{bmatrix} + (n_H + n_L) \tau. \quad (32)$$



This quadratic form is negative semidefinite with a maximum value of 0 at a “ridge” along  $r_A = r_B$ . However, in contrast to the joint profit function (12) where the ridge was upward sloping in the direction  $r_A = r_B$ , this ridge is horizontal. This difference is crucial when comparing maximum of (32) with the non-cooperative solution (31) we observe that the industry profit cannot be improved upon colluding on refunds. Hence,

**Proposition 12**

*When consumers view the reservation systems as differentiated, service providers have no incentives to collude on refund levels.*

Using an alternative interpretation, when consumers always pay the transportation cost  $\tau x$  and  $\tau(1 - x)$  independently of whether they actually end up showing up at the service delivery time, firms cannot enhance their profits by agreeing on refund levels. This result was also obtained in Proposition 10 under collusion on s&h charges. Here, any change in raising refunds is offset by a corresponding increase in price. Thus, the equilibrium level  $r_A = r_B = c$  (refund equals unit operation cost) is also the collusive level.

**7. Conclusion**

The purpose of our research was to identify situations where industry-wide explicit or implicit agreements on joint refund policies weaken price competition and reduce consumer welfare. Our major finding is that no general conclusions can be drawn on the nature of collusion on industry-wide refund policies. The precise refund levels that maximize joint industry profit is highly sensitive to the order in which firms make their decisions.

If service providers can commit to refund levels before they compete in prices, they will raise refund levels above the competitively-determined refund levels. In this case, collusion on refunds reduces consumer welfare. In contrast, service providers will collude on no refunds whenever prices cannot be changed. The latter case occurs either under imperfect price competition prior to colluding on refunds, or in a price-regulated industry. Under price competition prior to colluding on refunds, consumers benefit from this collusion since under no refunds price competition is more intense than under positive refunds levels. Altogether, what we have learned is that by simply observing industries’ refund policies one cannot conclude whether consumers benefit or are harmed by firms’ refund policies, and whether these policies are driven by competition or collusive agreements.

We also found out that the amount of refunds as well as the incentives to collude depend on whether consumers prepay for their transaction cost or a disutility cost for a good or a service. In markets where all consumers pay a disutility (or transaction) cost for participating in the market, for example, mail order of goods, the refunds cover only the operation cost,  $c$ , when the firms compete, but collusion on refunds is not profitable. In markets where only those who show up are paying the disutility or transaction cost like car rentals or cinemas, the refunds cover the

operation cost,  $c$ , plus a markup equal to the product differentiation parameter  $\tau$ . Under these circumstances the firms have incentives to collude on refunds.

Our analysis demonstrates why we observe high refunds on car rentals, whereas the refunds are surprisingly low for items delivered via mail orders. One reason for the low refund on mail orders is that they do not have any incentives to refund the profit generated by the duopoly markup  $\tau$ . A profit maximizing mail order firm should announce a “full money back guarantee” only on the operation part of the cost, and include the capacity cost as well as the profit margin  $\tau$  in their announced “shipping and handling” charges.

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