

# Entry Deterrence and Signaling in Markets for Search Goods

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## Abstract

*This paper studies entry in markets for search goods. Signaling through prices is studied when an entrant's quality is (i) private information; and (ii) common information of entrant and incumbent. When consumers visit a store, they observe quality and can switch before purchasing. When switching costs are low, an entrant can signal high quality by setting a sufficiently high price; consumers who find out that quality is low switch to the incumbent. Entry may be facilitated when switching costs are sufficiently low, or when the incumbent knows the entrant's type.*

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# 1 Introduction

Being the first firm to enter a market may be advantageous – for instance, when consumers are uncertain about product quality.<sup>1</sup> If only the pioneering brand's quality is known by consumers after subsequent entry, there is informational product differentiation: consumers know the incumbent's quality, but are uncertain about the entrant's. This paper explores two issues in such a setting.

The first question under consideration is the following: How do lock-in effects influence the possibilities for entry in markets for search goods? A consumer who visits a store and finds out that product quality is too low given the price that is charged, may switch to another seller, provided that the cost of switching is not too high. There is a variety of examples of products that have quality as a search-characteristic. Fruit vendors often allow consumers to inspect the fruit before buying. Stores selling audio equipment provide demonstrations for clients to help them decide. Automobile sellers allow consumers to make test drives so that quality assessments can be made. Switching costs arise, for instance, when visiting another seller takes considerable time – so that future benefits are discounted.

The second question concerns the distribution of information. In markets for search goods, is the incumbent better off if he can observe the quality of an entrant? This situation gives rise to a signaling problem with common information. In a model in which the firms simultaneously choose prices, the prices of both firms, rather than only the entrant's price, serve as signals of the entrant's type to consumers. The assumption that an incumbent firm is informed about the quality of an entrant's product or service corresponds to various situations. For instance, firms may have more expertise than consumers, as is the case for technically complicated products. Alternatively, professionals may have knowledge about each other's performance because of a common history, such as having shared their education.

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<sup>1</sup>This is, for example, the case in markets for search goods and in markets for experience goods. Search goods can be inspected to make a quality assessment before purchase, whereas the quality of experience goods is learned after a purchase. The distinction between experience goods and search goods was made by Nelson [16].

The first question is explored under the assumption that the entrant is privately informed about his type. An important observation is that a sufficiently high price signals high quality. To see this, suppose the entrant's price is so high that a consumer who finds out that quality is low, will switch to the incumbent; such a price will convince consumers of high quality. Under low switching costs, in a separating equilibrium consumers can visit the incumbent if the entrant's quality turns out to be lower than expected. Therefore it makes no sense for a low-quality seller to mimic a high type, and a firm of higher quality than the incumbent can enter the market and make profits. In a regime of sufficiently high switching costs, the incumbent can deter entry of a high-quality seller: fear of lock-in creates an entry barrier.

Pooling equilibria exist only if switching costs are sufficiently high. To see this, consider a regime of low switching costs, and note that in a pooling equilibrium the entrant charges an "intermediate" price (in accordance with consumers' prior beliefs). Since a sufficiently high price signals high quality, a high-quality entrant could deviate by increasing his price.

To answer the second question, I analyze the model under the assumption that the incumbent observes the entrant's quality. If the incumbent's price is informative about the entrant's type, then the entrant has a large degree of freedom in its price choice, since he can rely on his rival's price to inform consumers. In the light of this observation, one can argue that the notion of perfect Bayesian equilibrium (and also sequential equilibrium) allows for unreasonable equilibria. In order to rule these out, I apply (a customized version of) Bagwell and Ramey's [2] refinement of "unprejudiced" sequential equilibrium. This criterion captures the idea that if one of the firms chooses an out-of-equilibrium signal, while its rival's equilibrium signal is informative, consumers will rely on the equilibrium signal.

The incumbent is not able to exploit private information about the entrant in a profitable way, that is, he cannot improve upon his situation if he observes the entrant's quality. The intuition is that the entrant, knowing that the incumbent can observe his type and that consumers realize this, faces less difficulty in convincing consumers of high quality. Additionally, entry is facilitated if the incumbent's price contains information about the entrant's quality, no matter how severe lock-

in effects. In this case an informative incumbent's price helps the entrant to circumvent lock-in effects and incentive-compatibility problems.

There is some closely related literature on entry and quality uncertainty. Demsetz [6] argued that in markets for experience goods, promotional pricing (that is, below marginal cost) by an entrant may be necessary to induce consumers to try his product. Accordingly, the entrant incurs "information costs," that may be recouped when consumers purchase at a higher price after having experienced his quality. Schmalensee [17], Farrell [7], and Bagwell [1] formally examined the difficulty faced by a potential entrant to persuade consumers that he sells a high-quality product. The informational asymmetry may result in an entry barrier, even if the entrant's expected quality is higher than the incumbent's quality. My paper differs in two important ways. First, whereas the literature cited above considers experience goods, I examine markets for search goods. In my model, switching costs play a crucial role: due to lock-in effects, high prices signal quality, instead of low prices in markets for experience goods.<sup>2</sup> The second difference is that I study also the case in which the entrant's type is common information.

Some literature investigates games with common information, although issues of quite different nature are under study. Matthews and Fertig [13] study wasteful advertising by an incumbent and an entrant, both informed about the latter's quality, in a market for experience goods.<sup>3</sup> The entrant, and subsequently the incumbent, select advertising expenditures that determine consumers' beliefs. Then entry occurs automatically and the firms play a duopoly game in which beliefs affect demand levels. The entrant may have difficulty trying to influence beliefs because the incumbent (the second-mover) can counteract. Bagwell and Ramey [2] investigate limit pricing by two incumbents, both informed about an industry cost parameter. They impose "unprejudiced" beliefs, which poses a restriction on beliefs for signaling games with common information. Milgrom and Roberts [15]

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<sup>2</sup>Notice the difference with Klemperer [10], also on entry deterrence in the presence of switching costs. In his model, a consumer who previously bought from the incumbent incurs a cost if he decides to purchase from the entrant.

<sup>3</sup>The literature in which firms signal quality by wasteful advertising is based on ideas in Nelson [16]; see Milgrom and Roberts [14].

study competition among interested parties with common information, who try to persuade a decisionmaker to make a particular decision. These parties can only report truthful information. The main result is that competition leads to the full-information outcome. In my model, however, instead of disclosing, the firms signal their information.

The model is presented in section 2. The model under the assumption that the entrant is privately informed is analyzed in section 3. Next, in section 4, I investigate what happens if the incumbent can observe the entrant's quality, while consumers are still uncertain. Section 5 concludes.

## 2 The Model

Consider a market with an incumbent (firm 1), and a potential entrant (firm 2). Entry is costless. The incumbent's quality is known to be low, and is denoted by  $q_1 = q_\ell$ . The entrant's quality is denoted by  $q_2 \in \{q_\ell, q_h\}$ , where  $q_h > q_\ell > 0$ . The entrant's quality is determined by Nature, which selects quality  $q_h$  with probability  $\alpha \in (0, 1)$ .

The unit cost of producing low quality is  $c_\ell \geq 0$ , whereas producing high quality costs  $c_h > c_\ell$  per unit. Higher quality generates a higher surplus:

$$q_h - c_h > q_\ell - c_\ell > 0. \quad (1)$$

As in Bagwell [1], the parameter assumptions favor entry. That is, firm 1 has no scale economies or cost advantage, firm 2's product quality is equal to or higher than the quality of the incumbent's product, and there is no cost of entry (the "pro-entry" assumption). This assumption makes it possible to focus on informational product differentiation and lock-in effects as possible sources of entry barriers. Following Bagwell, entry is said to be deterred if a high-quality firm does not attract consumers who are uncertain about its quality.

Qualities and costs are fixed during the game. The firms, who maximize expected profits, compete by simultaneously setting prices  $p_1$  and  $p_2$  that cannot be changed afterwards. In section 3, only the entrant observes his type, whereas in

section 4, both firms observe the entrant's type before setting prices. The expected profits of firm  $i$  are denoted by  $\Pi_i$ .

The number of consumers is normalized to 1. A consumer buys at most one unit. A product of quality  $q$  at price  $p$  yields utility  $q - p$ . The reservation utility level is 0 and consumers maximize expected net benefits. The social welfare level, denoted by  $W$ , is defined as the sum of producers' surplus and consumers' surplus.

Initially, a consumer has information  $(p_1, p_2)$ . In order to find out  $q_2$ , he has to visit the entrant's outlet. Consumers' beliefs after having observed prices are denoted by  $\mu(p_1, p_2)$ , which is the probability attached to the event that the entrant sells a high quality product. If a consumer who observes the quality during a visit decides not to buy but to visit the other firm, he incurs a switching cost: future benefits are discounted by a factor  $\delta \in [0, 1]$ .<sup>4</sup>

The structure of the model is common knowledge. In particular, if the incumbent is informed about the entrant's type, then the entrant and the consumers know this.

The sequence of events is as follows. First, Nature selects the quality of the potential entrant. Second, the two firms simultaneously set prices, which are observed by the consumers. Third, consumers (who know the quality of the incumbent, but are uncertain about the entrant's quality) decide which firm to visit. Since quality is observed before purchase, consumers can switch from the entrant to the incumbent (and incur a switching cost) if they find out that the entrant sells a low-quality product.

The notion of perfect Bayesian equilibrium of Fudenberg and Tirole [8] is used to solve for pure strategy equilibria. A strategy of firm  $i$  is a function  $p_i(q_2)$ ,  $i = 1, 2$ . Equilibrium prices are denoted by  $p_1^*(\cdot)$  and  $p_2^*(\cdot)$ .<sup>5</sup> Note that if firm 1 cannot observe firm 2's type,  $p_1(q_2)$  cannot depend on  $q_2$ , and consumers' beliefs

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<sup>4</sup>This way of modeling switching costs is derived from Bester [4]. A higher value of  $\delta$  corresponds to lower switching costs.

<sup>5</sup>Since setting price below marginal cost is a dominated strategy, consumers will interpret a price below the unit cost of producing high quality as a signal of low quality. Also, a firm that produces low quality has no incentive to charge a price higher than the consumers' reservation value for low quality. The range of  $p_1(q_2)$ ,  $q_2 \in \{q_\ell, q_h\}$ , and the range of  $p_2(q_\ell)$  will be restricted to  $[c_\ell, q_\ell]$ , and the range of  $p_2(q_h)$  to  $[c_h, q_h]$ .

$\mu(p_1, p_2)$  cannot depend on  $p_1$  (see also section 3). A consumer's strategy will be informally described by his visiting and purchasing behavior.

In a separating equilibrium, prices are informative, that is,  $p_1^*(q_\ell) \neq p_1^*(q_h)$  or  $p_2^*(q_\ell) \neq p_2^*(q_h)$ . Prices are uninformative in a pooling equilibrium, that is,  $p_1^*(q_\ell) = p_1^*(q_h)$  and  $p_2^*(q_\ell) = p_2^*(q_h)$ .

In the first-best outcome, a high-quality entrant attracts consumers. This outcome is attained for  $\delta = 1$ , a situation, effectively, of complete information: consumers can costlessly search. Prices in this outcome are  $p_1^*(q_\ell) = p_2^*(q_\ell) = p_1^*(q_h) = c_\ell$ , and  $p_2^*(q_h) = c_\ell + q_h - q_\ell$ . Expected profits are  $\Pi_1^* = 0$  and  $\Pi_2^* = \alpha(c_\ell + q_h - q_\ell - c_h)$ . The first-best welfare level  $W^{FB}$  equals

$$W^{FB} = \alpha(q_h - c_h) + (1 - \alpha)(q_\ell - c_\ell).$$

### 3 Lock-In Effects and Quality Uncertainty

Following the informational assumptions made in most of the literature, I assume in this section that the entrant has private information about his type. Consequently, consumers and the incumbent are uncertain about the entrant's quality.

#### Preliminary Remarks

Since the incumbent cannot observe the type of a potential entrant, his price cannot convey information about the entrant's quality to consumers. The notation  $p_1$  will be used instead of  $p_1(q_2)$ . Accordingly, if one considers deviations by the incumbent, consumer beliefs cannot vary with the incumbent's price.<sup>6</sup>

**Assumption 3.1** *Given an equilibrium price  $p_2^*(q_2)$ , consumers' beliefs satisfy  $\mu(p_1, p_2^*(q_2)) = \mu(p_1', p_2^*(q_2))$  for all  $p_1 \neq p_1'$ .*

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<sup>6</sup>This is the "no-signaling-what-you-don't-know" condition of perfect Bayesian equilibrium: a player's deviation should not signal information that he himself does not have (see Fudenberg and Tirole [8]). This condition is implied by the consistency requirement of the sequential equilibrium concept of Kreps and Wilson [12].

Intuitively, the incumbent and consumers have exactly the same information (namely the prior distribution), so that the incumbent's price  $p_1$  cannot directly influence consumers' beliefs.

Suppose that the difference between high and low quality is relatively high, that is,  $q_h - q_\ell > q_\ell - c_\ell$ . Let  $p_1^* \geq c_\ell$  be given. The best response of a high-quality entrant is a price  $p_2^* = p_1^* + q_h - q_\ell$ . Since  $p_2^* \geq c_\ell + q_h - q_\ell > q_\ell$ , price  $p_2^*$  signals high quality because of assumption 3.1. Consumers are indifferent between the two firms. However, they visit the entrant; otherwise he could slightly decrease  $p_2^*$ . Switching costs or informational asymmetries do not play a role under this parameter constellation: the price of a high-quality entrant is always larger than the reservation value for low quality. To focus on more interesting cases, I will assume throughout the paper that the difference between high and low quality is not too high, that is,

$$q_h - q_\ell \leq q_\ell - c_\ell. \quad (2)$$

Prices play a particular role. The entrant knows that consumers can get utility level  $q_\ell - p_1^*$  by purchasing from firm 1. Moreover, he knows that a consumer who finds out that he sells low quality will switch to the incumbent if prices are such that

$$q_\ell - p_2 < \delta(q_\ell - p_1^*). \quad (3)$$

Accordingly, any price  $p_2 > q_\ell - \delta(q_\ell - p_1^*)$  is dominated for a low-quality entrant, while this is not necessarily the case for a high-quality firm. Therefore, given equilibrium price  $p_1^*$  (rationally expected by consumers and firm 2 in equilibrium), a price  $p_2$  that satisfies (3) should convince consumers that firm 2 sells high quality. Formally, I will use the following assumption:<sup>7</sup>

**Assumption 3.2** *Given an equilibrium price  $p_1^*$ , consumers' beliefs satisfy  $\mu(p_1^*, p_2) = 1$  for all  $p_2$  such that  $q_\ell - p_2 < \delta(q_\ell - p_1^*)$ .*

## Analysis

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<sup>7</sup>Assumption 3.2 is an equilibrium refinement strongly inclining to the Dominance Criterion of Cho and Kreps [5] and the "independence of never a weak best response" (INWBR) criterion of Kohlberg and Mertens [11]. See also Bester [4], section III, for a similar beliefs restriction.



In a separating equilibrium, the entrant's price is informative and hence  $\mu(p_1^*, p_2^*(q_\ell)) = 0$  and  $\mu(p_1^*, p_2^*(q_h)) = 1$ . One can easily see that  $p_1^* = p_2^*(q_\ell) = c_\ell$ . The reason is that a price  $p_1^* > c_\ell$  will be undercut by the low-quality entrant with a price  $p_2$  just below  $p_1^*$ , which in turn gives firm 1 an incentive to deviate.

Suppose that in equilibrium a high-quality seller enters and attracts consumers. Two conditions must then hold. First,

$$q_h - p_2^*(q_h) \geq q_\ell - p_1^*. \quad (4)$$

That is, the entrant must offer a better deal than does the incumbent. Second,

$$q_\ell - p_2^*(q_h) < \delta(q_\ell - p_1^*). \quad (5)$$

The interpretation is that if a consumer finds low quality in the entrant's store, he must switch to the incumbent. Hence, a low-quality entrant has no incentive to pretend that he sells high quality. From (4) and (5) it follows that a necessary condition for existence of a separating equilibrium in which a high-quality firm enters is  $\delta > \delta_1$ , where  $\delta_1$  is defined by

$$\delta_1 \equiv 1 - \frac{q_h - q_\ell}{q_\ell - c_\ell}, \quad (6)$$

and satisfies  $0 \leq \delta_1 < 1$ .

Suppose that  $\delta > \delta_1$ . Can an outcome in which a high-quality firm enters be supported as an equilibrium? Consider prices  $p_1^* = c_\ell$  and  $p_2^*(q_h) = c_\ell + q_h - q_\ell$ , and beliefs  $\mu(p_1^*, p_2) = 0$  if  $p_2 \leq q_\ell - \delta(q_\ell - p_1^*)$ , and  $\mu(p_1^*, p_2) = 1$  otherwise. In particular, these beliefs satisfy assumptions 3.1 and 3.2. Suppose that consumers visit the entrant if they observe prices  $p_1^*$  and  $p_2^*(q_h)$ . Clearly, these strategies and beliefs constitute an equilibrium. Moreover, by assumption 3.2 it cannot be that  $p_2^*(q_h) < c_\ell + q_h - q_\ell$ .

Now suppose that  $\delta \leq \delta_1$ . If an equilibrium exists, then the incumbent deters entry of a high-quality firm. Consequently,  $q_\ell - p_1^* \geq q_h - p_2^*(q_h)$ , or equivalently,  $p_2^*(q_h) \geq c_\ell + q_h - q_\ell$ . Since the incumbent should have no incentive to increase his price, it must be that  $p_2^*(q_h) = c_\ell + q_h - q_\ell$ . With the same beliefs as in an equilibrium with entry, none of the firms will deviate.

Summarizing, we have the following proposition:

**Proposition 3.1** *Suppose that assumptions 3.1 and 3.2 hold. For any  $\delta$ , there exists a unique separating equilibrium:*

(i) *If  $\delta > \delta_1$  then a high-quality firm enters;  $p_1^* = p_2^*(q_\ell) = c_\ell$  and  $p_2^*(q_h) = c_\ell + q_h - q_\ell$ ;  $\Pi_1^* = 0$  and  $\Pi_2^* = \alpha(c_\ell + q_h - q_\ell - c_h)$ ; the first-best welfare level  $W = W^{FB}$  is attained.*

(ii) *If  $\delta \leq \delta_1$  then the incumbent deters entry of a high quality firm;  $p_1^* = p_2^*(q_\ell) = c_\ell$  and  $p_2^*(q_h) = c_\ell + q_h - q_\ell$ ;  $\Pi_1^* = \Pi_2^* = 0$ ; since  $W = q_\ell - c_\ell$ , an inefficiency exists.*

According to proposition 3.1, entry of a high-quality seller is possible if and only if switching costs are sufficiently low.<sup>8</sup> In this case, consumers' surplus is maximal, and the first-best welfare level is attained. The range  $(\delta_1, 1]$  in which the first-best outcome can be supported as an equilibrium, increases as  $q_h - q_\ell$  gets larger, or as  $q_\ell - c_\ell$  gets smaller.

If the lock-in effect is severe, an entry barrier exists that causes an inefficiency. Consumers are indifferent between the incumbent and the high-quality entrant. In equilibrium however, they must visit the incumbent, since otherwise a low-quality seller could mimic a high-quality firm and the consumer would be locked in.

Consumers' surplus equals  $q_\ell - c_\ell$  for any level of  $\delta$ . In a regime of low switching costs, the price of a high-quality entrant is a markup over marginal costs, reducing consumers' surplus to the same level as under high switching costs.

I will now investigate under which conditions pooling equilibria exist. In such an equilibrium,  $p_2^* \equiv p_2^*(q_\ell) = p_2^*(q_h)$ . By Bayes' rule, consumers' beliefs satisfy  $\mu(p_1^*, p_2^*) = \alpha$ . Since independently of firm 1's price, a price  $p_2 < c_h$  signals low quality, and a price  $p_2 > q_\ell$  high quality, it must be that  $c_h \leq p_2^* \leq q_\ell$ . Necessarily,  $c_h \leq q_\ell$  must hold.

If the entrant captures the market, then the incumbent does not make any profits. If firm 1 serves the market then it charges a price  $p_1^* = c_\ell$ ; otherwise a low-quality entrant could undercut  $p_1^*$  and attract consumers. Consequently, firm 1

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<sup>8</sup>It is shown below that no pooling equilibria exist if  $\delta > \delta_1$ , so that this separating equilibrium is then the unique equilibrium.

earns zero profits in any pooling equilibrium outcome.

By assumption 3.2, any price  $p_2$  that satisfies  $q_\ell - p_2 \leq \delta(q_\ell - p_1^*)$  signals high quality. Therefore, in any pooling equilibrium

$$p_2^* < q_\ell - \delta(q_\ell - p_1^*). \quad (7)$$

Additionally, a high-quality entrant must not be able to offer a more favorable deal than the incumbent by charging a price that convinces consumers of high quality, that is,  $q_h - p_2 \leq q_\ell - p_1^*$  for all  $p_2 \geq q_\ell - \delta(q_\ell - p_1^*)$ . Equivalently,

$$p_1^* \leq q_\ell - \frac{q_h - q_\ell}{1 - \delta}. \quad (8)$$

There exists a price  $p_1^* \geq c_\ell$  satisfying (8) if and only if  $\delta \leq \delta_1$ .

Inequality (7) implies that when the entrant's price signals no information about his quality, consumers who find out that he sells low quality will not switch to the incumbent. Thus if the entrant attracts consumers, they take into account that they may end up buying a low-quality product at a fairly high price.

**Proposition 3.2** *Suppose that assumptions 3.1 and 3.2 hold. Pooling equilibria (with and without entry) exist if and only if  $\delta \leq \delta_1$  and  $\alpha \geq (c_h - c_\ell)/(q_h - q_\ell)$ :*

*(i) If entry occurs then  $p_1^* \in [c_\ell, q_\ell - (q_h - q_\ell)/(1 - \delta)]$  and  $p_2^* \in [c_h, c_\ell + \alpha(q_h - q_\ell)]$  such that  $q_\ell - p_1^* \leq \alpha q_h + (1 - \alpha)q_\ell - p_2^*$ ;  $\Pi_1^* = 0$  and  $\Pi_2^* = p_2^* - \alpha c_h - (1 - \alpha)c_\ell$ ; the first-best welfare level  $W^{FB}$  is attained.*

*(ii) If entry is deterred then  $p_1^* = c_\ell$  and  $p_2^* = c_\ell + \alpha(q_h - q_\ell)$ ;  $\Pi_1^* = \Pi_2^* = 0$ ; since  $W = q_\ell - c_\ell$ , an inefficiency exists.*

**Proof:** See the appendix.

To conclude this section, I will discuss an important difference with Bagwell [1] in more detail. That paper investigates an experience good market in which consumers know that the incumbent sells a low-quality good, whereas consumers and the incumbent are uncertain about the entrant. A reputation for high quality can be established by the entrant in the first of two periods. To signal its quality, a high-quality firm should select a price in the first period so low that it results in negative profits (in that period) only for the high-quality type. Thus, low prices may signal high quality.<sup>9</sup> In Bagwell's model there is an entry barrier if the initial sacrifice of such a low price is prohibitively high; a low price is a costly signal. The model of this paper demonstrates that in markets for search goods with switching costs, a sufficiently high price signals high quality. Setting a price high enough so that a consumer who finds out that quality is low will switch, is a means to convince consumers of high quality.

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<sup>9</sup>This argument goes through because all consumers are uninformed about the entrant's quality ex ante. See Bagwell and Riordan [3] for a model in which some consumers are informed, and high prices signal quality.

## 4 Prices Signal Common Information

This section investigates the case in which the incumbent can observe the entrant's quality, while consumers are still uncertain. Assumption 3.1, no longer justifiable, is dropped. For prices  $p_1^* \equiv p_1^*(q_\ell) = p_1^*(q_h)$ , the intuition and motivation behind assumption 3.2 still holds. A slightly modified version of this assumption will be applied:

**Assumption 4.1** *Given equilibrium prices  $p_1^* \equiv p_1^*(q_\ell) = p_1^*(q_h)$ , consumers' beliefs satisfy  $\mu(p_1^*, p_2) = 1$  for all  $p_2$  such that  $q_\ell - p_2 < \delta(q_\ell - p_1^*)$ .*

In a separating equilibrium, at least one of the firms' prices is informative about firm 2's type, that is,  $p_i^*(q_\ell) \neq p_i^*(q_h)$  for at least one  $i$ . Equilibrium beliefs are  $\mu(p_1^*(q_\ell), p_2^*(q_\ell)) = 0$  and  $\mu(p_1^*(q_h), p_2^*(q_h)) = 1$ .

The fact that two firms try to signal common information may lead to unreasonable equilibria. The following example demonstrates this.

**Example** *Free riding on the incumbent's signal*

Consider prices  $p_i^*(q_\ell) \neq p_i^*(q_h)$ ,  $i = 1, 2$  (see figure 1). Let  $p_1^*(q_\ell) = p_2^*(q_\ell) = c_\ell$ . Suppose that  $q_\ell - p_1^*(q_h) = q_h - p_2^*(q_h)$  and consumers visit the incumbent after observing price combination  $(p_1^*(q_h), p_2^*(q_h))$ . Let consumer beliefs be such that firm 2 has no incentive to decrease its price, that is,

$$\mu(p_1^*(q_h), p_2)q_h + (1 - \mu(p_1^*(q_h), p_2))q_\ell - p_2 \leq q_1 - p_1^*(q_h), \quad p_2 < p_2^*(q_h).$$

For instance,  $\mu(p_1^*(q_h), p_2) = 0$  for all  $p_2 < p_2^*(q_h)$ ; if the high-quality entrant would reduce his price, consumers would believe that he sells low quality. It must also hold that  $p_1^*(q_h) \leq c_h$ , so that a price decrease  $p_2$  below the incumbent's price (with the purpose to be taken for a low-quality seller) does not pay. Accordingly, we have an equilibrium.



The example demonstrates that the equilibrium notion needs further refinement. Bagwell and Ramey [2] give a similar example (in a limit-pricing model with multiple incumbents), which suggests that “free riding on the rival’s signal” is a general problem when there is common information. They formulate a restriction on beliefs for signaling games with common information (“unprejudiced” beliefs).<sup>11</sup> For convenience, I use a different but equivalent formulation of their criterion. To do so, a definition is given:

**Definition** *In an equilibrium with prices  $p_1^*(q_2)$  and  $p_2^*(q_2)$ ,  $q_2 \in \{q_\ell, q_h\}$ , price vector  $(p_1, p_2)$  is said to be weakly consistent with  $q_2 \in \{q_\ell, q_h\}$  if there exists an  $i \in \{1, 2\}$  such that  $p_i = p_i^*(q_2)$ .*

In the rest of this paper, beliefs in a perfect Bayesian equilibrium have to satisfy assumption 4.1 and the following criterion:

**Assumption 4.2** *Let equilibrium prices  $p_1^*(q_2)$  and  $p_2^*(q_2)$ ,  $q_2 \in \{q_\ell, q_h\}$ , be given.*  
*(i) Consider prices  $p_1, p_2 \in [c_\ell, q_\ell]$ . If  $(p_1, p_2)$  is weakly consistent with  $q_\ell$ , but not with  $q_h$ , then  $\mu(p_1, p_2) = 0$ .*  
*(ii) Consider prices  $p_1 \in [c_\ell, q_\ell]$  and  $p_2 \in [c_h, q_h]$ . If  $(p_1, p_2)$  is weakly consistent with  $q_h$ , but not with  $q_\ell$ , then  $\mu(p_1, p_2) = 1$ .*

Assumption 4.2 explicitly takes into account the common information aspect of the game. In the example above,  $(p_1^*(q_h), p_2)$  is weakly consistent with  $q_h$ , but not with  $q_\ell$ . Consequently, after observing equilibrium price  $p_1^*(q_h)$  and deviation  $p_2$ , consumers believe that the entrant sells high quality. Since it is sufficient to pin

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pletely mixed strategies are  $\mu^\varepsilon(p_1^*(q_h), p_2) = [\alpha(1 - 2\varepsilon)\varepsilon^3]/[\alpha(1 - 2\varepsilon)\varepsilon^3 + (1 - \alpha)\varepsilon^2]$ . Now  $\lim_{\varepsilon \rightarrow 0} \mu^\varepsilon(p_1^*(q_h), p_2) = 0$ , i.e., the consistency requirement is satisfied. As argued in Bagwell and Ramey [2], requiring that all trembles have the same magnitude would eliminate the equilibrium.

<sup>11</sup>Bagwell and Ramey [2] provide a somewhat different motivation for their beliefs restriction. In my example, their argument would be that consumers observing  $(p_1^*(q_h), p_2)$  should believe that the entrant’s quality is high because then one deviation instead of two occurred; consumers should not be “prejudiced” in believing that any deviation is more likely than any other. Their notion of unprejudiced sequential equilibrium requires that a deviant price pair is rationalized with the fewest deviations.

down out-of-equilibrium beliefs only for slight deviations, a weaker formulation of the refinement criterion will also satisfy.

The appendix derives necessary conditions on informative equilibrium prices (lemmas 4.1-4.3). I will briefly discuss some of them. First, if the incumbent deters entry of a high-quality seller, then the incumbent's price must be uninformative, that is,  $p_1^*(q_\ell) = p_1^*(q_h)$ . This result generalizes the example above and is a direct consequence of the application of the refinement criterion. An informative price strategy by firm 1 that deters entry cannot occur in equilibrium, since it allows a high-quality entrant to convince consumers of high quality and attract consumers. An implication is that an incumbent that wants to adopt a "tough" posture (in the sense of making entry difficult) should not employ a strategy conveying information about an entrant to consumers. Second, if a high-quality seller captures the market, then  $p_1^*(q_\ell) \geq p_1^*(q_h)$ ; the incumbent sets an equally or more aggressive price if he faces a high-quality rival.

**Proposition 4.1** *Suppose that assumptions 4.1 and 4.2 hold. For any  $\delta$ , there exist exactly two separating equilibria:*

- (i) *If  $\delta > \delta_1$  then there exists a separating equilibrium in which a high-quality firm enters, and  $p_1^* \equiv p_1^*(q_\ell) = p_1^*(q_h) = c_\ell$ ,  $p_2^*(q_\ell) = c_\ell$ , and  $p_2^*(q_h) = c_\ell + q_h - q_\ell$ ;  $\Pi_1^* = 0$  and  $\Pi_2^* = \alpha(c_\ell + q_h - q_\ell - c_h)$ ; the first-best welfare level  $W^{FB}$  is attained.*
- (ii) *If  $\delta \leq \delta_1$  then there exists a separating equilibrium in which the incumbent deters entry of a high-quality firm, and  $p_1^* \equiv p_1^*(q_\ell) = p_1^*(q_h) = c_\ell$ ,  $p_2^*(q_\ell) = c_\ell$ , and  $p_2^*(q_h) = c_\ell + q_h - q_\ell$ ;  $\Pi_1^* = \Pi_2^* = 0$ ; since  $W = q_\ell - c_\ell$ , an inefficiency exists.*
- (iii) *For any  $\delta$  there exists a separating equilibrium in which each type of entrant attracts consumers; in this equilibrium  $p_1^*(q_\ell) = c_\ell + q_h - q_\ell$ ,  $p_1^*(q_h) = c_\ell$ ,  $p_2^* \equiv p_2^*(q_\ell) = p_2^*(q_h) = c_\ell + q_h - q_\ell$ ;  $\Pi_1^* = 0$  and  $\Pi_2^* = c_\ell + q_h - q_\ell - c_h$ ; the first-best welfare level  $W^{FB}$  is attained.*

**Proof:** (i) For necessary conditions on the prices when a high-quality firm enters, see lemmas 4.1 and 4.3 in the appendix. Given that  $p_1^* \equiv p_1^*(q_\ell) = p_1^*(q_h)$ , the proof of proposition 3.1 (i) applies to show that  $\delta > \delta_1$  is necessary and sufficient. Beliefs  $\mu(p_1, p_2^*(q_\ell)) = 0$  and  $\mu(p_1, p_2^*(q_h)) = 1, \forall p_1$ , satisfy the refinement criterion.



(ii) For necessary conditions on the prices when entry is deterred, see lemmas 4.1 and 4.2. Since  $p_1^* \equiv p_1^*(q_\ell) = p_1^*(q_h)$ , the proof of proposition 3.1 (ii) applies to show that  $\delta \leq \delta_1$  is necessary and sufficient. As in (i), beliefs satisfy assumptions 4.1 and 4.2.

(iii) See lemmas 4.1 and 4.3. One can support the equilibrium prices, for any value of  $\delta$ , with beliefs  $\mu(p_1^*(q_\ell), p_2) = 0 \forall p_2$ ;  $\mu(p_1^*(q_h), p_2) = 1 \forall p_2$ ;  $\mu(p_1, p_2^*) = 1 \forall p_1 < p_1^*(q_\ell)$ ; and  $\mu(p_1, p_2^*) = 0 \forall p_1 \geq p_1^*(q_\ell)$ . If consumers do not visit firm 2 in equilibrium, then firm 2 can slightly decrease its price and attract consumers – a contradiction.

In parts (i) and (ii) of the proposition, the incumbent's price is uninformative. Accordingly, the lock-in effect plays the same role as in the model of the previous section, which contains a discussion.

Part (iii) of proposition 4.1 shows that, contrary to the model of the previous section, for any value of  $\delta$  there exists a separating equilibrium with entry. In this equilibrium, the incumbent's price reveals the entrant's type to consumers. The reason that the lock-in effect does not play a role is that a low-quality entrant alone cannot mimic a high-quality type, since the incumbent's price would still inform consumers that the entrant sells low quality. The incumbent charges a relatively high price to signal that the entrant sells low quality, and a relatively low price in the opposite case.<sup>12</sup> Note that the first-best welfare level is attained in this outcome.

Any pooling equilibrium of the model in the previous section is also an equilibrium in this model (the only difference is that assumption 3.1 has been dropped). Because of the larger degree of freedom in defining consumer beliefs out of equilibrium, additional pooling equilibria may exist. In particular, pooling equilibria exist for any  $\alpha \in (0, 1)$ .

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<sup>12</sup>There is an argument against this equilibrium. In the spirit of Grossman and Perry's [9] perfect sequential equilibrium, beliefs  $\mu(p_1, p_2^*) = 1$  for  $p_1 \in (p_1^*(q_h), p_1^*(q_\ell))$  are not reasonable. Since firm 1 attracts no consumers in equilibrium, each "type" of incumbent has the same incentive to select a price  $p_1 < p_1^*(q_\ell)$ . Therefore after a deviation by firm 1, consumers should not draw any conclusion about the entrant's quality:  $\mu(p_1, p_2^*) = \alpha$ . Then firm 1 is able to attract consumers by deviating.

**Proposition 4.2** *Suppose that assumptions 4.1 and 4.2 hold. Pooling equilibria (with and without entry) exist if and only if  $\delta \leq \delta_1$ :*

*(i) If entry occurs then  $p_1^* \in [c_\ell, q_\ell - (q_h - q_\ell)/(1 - \delta)]$  and  $p_2^* \in [c_h, c_\ell + q_h - q_\ell]$  such that  $q_\ell - p_1^* \leq \alpha q_h + (1 - \alpha)q_\ell - p_2^*$  and (7);  $\Pi_1^* = 0$  and  $\Pi_2^* = p_2^* - \alpha c_h - (1 - \alpha)c_\ell$ ; the first-best welfare level  $W^{FB}$  is attained.*

*(ii) If entry is deterred then  $p_1^* = c_\ell$  and  $p_2^* \in [c_h, c_\ell + q_h - q_\ell]$  such that  $p_2^* \geq c_\ell + \alpha(q_h - q_\ell)$  and (7);  $\Pi_1^* = \Pi_2^* = 0$ ; since  $W = q_\ell - c_\ell$ , an inefficiency exists.*

**Proof:** See the appendix.

To conclude this section, I will make a comparison with the results of the previous section. If one considers separating equilibria, for any value of the switching cost parameter there exists an additional separating equilibrium under common information (the equilibrium given in proposition 4.1 (iii)). In this additional equilibrium entry occurs. Accordingly, whereas without common information entry cannot occur if the lock-in effect is severe (see proposition 3.1 (ii)), the fact that the incumbent is informed may help the entrant to circumvent the adverse selection problem. From a welfare point of view, common information may restore efficiency for sufficiently high switching costs (compare propositions 3.1 (ii) and 4.1 (iii)).

Considering pooling equilibria, under common information there exist equilibria with and without entry in a larger parameter range. One cannot, however, draw conclusions concerning the possibilities of entry as clear-cut as in the case of separating equilibria. Under common information, however, it is possible that if entry occurs the entrant charges a higher price than in any pooling equilibrium without common information. As a consequence the incumbent's additional information may increase the entrant's profits and decrease consumers' surplus.

A direct consequence of propositions 4.1 and 4.2 is that the incumbent cannot benefit from observing the entrant's quality. At first sight, this result may look surprising. One would perhaps expect that it would be advantageous for the incumbent firm to have this information.<sup>13</sup> Intuitively, the entrant, who knows that

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<sup>13</sup>For instance, Bagwell [1] presumed (in a model with experience goods, see the discussion

the incumbent is informed, and knows that consumers know this, has an incentive to exploit any informative price strategy by the incumbent. The role played by assumption 4.2 implies a caveat – namely, that without the assumption, information about an entrant could be valuable to the incumbent (as shown in the opening example of this section).

## 5 Conclusion

In markets for search goods, an entrant can signal high quality by selecting a high price. The reason is that a consumer who finds out that the entrant sells low quality, will switch to the incumbent. However, fear of lock-in if the entrant sells low quality may keep consumers from visiting the entrant.

The model demonstrates that the incumbent may not be able to benefit from knowing the type of the entrant. having less information, The entrant, who knows that the incumbent can observe his type and that consumers realize this, may face less difficulty in convincing consumers of high quality under common information. If the incumbent's price is informative about the entrant's quality, the entrant is enabled to circumvent lock-in effects, that is, that he may enter independently of the level of switching costs.

An interesting extension of the model would be to consider the choice of location as a quality signal. Nelson [16] already argued that stores selling search goods have an incentive to cluster. Recall that a price such that a consumer who would observe low quality in the entrant's store switches to the incumbent, signals that the entrant sells high quality. Thus if the cost of switching from the entrant to the incumbent is low, consumers are more easily convinced of high quality. Endogenizing switching costs, for example by the choice of location, would give the entrant an additional instrument to signal his type. One might then explain why sellers often locate themselves near to each other, despite increased competition. An example that comes immediately to mind is a fruit and vegetables market.

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in the previous section) that “[. . .] the entrant would be worse off if its type were known to the incumbent” (footnote 4, p. 210).

Another direction for further research would be to allow the incumbent to spy a potential entrant, in order to observe his quality before the firms compete on the product market. This information may, however, be of value to the incumbent. The reason is that if spying remains undetected and the entrant is not sure whether he has been investigated, the entrant cannot rely on the incumbent's strategy to signal his type.

## Appendix

### Proof of proposition 3.2:

(i) The entrant attracts consumers only if  $q_\ell - p_1^* \leq \alpha q_h + (1 - \alpha)q_\ell - p_2^*$ . If  $p_1^* > c_\ell$ , then firm 1 has no incentive to decrease its price if  $q_\ell - p_1 \leq \alpha q_h + (1 - \alpha)q_\ell - p_2^*$  for all  $p_1 \in (c_\ell, p_1^*)$ . Equivalently,  $p_2^* \leq c_\ell + \alpha(q_h - q_\ell)$ . The latter condition must also hold if  $p_1^* = c_\ell$ . Since any price  $p_2 < c_h$  signals low quality, it must be that  $p_2^* \geq c_h$ . Combining these two constraints, it follows that  $\alpha \geq (c_h - c_\ell)/(q_h - q_\ell)$  must hold. There exists a  $p_1^* \geq c_\ell$  that satisfies (8) if and only if  $\delta \leq \delta_1$ . Since  $p_2^* \leq c_\ell + \alpha(q_h - q_\ell) < c_\ell + q_h - q_\ell$  and  $p_1^* \geq c_\ell$ , a sufficient condition for (7) is  $c_\ell + q_h - q_\ell \leq q_\ell - \delta(q_\ell - c_\ell)$ . The latter condition is equivalent to  $\delta \leq \delta_1$ . The equilibrium outcome can be supported by beliefs  $\mu(p_1^*, p_2) \leq \alpha$  for all  $p_2 \in (c_h, q_\ell - \delta(q_\ell - c_\ell))$ .

(ii) It must be that  $p_1^* = c_\ell$  (see section 3). The incumbent cannot attract consumers by a price increase only if  $q_\ell - p_1^* = \alpha q_h + (1 - \alpha)q_\ell - p_2^*$ , so that  $p_2^* = c_\ell + \alpha(q_h - q_\ell)$ . Since  $p_2^* \geq c_h$ ,  $\alpha \geq (c_h - c_\ell)/(q_h - q_\ell)$  must hold. Inequality (8) holds if and only if  $\delta \leq \delta_1$ . As in (i),  $\delta \leq \delta_1$  implies (7). The equilibrium outcome can be supported by beliefs  $\mu(p_1^*, p_2) \leq \alpha$  for all  $p_2 \in (c_h, p_2^*) \cup (p_2^*, q_\ell - \delta(q_\ell - c_\ell))$ .

### Lemma 4.1 (Necessary condition in separating equilibria)

$$q_\ell - p_1^*(q_h) = q_h - p_2^*(q_h).$$

**Proof:** If  $q_\ell - p_1^*(q_\ell) > q_h - p_2^*(q_h)$ , then firm 1 can increase its price, a contradiction. Therefore,  $q_\ell - p_1^*(q_\ell) < q_h - p_2^*(q_h)$ . If  $p_1^*(q_\ell) \neq p_1^*(q_h)$ , then there exists a price  $p_2 > p_2^*(q_h)$  such that  $q_\ell - p_1^*(q_h) \leq q_h - p_2$  and  $p_2 \neq p_2^*(q_\ell)$ , that is,  $(p_1^*(q_h), p_2)$  is weakly consistent with  $q_h$ , but not with  $q_\ell$ . According to the refinement criterion,  $\mu(p_1^*(q_h), p_2) = 1$ . Therefore, firm 2 can increase its price and

attract consumers, a contradiction. Consequently,  $p_1^* \equiv p_1^*(q_\ell) = p_1^*(q_h)$ . Since consumers visit the entrant in case of high quality, a low-quality entrant must not be able to mimic a high type, that is,  $q_\ell - p_2^*(q_h) < \delta(q_\ell - p_1^*)$  must hold. But then any price  $p_2 > p_2^*(q_h)$  satisfies  $q_\ell - p_2 < \delta(q_\ell - p_1^*)$ . By assumption 4.1, a high-quality entrant has an incentive to increase his price, a contradiction.

**Lemma 4.2** *(Necessary conditions in separating equilibria)*

Suppose that consumers observe  $(p_1^*(q_h), p_2^*(q_h))$ . If they visit firm 1 then

- (i)  $p_1^* \equiv p_1^*(q_\ell) = p_1^*(q_h)$ , and
- (ii)  $p_1^* = c_\ell$ ,  $p_2^*(q_\ell) = c_\ell$  and  $p_2^*(q_h) = c_\ell + q_h - q_\ell$ .

**Proof:** (i) Suppose that  $p_1^*(q_\ell) \neq p_1^*(q_h)$ . From lemma 4.1 and (1) it follows that  $p_2^*(q_h) = p_1^*(q_h) + q_h - q_\ell > c_h$ . There exists a price  $p_2 < p_2^*(q_h)$  such that  $(p_1^*(q_h), p_2)$  is weakly consistent with  $q_h$ , but not with  $q_\ell$ . Thus  $\mu(p_1^*(q_h), p_2) = 1$ , and firm 2 can attract consumers by decreasing its price – a contradiction.

(ii) If  $p_1^* > c_\ell$ , then in case of  $q_2 = q_\ell$ , the entrant captures the market at a price  $p_2^*(q_\ell)$  just below  $p_1^*$ . There exists a price  $p_1 \in (c_1, p_2^*(q_\ell))$  such that  $(p_1, p_2^*(q_\ell))$  is weakly consistent with  $q_\ell$ , but not with  $q_h$ . Hence  $\mu(p_1, p_2^*(q_\ell)) = 0$ , and firm 1 can increase its profits by undercutting firm 2 after observing that  $q_2 = q_\ell$ , a contradiction. Accordingly, it must be that  $p_1^* = c_\ell$ . Moreover,  $p_2^*(q_\ell) = c_\ell$  must hold, since otherwise firm 1 would have an incentive to increase  $p_1^*(q_\ell)$ . From lemma 4.1 it follows that  $p_2^*(q_h) = c_\ell + q_h - q_\ell$ .

**Lemma 4.3** *(Necessary conditions in separating equilibria)*

Suppose that consumers observe  $(p_1^*(q_h), p_2^*(q_h))$ . If they visit firm 2 then

- (i) either  $p_1^*(q_\ell) = c_\ell$  and  $p_2^*(q_\ell) = c_\ell$ ; or  $p_1^*(q_\ell) = c_\ell + q_h - q_\ell$  and  $p_2^*(q_\ell) = c_\ell + q_h - q_\ell$ , and
- (ii)  $p_1^*(q_h) = c_\ell$  and  $p_2^*(q_h) = c_\ell + q_h - q_\ell$ .

**Proof:** (In reverse order) (ii) Notice that  $p_1^*(q_h) = c_\ell$ , otherwise firm 1 could attract consumers by decreasing its price. By lemma 4.1,  $p_2^*(q_h) = c_\ell + q_h - q_\ell$ .

(i) First, suppose that  $p_2^*(q_\ell) \neq p_2^*(q_h)$ . If  $q_\ell - p_1^*(q_\ell) > q_\ell - p_2^*(q_\ell)$  then, by the refinement criterion, firm 1 can increase its price. If  $q_\ell - p_1^*(q_\ell) < q_\ell - p_2^*(q_\ell)$ , then

firm 2 can increase its price. Therefore it follows that  $q_\ell - p_1^*(q_\ell) = q_\ell - p_2^*(q_\ell)$ . From similar arguments it follows that  $p_1^*(q_\ell) = c_\ell$  and  $p_2^*(q_\ell) = c_\ell$ .

Second, suppose that  $p_2^*(q_\ell) = p_2^*(q_h)$ . Therefore,  $p_1^*(q_\ell) > p_1^*(q_h)$ . If  $q_\ell - p_1^*(q_\ell) > q_\ell - p_2^*(q_\ell)$  then the incumbent has an incentive to pretend that he observed a low-quality entrant by selecting  $p_1^*(q_\ell)$  if the entrant's actual quality is high. If  $q_\ell - p_1^*(q_\ell) < q_\ell - p_2^*(q_\ell)$ , then firm 2 can increase its price. It follows that  $q_\ell - p_1^*(q_\ell) = q_\ell - p_2^*(q_\ell)$  (and consumers visit the entrant). Accordingly  $p_1^*(q_\ell) = c_\ell + q_h - q_\ell$ .

#### **Proof of proposition 4.2:**

In any pooling equilibrium, (7) and (8) must hold. Firm 1 should not have an incentive to deviate with some price  $p_1 > c_\ell$ . Let  $\mu(p_1, p_2^*) = 1$  for such a deviation, so that it is sufficient to require  $q_\ell - p_1 \leq q_h - p_2^*$  for all  $p_1 > c_\ell$ . Equivalently,  $p_2^* \leq c_\ell + q_h - q_\ell$ . Entry occurs only if  $q_\ell - p_1^* \leq \alpha q_h + (1 - \alpha)q_\ell - p_2^*$ . Entry is deterred only if  $q_\ell - p_1^* \geq \alpha q_h + (1 - \alpha)q_\ell - p_2^*$ . Also, if entry is deterred then  $p_1^* = c_\ell$ . The equilibrium outcomes can be supported by beliefs  $\mu(p_1^*, p_2)$  similar to those in the proof of proposition 3.2.

## **References**

- [1] Bagwell, K. (1990), "Informational Product Differentiation as a Barrier to Entry," *International Journal of Industrial Organization*, Vol. 8, No. 2, 207-223.
- [2] Bagwell, K. and Ramey, G. (1991), "Oligopoly Limit Pricing," *RAND Journal of Economics*, Vol. 22, No. 2, 155-172.
- [3] Bagwell, K. and Riordan, M.H. (1991), "High and Declining Prices Signal Product Quality," *American Economic Review*, Vol. 81, No. 1, 224-239.
- [4] Bester, H. (1993), "Bargaining Versus Price Competition in Markets with Quality Uncertainty," *American Economic Review*, Vol. 83, No. 1, 278-288.
- [5] Cho, I.-K. and Kreps, D.M. (1987), "Signaling Games and Stable Equilibria," *Quarterly Journal of Economics*, Vol. 102, No. 2, 179-221.

- [6] Demsetz, H. (1982), "Barriers to Entry," *American Economic Review*, Vol. 72, No. 1, 47-57.
- [7] Farrell, J. (1986), "Moral Hazard as an Entry Barrier," *RAND Journal of Economics*, Vol. 17, No. 3, 440-449.
- [8] Fudenberg, D. and Tirole, J. (1991), "Perfect Bayesian Equilibrium and Sequential Equilibrium," *Journal of Economic Theory*, Vol. 53, No. 2, 236-260.
- [9] Grossman, S.J. and Perry, M. (1986), "Perfect Sequential Equilibrium," *Journal of Economic Theory*, Vol. 39, No. 1, 97-119.
- [10] Klemperer, P. (1987), "Entry Deterrence in Markets with Consumer Switching Costs," *Economic Journal*, Vol. 97, Conference Papers, 99-117.
- [11] Kohlberg, E. and Mertens, J.-F. (1986), "On the Strategic Stability of Equilibria," *Econometrica*, Vol. 54, No. 5, 1003-1037.
- [12] Kreps, D. and Wilson, R. (1982), "Sequential Equilibrium," *Econometrica*, Vol. 50, No. 4, 863-894.
- [13] Matthews, S.A. and Fertig, D. (1990), "Advertising Signals of Product Quality," Discussion Paper No. 881, Center for Mathematical Studies in Economics and Management Science, Northwestern University.
- [14] Milgrom, P. and Roberts, J. (1986), "Price and Advertising Signals of Product Quality," *Journal of Political Economy*, Vol. 94, No. 4, 796-821.
- [15] Milgrom, P. and Roberts, J. (1986), "Relying on the Information of Interested Parties," *RAND Journal of Economics*, Vol. 17, No. 1, 18-32.
- [16] Nelson, P. (1970), "Information and Consumer Behavior," *Journal of Political Economy*, Vol. 78, No. 2, 311-329.
- [17] Schmalensee, R. (1982), "Product Differentiation Advantages of Pioneering Brands," *American Economic Review*, Vol. 72, No. 3, 349-365.