forthcoming in *Journal of Institutional and Theoretical Economics*

Product Differentiation and Price Competition between a Safe and a Risky Seller

by

WINAND EMONS*

University of Bern and CEPR

revised May 2000

Abstract

A safe and a risky seller serve a market. While the expensive safe seller can solve the problems of all consumers, the cheap risky seller can help a consumer only with a certain probability. The risky seller's success probabilities are distributed across consumers; by the choice of her quality the risky seller determines the shape of this distribution. If the risky seller fails, a consumer ends up with the safe seller, paying for the service twice. The risky seller chooses a quality-price pair inducing the safe seller to stick to his monopoly strategy. Some but not maximum differentiation results. (JEL: D 43, L 13, L 15)

*I thank Jan Bouckaert, Fridolin Marty, Mark de Snaijer, Martin Schellhorn, Gabrielle Wanzenried, Martin Werner, and two referees for helpful comments, as well as UC Berkeley Law School for its hospitality. Financial support from the Schweizerischer Nationalfonds is gratefully acknowledged.

1 Introduction

In quite a few markets consumers have a pretty good idea about what kind of product or service they need. The consumer's problem is to find a seller who offers a successful match. Often these markets are characterized by the coexistence of a variety of sellers with different chances of serving the consumer's needs: there are cheap sellers where chances of being successfully served are rather low; there are expensive sellers offering a high probability of getting the consumer's problem solved.

A divorce, for example, can be handled by a mediator or a lawyer. A mediator, if successful, conducts the divorce at a low price. A lawyer is more expensive but, in turn, chances that he can actually handle the divorce are high. The mediator is a risky cheap substitute for the safe expensive lawyer. Similarly, a disease may be treated by a general practitioner or a specialist. Again, the generalist is cheaper and has lower success probability than the specialist. A company can try to do business with a cheap local bank or it can choose an expensive multinational bank offering the whole range of financial services. A backyard as well as a certified dealer garage may both solve a car problem, the first being cheaper and more risky than the second. A consumer can try to fix a leaking faucet himself using parts from the hardware store or he can call a plumber. All these examples have in common that a successful service is valued the same by the consumer, regardless of whether it was provided by the safe or the risky seller. Sellers differ, however, in the probability that they can solve the consumer's problem.

Given such a variety of choices, consumers face the following basic trade-off: Should they go right away to the expensive safe seller where they get their problems solved for sure, or should they first try the cheap risky seller. If she is successful, the consumer saves a lot of money in comparison to the safe seller. But if she cannot solve the problem, the unlucky consumer finally ends up with the safe seller. The consumer's attempt to save some money turns out to be more expensive than if he had visited the safe seller in the first place.

In this paper we analyze a market characterized by these features. We describe the price-quality competition between a safe and a risky seller. In particular we are interested in the degree of vertical product differentiation that will prevail in equilibrium, more specifically in the trade-off between the degree of product differentiation and the degree of price competition. Lowering quality has the strategic effect of softening price competition, forcing firms apart; yet, at the same time lower quality has the direct effect of lower demand, driving the lower price firm to choose a higher quality (forcing firms together). Will in this model the principle of maximal product differentiation hold, which states that firms position their products in product space as far apart as possible in order to relax price competition (Shaked and Sutton [1982])?[1] In other words, will as in Shaked and Sutton [1982] the strategic effect dominate the direct effect, or will we observe some but not maximal product differentiation?

To answer this question, we consider the following set-up. A safe seller can solve the problems of all consumers. The risky provider's characteristics, in contrast, are buyer-specific. Each consumer has a certain probability of being successfully served by the risky provider. These success probabilities are continuously distributed in the market. By the choice of her quality the risky provider determines the shape of this distribution: a higher quality level means that more consumers have high success probabilities with the risky provider.

The success probabilities of both sellers are common knowledge. Each consumer compares visiting the safe seller with visiting the risky seller, anticipating the risk of buying an unsuccessful service. If this happens, the consumer finally ends up with the safe seller and pays for the service twice. Obviously, for a consumer having a low success probability the risky seller is a poorer substitute for the safe seller than for a consumer with a high success probability. This setup with buyer-specific success probabilities for the risky seller generates a system of continuous demand functions for both providers.

In a next step we analyze price-quality competition within this framework. Here we model the situation in which the safe seller is already in the market and committed to his quality. The risky seller enters and strategi-

[1]See also Gabszewicz and Thisse [1979, 1980]. For the case of horizontal product differentiation d'Aspremont, Gabszewicz and Thisse [1979] show that with quadratic transportation cost firms want to maximize product differentiation in order to relax price competition. If the product space is multidimensional, firms maximize product differentiation in the dominant characteristic and minimize differentiation in the other dimensions (Neven and Thisse [1990], Tabuchi [1994], Irmen and Thisse [1998]).

cally picks her quality and her price. The safe seller then reacts to these new circumstances by adjusting his price.

We consider this setup for the following reasons. We want to model markets which have been regulated and are now opened for competition, such as telecommunications, electricity, or health care. Moreover, this sequencing of events is appropriate for markets where new technologies have been developed offering a cheap yet less reliable alternative to the existing process, such as Internet phone calls, Personal Communication Services (cheap mobile phones using digital technology), and steel minimills. Finally, our setup describes markets where for some reason a dealer must have repair facilities being able to cope with all problems quickly whereas specialized repair shops can follow a cream-skimming policy. This is often the case for vehicles, computers, and household appliances.

Formally, we consider the following Stackelberg-type game. In the first stage, the risky seller chooses her quality and her price. Upon having observed these choices, the safe seller then picks his price.[2] To focus on the interdependencies generated by the demand side, we first ignore all costs; our sellers seek to maximize revenues. In a second step we then show that our qualitative results concerning the degree of product differentiation also hold for positive cost.

We first analyze the safe seller's stage two revenue when the risky seller's quality and price are given. It turns out that the safe seller's revenue is strictly convex so that he either charges the consumers' reservation price or the same price as the risky seller. If he charges the reservation price, he attracts the customers for whom the risky seller is a poor alternative plus those consumers who tried the risky seller but were unlucky. If he matches the risky seller's price, he has the whole market because he has the superior technology.

We then turn to the risky seller's stage one problem. The risky seller will never choose a price-quality combination that leads the safe seller to match her price: the risky seller then has no customers. Accordingly, the risky seller tries to find the revenue maximizing price-quality combination such that the safe seller goes for the reservation price. To put it differently: the risky seller

[2]We use the Stackelberg framework to avoid mixed strategy price equilibria which would occur if the two sellers choose their prices simultaneously.

has to find the best price-quality combination that doesn't trigger a 'price war'.

Now the trade-off between product differentiation and price competition shows up neatly. The further away the risky seller's quality from the safe seller's quality, the higher is the price the risky seller can charge. Nevertheless, the maximum product differentiation principle does not hold in our model. An increase in quality together with a decrease in price increases the risky seller's demand and this direct quantity effect on revenue is greater than the strategic effect of the price change. The risky seller will thus choose a rather high quality together with a rather low price; she does not choose high product differentiation to relax price competition. This result has the following interesting implication for a government contemplating to open a regulated market such as telecommunications or health care to competition: The risky seller does not enter the market with the minimum quality at a high price. Rather she chooses a high quality at a low price to have higher demand.

The papers closest to ours are Glazer and McGuire [1996], Bouckaert and Degryse [1998], and Krishna and Winston [1998]. Glazer and McGuire's basic setup is more or less the same as ours. The major difference is that in their model consumers do not know their success probability with the risky provider. By diagnosing the consumer, the risky seller learns this probability and then decides whether to treat the consumer herself or whether to refer him to the safe seller. Glazer and McGuire analyze whether in equilibrium there will be socially optimal referral by the risky provider. Their paper thus focuses on the informational problem created by informed experts.[3]

Bouckaert and Degryse consider a safe and risky seller located at the extreme points of a linear market. Consumers are located uniformly along this market and have a linear transportation cost. While the safe seller solves all consumers' problems for sure, the risky seller merely does so with probability less than one. This probability is exogenously given and the same for all consumers. Consumers face the same basic trade-off as in our model, meaning to visit the risky seller can become very expensive. Bouckaert and

[3]Other papers in this area include Wolinsky [1993, 1995], Taylor [1995], and Emons [1997, 2000].

Degryse analyze price competition between the two sellers.

Horizontal differentiation is generated in their model by transportation costs.[4] There are three differences to our setup. First, all of the risky provider's failures visit the expert in our model. In contrast, in the transportation cost model whether or not a failure visits the expert depends on where the consumer is located. Second, if the safe seller lowers his price in the transportation cost model, he attracts the marginal customer that he would have otherwise served with the risky seller's failure probability. This probability is independent of who the marginal customer is, thus generating a linear demand for the safe seller. If the failure probabilities are buyer-specific as in our model, it is more attractive for the safe seller to attract customers who have a low failure probability with the risky seller than customers with high failure probability: they are very likely to show up anyway. Demand is thus non-linear. Third, while Bouckaert and Degryse take the risky seller's quality as exogenously given, we determine her quality level endogenously.

In Krishna and Winston each of two firms first chooses its quality which is, as in our model, the probability that it solves the consumers' problem. Then firms simultaneously choose prices. In equilibrium one firm chooses a high quality level while the other firm picks a low one; product differentiation is not maximal. The equilibrium of the price game is in mixed strategies. The high quality product is more profitable than the low quality one. Moreover, Krishna and Winston show that the spirit of their results remains when there are more than two firms.

In Krishna and Winston consumers are identical. This means that either all or no consumers try the low quality seller which, in turn, implies that the high quality firm has either the low quality seller's residual demand or the whole market. Demand in this identical consumers world is thus discontinuous. Such drastic demand behavior generates some strange effects as we explain in section 5. In our model the risky seller's success probability is buyer-specific and distributed in the market. This feature generates smooth demand functions for both sellers so that our results are not driven by drastic

[4]The difference between our and Bouckaert and Degryse's model may be explained by means of the medical doctor example: In our model the general practitioner's chances of being successful are high for young and low for old folks. In Bouckaert and Degryse the general practitioner's chances are the same for both age groups; yet young people happen to live closer to the general practitioner than old folks.

demand behavior.

The remainder of the paper is organized as follows. In the next section we describe the basic model. In section 3 and 4 we analyze the safe and the risky seller's problems and derive the equilibrium. In the subsequent section we discuss our results. Section 6 concludes.

2 The Model

Consider a market with a continuum of consumers, each wishing to receive a certain service. The service can be supplied by two providers: a safe provider and a risky provider. The distinction between the two types of sellers is not in the kind of service they provide, but only in the probability that they will serve the consumer successfully. If the service is carried out successfully, each consumer values it the same, regardless of whether it was provided by the safe or the risky seller. Denote this valuation for a successful service by v. This willingness to pay is the same for all consumers.

The service of the safe provider – the expert – is the same for all consumers. We normalize the probability that the safe provider is successful to one for all consumers. The safe provider thus represents the 'state of the art'.

The service of the risky provider differs from the safe provider's service. Each consumer has some probability $\lambda \in [0,1]$ of being successfully served by the risky provider. If the risky provider has tried once and failed, the consumer's problem cannot be solved by the risky provider. This particular consumer and the risky seller's service are incompatible. It is thus useless that the risky provider gives it another try; all the consumer can do in this case is to visit the safe provider.

The risky provider chooses her quality q. This parameter q determines the distribution of λ. Increasing q means that mass is shifted from the low to the high success probabilities: more consumers have good chances with the risky seller. Formally, we model this effect by assuming the density function of λ conditional on q as

$$f(\lambda|q) = 2 - q - (2 - 2q)\lambda; \qquad \lambda \in [0,1]\,,\ q \in [1,2]\,.$$

The effect of q on the density f can be seen in Figure 1.[5]

- insert Figure 1 about here -

Let $F(\lambda|q)$ be the distribution of $f(\lambda|q)$. Since $F(\lambda|q_1) < F(\lambda|q_2)\ \forall\lambda \in (0,1)$, $\forall q_1, q_2$ with $q_1 > q_2$, the distribution $F(\lambda|q_1)$ first-order stochastically dominates $F(\lambda|q_2)$; see Rothschild and Stiglitz [1970]. For the average success probabilities we compute $E(\lambda|q) = 1/3 + q/6$ so that, e.g., $E(\lambda|1) = 1/2$ and $E(\lambda|2) = 2/3$. Accordingly, within this modelling framework $q = 1$ means maximal differentiation and $q = 2$ minimal differentiation between the two sellers. The safe provider's quality is the same for all consumers, whereas the risky provider's quality is buyer-specific. For some buyers (λ close to 1) the risky seller is a close substitute for the safe seller, while for others (λ close to 0) the risky provider is out of question.

We consider the following two stage game. In the first stage the risky provider picks q and her price p_r. In the second stage the safe provider, upon having observed the risky provider's choices, picks his price p_s. Marginal production costs are zero for both sellers. The safe provider thus maximizes revenue. The risky provider incurs a setup cost for the quality q of $C(q)$ with $C' \geq 0$ and $C'(1) = 0$. The risky provider maximizes revenue minus these setup costs. We derive first the subgame perfect equilibrium for the case where setup costs are zero. Then we show that our result on product differentiation also holds for positive setup costs.

3 The Safe Provider

We solve the game by backwards induction. Before doing so we need two more technical assumptions: a consumer who is indifferent whether or not to see a seller, visits a provider; a consumer who gets no service, be it that he

[5] We do not consider $q \in [0,1)$ for the following reason. For any $q \in [0,1]$, the save seller charges the reservation price v. Obviously, for the risky seller $q = 1$ dominates the other quality levels out of this interval. If we take $q \in [0,2]$, this observation implies already that the risky seller will not choose maximum differentiation, i.e., the optimal $q > 0$. See also section 5.

didn't consult a seller or that the risky provider failed, ends up with a utility of zero.[6]

Let us start with the safe provider's demand $D_s(p_s, p_r, q)$ in stage two when q and p_r are given. First note, if the safe provider charges $p_s > v$, his demand is zero because his price is above the consumers' willingness to pay. Next, as a point of reference, consider the case where the safe provider has a monopoly. He faces an inelastic demand up to the reservation price v. Accordingly, as monopolist he charges the monopoly price $p_s^M = v$, serves the whole market, and appropriates the entire surplus.

Let us now return to the duopoly case. If he charges $p_s \leq p_r \leq v$, he has the whole market because he is cheaper than the risky provider and offers the better service.

Finally, if $0 \leq p_r < p_s \leq v$, the two sellers split the market. In this situation consumers face the following trade-off. Either they go to the safe provider right away. There they pay the high price but, in return, get their problem solved for sure. Or they try the cheap, risky provider. If she solves the problem, the consumer is happy because he saved money compared to having visited the save provider; consumers value a successful service the same regardless of the type of seller. If, however, the risky provider cannot solve the problem, the consumer has paid p_r for nothing.[7] He reenters the market and goes to the safe provider who offers a surplus of $v - p_s$ after all. In this case the consumer is worse off than if he had visited the safe provider in the first place. Obviously, for consumers with low λ the safe provider is more attractive compared to the risky provider than for consumers with high λ.

Formally, consumers prefer the safe provider if

$$0 \leq \lambda(v - p_r) + (1 - \lambda)(v - p_r - p_s) \leq v - p_s \quad \textit{or} \quad \lambda \leq p_r/p_s \leq 1.$$

Accordingly, consumers with $\lambda \in [0, p_r/p_s]$ directly go to the safe seller while consumers with $\lambda \in (p_r/p_s, 1]$ first give it a shot with the risky provider.

[6] His payoff is his utility minus the price he paid so that in case of failure of the risky seller the consumer will end up with a negative payoff.

[7] We assume that the consumers' satisfaction is not verifiable. 'Satisfaction guaranteed' warranties are thus not feasible. Moreover, the safe provider cannot discriminate between failures and non-failures.

Those whom the risky provider could not help also end up with the safe provider. Thus, for $0 \leq p_r < p_s$ the safe provider's demand is

$$
\begin{aligned}
D_s(p_s, p_r, q) &= \int_0^{p_r/p_s} f(\lambda|q)d\lambda + \int_{p_r/p_s}^1 (1-\lambda)f(\lambda|q)d\lambda = \\
& 2/3 - q/6 + (p_r^2/p_s^2)[1 - q/2 + (2p_r/3p_s)(q-1)].
\end{aligned}
$$

Summed up, the safe provider's demand is given as

$$
D_s(p_s, p_r, q) = \begin{cases} 1, & \text{if } p_s \leq p_r \leq v; \\ 2/3 - q/6 + (p_r^2/p_s^2)[1 - q/2 + (2p_r/3p_s)(q-1)], & \text{if } p_r < p_s \leq v; \\ 0, & \text{if } p_s > v. \end{cases}
$$

Next consider the safe provider's revenue $R_s(p_s, p_r, q) := p_s D_s(p_s, p_r, q)$. This function has the following properties. It is continuous in p_s on $[0, v]$, monotonically increasing on $[0, p_r]$, $p_r \leq v$, strictly convex on $[p_r, v]$, and zero for $p_s > v$. Revenue maximizing choices are thus either $p_s^* = p_r$ or $p_s^* = v$. If the safe supplier matches the risky supplier's price, he has the whole market and $R_s(p_s^* = p_r, p_r, q) = p_r$. If he charges the monopoly price $p_s^* = v$, he goes for the low λ's plus the residual demand and

$$
R_s(p_s^* = v, p_r, q) = v\,[2/3 - q/6] + (p_r^2/v)\,[1 - q/2] + (2p_r^3/3v^2)\,[q-1]\,.
$$

We have $R_s(p_s^* = v) \geq R_s(p_s^* = p_r)$ for $p_r \in [0, \bar{p}_r]$ and vice versa for $p_r \in (\bar{p}_r, v]$ where

$$
\bar{p}_r(q) = \frac{-v(2+q) + \sqrt{-60v^2 + 84v^2q - 15v^2q^2}}{8(q-1)}.
$$

The safe provider's reaction function $p_s(p_r, q)$ is thus as given in Figure 2.

- insert Figure 2 about here -

If the risky provider charges a low price, matching this price means low profits for the safe provider. He is better off with the monopoly price serving the low λ's plus the residual demand at the reservation price. In contrast, if the risky seller's price is high, matching this price means that profits per consumer are high. Having the whole market at this price is more attractive than serving the residual demand at the monopoly price. Note that $\bar{p}_r(q)$ is decreasing in q; see Figure 3. If the risky seller wants to increase quality and keep the safe seller indifferent, she has to lower her price. Increasing q implies that the risky provider increases her demand at the expense of the safe provider as long as he continues to charge v. Throwing the risky provider out of the market by matching her price thus becomes the better alternative for the safe seller.

4 The Risky Provider

Let us start with the risky provider's demand. It follows immediately from the previous section that her demand $D_r(p_r, p_s, q)$ is zero whenever she is more expensive than the safe provider or when her price exceeds the consumer's willingness to pay v. For $0 \leq p_r < p_s \leq v$ consumers prefer the risky to the safe provider if

$$0 \leq v - p_s < \lambda(v - p_r) + (1 - \lambda)(v - p_r - p_s) \quad or \quad p_r/p_s < \lambda \leq 1.$$

Accordingly, for $0 \leq p_r < p_s \leq v$ the risky provider's demand is

$$D_r(p_r, p_s, q) = \int_{p_r/p_s}^{1} f(\lambda|q)d\lambda = 1 - (p_r/p_s)[2 - q + (p_r/p_s)(q - 1)].$$

Finally, for $0 \leq p_r \leq v < p_s$ the risky provider has a monopoly. Consumers buy from the risky provider if

$$\lambda(v - p_r) + (1 - \lambda)(-p_r) \geq 0 \quad or \quad p_r/v \leq \lambda.$$

Demand is thus

$$D_r(p_r, p_s, q) = \int_{p_r/v}^{1} f(\lambda|q)d\lambda = 1 - (p_r/v)[2 - q + (p_r/v)(q - 1)].$$

The case of a monopoly for the risky provider is of particular importance because it is formally equivalent to the duopoly scenario in which the safe provider charges his monopoly price $p_s^M = v$. In both cases the risky provider competes against the consumers' outside option of zero: if the risky seller is alone in the market, the consumers' outside option is not going to the risky seller which means zero payoff; in the duopoly case a consumer treated by the safe provider pays his reservation price so that he also ends up with zero utils.

Let $R_r(p_r, p_s, q) := p_r D_r(p_r, p_s, q)$ denote the risky provider's revenue. Since the demand function $D_r(\cdot)$ is concave in p_r on $[0, \min[p_s, v]]$, so is the revenue function. Over this range the risky seller's revenue is given as

$$R_r(p_r, p_s, q) = p_r((p_s - p_r)/p_s)[(p_s - p_r)/p_s + (1 - (p_s - p_r)/p_s)q].$$

As a useful point of reference let us first determine the risky seller's optimal choice of p_r given q and p_s. Solving the first-order condition yields

$$p_r(p_s, q) = \frac{p_s(q - 2 + \sqrt{1 - q + q^2})}{3(q - 1)}.$$

Now consider the case where the risky seller has a monopoly. Since the risky seller has de facto a monopoly whenever $p_s \geq v$, we will identify this case with $p_s = v$. Since revenue is linear in q, the risky monopolist picks $q^M = 2$ and, accordingly, $p_r(v, 2) = v/\sqrt{3}$.

- insert Figure 3 about here -

Let us return to our duopoly game which we can now solve rather easily. Consider Figure 3 where we have plotted all the information we have gathered so far in (p_r, q) - space. Consider first the function $\bar{p}_r(q)$ along which the safe provider is indifferent between charging his monopoly price $p_s^M = v$ and matching the risky provider's price. In order not to work on open sets, assume that the safe provider goes for the monopoly price v for all price-quality combinations on $\bar{p}_r(q)$. Accordingly, for all price-quality combinations below $\bar{p}_r(q)$ (region I) the safe provider charges the monopoly price, whereas for all price-quality combinations above $\bar{p}_r(q)$ (region II) he matches the risky provider's price.

What does this discontinuous stage 2 behavior of the safe seller imply for the risky seller in stage 1? If she chooses a price-quality combination in region II, the safe seller will match her price and, given that he has the better technology, he will attract all customers. The risky seller thus ends up with zero demand and zero revenue in region II and she can certainly do better by offering a price-quality combination in region I. The risky seller's problem, therefore, boils down to find the revenue maximizing combination (p_r, q) in region I.

Rather than deriving this solution explicitly, we will discuss its qualitative properties by means of Figure 3. There we have depicted the function $p_r(v, q)$ which gives us the risky seller's monopoly price for a given q. Straightforward computations confirm that the functions $\bar{p}_r(q)$ and $p_r(v, q)$ have a unique intersection $(\widehat{p}_r, \widehat{q})$ with $\widehat{q} \in (1, 2)$. Since the risky seller's revenue is increasing in q along $p_r(v, q)$, we can deduce already that $(\widehat{p}_r, \widehat{q})$ is the best choice for the risky seller on the intersection of $p_r(v, q)$ within region I. Put differently, if we restrict the risky seller to price-quality combinations on $p_r(v, q)$, she will pick $(\widehat{p}_r, \widehat{q})$: She will definitely not go for maximal product differentiation, i.e., $\widehat{q} > 1$.

The last question we want to ask is whether the risky seller wants to decrease or increase product differentiation relative to $\widehat{q}$ when she is free to choose any price-quality combination out of region I. Here the answer is that the risky seller increases her revenue if she raises q and at the same time lowers p_r, meaning that she will decrease product differentiation.

In $(\widehat{p}_r, \widehat{q})$ revenue is maximized with respect to p_r given $\widehat{q}$. This means by the envelope theorem that the first-order effect of a price reduction is zero. Increasing q, however, raises revenue so that a movement up the curve $\bar{p}_r(q)$ increases the risky seller's revenue. Graphically, the iso-revenue curve R_r^1 passes through $(\widehat{p}_r, \widehat{q})$ with zero slope. Thus, there exist higher iso-revenue curves in the lens formed by R_r^1 and $\bar{p}_r(q)$. The risky seller will pick a price-quality combination (p_r^*, q^*) which is to the north-west of $(\widehat{p}_r, \widehat{q})$. Consequently, the risky seller will not opt for maximal product differentiation.

To sum up our results:

Proposition 1: In the unique subgame perfect equilibrium of our two stage game with $C(q) = 0$, in the first stage the risky seller chooses $q^* > \widehat{q} > 1$ and $p_r^* = \bar{p}_r(q^*)$. In the second stage the safe seller picks the monopoly price $p_s^M = v$.

We have shown that the risky seller's equilibrium revenue is increasing over the range of $q \in [1, q^*]$. Accordingly, we may immediately deduce that if the setup cost is not too high so that the risky seller wants to be in the business, she will also not opt for maximum product differentiation.

Proposition 2: Let $C(q) < R_r(q, \bar{p}_r(q))$ for some $q \in [1, 2]$. Then the optimal $q^* > 1$.

Proof: The assumption $C(q) < R_r(q, \bar{p}_r(q))$ for some $q \in [1, 2]$ implies that the stage two revenue exceeds the setup costs for some $q \in [1, 2]$. Since $R_r(q, \bar{p}_r(q))$ is increasing in q for $q \in [1, q^*]$ and $C'(1) = 0$, the result follows. *Q.E.D.*

5 Discussion

Let us first explain why we have chosen a model in which the risky provider's quality is buyer-specific. Suppose we had instead chosen the simpler setup where the risky provider picks Q which is the probability of being successful with all consumers.[8] Then either all or no consumers try the risky seller. The safe seller, in turn, has either the whole market of 1 or he gets the residual demand $(1-Q)$. Accordingly, both providers' demand functions are discontinuous in their own prices. In contrast, in our setup both demand functions are continuous in their own price for prices not exceeding v: any small price change leads to a small change in demand. Our results are thus not driven by drastic demand behavior.

The simple setup has another unpleasant feature. Given (p_r, Q), the safe seller either charges v and gets the residual demand $(1 - Q)$ or he undercuts with p_r/Q and gets the whole market. Charging the monopoly price v is better than undercutting if $p_r \leq Q(1 - Q)v$, which also defines a 'region I' in (p_r, Q) - space. Here we have, however, the strange phenomenon that for $Q < 1/2$ the risky seller can actually increase p_r together with Q and keep the safe seller indifferent between his two actions. Increasing Q, ceteris

[8]This is the modelling of KRISHNA AND WINSTON [1998].

paribus, lowers p_r/Q and $(1-Q)v$. For $Q < 1/2$ the first effect dominates the second.[9]

In our setup the first effect is absent. Even for very low q there are always some customers for whom the risky provider is very attractive. To get the whole market, the safe seller has to charge the same price as the risky seller independently of q. Accordingly, if the risky seller wants to increase q and keep the safe seller indifferent, she has to lower p_r. Note that for $q \in [0,1]$ the safe seller will always charge v. Thus, even for values of q which we didn't explicitly consider in the paper, $\bar{p}_r(q)$ is never increasing. This last observation explains why we didn't consider values of $q \in [0,1)$; they are dominated for the risky seller by $q = 1$.

The risky seller's equilibrium strategy is reminiscent of the *judo economics* strategy of Gelman and Salop [1983]: enter the market with the "profile" which is just low enough to insure that the installed firm will accommodate. In Gelman and Salop, a small capacity does the job, here it is a limited quality (combined in both cases with an adequate pricing).

Let us conclude this section by a discussion of the welfare properties of our equilibrium. Obviously, welfare is maximized if the safe seller alone serves the market. The problems of all consumers are solved so that the maximum welfare of v is realized. The monopolist appropriates the entire surplus. Our equilibrium is inefficient. Again, all consumers have their problem solved but the risky seller incurs the setup costs so that welfare amounts $v - C(q^*)$. Of this surplus a positive share goes to all of our three actors, the safe, the risky provider, and consumers as a whole. Consequently, consumers do better under the inefficient duopoly than under the efficient monopoly of the safe provider. Entry by the risky provider thus redistributes surplus from the safe seller to consumers.[10]

---

[9] Note that this implies that in the simple model the rsiky seller will choose $Q \geq 1/2$, i.e., she will also not go for maximal product differentiation.

[10] Note that the safe seller also disciplines the risky provider's decisions: to make the safe seller pick the reservation price (region I), the risky provider must reduce price and increase product differentiation.

6 Conclusions

The purpose of this paper is to study the price and quality choices of a risky provider who enters a market which was dominated by a safe provider. We are particularly interested in the quality level the risky provider chooses when entering the market. A quality level close to the safe provider's quality means unbridled price competition which the risky seller can relax by moving her quality further away from the safe seller's. Price competition is minimized by maximal product differentiation. Nevertheless, in our model the risky seller does not go for maximal product differentiation. She prefers a higher quality level even though this means a lower price.

This result has the following interesting implication for a government contemplating to open a regulated market such as telecommunications or health care to competition: The risky seller does not enter the market with the lowest quality at a high price. Rather she chooses a high quality at a low price to have higher demand. Thus, if the government wants to redistribute surplus from the safe seller to consumers, opening the market for the risky seller is a pretty good means to achieve just this.

References

BOUCKAERT, J. AND H. DEGRYSE [1998], "Price Competition between an Expert and a Non-Expert," *International Journal of Industrial Organization,* forthcoming.

D'ASPREMONT, J. GABSZEWICZ, AND J.-F. THISSE, [1979], "On Hotelling's Stability in Competition," *Econometrica* 47, 1145-1150.

EMONS, W. [1997], "Credence Goods and Fraudulent Experts," *Rand Journal of Economics* 28 , 107-119.

EMONS, W. [2000], "Credence Goods Monopolists," *International Journal of Industrial Organization,* forthcoming.

GABSZEWICZ J. AND J.-F. THISSE, [1979], "Price Competition, Quality and Income Disparities," *Journal of Economic Theory* 20, 340-359.

GABSZEWICZ J. AND J.-F. THISSE, [1980], "Entry (and Exit) in a Differentiated Industry," *Journal of Economic Theory* 22, 327-338.

GELMAN J. AND S. SALOP, [1983], "Judo Economics: Capacity Limitation and Coupon Competition," *Bell Journal of Economics* 14, 315-325.

GLAZER, J. AND T. MCGUIRE [1996], "Price Contracts and Referrals in Markets for Services," Discussion Paper, Department of Economics, Boston University.

IRMEN, A. AND J.-F. THISSE, [1998], "Competition in Multi-characteristics Spaces: Hotelling was almost right," *Journal of Economic Theory* 78, 76-102.

KRISHNA, K. AND T. WINSTON [1998], "If at First You Don't Succeed...: Profits, Prices and Market Structure in a Model of Quality with Unknowable Consumer Heterogeneity," Discussion Paper, Department of Economics, Pennsylvania State University.

NEVEN, D. AND J.-F. THISSE [1990], "On Quality and Variety Competition," pp. 175-199, in: J. Gabszewicz, J.-F. Richard, and L. Wolsey (eds.), *Economic decision-making: Games, econometrics and optimization: Contributions in honor of Jacques H. Dreze*, North-Holland: Amsterdam-Oxford-Tokyo.

SHAKED, A. AND J. SUTTON [1982], "Relaxing Price Competition Through Product Differentiation," *Review of Economic Studies* 49, 3-13.

ROTHSCHILD, M. AND J. STIGLITZ [1970], "Increasing Risk I: A definition," *Journal of Economic Theory* 2, 225-243.

Tabuchi, T. [1994], "Two-stage two Dimensional Spatial Competition between two Firms," *Regional Science & Urban Economics* 24, 207-227.
Taylor, C. [1995], "The Economics of Breakdowns, Checkups, and Cures," *Journal of Political Economy* 103, 53-74.
Wolinsky, A. [1993], "Competition in a Market for Informed Expert Services," *Rand Journal of Economics* 24, 380-398.
Wolinsky, A. [1995], "Competition in Markets for Credence Goods", *Journal of Institutional and Theoretical Economics* 151, 117-131.

Winand Emons
Volkswirtschaftliches Institut
Abteilung Wirtschaftstheorie
Universität Bern
Gesellschaftsstrasse 49
CH-3012 Bern
Switzerland
winand.emons@vwi.unibe.ch, www-vwi.unibe.ch/theory/emons03.htm.

Figure 1

The density $f(\lambda \mid q)$

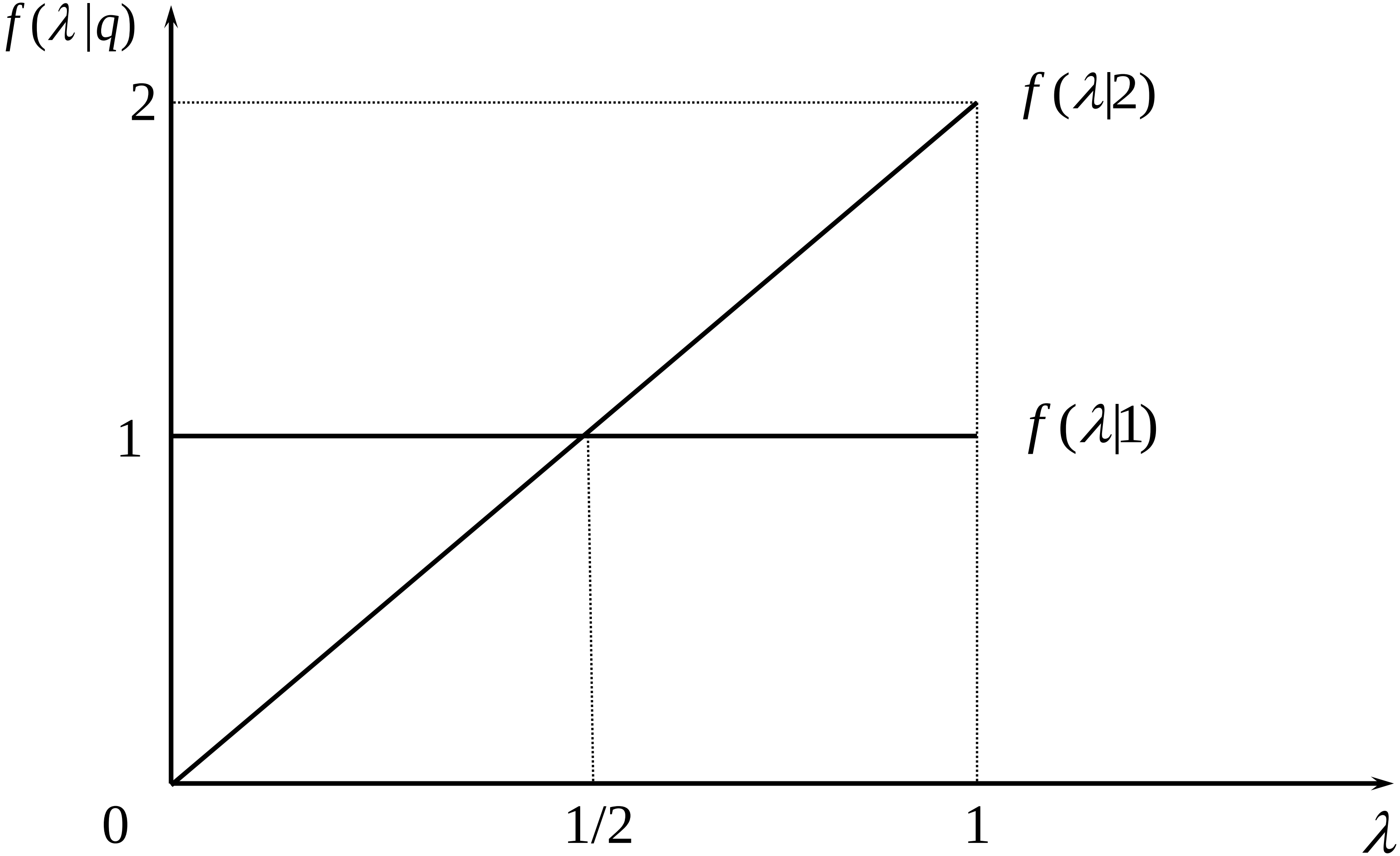

Figure 2
The safe provider's reaction function

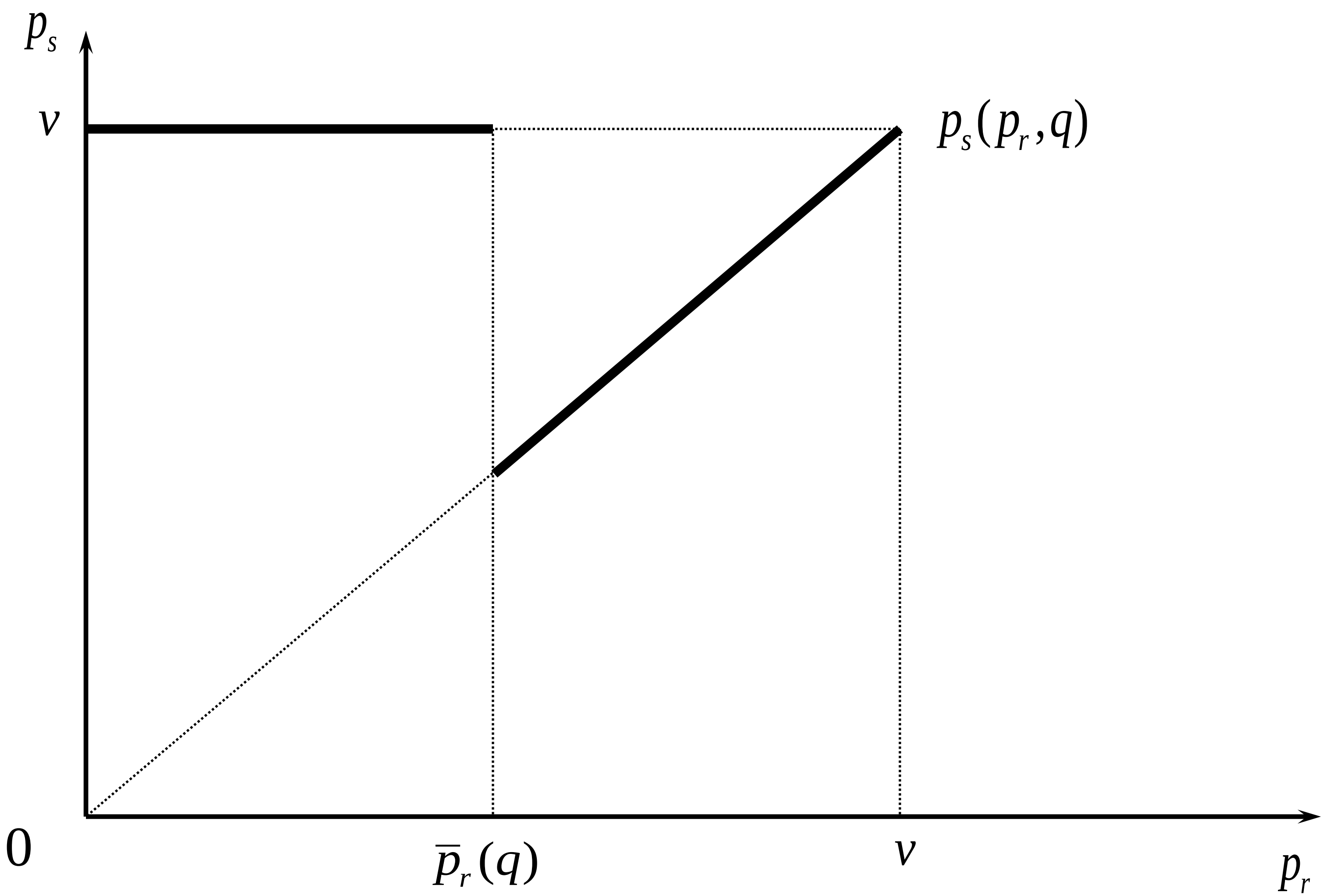

Figure 3
The equilibrium levels of price and quality