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PRICE COMPETITION BETWEEN AN EXPERT AND A NON-EXPERT

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Abstract

This paper characterizes price competition between an expert and a non-expert. In contrast with the expert, the non-expert's repair technology is not always successful. Consumers visit the expert after experiencing an unsuccessful match at the non-expert. This re-entry affects the behavior of both sellers. For low enough probability of successful repair at the non-expert, all consumers first visit the non-expert, and a "timid-pricing" equilibrium results. If the non-expert's repair technology performs well enough, it pays for some consumers to disregard the non-expert a visit. They directly go to the expert's shop, and an "aggressive-pricing" equilibrium pops up. For intermediate values of the non-expert's successful repair a "mixed-pricing" equilibrium emerges where the expert randomizes over the monopoly price and some lower price.

Keywords: price competition, differentiation, re-entry, quality.
JEL Classification No.: D43,L13,L15.

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1 Introduction

What do the following have in common? (1) buying a new good after having spent a considerable amount of money in trying to repair an old good; (2) visiting the specialist after having wasted one's time at the general practitioner; (3) arranging a divorce via a lawyer after spending time and money using a mediator; (4) buying genuine spare parts after having wasted money on imitation parts; (5) trying to fix an object doing-it-yourself and afterwards needing to visit a craftsman. Answer: they all describe situations in which trying to save money potentially turns out to be very costly. In other words, consumers face the choice between visiting an expert directly and first trying to solve the problem using a non-expert. The latter action has the potential drawback of ending up anyway in a visit to the expert. These real-life situations raise a number of interesting questions. What does competition between the expert and non-expert look like? Will the expert only aim at customers the non-expert failed to help? What prices will they charge? What quality level will the non-expert offer? Which consumers will be served by whom? The purpose of this paper is to provide answers to these questions by modelling price competition between an expert and a non-expert.

To be more precise, this paper characterizes price competition in a special type of duopoly in which consumers look for a successful match. The duopolists are denoted as the expert and the non-expert. The consumers' match with the expert's good is always successful. The non-expert's good successfully matches the consumers' needs only with some commonly known probability. With the remaining probability the match is not successful. In other words, the non-expert sells an experience good: its quality is known only after consumption. All consumers attach a common positive value to a successful match, but assign no value if the match was unsuccessful. They seek to minimize their expected expenditures. Therefore, they can go immediately for the expert's good and thus face only one purchase decision. Alternatively, they may choose for the non-expert's good, anticipating the risk of an unsuccessful match. In the event of a bad match, these consumers re-enter the market since bygones are forever bygones. If the non-expert fails to successfully match a consumer's needs, however, another visit at his store yields no success with probability one. That is, the non-expert's matching technology is characterized by perfect correlation. Therefore, these consumers' only choice is to purchase the expert's good. Summing up, the consumers make a purchase decision under uncertainty: going directly for the expert's good may be unnecessary, while buying the services of the non-expert may turn out to be a pure waste.

The above examples fit the general model as follows. Consider competition between a craftsman and a handyman. A craftsman always repairs successfully. By contrast, a handyman's repair technology is imperfect. A consumer, therefore, may turn to the craftsman after experiencing an unsuccessful match at the handyman. A second example concerns competition between a repair shop and a shop selling new goods. A consumer's decision to patch up his broken car depends on the probability of successful repair, the price of patching up, and the price of a new car. Third, the model also shows some insight regarding price competition between a store selling low quality products and another store selling high quality products: only the low quality store sells a product that may break down or is incompatible with another product with some probability. Fourth, consider the market for medical services. General practitioners argue that a mandatory referral prevents patients from a needless visit to the more expensive specialist. The latter argue, however, that if patients are allowed to visit the specialist without the mandatory referral of the general practitioner, it keeps them from making two visits. Finally, the do-it-yourself shops compete with professional repair services. A consumer can fix an object himself by purchasing services at the do-it-yourself shop in order to reduce expenditures. This decision, however, may turn out either to be cheap or very expensive. The latter happens if, after all, the customer has to call on a professional repairer.

We study this problem in a simple horizontal differentiation model and use Hotelling's line as our framework. The consumers are uniformly distributed along the unit interval. The two sellers are located at the extremes of this interval; the non-expert is at the left extreme and the expert at the right extreme. The Hotelling set up should be seen as a representation of different models. These alternative models yield very similar demand functions, and hence qualitatively comparable equilibria. The first alternative is a model where consumers face different costs in the event of switching from the non-expert to the expert. Consumers with a high switching cost are more inclined to visit immediately the expert. In contrast, those with low switching costs take the risk of experiencing first the services of the non-expert. Secondly, consumers may differ with respect to their time preference. Those consumers having a high rate of time preference are more eager to visit the expert at once than are the consumers with a low time preference. Thirdly, individuals may perceive differences in the probability of being successfully matched by the non-expert. Customers with a high perceived probability of success at the non-expert will be more inclined to show up there first.

The analysis shows that three types of equilibria can occur. In the first equilibrium, some consumers prefer to first visit the non-expert, while others directly visit the expert. This happens when the horizontal differentiation is high enough and the non-expert's repair technology is sufficiently successful. The intuition is that the expert's residual demand of "failures" becomes very small when the non-expert becomes a close substitute. This equilibrium is in pure strategies. Both firms adopt an "aggressive-pricing" strategy, since the expert competes in a direct way with the non-expert. That is, the expert attracts consumers directly to his shop in addition to the non-expert's failures. More specifically, the expert persuades consumers with an "address" close to his. By this we mean consumers that feel "close to him" – those with high switching costs, a high rate of time preference, or a low probability of success at the non-expert. Those consumers who visit the expert directly prefer a high price and certainty of repair. The others prefer the gamble of a low price at the non-expert and possibly on top of that the high price of the expert and additional transportation costs. We show that the non-expert has incentives to underinvest in his repair technology if the parametric environment supports the "aggressive-pricing" equilibrium. On the one hand, there is a positive demand effect of providing a better technology, as the non-expert becomes more attractive to all consumers. The demand effect is not particularly strong, as customers close to the non-expert value a higher quality more than those located at the expert. On the other hand, a technology improvement generates a negative strategic effect. This results from two forces. First, it becomes less attractive for the expert to specialize on the non-expert's failures, and the non-expert becomes less vertically differentiated as he improves upon his quality. Second, the probability of ending up at the expert decreases such that the importance of transportation costs, determining the substitutability between both sellers, increases.

In the second type of equilibrium, the expert adopts a mixed strategy where he charges with some probability a low price. With the remaining probability, he charges the monopoly price. In this event, all consumers first visit the non-expert. The non-expert, however, adopts a pure strategy given the expert's mixed strategy. In this "mixed-pricing" equilibrium, the expert's profit is independent of the actual price he charges. This equilibrium occurs for low enough degrees of horizontal differentiation and intermediate probabilities of successful repair.

For sufficiently low probabilities of successful repair at the non-expert, a "timid-pricing" equilibrium occurs. In this equilibrium, the firms' pricing strategies are "timid": the non-expert can charge a high price since the expert finds it optimal to serve only the non-expert's "failures" at the monopoly price. Both sellers specialize on their own market segment without competing directly. The expert specializes in the failures of the non-expert, whereas the non-expert specializes in giving all consumers a first try. In the environment where the "timid-pricing" equilibrium holds, the non-expert has incentives to upgrade his repair technology. The reason is that it allows him to increase his price without affecting his demand, as both suppliers do not compete in a direct way.

The welfare analysis makes it clear that when the expert incurs a sufficient cost disadvantage, the market outcome in the "aggressive-pricing" equilibrium results in too many consumers directly visiting the expert. The opposite happens for low enough cost differences. In the "timid-pricing" equilibrium, the market outcome is optimal whenever the transportation costs are low relative to the cost differences between both suppliers. Consumers should be forced to visit the expert directly in the opposite case.

Some governments have established mandatory health care referral; consumers are forced to first visit a general practitioner before visiting a specialist.[1] The OECD (1994) discusses the health care referral system as follows: "It developed in the nineteenth century in England where there were two classes of doctors ... The "ethical" principle of referral was agreed upon after the general practitioners threatened not to refer to consultants for fear of losing patients to them." (OECD (1994), op cit p. 27). This fear of losing patients would be in line with an "aggressive-pricing" equilibrium, as then health care consumers decide to go directly to the specialist. The lobbying for mandatory referral by the general practitioners allows then to avoid the "aggressive-pricing" equilibrium. Pure welfare considerations, of course, could also be the driving

[1]According to the OECD (1994), systems of mandatory referral exist in 1990 for Austria, Australia, Canada, Denmark, Finland, Greece, Italy, New Zealand, Norway, Portugal, Sweden, and Turkey (OECD (1994)). Free choice exists in Iceland, Japan, Luxembourg, Switzerland, and the US.

force behind the absence/presence of referral systems.

Meurer and Stahl (1994) consider a market with two firms, each selling a horizontally differentiated good. In their model, consumers either experience a good or a bad match. Consumers experiencing a bad match, however, never re-enter the market. This paper, in contrast, allows consumers to re-enter the market after experiencing a bad match. The consumers are horizontally differentiated and two firms sell a vertically differentiated product. The probability of a successful match serves as a measure for quality: at equal expenditures every consumer prefers the expert's good. Meurer and Stahl's (1994) examples apply in this model if we make some modifications: e.g. low quality machinery and equipment may break down and become irreparable. The value of a good match after this breakdown, however, may still be positive. Buying high quality after the breakdown of the low quality machinery, therefore, can be justified. In a somewhat different context, Lal and Matutes (1989) consider price competition between two stores, each selling the same assortment of two independent goods. In their model, two types of consumers exist. In one equilibrium, the two stores charge the same full price for the assortment, but different prices for each good in the bundle. Poor consumers buy each product at the store charging the cheapest price and, therefore, re-enter the market after their first purchase at one of the two stores. Rich consumers, however, never shop around; they never re-enter the market. In this paper, there is only one type of consumer. In addition, the stores sell vertically differentiated goods. Some consumers visit both firms as they find it ex ante optimal to try out the non-expert's good.

In contrast with most of the literature on credence, experience, or search goods, this paper abstracts from sellers' incentives to provide the right amount of quality in the service, repair, or product offered.[2] There is no asymmetric information or search cost involved in the model. Consumers and producers know the probability of successful match at the two stores. Their technology is taken as a given. The paper also abstracts from the possibility of warranties for the low quality good. This assumption can be justified as "quality may be impossible or very costly to measure for a court ... [or] enforcement costs [are] incommensurate with the issue" (Tirole (1988), p. 106). We

[2] Wolinsky (1993), Emons (1994), and Taylor (1995) analyze features of market diagnoses and treatments. The seminal paper on experience goods is Nelson (1970). Tirole (1988) offers an overview of models with experience and search goods.

do, however, analyze whether the non-expert faces incentives to improve upon his repair technology.

The remainder of the paper proceeds as follows. Section 2 offers the model. The demand analysis follows in Section 3, while equilibrium is characterized in Section 4. Section 5 provides some welfare considerations. Section 6 makes some concluding remarks. Finally, Section 7 contains all proofs.

2 The Model

Consider a linear market of length one. All consumers are located uniformly along this interval and own a good needing a repair. All consumers have a common (reservation) value r for getting the good fixed, and minimize their repair expenditures. They incur a linear transportation cost t per unit of length. The density of consumers is normalized to one. There are two sellers. The first seller (the non-expert) is located at the left extreme of the interval ($x = 0$) and sells at price q. He repairs successfully with probability $0 \leq \gamma \leq 1$, and his marginal cost of production is normalized to zero.[3] The repair technology is characterized by perfect correlation between two or more visits to the non-expert's store for every consumer. That is, if the non-expert fails to repair a consumer's good, a second repair at his store yields failure with probability one. The other seller (the expert) is located at the other extreme of the interval ($x = 1$) and always repairs successfully at price p. The expert has a constant marginal production cost of $c \geq 0$.[4] Every consumer has to choose between two possible actions. The first action is to visit the expert's store immediately. With this action, the consumer at location z, obtains a surplus of $r - p - t(1 - z)$. The other choice is to go to the non-expert first. A successful repair at this store yields a consumer at location z a surplus of $r - q - tz$. If the repair

[3]The location of the two providers at the extremes of the line is not really restrictive, especially if we reconsider the alternative models put forward in the introduction. In particular, consumers with an "address" close to the non-expert (expert) can be interpreted as consumers with low (high) switching costs. The same applies for the opportunity cost of time interpretation: those living close to the expert are representative for consumers with a high time preference. Finally, consumers with a low probability of successful repair at the non-expert could be considered as having their location close to the expert.

[4]The value of c can be interpreted as the difference between the expert's and the non-expert's marginal costs.

was not successful, another visit to the non-expert's store is useless; the characteristics of the repair technology imply zero probability of success. Therefore, the consumer re-enters the market and decides whether to visit the expert's store or not. If he visits the expert's store, the consumer pays, however, the additional amount of $p + t(1 - z)$.[5] His ex ante expected utility, as a consequence, amounts to

$$r - q - tz - (1 - \gamma)(p + t(1 - z)).$$

Accordingly, the consumer located at y is indifferent between these two actions if

$$q + ty + (1 - \gamma)(p + t(1 - y)) = p + t(1 - y),$$

where $y \in [0, 1]$ equals

$$y = \frac{(\gamma(p + t) - q)}{(1 + \gamma)t}. \tag{1}$$

To complete the set-up of the model, the expert cannot distinguish buyers once they enter his store: buyers having experienced an unsuccessful repair at the non-expert and entering the expert's store are identical to consumers following the first action. The expert cannot, therefore, make his price contingent on such information.

The next section provides a complete characterization of both firms' demand curve.

3 Demand Analysis

For a fixed value of p, say $\overline{p}$, the non-expert's (contingent) demand curve is defined as

$$D_n(\overline{p}, q) \equiv \begin{cases} 0 & \text{if } q \geq \gamma(\overline{p} + t) \\ y & \text{if } \gamma(\overline{p} + t) \geq q \geq \gamma\overline{p} - t \\ 1 & \text{if } \gamma\overline{p} - t \geq q. \end{cases} \tag{2}$$

The non-expert's demand is continuous and piecewise linear. Three possible price regions have to be distinguished. In the first, the non-expert's demand equals zero if the

[5] We will assume r to be large enough, so that the option not to visit the expert disappears.

consumer located at 0 finds it more profitable to visit the expert first. In the second, a positive fraction y of the consumers finds it profitable to visit the non-expert first at a lower price q. Finally, when the price q is sufficiently low, the non-expert's demand equals one since all consumers find it profitable to visit him first.

Similarly, for a fixed value q, say $\overline{q}$, the expert's (contingent) demand curve is defined as

$$D_e(p,\overline{q}) \equiv \begin{cases} 0 & \text{if } p \geq r \\ (1-\gamma)(r-p)/t & \text{if } r \geq p \geq r-t \\ 1-\gamma & \text{if } r-t \geq p \geq (\overline{q}+t)/\gamma \\ 1-\gamma y & \text{if } (\overline{q}+t)/\gamma \geq p \geq (\overline{q}/\gamma)-t \\ 1 & \text{if } (\overline{q}/\gamma)-t \geq p. \end{cases} \tag{3}$$

The expert's demand is continuous and piecewise linear. It consists of five price regions. In the first constellation of this demand schedule, no consumer visits the expert's store. In the second one, all consumers first visit the non-expert. More distant consumers, however, prefer not to visit the expert if failure at the non-expert occurred. For example, the consumer at location 0 will never buy at the expert's store; doing so would at most yield her negative utility. In the third constellation, all consumers first visit the non-expert and, if necessary, buy at the expert. The fourth price constellation of the demand schedule shows that consumers to the left of y first visit the non-expert and, if necessary, the expert. The other consumers immediately go to the expert's store. Notice that the third and fourth price region destroy the concavity in the expert's demand curve. For extremely low prices, as in the last price region, the expert serves the whole market.

Figure 1 illustrates the corresponding price regions. As defined in Eq. (3), it assumes that $r-t \geq (\overline{q}+t)/\gamma$. Thus, if the expert charges the price $p = r-t$, all consumers first visit the non-expert. That is, at $p \geq r-t$ the expert can only attract "failures." It follows from the above demand analysis that total market demand $D_n(p,q) + D_e(p,q)$ varies between 0 and $2-\gamma$.

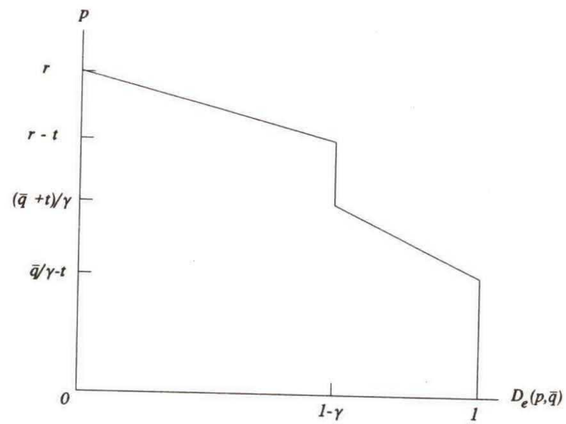

Figure 1: The expert's inverse demand curve

A different situation occurs when $(\overline{q}+t)/\gamma > r-t$. If $p = r-t$, some consumers visit the expert directly. In this event, the vertical line of the inverse demand in Figure 1 at $1-\gamma$ disappears. If $(\overline{q}+t)/\gamma > r-t \geq p$, all failures still visit the expert. If, however, $(\overline{q}+t)/\gamma \geq p > r-t$ some consumers who experienced a bad match at the non-expert do not visit the expert anymore. In particular, those consumers sufficiently close to zero incur a negative utility from doing so. Since this paper aims at discussing when it is optimal for all consumers to first visit the non-expert before the expert, we will only consider the situation where $(\overline{q}+t)/\gamma \leq r-t$. In the next section, Assumptions 1 and 2 make clear that this implies a restriction on the parameters.

4 Equilibrium Analysis

To get some intuition from the start, consider first the case in the absence of horizontal differentiation ($t = 0$). On the one hand, the expert is able to guarantee himself a minimum profit by serving the failures from the non-expert and charging the reservation value r. On the other hand, the expert can aim at attracting the entire market directly by offering slightly better conditions than the non-expert. This generates a discontinuity in the expert's best-response function. Therefore, a mixed equilibrium results in which the expert charges with some probability the reservation value r and with the remaining probability the marginal production cost c. We come back to this case at the end of this section.

Now return to the case with horizontal differentiation. We proceed as follows. We first discuss the best-response functions of both sellers. After that, we turn to the different equilibria. Let us start with the following two assumptions:

Assumption 1: $r \geq 2t + c$.

Assumption 2: $r \geq 2t(1+\gamma)/\gamma$.

Assumption 1 guarantees that the expert would serve the whole market if he were in a monopoly position. The second assumption implies that if the expert charges the monopoly price $p = r - t$, the non-expert finds it optimal to serve the whole market. In other words, if the expert charges the monopoly price, all consumers find it optimal to first visit the non-expert. If $2t/c \geq \gamma$, it is sufficient if the consumers' reservation value satisfies Assumption 2. Otherwise, Assumption 1 is sufficient. At price $p = r - t$, all consumers who had an unsuccessful match at the non-expert's store find it also optimal to visit the expert. Therefore, at the monopoly price the expert only serves the failures.

From Eq. (2) the non-expert's profit function equals

$$\pi_n(q, \overline{p}) = qD_n(\overline{p}, q) \tag{4}$$

and is continuous and concave in the non-expert's price q. Lemma 1 characterizes the non-expert's best-response function.

Lemma 1: *The non-expert's best-response function equals* $R_n(p) = \max[0.5\gamma(p+t), \gamma p - t]$.

Lemma 1 shows that the non-expert chooses either to serve the whole market or part of it. Lemma 1 implies that if $p < \hat{p} \equiv t(2+\gamma)/\gamma$, the non-expert does not serve the whole market. If, however, $p \geq \hat{p}$, it is optimal for the non-expert to serve all consumers. It follows from Lemma 1 that the second part of Eq. (2) of the non-expert's demand is the only relevant one since he will never set any $q < \gamma p - t$ or $\gamma(p+t) < q$.

From Eq. (3) the expert's profit function equals

$$\pi_e(p, \overline{q}) = (p-c)D_e(p, \overline{q}). \tag{5}$$

Equation (5) is continuous but non-concave in the expert's price p. However, due to the form of the expert's demand function, Eq. (5) only shows two possible peaks. The expert's best response is to pick the maximum of these two peaks. In particular, he chooses among the following alternatives. The first possible peak occurs whenever the expert serves only the non-expert's "failures," that is $y \geq 1$. Then, the expert charges $r - t$ due to the inelasticity of the third part of Eq. (3). Actually, the expert is able to guarantee himself this profit by specializing in only the failures. In this event, the expert's demand is given by the third price region in Eq. (3) and equals $1-\gamma$. Therefore, if the non-expert serves the whole market, the expert's profit equals

$$\pi_e(r-t, \overline{q}) = (r-t-c)(1-\gamma). \tag{6}$$

A second possible peak occurs at one of the two following mutually exclusive alternatives. *First*, the expert charges a price such that some but not all consumers visit him directly. That is, $0 < y < 1$. In this price region the expert's profit function is quadratic and equals

$$\pi_e(p, \overline{q}) = (p-c)(1-\gamma y). \tag{7}$$

The first-order condition for the r.h.s. of Eq. (7) whenever it applies is defined as

$$\tilde{p}(q) \equiv p = \frac{t + \gamma(q+t) - \gamma^2(t-c)}{2\gamma^2}. \tag{8}$$

The price $\tilde{p}(q)$ is increasing in the non-expert's price q. It is, however, decreasing in the probability of success of the non-expert. *Second*, the expert charges a price such that he immediately attracts all consumers, i.e. $y = 0$. His optimal price becomes $q/\gamma - t$, as a lower price does not generate additional demand.

Define

$$q_l \equiv \gamma(c-t) - t(1 - 1/\gamma), \tag{9}$$

$$q_h \equiv \gamma c + t(1 + \gamma + (1/\gamma)), \tag{10}$$

$$\hat{q}(\gamma) \equiv 2\sqrt{t(1-\gamma^2)(r-t-c)} + \gamma(c+t) - t(1+1/\gamma), \tag{11}$$

and

$$\dot{q} \equiv \gamma((r-t-c)(1-\gamma) + t + c). \tag{12}$$

Comparison of the two potential peaks yields the expert's best response. Lemma 2 characterizes the expert's best-response function.

Lemma 2: *The expert's best-response function is*

$$p = \begin{cases} r-t & \text{if } 0 \leq q \leq q_l \\ r-t & \text{if } q_l \leq q \leq \min(\hat{q}(\gamma), q_h) \\ \tilde{p}(q) & \text{if } \max(q_l, \hat{q}(\gamma)) \leq q \leq q_h \\ r-t & \text{if } q_h \leq q \leq \dot{q} \\ q/\gamma - t & \text{if } \max(q_h, \dot{q}) \leq q. \end{cases} \tag{13}$$

Lemma 2 shows that if the price of the non-expert is sufficiently low, it is optimal to charge that price not exceeding some consumer's willingness to pay, and serve only the non-expert's failures. Thus, all consumers first go to the non-expert; consequently, the expert serves only consumers who had an unsuccessful match at the non-expert. This is the case in the first and third region of Eq.(13). The expert's best response for intermediate q is to price such that he directly attracts a sufficient fraction of consumers. In other words, some consumers first go to the non-expert, while others go directly to the expert. The expert has to attract a substantial fraction, and thus must decrease significantly his price. This occurs in the third region of Eq.(13). A third strategy which is optimal given that the non-expert sets a relatively high price, is to ask a price such that he attracts all consumers immediately. This occurs in the fifth region of Eq. (13). In sum, lemma 2 implies that the expert will never charge a price exceeding some consumer's willingness to pay, i.e. $p \leq r - t$. In addition, he will never charge a lower price than that one already attracting the entire market, i.e. $p \geq q/\gamma - t$. Thus, the expert's best response is between $q/\gamma - t$ and $r - t$. That is, only the third and fourth price region in Eq. (3) are relevant.

In essence, the expert's choice is whether to serve *only* failures or not. If he serves only failures, there is no need to compete fiercely for consumers: an increase in the price p does not affect his demand. Hence, by charging the monopoly price $p = r - t$, the expert adopts a "timid-pricing" strategy. The other choice for the expert is to charge a price that will allow some consumers visit him directly. If the non-expert's price is high, consumers are more willing to visit the expert's store directly. In this case, by adopting an "aggressive-pricing" strategy, the expert can increase his demand substantially.

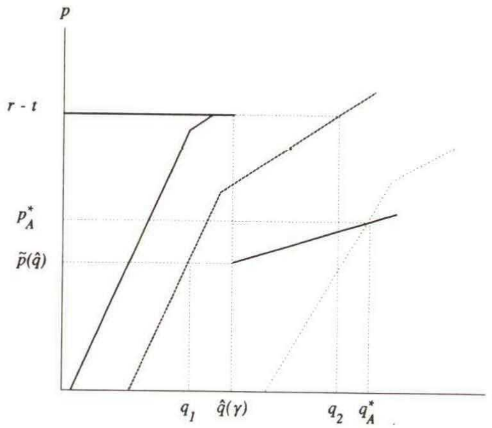

Figure 2: The best-response functions

Figure 2 illustrates the best-response functions of both sellers. The expert's best-response function starts at $p = r - t$ and remains horizontal for all prices to the left of $\max(q_l, \min(\hat{q}(\gamma), q_h))$. At this point, the best response shows one of the following two mutually exclusive downward jumps. The first occurs at $\max(q_l, \hat{q}(\gamma))$ for all $\max(q_l, \hat{q}(\gamma)) \leq q_h$. It becomes optimal for the expert to attract some consumers directly to his shop. The expert's best response increases in a linear way. Figure 2 shows the situation where $\max(q_l, \min(\hat{q}(\gamma), q_h)) = \hat{q}(\gamma)$. The second possible downward jump occurs at $\max(q_h, \dot{q})$ if $\max(q_h, \dot{q}) \leq q$.This downward jump occurs since it becomes optimal for the expert to attract all consumers directly to his shop. The non-expert's best response is increasing, continuous, and shows a kink at $p = \hat{p}$.

Before discussing the different equilibria, we can rule out the following cases. Setting a price such that the expert serves directly the entire market can never be a pure strategy equilibrium. In this event, the non-expert realizes zero profits which gives him an incentive to reduce his price. Thus, parts (4) and (5) of Eq. (13) never yield a pure strategy equilibrium. We are now ready to focus on the different equilibria. We distinguish three types of equilibria as a function of whether the non-expert's repair technology γ is high, intermediate or low.

Proposition 1: *There is a* $0 < \gamma_A^* \leq 1$ *such that some consumers go directly to the expert if the probability of success* γ *at the non-expert is at least* γ_A^*. *In this pure strategy "aggressive-pricing" equilibrium* (p_A^*, q_A^*) *it holds that*

$$p_A^* = \frac{\gamma^2(2c - t) + 2\gamma t + 2t}{3\gamma^2}, q_A^* = \frac{\gamma^2(c + t) + (1 + \gamma)t}{3\gamma}.$$

The non-expert's market share in this "aggressive-pricing" equilibrium equals

$$0 \leq y_A^* = \frac{c\gamma^2 + (1 + \gamma + \gamma^2)t}{3\gamma t(1 + \gamma)} \leq 1. \tag{14}$$

The dotted line in Figure 2 illustrates the non-expert's best-response function in the "aggressive-pricing" equilibrium. Some consumers prefer to directly visit the expert's store. Not surprisingly, $p_A^* \geq q_A^*$. The expert charges at least as high a price as the non-expert. The expert's profits, however, exceed the non-expert's provided c is not too large. Of course, for $c = 0$ and $\gamma = 1$, their prices and profits coincide. Both prices increase with the expert's marginal cost c and the rate of tranportation cost t. More consumers directly visit the expert when the cost of transportation increases, while the opposite happens when the expert's cost increases. Note that when t approaches zero, Eq. (14) does no longer satisfy the boundaries. The reason is that demand becomes very price-elastic such that the expert is stimulated to undercut the non-expert. We discussed this case at the outset of this section.

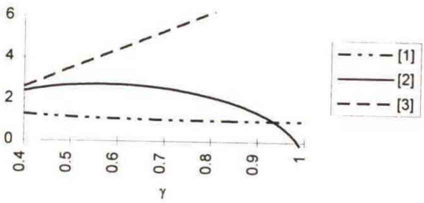

Fig. (3a): c=0, t=1, r=10

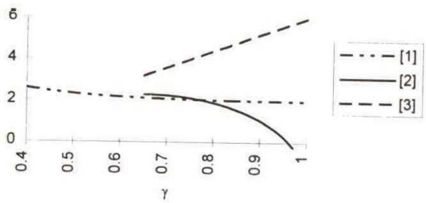

Fig. (3b): c=0, t=2, r=10

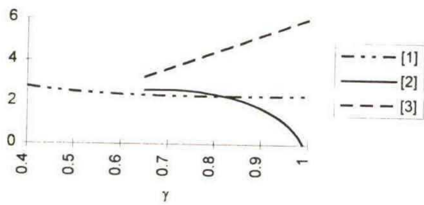

Fig. (3c): c=1, t=2, r=10

Figure 3: The relevant ranges of γ in the "aggressive-pricing" equilibrium

Using some representative numerical examples, Figures $3a$-c illustrate the relevant ranges of γ for which an "aggressive-pricing" equilibrium exists. The horizontal axis depicts the values for γ. The vertical axis shows the non-expert's price q_A^* from Proposition 1, $\hat{q}(\gamma)$ as defined in Eq. (11), and the non-expert's price $\gamma(r-t)-t$ when the expert charges his monopoly price. They are indicated by [1], [2], and [3], respectively. Since any equilibrium must satisfy Assumption 2, a necessary condition is that $\gamma \geq \tilde{\gamma}$. In addition, the following condition should hold: $q_l \leq \gamma(r-t)-t$. Equivalently, $\gamma \geq \gamma_l \equiv \sqrt{t/(r-c)}$. Finally, $0 \leq y_A^* \leq 1$ in any "aggressive-pricing" equilibrium. This is equivalent to $\underline{\gamma}_A \leq \gamma$. Therefore, the horizontal axis is only relevant for values of $\gamma \geq \max(\tilde{\gamma}, \gamma_l, \underline{\gamma}_A)$. Figures $3a$-c show there is an "aggressive-pricing" equilibrium if $\hat{q}(\gamma) \leq q_A^*$. That is, for all $\gamma \geq \gamma_A^*$. As an example, take Figure $3a$. The probability of success at the non-expert is at least $\gamma_A^* \approx 0.934$ in any "aggressive-pricing" equilibrium. Thus, the probability of a successful match of the non-expert should be high enough. The intuition is that a relatively successful non-expert is a close substitute for the expert. In other words, the expert's residual demand for "failures" becomes very small. As a consequence, the expert finds it much less attractive to charge the monopoly price. Figures $3b-c$ are interpreted in a similar way.

Suppose there exists a first stage in which the non-expert could decide on the quality of his repair technology, before competing in prices. What quality level would the non-expert offer? Within the environment for which the "aggressive-pricing" equilibrium exists, the overall result is determined by two opposing effects. On the one hand, a higher γ induces a positive demand effect. An increase in γ shifts and rotates the non-expert's best reply outwards. The reason is that the attractiveness of the non-expert increases for all consumers, as the quality difference between both sellers decreases. Thus, the vertical differentiation between both sellers decreases. The demand effect, however, is not very large, as consumers located close to the expert value an increase in γ less than those located close to the non-expert. On the other hand, an increase in γ generates a negative strategic effect; the expert's best response shifts and rotates inwards. This results from the interplay of a reduction in vertical and an increase in horizontal differentiation. An increase in γ reduces the quality difference between the two sellers and changes the importance of transportation costs i.e. horizontal differentiation: it makes consumers less likely to switch from one seller to the other due to the decrease in probability of ending up in a visit at the expert. Thus, the non-expert should underinvest in the quality of his repair technology in order to dampen the aggressive response by the expert. Or, using the Fudenberg-Tirole (1984) terminology, the non-expert should behave as a puppy dog in his repair technology decision. The overall effect on the non-expert's profits of an increase in γ is ambiguous.

Our model in which consumers re-enter to visit the expert provides different insights than a model in which consumers after having failed at the non-expert would not re-enter; that is, buy the outside good. In particular, in the latter setup, the positive demand effect dominates the negative strategic effect. Thus without consumer re-entry at the expert, the non-expert has incentives to improve his repair technology. The force driving these results is the following. Without re-entry at the expert, an increase in γ is equally valued by all consumers independent of their location. With re-entry at the expert, however, consumers located close to the expert benefit less than those located close to the non-expert. Thus, without re-entry at the expert an increase in γ implies a larger demand effect without affecting horizontal differentiation. An increase in γ only mitigates the quality difference between both sellers, since consumers do not face any transportation costs after a bad experience at the non-expert. Thus, increasing the quality without re-entry at the expert does not increase the importance of transportation costs, i.e. horizontal differentiation.

The entries in Table 1 are the critical values for γ_A^* given parametric values of r, c, and t. In other words, the "aggressive-pricing" equilibrium holds for all $\gamma \geq \gamma_A^*$. Table 1 illustrates that an increase in the expert's cost c positively affects the value of γ_A^*. The intuition is the following: an increase in the expert's cost structure, undoubtedly, decreases his profits from serving only "failures." This practice, however, keeps him from being exposed to a weakened competitive position because of this higher cost structure. Therefore, only a higher probability of the non-expert's success can make it more profitable for the expert to directly compete with the non-expert. This explains the positive relationship between c and γ_A^*. An increase in the cost of transportation t, however, makes it less attractive for both sellers to serve the whole market and, therefore, negatively affects γ_A^*.

	$t=1$	$t=2$
$c=0$	0.934	0.770
$c=1$	0.967	0.820

Table 1: Critical values for γ_A^* (for $r=10$)

Proposition 2: *There is no equilibrium in pure strategies if the probability of success is such that* $\max(\tilde{\gamma}, \gamma_l) \leq \gamma \leq \gamma_A^*$.

Figures 3*a*-*c* illustrate Proposition 2: for $\max(\tilde{\gamma}, \gamma_l) \leq \gamma \leq \gamma_A^*$ there exists no "aggressive-pricing" equilibrium. That is, for intermediate probabilities of successful repair, an "aggressive-pricing" equilibrium does not exist. In addition, when the cost of transportation t decreases, the critical value γ_A^* increases. That is, a lower degree of horizontal differentiation increases the range of γ-values for which an equilibrium in pure strategies does not exist. The non-existence of an equilibrium in pure strategies results from the non-concavity of the expert's profit function. Two mutually exclusive situations should be considered. First, the expert is indifferent between charging p_A^* and his monopoly price $r-t$ only if the non-expert sets the price $\hat{q}(\gamma)$. Second, the expert is indifferent between charging $r-t$ and $\dot{q}/\gamma - t$ only if the non-expert sets the price $\dot{q}$. The non-expert, however, optimally charges another price in response to the expert's prices. The dashed best-response function for the non-expert in Figure 2 illustrates Proposition 2. As the dashed line passes through the discontinuous part of the expert's best response, no equilibrium in pure strategies exists.[6] Proposition 3, however, shows that for these values of γ, there exists a unique equilibrium in mixed strategies.

Proposition 3: *If* $\max(\tilde{\gamma}, \gamma_l) \leq \gamma \leq \gamma_A^*$, *there exists a unique "mixed-pricing" equilibrium* (p_M^*, q_M^*, α^*). *In this equilibrium the non-expert charges* $q_M^* = \min(\dot{q}, \hat{q}(\gamma))$ *with probability one. The expert charges his monopoly price* $p = r - t$ *with probability* α^*. *In this event, all consumers first visit the non-expert. With the remaining probability* $1-\alpha^*$, *the expert charges* $p_M^* = \tilde{p}(\hat{q}(\gamma))$ if $\min(\dot{q}, \hat{q}(\gamma)) = \dot{q}$ *and* $p_M^* = \dot{q}/\gamma - t$ *otherwise.*

[6]Krishna's (1989) model has identical features in the context of voluntary export restrictions (see also Krugman (1989)).

Proposition 3 says that, depending on the parametric environment, the expert "randomizes" between the monopoly price and one of the two following mutually exclusive alternatives. The first is setting a price $\tilde{p}(\hat{q}(\gamma))$ such that he directly attracts some but not all consumers. The second alternative is to charge a price $\dot{q}/\gamma - t$ such that all consumers immediately visit his shop. Harsanyi (1973) provides a rationale for the above "mixed-pricing" equilibrium by constructing a related "disturbed" game. In this disturbed game, the expert's cost structure c is subject to some exogenous random shock, the value of which the expert knows with certainty. In contrast, the non-expert faces uncertainty about its exact value. In addition, suppose the non-expert believes that the expert's costs are uniformly distributed around c. Then, at the limit, as these pay-off related disturbances vanish, the non-expert's beliefs approach the mixed strategy equilibrium. In other words, Harsanyi interprets the probabilities with which the expert "randomizes" in the mixed strategy context, as the non-expert's "rate of ignorance" about the expert's cost structure. In this sense, the expert's "randomizing" behavior gets purified and, therefore, becomes completely deterministic.

Two limiting cases of Proposition 3 are considered. First, there is a "timid-pricing" equilibrium (p_T^*, q_T^*) when $\alpha \to 1$. In this equilibrium $p_T^* = r - t$ and $q_T^* = \gamma(r-t) - t$ if $0 \leq q_T^* = \hat{q}(\gamma)$. From Eq. (13) in Lemma 2, the expert's best response, indeed, equals $p_T^* = r - t$ if $0 \leq q_T^* \leq \hat{q}(\gamma)$. By assumption 2, the non-expert's best response is $q_T^* = \gamma(r-t) - t$ if $p_T^* = r - t$. In that case, all consumers first visit the non-expert and the expert serves only the failures. Both firms adopt a "timid-pricing" strategy: the non-expert can charge a very high price since the expert charges his monopoly price. The expert's profit equals $(r-t-c)(1-\gamma)$ and the non-expert's profit is $\gamma(r-t)-t$. Second, there is a "competitive-pricing" equilibrium (p_C^*, q_C^*) when $\alpha \to 0$ and when $t = 0$. In this equilibrium the non-expert charges $q_l = \hat{q}(\gamma) = q_h = \gamma c$, and the expert charges the perfect competitive price c.

Proposition 4: *If the probability of success at the non-expert is sufficiently low, i.e.* $\gamma \leq \gamma_l \equiv \sqrt{t/(r-c)}$, *there exists a unique "timid-pricing" equilibrium where the expert charges the monopoly price* $p = r - t$ *and the non-expert* $q = \gamma(r-t) - t$.

The full dark line in Figure 2 illustrates the non-expert's best-response function in the "timid-pricing" equilibrium. All consumers first have a try at the non-expert although his repair technology is weak. The expert has no incentives to price aggressively as his profits on the non-expert failures are considerable. This allows the non-expert to charge a relatively high price as well. This equilibrium shows relatively high prices, as both sellers are not competing directly with each other. The expert specializes in the non-expert's failures, whereas the non-expert covers the entire market at first instance.

Notice that within the parametric environment where the "timid-pricing" equilibrium applies, the non-expert would have incentives in a first stage to improve upon his repair technology. The reason is that this allows him to ask for a higher price without affecting his demand. Thus his profits increase in γ.

In sum, the overall picture for the equilibrium looks as follows. For very low values of γ, a "timid-pricing" equilibrium results. Both sellers are specializing on their market segment and do not compete fiercely. For intermediate γ, a "mixed-pricing" equilibrium occurs where the expert randomizes over the monopoly price and a lower price. For high values of γ, an "aggressive-pricing" equilibrium pops up, as it becomes interesting for both sellers to attract consumers directly to their shops.

5 Welfare

This section compares the "aggressive-pricing" equilibrium with the social optimum. The social planner chooses the indifferent consumer $y = y_W^*$ such as to minimize total costs C:

$$\min_{y_W^*} \int_0^{y_W^*} ty dy + \int_{y_W^*}^1 t(1-y)dy + \int_0^{y_W^*} (1-\gamma)t(1-y)dy + (1-\gamma y_W^*)c. \tag{15}$$

The first term in Eq. (15) is the total transportation costs of all consumers going first to the non-expert. The second term is interpreted similarly, but for all consumers going directly to the expert. The third term represents the transportation costs of all consumers who, because of failure at the non-expert, visit the expert. Finally, the last term shows the expert's total costs.

Solving Eq. (15) for y_W^* yields

$$y_W^* = \frac{\gamma(t+c)}{(1+\gamma)t}. \tag{16}$$

In words, the indifferent consumer's location becomes closer to the expert's location if the probability of a successful repair at the non-expert increases ($\partial y_W^*/\partial\gamma > 0$). Also, an increase in the expert's marginal cost augments the fraction of consumers that first visits the non-expert ($\partial y_W^*/\partial c > 0$). Finally, an increase in the cost of transportation decreases the proportion of consumers going to the non-expert first ($\partial y^*/\partial t < 0$). The indifferent consumer is in the interior if $\gamma \leq t/c$. Substituting this into Eq. (15), one arrives at an optimal social cost

$$\tilde{C} = \frac{\gamma^2(t+c)^2}{2(1+\gamma)t} + 0.5t - \frac{\gamma^2(t+c)}{1+\gamma} + (1 - \frac{\gamma^2(t+c)}{(1+\gamma)t})c.$$

The total surplus in the first-best solution is then simply $r - \tilde{C}$. If the social planner can control both prices, the first-best solution can easily be achieved: each pair of prices resulting in the indifferent consumer located at y_W^* is optimal. Suppose the social planner can only control the expert's price.[7] Then, the first-best solution can still be achieved. This can readily be seen from Eqs. (1) and (16), where $y = y_W^*$ if $q = \gamma(p-c)$. Since the non-expert's best response is continuous, there exists a unique intersection. Following Meurer and Stahl (1994), this is the constrained efficient outcome. By contrast, if the social planner can only control the non-expert's price, the first-best solution is not necessarily obtained.[8] If $p = q/\gamma + c$ passes through the discontinuous part of the expert's best response, either too many or too few consumers directly visit the non-expert.

Before stating the next proposition, define

$$\gamma_W^* \equiv \frac{t + \sqrt{t^2 + 8t(c+t)}}{4(c+t)}. \tag{17}$$

The right-hand side of Eq. (17) is increasing with the rate of transportation cost t; in addition, it approaches zero when t vanishes. It is decreasing in the expert's marginal cost c and approaches one when c tends to zero.

[7]This may be of interest when it is too costly to trace the non-expert's repair activities, e.g. only the expert has an official licence for making repairs and the non-expert illegally offers repair services.

[8]This may be of interest when the expert has his location outside the social planner's area of control; e.g. abroad.

Proposition 5: *A socially efficient proportion of consumers first visit the non-expert in the "aggressive-pricing" equilibrium only when $\gamma = \gamma_W^*$ and $\gamma_A^* \leq \gamma_W^*$. If $\gamma_A^* \leq \gamma < \gamma_W^*$, then too few consumers from an efficiency point of view first visit the expert . If $\max(\gamma_A^*, \gamma_W^*) \leq \gamma$, then too many consumers first visit the expert.*

The entries in Table 2 are the γ-values for which the market outcome coincides with the socially efficient outcome given the parametric values of r, c, and t. Table 2 shows that in the numerical examples where $c = 0$, the probability of success at which the market outcome coincides with the socially efficient outcome is $\gamma_W^* = 1$. As a consequence, a comparison with Table 1 makes clear that $\gamma_A^* \leq 1$. That is, when there are no cost differences, not enough consumers from an efficiency point of view directly visit the expert in any "aggressive-pricing" equilibrium. In contrast, when $c = 1$, a comparison of Tables 1 and 2 illustrates that $\max(\gamma_W^*, \gamma_A^*) = \gamma_A^* \leq \gamma$. In words, in the "aggressive-pricing" equilibrium with such a cost difference, too many consumers first visit the expert. All consumers between y_W^* and y_A^* should, from an efficiency point of view, first visit the non-expert: the cost disadvantage results in the expert charging too aggressive a price.

	$t = 1$	$t = 2$
$c = 0$	1.000	1.000
$c = 1$	0.640	0.767

Table 2: Market outcome is efficient for $\gamma = \gamma_W^*$ (for $r = 10$)

In the "timid-pricing" equilibrium, all consumers first visit the non-expert. This implies that they potentially save the difference in marginal cost between the two suppliers. The drawback is that the average transportation costs are higher, as they potentially end up at the expert. The trade off between these two costs determines whether it would be optimal to force everybody to go directly to the expert or not.

6 Concluding Remarks

This paper has characterized price competition between an expert and a non-expert. In contrast with the expert, the non-expert's repair technology is not always successful. In a location framework which is representative for other interpretations, consumers require a successful repair and seek to minimize their expected expenditures. In the event of an unsuccessful match at the non-expert, the consumer re-enters the market and visits the expert. This simple framework offers the following insights: when the non-expert's repair technology is sufficiently successful, both sellers charge a low and deterministic price. Indeed, the non-expert's low number of failures does not make it attractive for the expert to charge the monopoly price. By doing this, he would only serve those consumers who had an unsuccessful match at the non-expert. In this equilibrium, both sellers charge a deterministic price and some consumers first visit the expert. When the non-expert's repair technology is of intermediate quality, the higher number of failures increases the profitability of the expert's residual demand. In equilibrium, the expert randomizes between the monopoly price and a low price. The non-expert, however, charges a deterministic price. If the expert charges his monopoly price, all consumers first visit the non-expert. For low probabilities of successful repair at the non-expert, both sellers specialize on their own segment and charge a relatively high price. The expert specializes in the non-expert's failures and asks these consumers the monopoly price. The non-expert specializes in giving the consumers' good a first repair.

Suppose there is a first stage in which the non-expert decides upon his repair technology. Our results show that the non-expert should underinvest in his repair technology whenever the "aggressive-pricing" equilibrium applies. The driving force is that a higher level of quality induces an aggressive response from the expert. The non-expert faces incentives to improve upon his repair technology whenever the "timid-pricing" equilibrium applies, as this allows him to increase his price without losing demand.

The fact that consumers re-enter the market at the expert drastically reshapes competition between both sellers. First, a repair technology with low success probability allows the expert to specialize in the non-expert's failures. This situation would never occur without re-entry. Second, without re-entry, there is no discontinuity in the expert's best response, and hence no "mixed-pricing" equilibrium. Third, the magnitude of both the demand and strategic effect are modified. The reason is that with re-entry at the expert, reducing vertical differentiation also increases horizontal differentiation. A welfare analysis shows that the market outcome with aggressive pricing results in too few consumers directly visiting the expert when there are no cost differences. In contrast, too many consumers directly visit the expert for high enough cost differences.

The following modifications to the simple model deserve a short discussion. Suppose the expert decides to *price discriminate* between the consumers who first visited the non-expert's store (the failures) and those who directly visit his store. Two scenarios are considered. In the first scenario, only failures can prove they first visited the non-expert. These failures should be charged the highest price: the non-expert's repairing technology is such that failures can only go to the expert's store for successful repair. In other words, the expert has a monopoly position with respect to the failures. The failures, certainly, must be given an incentive (a discount) to reveal themselves. Offering a discount to the failures, however, increases the number of consumers first visiting the non-expert. Both the discount and its effect on the indifferent consumer decrease the expert's profit. Therefore, in this scenario it is not optimal for the expert to price discriminate. In the second scenario, the failures cannot hide their visit to the non-expert. Hence, the expert could charge these consumers a higher price. Clearly, more consumers will prefer to directly visit the expert. This moves the position of the indifferent consumer to the left (the demand effect). The non-expert, however, will reduce his price (the strategic effect). A priori, it is not clear whether the expert optimally should price discriminate.

The non-expert could also consider offering a *No-Cure-No-Pay* contract. With such a contract, all consumers who had an unsuccessful match do not have to pay the non-expert. In this set-up, the indifferent consumer is located at y' such that $\gamma q' + ty' + (1-\gamma)(p' + t(1-y')) = p' + t(1-y')$. It turns out that in the "aggressive-pricing" equilibrium (see Proposition 1) the non-expert's price becomes $q'^{*}_A = q^{*}_A/\gamma$. The intuition is that, due to risk neutrality, the non-expert is indifferent between receiving q^{*}_A/γ with probability γ *or* q^{*}_A with certainty. A similar intuition applies to the consumers. It follows that the expert's price $p'^{*}_A = p^{*}_A$, and the indifferent consumer $y'^{*}_A = y^{*}_A$ do not change. Summing up, a *No-Cure-No-Pay* contract does not alter the results when all parties are risk-neutral. For a low enough degree of risk aversion, the indifferent consumer will certainly shift to the right given the expert's price (the demand effect). Since both sellers act as strategic complements, the introduction of such a *No-Cure-No-Pay* contract decreases the expert's price. This strategic effect, however, diminishes as the degree of risk aversion increases. In the limit, when the degree of risk aversion tends to infinity, the non-expert cannot attract any consumer whatever the expert's price.[9]

A similar interpretation under risk neutrality holds for an "*as long as the stock lasts*"-

[9]See Che (1996) for an analysis in a monopoly context with so-called "customer return policies."

contract. This situation arises if the expert faces no capacity constraints, whereas the non-expert has a capacity constraint. Then consumers are only served by the non-expert subject to the stock being unsold.[10] This induces the consumers to incur additional transportation costs when ending up at the expert. An example from financial markets is the following: an investor might consider to trade on a financial market via submitting a limit order, or via a market maker. The latter executes his order with certainty, whereas a limit order is only executed with a certain probability. In the end, he may have to switch to the market maker to have his order executed implying additional uncertainty and waiting costs.[11]

[10] We assume that all consumers have the same probability of obtaining the good at the non-expert.

[11] Two excellent overviews on the organization of financial markets are Pagano and Röell (1992) and O'Hara (1995).

7 Appendix

Proof of Lemma 1: Since Eq. (4) is concave in q, the non-expert's best response is $q = 0.5\gamma(p+t)$ for any $y \in [0,1]$. From Eq. (2), however, a necessary condition is that $\gamma(p+t) \geq 0.5\gamma(p+t) \geq \gamma p - t$. The first inequality is always satisfied. If the second is not satisfied, the non-expert's demand equals 1. Accordingly, the best response is $\gamma p - t$. □

Proof of Lemma 2:

First, notice that the expert's profit function is non-quasi concave due to the form of the demand function. However, it is quasi-concave for the two regions between r and $(\overline{q}+t)/\gamma$, and $(\overline{q}+t)/\gamma$ and 0. This implies that the expert's profit function shows two peaks. Comparison of those two peaks yields the desired best-response function. The first part shows its peak at $p = r - t$ due to the inelasticity of demand between $r - t$ and $(\overline{q}+t)/\gamma$. The second part reaches its maximum at the interior of the region $(\overline{q}+t)/\gamma$ and $\overline{q}/\gamma - t$, or at $\overline{q}/\gamma - t$. The latter is again due to the inelasticity of demand between 0 and $\overline{q}/\gamma - t$. In sum, we have to compare the expert profits for three possible prices: $r - t$, the interior, and $\overline{q}/\gamma - t$. Comparison of these profits yields the desired best-response function (see lemma 2 in text). This proves lemma 2. □

Proof of Proposition 1: The intersection of (8) with $q = 0.5\gamma(p+t)$ yields the equilibrium prices. The non-expert's market share y_A^* follows from substituting p_A^* and q_A^* into Eq. (1). An "aggressive-pricing" equilibrium only occurs whenever $0 < y_A^* < 1$. This implies that an aggressive equilibrium only occurs for $\hat{q}(\gamma) \leq q_A^*$. Therefore, a necessary and sufficient condition for $p_A^* = \tilde{p}(q_A^*)$ to be the expert's best response is that $\hat{q}(\gamma) \leq q_A^*$. In any "aggressive-pricing" equilibrium $0 \leq y_A^* \leq 1$. Let $0 \leq \underline{\gamma}_A \leq 1$ solve $y_A^* = 1$, it follows from Eq. (14) that $\gamma \geq \underline{\gamma}_A$ in any "aggressive-pricing" equilibrium. Finally, for all $\gamma \geq \underline{\gamma}_A$ we have that γ_A^* is the unique solution to $\hat{q}(\gamma) - q_A^* = 0$. Observe that $q_A^* \geq \hat{q}(\gamma_A^*)$, $\gamma \geq \gamma_A^*$. □

Proof of Proposition 2: Suppose there is an "aggressive-pricing" equilibrium in pure strategies such that $\gamma < \gamma_A^*$, or equivalently $q_A^* < \hat{q}(\gamma)$. From Lemma 2, it follows that the expert's best response is to charge $r - t$. From Lemma 1, however, the non-expert's best reply then equals $\gamma(r-t) - t$. But $\hat{q}(\gamma) < \gamma(r-t) - t$. A contradiction.

Suppose $\gamma < \gamma_l$, then the non-expert's best response is to charge $\gamma(r-t)-t$ such that a pure strategy equilibrium results (see Proposition 3). Recall that $\gamma > \tilde{\gamma}$ follows from assumption 2. $\square$

Proof of Proposition 3: If the non-expert charges $\hat{q}(\gamma)$, we know that the expert is indifferent between charging $r-t$ or $\tilde{p}(\hat{q})$. Since his profits are exactly identical, the expert is as well indifferent by charging these two prices with any probability α and $1-\alpha$, respectively. From the non-expert's best response, the non-expert's profit is increasing in his price for all $q \leq q_1$ (see Figure 2), irrespective the price p charged by the expert. For all prices $q_1 \leq q \leq q_2$ (see Figure 2), the non-expert's profit is decreasing in its price when $p = \tilde{p}(\hat{q})$ but increasing when $p = r-t$. For all $q_2 \leq q$, the non-expert's profit is decreasing in p. Thus, for all prices $q_1 \leq q \leq q_2$, there exists a unique value α^* such that the non-expert's marginal profit equals zero. Since $q_1 \leq \hat{q}(\gamma) \leq q_2$, this also holds for $\hat{q}(\gamma)$. Uniqueness results from the non-expert's concave profit function and that the expert only wants to randomize when the non-expert charges $\hat{q}(\gamma)$. Since $\hat{q}(\gamma) \leq \gamma(r-t)-t$, it follows from Assumption 2 that all consumers first visit the non-expert when the expert charges his monopoly price. $\square$

Proof of Proposition 4: Suppose $\gamma \leq \gamma_l \equiv \sqrt{t/(r-c)}$. This implies that the best response of the non-expert is to charge $\gamma(r-t)-t$, and for the expert to charge the monopoly price $r-t$. $\square$

Proof of Proposition 5: The proportion of consumers in the "aggressive-pricing" equilibrium of Eq. (14) and in the socially efficient outcome of Eq. (16) depends on γ. For positive values of γ, the r.h.s. of these two equations are identical only when $\gamma = \gamma_W^*$. The socially right amount of consumers first visit the non-expert if and only if $y_A^* = y_W^*$, or equivalently when $\gamma = \gamma_W^*$. Of course, in any "aggressive-pricing" equilibrium $\gamma \geq \gamma_A^*$. As a result, too few consumers first visit the expert when $y_W^* < y_A^*$, that is for $\gamma_A^* \leq \gamma < \gamma_W^*$. Similarly, too many consumers first visit the expert when $y_A^* \leq y_W^*$, that is for $\max(\gamma_A^*, \gamma_W^*) \leq \gamma$. $\square$

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References

Che, Y.-K., 1996, Customer Return Policies for Experience Goods, *Journal of Industrial Economics*, 44, 17-24.

Emons, W., 1994, Credence Goods and Fraudulent Experts, Discussion paper. Bern, Switz.:Univ. Bern, Volkswirtschaftliches Inst., Abteilung für Wirtschaftstheorie.

Harsanyi, J.C., 1973, Games with Randomly Disturbed Payoffs: A New Rationale for Mixed-Strategy Equilibrium Points, *International Journal of Game Theory*, 2, 1-23.

Fudenberg, D. and J. Tirole, 1984, The Fat-cat effect, the puppy-dog ploy, and the lean and hungry look, *American Economic Review, Papers and Proceedings*, 74, 361-368.

Krishna, K., 1989, Trade Restrictions as Facilitating Practices, *Journal of International Economics*, 26, 251-270.

Krugman, P., 1989, Industrial Organization and International Trade, in Schmalensee, R. and R. Willig (eds.), *Handbook of Industrial Organization*, North Holland, Amsterdam, 1179-1223.

Lal, R. and C. Matutes, 1989, Price Competition in Multimarket Competition, *RAND Journal of Economics*, 20, No. 4, Winter, 516-537.

Meurer, M. and D.O. Stahl, II, 1994, Informative Advertising and Product Match, *International Journal of Industrial Organization*, 12, No. 1, 1-20.

Nelson, P., 1970, Information and Consumer Behavior, *Journal of Political Economy*, 78, 311-329.

OECD, 1994, *The Reform of Health Care Systems: A Review of Seventeen OECD Countries*, OECD.

O'Hara, M, 1995, *Market Microstructure Theory* (Blackwell, Oxford).

Pagano, M and A. Röell, 1992, Auction and Dealership Markets: What Is the Difference?, *European Economic Review*, 36, 613-623.

Taylor, C. R., 1995, The Economics of Breakdowns, Checkups, and Cures, *Journal of Political Economy*, 103, No. 1, 53-74.

Tirole, J., 1988, *The Theory of Industrial Organization*, MIT Press.

Wolinsky, A., 1993, Competition in a Market for Informed Experts' Services, *RAND Journal of Economics*, 24, No. 3, 380-398.

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