INTERMEDIATION CAN REPLACE CERTIFICATION*

Paolo G. Garella and Martin Peitz**

_____

** Paolo G. Garella: University of Bologna, Martin Peitz: University of Alicante.

INTERMEDIATION CAN REPLACE CERTIFICATION

Paolo G. Garella and Martin Peitz

A B S T R A C T

We consider a market in which producers and an intermediary have perfect information about the qualities of the goods. Consumers do not observe the qualities. Producers can perfectly reveal that a good is of high quality through certification. This entails socially wasteful costs. Firms can choose whether to sell through an intermediary jointly or exclusively or to sell independently (vertical integration). We show that multi-brand retailing, which leads to a redistribution of profits but not to social costs, can fully or partially replace certification by signaling product quality.

Keywords: Intermediation; Retailing; Quality Certification; Signaling; Vertical Relations; Moral Hazard.

1. INTRODUCTION

For most goods that are not purchased frequently, consumers or users are offered a choice among many different brands without perfect knowledge of the quality differences that distinguish them. They must then make guesses about qualities. The literature to date has stressed the role of costly signaling by firms as a way of conveying information to consumers (e.g. Nelson, 1974, Kihlstrom and Riordan, 1984, and Milgrom and Roberts, 1986). Another possibility is costly quality certification. Yet another, which has been little explored, is the mode selected for selling the good. In this paper we show that the firm's decision to share a selling establishment together with other brands is a way to signal the high quality of its brand.

In the goods markets, when manufacturer and retailer are not vertically integrated, retailers, stores, and dealers function as independent intermediaries between producers and consumers. In the sequel the word "intermediary" is used to refer generically to any agent who sells or provides shelf space for goods that he has not produced.[1] The signaling role of shared intermediation is shown to exist in a world in which there are no reputation effects or intermediary expertise. In these circumstances, sharing an intermediary with other producers is a pure signal of product quality.

Under perfect information firms may benefit or be hurt by sharing an intermediary, depending on such factors as who takes the pricing decision, and how.[2] While one may speculate that in some cases a change in the pricing process explains why firms sell through intermediaries, this is not the point we wish to analyze (to simplify, we shall assume throughout that the same prices prevail, with or without intermediation). We also exclude the possibility that an intermediary may have a cost or demand advantage in selling to consumers (economies

---

[1]This definition does not preclude a firm selling its own products provided it also sells goods produced by other firms

[2]Bonanno and Vickers (1988) show that one reason for establishing exclusive dealers instead of selling directly is that this softens price competition, but this effect might be lost with shared intermediation (see Lin, 1990). Mathewson and Winter (1987) show that exclusivity clauses may be imposed by producers of highly demanded products. Besanko and Perry (1993) view exclusive dealing as a means of avoiding the free-riding of competitors on investments in the retailer (see also Marvel, 1982). As they showed, such investment may intensify the competition between firms and thus generate an incentive to avoid exclusive dealing. Bernheim and Whinston (1998) provide a framework which explains some general principals of the effects of exclusive dealing clauses in contracting. See also Martimort (1996).

of scope or complementarieties): firms operate in a market in which, with perfect information, vertical integration is the most profitable channel of distribution, so that in this case no independent retailing sector exists.

Under imperfect information about products' qualities, shared intermediation, as the literature recognizes (e.g. Ornstein, 1989), opens the door to free-riding of low-quality firms on the brand image of high-quality producers. This suggests that the voluntary decision to share an intermediary can be interpreted as a signal that no such misrepresentation is occurring and accordingly that intermediation has the possible function of economizing the cost of information transmission.

To address this issue we use a duopoly model with moral hazard (or adverse selection) where a high quality firm can convince consumers of its high quality at a cost—the firm's certification action. Then we show that firms prefer shared intermediation as a signal rather than certifying as this avoids certification costs.

Our review of the literature found no theoretical explanation of intermediation in the goods markets that resembles our own (for a survey see Spulber, 1996), although asymmetric information has played an important role in explaining intermediation (e.g. Marvel and McCafferty, 1984, Biglaiser, 1993, Chu and Chu, 1994). In Biglaiser and Friedman (1994) intermediaries build a reputation, which firms use instead of their own. In their model too it is important that an intermediary carry more than one product; the reason, however, is that this is necessary to make the retailer's profits more sensitive to reputation losses than those of firms'. The main differences from the present work are that (i) the intermediary in our framework is both negligible as a player and has no reputation, while (ii) the effect of firms' decisions on one another's payoffs is essential to the use of intermediation.

Payoff interdependence, which we emphasize, may arise from reputation effects or from competitive effects. In this paper we focus on the competitive effect: a high-quality firm gains by unmasking a low-quality competitor, which adds another element of rivalry to oligopolistic competition. Imperfect competition between the producers implies that a firm chooses an independent distribution channel if the competitor defaults on quality, and this instills a certain discipline effect against cheating. It protects shared intermediation as a signal against individual quality lapses. But if certification is too expensive, this disciplining device is out of reach and no equilibria in which intermediation is a signal arise. It is also essential that firms have knowledge of their competitor's quality, because

4

otherwise they cannot make their subsequent actions conditional on the "state of the world".

Clearly, we do not deny that intermediaries are selective among the products available and may acquire reputation through time, but we think that a model where this is not the reason for intermediation has great appeal. For one thing, building a reputation takes time, and this generates a cost; also, one can cite many real world cases in which retailers themselves never build a reputation and would suffer little loss by cheating consumers—we are thinking of many instances of domestic appliances retailing, computers, and so forth, where the intermediary is known to consumers primarily as a selling point.

Since our explanation of shared intermediation is independent of reputation and of repeat purchases we can present an atemporal model. To proceed, we first describe the features of duopoly under perfect information in section 2.1. The products of the two firms are exogenously differentiated and each firm can choose whether to produce a good of high or of low quality. Section 2.1 describes a model of the competitive process in which at a perfect information equilibrium both firms produce a good of high quality because quality, though more costly to produce, yields a premium. Important to our analysis is the strategic interaction between producers, which hinges upon individual firm's profits depending on the competitor's quality.

In section 2.2 we analyze the implications of imperfect information: consumers do not observe the quality of the good. In a two stage game, if at the first stage firms choose their level of quality then the game represents a moral hazard problem; if quality is chosen by Nature then it is an adverse selection problem. While our main focus is on moral hazard we provide results for both cases. Firms can resolve this moral hazard (or adverse selection) problem by certifying quality (section 2.3). Certification is the costly provision of unambiguous and indisputable evidence that a product is of high quality. By definition, low- quality firms cannot certify high quality. Under moral hazard, the strategy profile with both firms choosing to produce high quality and certifying is an equilibrium, provided that certification costs are not too high. Under adverse selection, certification is always used by high-quality firms and full separation obtains.

In section 3 we analyze shared intermediation as a full replacement for certification. First, we describe a four stage game. In the first stage firms (or Nature, if applicable) choose H (high) or L (low) quality. In the second, firms either propose a contract to the intermediary to sell their product, or choose to sell directly.

In the third, the intermediary accepts or refuses sales contracts, if any. At the fourth, firms decide whether or not to certify their quality.

We study two versions of this game, differing in the second stage; each version, furthermore, has a moral hazard and an adverse selection mode depending on assumptions about quality choice in the first stage. Adverse selection is treated in Appendix 1. Sections 3 and 4 together provide an almost full characterization of the set of Perfect Bayesian Equilibria of the two versions.

The first version (Game 1) is the simpler, as it restricts firms in stage 2 to a binary choice: each firm must either stay out or state its willingness to join the intermediary unconditionally (we term this statement the proposal of an "open contract", i.e. one without restrictive clauses). This game is well suited to focus on why the observation that the two firms share the same intermediary can be a signal of quality. Intermediation can replace certification under both moral hazard and adverse selection. Under moral hazard, at equilibrium both firms produce quality H and sell through the intermediary; under adverse selection intermediation is used only in the state (H, H), separating this from the other states. Game 1 has at least two drawbacks. First, it restricts the strategy space of firms in stage 2. Second, the system of beliefs is also shared by another Perfect Bayesian Equilibrium where both firms certify and do not use the intermediary.

In the second version (Game 2) at the second stage firms can propose either unconditional or conditional contracts. The latter are defined as: (i) the "joint contract" where a firm agrees to merchandising intermediation only on condition that the intermediary also carry the rival's product; (ii) the "exclusive contract", specifying that a firm accepts intermediation only if the other firm's product is *not* carried. The introduction of the exclusivity clause plays an important role in determining the intermediation outcome. Again intermediation can fully replace certification as a solution to the moral hazard problem. Since the system of beliefs supports a unique outcome, the result is sharper than in the first version. We obtain that joint intermediation prevails independent of out-of-equilibrium beliefs when consumers believe in the signaling role of joint intermediation.

This leads to section 4, which shows that intermediation can partially replace certification in both games under moral hazard and under adverse selection. Intermediation can separate the state (H, H), if the intermediary carries both products but certification is provided for only one. This saves half the certification costs. This halving of certification costs can thus be interpreted as the minimum amount of socially wasteful costs saved through shared intermediation. When firms can

6

offer conditional contracts, the result is again essentially independent of out-of-equilibrium beliefs.

The results in section 4 would appear to be a suggestive explanation for some phenomena observed in the distribution of products. For example there are cases in which producers are concerned about which competitors are sold through the same distribution channel. Our results explain why unknown brands prefer to be sold together with established high-quality brands, while high-quality producers withdraw their products from intermediaries that also market low-quality brands masquerading as high quality. Joint intermediation of an established and an unknown brand is a signal of high quality.

Moral hazard is analyzed in the main text whereas, adverse selection is treated in Appendix 1. In Appendix 2 we summarize our results for all fully separating beliefs when consumers believe in the signaling role of joint intermediation.

2. THE MODEL WITHOUT INTERMEDIATION

2.1. Duopoly under complete information

Consider a market for a horizontally differentiated product where, in addition to the horizontally distinguishing feature, brands are also defined by a characteristics of which all consumers prefer more to less. This characteristics we call quality. Its production is costly. This cost may be fixed or variable. Since firms are committed to their quality choice, the cost may be best understood to be a sunk cost which the firm incurs when it chooses quality. To simplify, let there be only two possible levels of quality, high and low, denoted as H and L respectively. Firms and consumers meet only once. The profit of firm 1 (resp. of firm 2) is denoted as $\pi_1(q_1, q_2)$ (resp. $\pi_2(q_1, q_2)$), where $q_i \in \{H, L\}$ for $i = 1, 2$. Assuming price competition and a sufficiently low cost of quality, in a variety of models one can show that the firms' profits as a function of the quality pair chosen display the following properties A.1 and A.2.

- **A.1.** Firms' symmetry. $\pi_1(q_1, q_2) = \pi_2(q_2, q_1)$.

- **A.2.** $\pi_1(H, L) > \pi_1(H, H) > \pi_1(L, L) > \pi_1(L, H) \geq 0$.

Remark that under A.2 choosing H is a dominant strategy when the quality choice is given to the firms. Independent of its quality a firm prefers to compete

against a low quality firm: competing against low quality gives a competitive advantage. With A.2 we also state that under perfect information a high quality duopoly is more profitable than a low quality duopoly although high quality is more expensive to produce. Note that there exist well known models of vertical differentiation where these assumptions cannot be verified (Gabszewicz and Thisse, 1979, and Shaked and Sutton,1982). However, in these models brands are differentiated only by quality. For the markets we have in mind (see the introduction above) a model such as the one by Economides (1989) in which there is vertical and sufficient horizontal product differentiation seems to us a better description. If that model is translated into our setup both firms choose high quality (under some assumptions on the parameters). Horizontal product differentiation can be replaced by heterogeneous search costs or random utility of the consumers. We work with reduced profit functions which satisfy A.1 and A.2.

The outcome of a one stage game where firms choose qualities and collect the payoffs obeying A.1 and A.2 under perfect information is obviously the choice $(q_1, q_2) = (H, H)$.

2.2. Moral hazard and adverse selection

We assume that consumers are imperfectly informed while firms retain complete information. This means that consumers do not know the qualities while each producer knows both qualities. Firms operate either in a world of moral hazard or adverse selection. Under A.1 and A.2 a low quality firm would like to be mistaken as a high quality firm. Under moral hazard firms choose their qualities and share an incentive to misrepresent low quality. As a consequence, if certification is unavailable they choose low quality and high quality does not exist in the market. Under adverse selection Nature chooses the state and firms then decide whether, given the state of Nature, they want to sell. The *a priori* probabilities assigned to each of the four possible states chosen by Nature namely the states (H, H), (L, L), (L, H) and (H, L), are all strictly positive.[3]

Consumers' beliefs shall be discussed more thoroughly below, however for the sake of exposition the notation h is introduced here to represent a firm of quality L which is believed to be of quality H with probability one—the notation H shall continue to denote a firm of quality H which is believed to be H with probability

---

[3]They are assumed to be equally likely (two independent draws), i.e. they occur with probability $\frac{1}{4}$.

one. Similar meaning is attached to the notation l and L respectively. The notation $\pi_1(h, q_2)$ (resp. $\pi_1(l, q_2)$) is introduced to define the profit of firm 1 when consumers erroneously perceive the quality of firm 1 as H (resp. as L) and believe the other firm to be of quality q_2. Similar meaning is attached to $\pi_2(q_1, h)$ and $\pi_2(q_1, l)$. Since high quality is more costly than low, one has

$$\pi_1(H, q_2) < \pi_1(h, q_2).$$

Clearly, by symmetry $\pi_1(h, q) = \pi_2(q, h)$ and the same inequality holds for firm 2, i.e. $\pi_2(q_1, H) < \pi_2(q_1, h)$. By the same argument $\pi_1(L, q_2) > \pi_1(l, q_2)$, this means that a firm which is believed to be of low quality prefers not to sell high quality. The perceived rather than the true quality of the competitor affects profits, i.e. $\pi_1(q_1, H) = \pi_1(q_1, h)$ and $\pi_1(q_1, L) = \pi_1(q_1, l)$.

The possibility of adverse selection, here the non-participation of high quality firms, arises when $\pi_1(l, L) < 0$. If brands are believed to be of low quality it is optimal for high quality firms not to sell in the market and all available qualities are low[4]. High quality which is mistaken to be of the average quality chosen by Nature is denoted by $\bar{q}$. In order to rule out the possible coexistence of high and low quality when Nature chooses quality, it is sufficient to assume that $\pi_1(\bar{q}, q_2) < 0$ for all q_2. Since low quality firms always stay in the market, the most favorable belief for firms is that consumers perceive goods in the market as average quality. If in this case a high quality firm makes negative profits it will not enter the market and adverse selection results. We also analyze the case where participation is independent of product quality.

Instead of non-participation firms which are able to produce high quality might have the choice to downgrade their brand and avoid the higher cost associated with high quality. In this case all firms provide low quality and stay in the market independent of type.

2.3. Asymmetric information and certification

Assume that costly certification is available. The certification cost is socially wasteful. Low quality cannot be certified, hence a high quality firm can make sure by certification that its quality is recognized. Our specification can be seen as a short-cut for a model with reputation where a firm seeks certification from

---

[4]We do not need to make assumptions on the profits $\pi_i(L)$, they only have to be positive.

a professional appraiser (see Biglaiser, 1993). Alternatively, certification can be seen as the provision of a full warranty.

Under moral hazard we analyze a two stage game denoted as "Game 0" in which firms choose quality at the first stage and at the second they decide whether to certify or not.

Consumers form beliefs after observing the firms' certification actions. We assume that price signals, if they could work, are more costly than certification.[5] In the adverse selection case, Nature and not the firms chooses qualities. Nature chooses qualities at the stage 1A, then firms decide whether to enter the market at stage 1B and finally firms certify or not. Alternatively, firms with the technology to produce high quality (Nature has chosen H) can downgrade their brand and produce at the cost of a low quality firm.

The certification choice is denoted by the pair (c_1, c_2), $c_i \in \{C, N\}$, where, for $i = 1, 2$, $c_i = C$ stands for "certification" of firm i and $c_i = N$ stands for "no-certification". Since it cannot contain statements about the quality of the competitor, certification involves a partial revelation of the information possessed by a firm. Formally speaking it induces a partition on the set $\{(H, H), (H, L), (L, H), (L, L)\}$.

Consumers' posterior beliefs about the state (q_1, q_2), where $q_i \in \{H, L\}$, are described by the probability function $b((q_1, q_2)|(c_1, c_2))$, taking values in the $[0, 1]$ interval and such that for each pair (c_1, c_2) the sum of the probabilities over the four states is equal to 1, namely $b((H, H)|(c_1, c_2)) + b((H, L)|(c_1, c_2)) + b((L, H)|(c_1, c_2)) + b((L, L)|(c_1, c_2)) = 1$. We also assume beliefs symmetry: $b((q', q'')|(c', c'')) = b((q'', q')|(c'', c'))$ for $c', c'' \in \{C, N\}$ and $q', q'' \in \{H, L\}$.

Fully separating equilibria are those perfect Bayesian equilibria (PBE) with belief systems such that $b((q', q'')|(c', c'')) \in \{0, 1\}$, for $c', c'' \in \{C, N\}$ and $q', q'' \in \{H, L\}$. Since certification provides unambiguous evidence of product quality, it must be $\sum_{q_2} b((H, q_2)|(C, N)) = 1$ and $b((H, H)|(C, C)) = 1$.

Certification costs are reflected in a reduction in the final payoffs with respect to the full information case. The profit of a high quality firm after certification are denoted as: $\Pi_1(H, q_2)$ if the rival is believed to be of quality q_2. Clearly, for all values of q_2

$$\Pi_1(H, q_2) < \pi_1(H, q_2),$$

---

where $\pi_1(H, q_2)$ is the full information profit. The same holds for firm 2. We assume that certification costs do not affect the payoff ranking, i.e. in particular $\Pi_1(H, L) > \Pi_1(H, H)$ because $\pi_1(H, L) > \pi_1(H, H)$. Also we assume that certification is viable:

- **A.3.** $\Pi_1(H, q_2) > \pi_1(L, q_2)$.

Under A.3 in the moral hazard case at a revealing equilibrium a firm at the first stage chooses to produce quality H and certifies rather than choose L and avoid certification costs. A.3 implies that $\Pi_1(H, q_2) > \pi_1(l, q_2)$, i.e. for a type H it is a dominant strategy to certify if a firm is believed to be of low quality in the absence of certification. A.3 puts an upper bound on the certification cost. If A.3 is not satisfied the moral hazard or adverse selection problem cannot (fully) be solved by certification.

The following system of beliefs and firms strategies form a separating PBE. Note that the belief $b((H, L)|(C, N)) = 1$ implies that in the state (H, L) or (L, H) certification by one firm unmasks that the opponent is of quality L.

- Belief System (B.N): $b((H, H)|(C, C)) = 1$, $b((H, L)|(C, N)) = 1$, $b((L, L)|(N, N)) = 1$. (By symmetry, $b((L, H)|(N, C)) = 1$).

- Strategy 0 (moral hazard): At stage 1 each firm chooses H and at stage 2 each firm chooses to certify if it is of quality H and no-certification if it is of quality L irrespective of the opponent quality.

- Strategy 0 (adverse selection): At stage 1B firms enter the market independent of the move of Nature (alternatively, it produces according to its technological possibilities). At stage 2 each firm chooses to certify if it is of quality H and no-certification if it is of quality L irrespective of the opponent quality.

Formally, the second stage strategies of firm 1 can be written as:
$(H, q_2) \Longrightarrow c_1 = C$ for $q_2 = H, L$; $(L, q_2) \Longrightarrow c_1 = N$ for $q_2 = H, L$. Our first result shows the existence of a PBE. All proofs are in Appendix 3.

Proposition 1. *The consumers belief system (B.N) and the Strategy profile 0 form a PBE of Game 0.*

11

Next we characterize the equilibria of Game 0. In the case when Nature chooses quality and adverse selection does not result, i.e. firms always enter the market, the average quality in the market is $\bar{q}=\frac{1}{2}(H+L)$. In order to make certification profitable one has to assume that certification costs less than the gain from being perceived to be of H instead of $\bar{q}$.

- **A.4.** (adverse selection) $\Pi_1(H, q_2) > \pi_1(\overline{q}, q_2)$.

Under moral hazard we assume that certification is profitable when it reveals the quality of the brand which is otherwise correctly perceived to be of low quality even if also the perception of the competitor's brand switches from low to high by certification.

- **A.4.** (moral hazard) $\Pi_1(H, H) > \pi_1(L, L)$.

A.4(moral hazard) is stronger than A.3. Implications of A.4 are discussed in Appendix 3.

With our second result we provide a characterization of all PBE of Game 0. In the proof we make use of the fact that $b((H, H)|(N, C))$ has to be sufficiently small.

Proposition 2. *Whether under moral hazard or under adverse selection all PBE of Game 0 involve certification by any firm of quality H. Under adverse selection all PBE are fully separating. Under moral hazard the two firms choose (H, H) at stage 1 and (C, C) at stage 2.*

Since certification solves the adverse selection problem we will no longer introduce stage 1B in the specification under adverse selection. Our results are not affected by the introduction of this additional stage.

In the remainder we always take beliefs (B.N) as given.[6]

---

[6]Under moral hazard also the belief system (B.N)' with $b((H, H)|(C, C)) = 1$, $b((H, L)|(C, N)) = 1$, $b((H, H)|(N, N)) = 1$ supports the outcome $((H, C), (H, C))$. (B.N)' can be criticized because also (L, L) are mutual best replies at stage 1 if $\Pi_1(H, L) < \pi_1(h, h)$. All further results in this paper on moral hazard can alternatively be shown under (B.N)' or any beliefs $b((.,.)|(N, N)) > 0$. As shown in the proof of Proposition 2 also beliefs $b((H, H)|(N, C)) > 0$ sufficiently small are allowed.

3. INTERMEDIATION AS A FULL REPLACEMENT OF CERTIFICATION

3.1. Introduction

The two firms can place their products for sale at the intermediary. Consider the intermediary as a player. If no firm contacts the intermediary she remains inactive and has a payoff of zero. The intermediary prefers to be active rather than inactive even at zero payoff. Although the intermediary requires a payment we do not need to specify the rules that govern the transfers from firms to the intermediary. We see intermediation as a way to avoid certification costs, which has no cost for society but only involves a redistribution of profits from firms to the intermediary. This means that intermediation is a costly activity for the firms but not for society. In our model, firms are only using the intermediary if this gives them the possibility of signaling. If the consumers beliefs are such that intermediation has no signaling effect then firms cannot have an incentive to use intermediation since this cannot replace certification.

Intermediated goods appear in square brackets. We distinguish three different intermediation structures. Either no intermediation, i.e. (q_1, q_2), or single intermediation, i.e. $([q_1], q_2)$ or $(q_1, [q_2])$, or joint intermediation, i.e. $([q_1, q_2])$. The intermediary's payoff is denoted as π_I.

The use of intermediation, ignoring its signaling role, is costly for the firms meaning that for any vector of qualities and perceptions, $q_1, q_2 \in \{l, L, h, H\}$, it holds that $\pi_1(q_1, q_2) > \pi_1([q_1], q_2)$ and $\pi_1(q_1, q_2) > \pi_1([q_1, q_2])$. Results when vertical integration instead of intermediation is assumed to be more costly are briefly discussed below. For simplicity, we assume that a firm which does not sell through the intermediary is unaffected by the competitor selling or not selling through the intermediary, i.e. $\pi_1(q_1, q_2) = \pi_1(q_1, [q_2])$. In addition, we assume that intermediation does not affect the profit ranking: any inequality $\pi_1(q_1', q_2') > \pi_1(q_1'', q_2'')$, $q_1', q_2', q_1'', q_2'' \in \{l, L, h, H\}$, implies $\pi_1([q_1'], q_2') > \pi_1([q_1''], q_2'')$ and $\pi_1([q_1', q_2']) > \pi_1([q_1'', q_2''])$. All these inequalities are also assumed to hold in the presence of certification.

We assume that if only one good is intermediated the profit ranking of the intermediary coincides with the profit ranking of the corresponding firm, i.e. $\pi_I([q_1], q_2) > \pi_I(q_1, [q_2])$ if and only if $\pi_1([q_1], q_2) > \pi_2(q_1, [q_2])$. In addition, we assume that the intermediary prefers more to less brands if the perception of a

13

brand does not change or when it is improved when taken in. This implies that

(I1) $\pi_I([H,h]) > \pi_I([H],L)$, $\pi_I([H,H]) > \pi_I([H],l)$, $\pi_I([h,H]) > \pi_I([h],l)$, and $\pi_I([h,h]) > \pi_I([h],L)$.

All other inequalities are not problematic[7] because, for instance, they are satisfied if the intermediary receives a fixed share of the firms' profits of the traded brands. By contrast, in that case (I1) does not necessarily hold.

If the first inequality in (I1) is reversed the role for intermediation becomes stronger because in the case (H,L) the intermediary selects to trade only the high quality. Hence deviations to low quality are punished by the intermediary and it can be shown that a low quality firm is not mistaken to be of high quality. The role of intermediation as a signal of quality is then obvious and we do not analyze this case any further.

Firms can choose to use the intermediary or to sell directly (vertically integrate); in the first case they are said to offer a contract to the intermediary, while in the second they are said to choose the *no-contract* option. We shall consider two versions of the game composed by the four stages described as follows.

At *stage 1* firms choose qualities.

At *stage 2* firms propose contracts or choose the no-contract option.

At *stage 3* the intermediary chooses which contract to sign.

At *stage 4* firms choose whether to certify or not.

Stages 1 and 4 of the four stage game correspond to stages 1 and 2 of Game 0 above, so that the notation for actions q_i and c_i is preserved. Stages 2 and 3 are new. After distribution channels are established at Stage 3, firms can certify as a last resort. Hence, according to the four stage game the certification action can be conditioned upon the prevailing distribution arrangement. We study Perfect

---

[7]These inequalities are (I2) $\pi_I([H,H]) > \pi_I([H],H)$, $\pi_I([h,H]) > \pi_I([h],H)$, $\pi_I([H,h]) > \pi_I([H],h)$, and $\pi_I([h,h]) > \pi_I([h],h)$,

(I3) $\pi_I([h,H]) > \pi_I([L],H)$, $\pi_I([H,H]) > \pi_I([l],H)$, $\pi_I([H,h]) > \pi_I([l],h)$, and $\pi_I([h,h]) > \pi_I([L],h)$, and

(I4) $\pi_I([h,h]) > \pi_I([L],L)$, $\pi_I([H,h]) > \pi_I([l],L)$, $\pi_I([H,H]) > \pi_I([l],l)$, and $\pi_I([h,H]) > \pi_I([L],l)$.

Bayesian Equilibria (PBE) in pure strategies of this game where the price decision and the consumer choices are implicit in the payoff functions.[8]

The outcome of the game is defined by whether intermediation rather than direct sale occurs and by the certification or not by firms. For $q_1, q_2 \in \{H, L\}$ and $c_1, c_2 \in \{C, N\}$, the possible outcomes are: $([(q_1, c_1), (q_2, c_2)])$ if the intermediary carries both products, $((q_1, c_1), (q_2, c_2))$ if she does not carry any product, $([(q_1, c_1)], (q_2, c_2))$ if she carries only the product of firm 1, $((q_1, c_1), [(q_2, c_2)])$ if she carries only the product of firm 2.

Since consumers observe how many products the intermediary carries, and the action pair (c_1, c_2) the belief function b is defined as $b((q_1, q_2) \mid ([c_1, c_2]))$ if the intermediary carries both products, $b((q_1, q_2) \mid ([c_1], c_2))$ (resp. $b((q_1, q_2) \mid (c_1, [c_2]))$)if she carries only the product of firm 1 (resp. firm 2), and $b((q_1, q_2) \mid (c_1, c_2))$ if she carries neither product. Obviously, irrespective of how many brands are intermediated double certification, the action pair $(c_1, c_2) = (C, C)$, implies that the beliefs assign probability one to state (H, H).

Let us define the possible beliefs when consumers observe both firms at the intermediary. These beliefs can either assign no information role to joint intermediation, so that a firm is believed of low quality unless it certifies, or a 'full' role, namely specify that irrespective of certification both firms are believed as H if they are jointly intermediated, or a 'partial' role, specifying that they are both believed of high quality provided at least one certifies.

(B.D) (no signal) $b((H, L)|([C, N])) = 1$ and $b((L, L)|([N, N])) = 1$.
(B.D) (partial) $b((H, H)|([C, N])) = 1$ and $b((L, L)|([N, N])) = 1$.
(B.D) (full) $b((H, H)|([C, N])) = 1$ and $b((H, H)|([N, N])) = 1$.

- Remark that since intermediation absorbs part of the firms' profits, joint intermediation cannot be supported as a PBE if (B.D) (no signal) is part of the belief system.

---

[8]Our notion of PBE adopts the concept of Fudenberg and Tirole (1991, chapter 8) to our game. In game theoretic terms there are three prefectly informed players (the firms and the intermediary) and one uninformed player (the consumers). We analyze a signaling game with several informed players. The informed players play a multi-stage game which is a multi-stage game with perfect information if the posterior beliefs of the uninformed player are fixed. Stage 0 contains the hidden action, stages 2 to 4 provide the signal to the uniformed player and at an unmodelled final stage the uninformed player chooses.

Let us define now five beliefs when a single firm is intermediated that can sustain full separation. Since beliefs are symmetric we only need to define belief systems for firm 1. Single intermediation can be belief-neutral, i.e. it does not affect beliefs neither positively nor negatively for the firm which is selling through the intermediary—intermediation neutrality here means that only certification affects beliefs. Single intermediation can be 'punished', i.e. a non-certified intermediated brand is believed to be of low quality conditional upon the other firm not certifying or unconditionally. Finally, beliefs can 'assign a prize' to the intermediated brand (believe that it is H) either conditional upon the other firm not certifying or unconditionally. The results for Game 1 will depend on whether single intermediation is interpreted as a signal product quality ('prize' case) or not ('neutral' or 'punish' cases).

(B.S) (neutral)
$b((H, L)|([C], N)) = 1, b((H, L)|([C], N)) = 1, b((L, L)|([N], N)) = 1.$

(B.S) (conditional punish)
$b((H, L)|([C], N)) = 1, b((L, H)|([N], .)) = 1.$

(B.S) (unconditional punish)
$b((H, H)|([C], .)) = 1, b((L, H)|([N], .)) = 1.$

(B.S) (conditional prize)
$b((H, L)|([.], N)) = 1, b((L, H)|([N], C)) = 1.$

(B.S) (unconditional prize)
$b((H, L)|([.], N)) = 1, b((H, H)|([.], C)) = 1.$

In total there are 16 different fully separating beliefs given single intermediation. We report the remaining 11 beliefs and the results given these beliefs in Appendix 2.

3.2. Moral hazard and open contracts

The first version of the four stage game we consider is a simplified version where the contract space of firms at stage 2 is restricted. Under moral hazard firms choose qualities at the first stage. At stage 2 firm i can choose the no-contract option (sell directly), this is represented by the choice $a_i = Z_i$, or it can choose an open contract, denoted O_i whereby it accepts to sell through the intermediary. Contract O_i is unconditional, i.e. the firm is willing to be intermediated irrespective of whether the competitor's product is or is not intermediated too. The second stage choice leads to the pair (a_1, a_2) where $a_i \in \{O_i, Z_i\}$. The choice

by the intermediary to sign contract with firm i only is denoted by $[i]$, while the choice to sign with both is denoted by $[12]$, the choice not to sign any contract is denoted by $quit$.

At stage 3 the intermediary signs contracts $[i]$, or $[12]$, or quits. The intermediary's action space, denoted $I(a_1, a_2)$, depends upon the firms' choices at stage 2. In particular, $I(Z_1, Z_2) = \{quit\}$, $I(O_1, Z_2) = \{[1], quit\}$, $I(Z_1, O_2) = \{[2], quit\}$, $I(O_1, O_2) = \{[1], [2], [12], quit\}$.

To start with we shall focus on the consumers' belief system composed of (B.D) (full) and (B.S) (neutral). We shall define strategies S.1 such that these strategies and the belief system considered form a PBE of the game. This PBE supports the outcome where both firms choose the high quality, both are intermediated, and no firm certifies. Thus, shared intermediation is shown to work as a signal replacing certification. Consider the system of beliefs (B.D) (full) and (B.S) (neutral), and

- Strategies S.1.

  Stage 4 (consider strategy of firm 1): (a) if firm 1 is L then $c_1 = N$. (b) If $([H, .])$ then $c_1 = N$; if $([H], .)$ or $(H, [.])$ or $(H, .)$ then C. For firm 2, analogously.

  Stage 3: The intermediary chooses $quit$ if $(a_1, a_2) = (Z_1, Z_2)$, chooses $[12]$ if $(a_1, a_2) = (O_1, O_2)$ finally she chooses $[i]$ whenever $a_i = O_i$ and $a_j = Z_j$.

  Stage 2: Firm 1 (and analogously for firm 2) chooses according to the state that prevails after stage 1 quality choices:$(H, H) \implies O_1$; $(H, L) \implies Z_1$; $(L, H) \implies Z_1$; $(L, L) \implies Z_1$.

  Stage 1: $q_i = H$ for $i = 1, 2$.

Costs of intermediation are assumed to be small enough to ensure that certification costs dominate.

- **A.5.** $\pi_1([H, H]) > \Pi_1(H, H)$ and $\pi_1([H], q_2) > \Pi_1(H, q_2)$

This assumption seems not restrictive when the intermediary has little market power.[9]

---

[9]Even if the intermediary is powerful it can be argued that this inequality will always be satisfied if producers bargain with the intermediary about the payment for intermediation because they will never jointly sell through the intermediary if the inequality is violated. An intermediary who is informed about the outside option of producers will respect this inequality.

Proposition 3. *The strategies (S.1) and the belief system (B.D) (full) and (B.S) (neutral) form a PBE of Game 1 under moral hazard. Therefore the outcome $[(H,N),(H,N)]$ can be supported at a PBE.*

As a comment, note that the outcome $((H,C),(H,C))$ can also be supported by a PBE with belief system (B.D) (full) and (B.S) (neutral). This follows from the coordination game at stage 2, namely at stage 2 the strategy by firm 1 and 2 must be replaced in S.1 by the choice of contract Z_i at all nodes. Indeed when (H,H) occurs the no-contract choice is a best reply to no-contract by the rival firm since staying in alone obliges to certify at the fourth stage and there is no advantage to be carried alone by the intermediary. The non-uniqueness of the outcome where intermediation replaces certification is one of the weaknesses of the formulation with restricted contract space.[10]

- Note that in this paper we assume that intermediation is more costly than vertical integration. If the reverse is assumed the outcome $((H,C),(H,C))$ cannot be supported in Game 1 by a PBE with belief system (B.D) (full) and (B.S) (neutral) and the moral hazard problem is solved. We do not further analyze this case because shared intermediation then also arises under perfect information.

We assume that certification is viable in a stricter sense than in A.3. In particular we shall assume that its costs be low enough to allow

- **A.6.** $\pi_1(h,h) < \Pi_1(H,L)$.

A.6 means that producing high quality and unmasking the competitor via certification is profitable if consumers are overoptimistic (i.e. when firms do not certify they believe that the state is (H,H)). Since $\pi_1(h,h) > \pi_1(H,h)$, A.6 implies that a high quality firm prefers the revelation of the state (H,L) or (L,H) respectively via certification, i.e. it unmasks the opponent of low quality. In other words, the gains from unmasking a low quality competitor are higher than the costs of certification.

---

[10]The equilibrium prediction might also be criticized because at (H,L) and (L,H) also O_1, O_2 can be mutual best replies, which would make deviations at stage 1 profitable. This possibility is ruled out if assumption A.6 below is introduced.

- Remark that the larger the number of types (or also the smaller the interval between qualities) the stronger is the assumption that unmasking the rival just one step below is profitable. Therefore A.6 is too strong for some sufficient closeness of types. This means that although there may be a continuum of potential qualities it is essential that only certain threshold qualities can be certified, e.g. if a firm can only certify that its brand is above a certain threshold quality the model with a continuum of qualities reduces to the present model.

One may consider what happens with other belief systems as those originated by the combinations of (BD) (full) with beliefs for single intermediation. These considerations are summarized by the following three remarks.

- The same result as in Proposition 3 applies if beliefs are (B.D) (full) and (B.S) (conditional punish) as is proved in appendix 3 (as Remark 4). The prediction is stronger in the sense that O_1, O_2 are not mutual best replies at stage 2 given choices (H, L) or (L, H).

- Only the outcome $((H, C), (H, C))$ can be supported by a PBE with belief system (B.D) (full) and (B.S) (unconditional punish). Firms have an incentive to deviate at stage 2 from O_1, O_2 to Z_i because $\pi_1(H, [H]) > \pi_1([H, H])$ and Z_1, Z_2 are mutual best replies at stage 2.

- Consider the system of beliefs formed by (B.D) (full) and (B.S) (conditional prize). This belief system *cannot* support a PBE in pure strategies because there do not exist mutual best replies at stage 2 when qualities are (H, L). The combination of beliefs (B.D) (full) and (B.S) (unconditional prize) *cannot* support a PBE because at the first stage firms choose (L, L) which does not confirm beliefs (see the appendix; proof of Remark 6).

3.3. Moral hazard and an extended contract space

Now we consider a formulation of the game where the contracts proposed by the firms may contain clauses which were forbidden in the case of Game 1. This strengthens the producers in relation to the intermediary because, for example, they may choose exclusive dealing contracts making it impossible to the intermediary to sign with both firms. In the belief system which is the focus of this

section single intermediation is also seen as a signal of quality provided the un-intermediated brand does not certify (*conditional prize to single intermediation*). The reason why we focus on this belief is that the full replacement of certification by shared intermediation given this system is the unique outcome—given other belief systems the same outcome can also be supported but, without a refinement, not uniquely, as discussed in the remarks at the end of the present section.

The role of the intermediary at a separating PBE is not only to offer shelf space for both brands but also to choose the right product when qualities are asymmetric (off equilibrium in subgames starting at stage 2 (H, L) and (L, H)).However this role of the intermediary is not essential to the results (see below).

Some additional notation is needed for the contract space of Game 2. A contract may or may not contain a clause. A clause specifying that intermediation is accepted only if the other firm is *out* is an exclusivity clause, and one conditioning intermediation upon intermediation of the opponent is a joint agreement clause. E_1 denotes the contract with an exclusivity clause and J_1 that with a joint agreement clause. Contract pairs (a_1, a_2) at stage 2 are such that $a_i \in \{O_i, J_i, E_i, Z_i\}$.

At stage 3, the intermediary's action is eventually limited by the clauses as for instance even if no firm has chosen the no-contract option she cannot take in both firms when one or both have included an exclusivity clause. Similarly, she cannot take in just one firm if they have both asked for joint intermediation. The complete description of the intermediary's action space $I(a_1, a_2)$ is as follows.

$I(Z_1, Z_2) = I(Z_1, J_2) = I(J_1, Z_2) = \{quit\}$

$I(E_1, Z_2) = I(E_1, J_2) = I(O_1, Z_2) = \{[1], quit\}$

$I(Z_1, E_2) = I(J_1, E_2) = I(Z_1, O_2) = \{[2], quit\}$

$I(J_1, J_2) = \{[12], quit\}$

$I(O_1, J_2) = \{[1], [12], quit\}$ and $I(J_1, O_2) = \{[2], [12], quit\}$

$I(E_1, E_2) = I(E_1, O_2) = I(O_1, E_2) = \{[1], [2], quit\}$

$I(O_1, O_2) = \{[1], [2], [12], quit\}$

The intermediary can condition her strategy on the qualities and the types of contracts which are offered. We analyze the case where the intermediary conditions only on observed qualities (which is the only payoff relevant information for the intermediary). Shortly below we shall show the robustness of our result when the intermediary also conditions on the types of contract.

Again we shall focus on a PBE of Game 2 under moral hazard such that both firms choose quality H, are intermediated, and do not certify—the outcome $([(H, N), (H, N)])$. Consider now the belief system obtained by combining

(B.D) (full) with (B.S) (conditional prize). Note that under this belief combination with $b((H, L)|([.], N)) = 1$ the conditional prize given to the intermediated brand corresponds to the idea that intermediation is a signal of quality, however $b((L, H)|([N], C)) = 1$ ensures that the unmasking effect of certification prevails against possible attempts to cheat consumers via single intermediation. Finally, $b((H, H)|([C], C)) = 1$ implies that certification is a defence against certification. Then consider the following strategies.

Strategies (S.2)

Stage 4; (a) Firm 1 is L, then it does not certify and plays N. (b) Firm 1 is H: in the case $([., .])$ it plays N; in case $([.], .)$ then if the opponent is L it plays N and if the opponent is H it plays C; case $(., [.])$ or $(., .)$ then firm 1 plays C. The same for firm 2, analogously.

Stage 3. If $I(a_1, a_2)$ is a singleton the intermediary's choice is trivial. Furthermore: Case A) $(q_1, q_2) = (H, H)$ implies the three following sub-cases (a.1) choose [12] whenever $[12] \in I(a_1, a_2)$, (a.2) randomize with equal probability between [1]and [2] if $\{[1], [2], quit\} = I(a_1, a_2)$; (a.3) choose $[i]$ if $\{[i], quit\} = I(a_1, a_2)$, for $i = 1, 2$. Case B) (H, L), (L, H) implies the three following sub-cases. (b.1) choose [12] if $[12] \in I(a_1, a_2)$; (b.2) if $\{[1], [2], quit\} = I(a_1, a_2)$, then if state is (H, L)choose [1] , and if it is (L, H) choose [2]. (b.3) if $\{[i], quit\} = I(a_1, a_2)$ then choose $[i]$. Case C) (L, L) same strategies as in case A) above.

Stage 2. Firm-1:if $(q_1, q_2) = (H, H)$ then choose J_1; if $(q_1, q_2) = (H, L)$ then choose E_1; if $(q_1, q_2) = (L, H)$ then choose indifferently Z_1, or O_1, or E_1, or J_1; if $(q_1, q_2) = (L, L)$ then choose E_1. Firm-2: as Firm-1, analogously.

Stage 1. $q_i = H$ for $i = 1, 2$.

The intermediary has an active role in subgame (H, L) where she refuses a contract proposed by firm L while she accepts one proposed by firm H. This behavior is profit maximizing because she is confronted with an exclusivity clause by the high quality firm. In other words, the intermediary's behavior out of the equilibrium path guarantees that deviating from the choice of H against H at the first stage cannot be optimal. However, the active role of the intermediary is not essential for the equilibrium result. We fully described strategies, also for subgames which only can be reached through joint deviations (and even in these subgames we have subgame perfection). Then it follows:

Proposition 4. *The strategies (S.2) and the belief system obtained by the combination of (B.D) (full) and (B.S) (conditional prize) form a PBE of Game 2 under moral hazard.*

Proposition 5. *After the elimination of weakly dominated strategies any PBE with the belief system obtained by the combination of (B.D) (full) and (B.S) (conditional prize) leads to the unique outcome $([(H, N), (H, N)])$.*

Propositions 4 and 5 show that the outcome where intermediation is used instead of certification to solve the moral hazard problem is sustained as a PBE. Furthermore the belief system is such that certification instead of intermediation is not part of a PBE (after the elimination of weakly dominated strategies). This reinforces the result since no coordination game appears at stage 2 and no ambiguity of outcome follows.

The intuition for the argument in the proof of Proposition 4 is the following. At stage 4 if both firms are with the intermediary then certification by either or both firms is redundant since it does not modify consumers beliefs about quality. Then, at stage 3, the intermediary takes in both firms if both propose mutually compatible contracts—in particular if both propose the contract with joint intermediation clause. The intermediary, furthermore, at stage 3 would "punish" a firm of low quality if the other is of high quality while would take in both firms if they were both of low quality.

The result may be criticized because joint contracts do not seem to be observed in reality. However, an open contract with the possibility of the firms to withdraw after the signing of a contract, mimics a joint contract in subgame (H, H).[11] If joint contracts are not available and this withdrawal possibility does not exist then there exist the two equilibrium outcomes $([(H, N), (H, N)])$ and $((H, C), (H, C))$.

As summarized in the table in Appendix 2 we derive a strong prediction when firms can choose from the extended contract space: in any PBE the equilibrium outcome is $([(H, N), (H, N)])$.

A digression is necessary on whether introducing the possibility for the intermediary to condition her choice on the type of contract offered does not destroy

---

[11]There are several ways in which withdrawal can be modelled. The argument holds that if there are two withdrawal possibilities, the first one after signing contracts and the second one conditional upon the withdrawal of the competitor. Also exclusive contracts can be replaced by a stage of possible withdrawal. Alternatively, one can model sequential contract offers to support the joint intermediation outcome.

any PBE. The answer is no, because at stage 3 the intermediary cannot increase her profits by conditioning. However, the intermediary can treat different contracts on offer differently, e.g. in the case $I(O_1, E_2) = \{[1], [2], quit\}$ she may decide always to favor the open contract. Because of perfection, the preference over types of contracts can only matter in case of payoff indifference of the intermediary. Indifference may hold in the cases (O_1, E_2), (O_1, J_2) and, by symmetry, (E_1, O_2), (J_1, O_2). Since the intermediary prefers more to less brands she will sign contracts with both firms in the cases (O_1, J_2) and (J_1, O_2) and conditioning does not occur. Hence only preferences $O_1 \succ E_2$ and $E_2 \succ O_1$ conditional on qualities have to be considered. Consider subgames (H, L) and (L, H). Whenever the intermediary has to choose between brands of different quality her profits depend on the intermediation structure and hence any deviation from the equilibrium behavior which occurs without conditioning on quality violates profit maximization together with perfection. To illustrate, take (B.D) (full) and (B.S) (unconditional prize). In the subgame (H, L) firms choose (E_1, O_2). These contracts weakly dominate all other contracts if the intermediary does not condition on contracts. If the intermediary signs with firm 1, the intermediary obtains $\pi_I([H], L)$ which according to our assumptions is greater than $\pi_I(H, [h])$ which she would obtain when signing with firm 2. Consider now subgame (H, H). For the belief systems considered our results are robust to the extension of the intermediary's strategy space except for (B.S) (unconditional prize). This also holds for all other results including those under adverse selection. Given beliefs (B.D) (full) and (B.S) (unconditional prize) contracts (E_1, E_2) are mutual best replies if $E_i \succ O_i$ by the intermediary because $\frac{1}{2}\Pi_1(H, [H]) + \frac{1}{2}\pi_1([H], H)$ is greater than $\Pi_1(H, [H])$ which obtains after a deviation to $a_1 \neq E_1$. Then, if $\pi_1([H, H]) > \pi_1([H], H)$ there are two equilibria but the PBE with outcome $([(H, N), (H, N)])$ Pareto dominates. If $O_i \succ E_i$, then $([(H, N), (H, N)])$ is the unique equilibrium outcome given beliefs.[12] Therefore, shared intermediation is preserved.

Finally, it is important to observe that shared intermediation does not depend on whether the intermediary knows the quality of the goods. Assume indeed that the intermediary has no information about qualities. The same results as under perfect information of the intermediary can be shown (except for the case

---

[12] One might argue that given the same qualities the intermediary should prefer the open contract because open contracts are less restrictive contracts for the intermediary. If firms know this at stage 2 they propose contracts which are preferred by the intermediary.

of beliefs (B.S) (unconditional prize)[13]). The idea is that if the intermediary picks the wrong quality the other firm will certify and unmask the rival.

Another issue concerns joint deviations. Note that under the belief system obtained as in Propositions 4 and 5 by the combination of (B.D) (full) and (B.S) (conditional prize) (L, L) may be mutual best replies at the first stage. However, as shall also be argued in the appendix on adverse selection, this leads to an outcome (namely $([h], L)$ or $(L, [h])$) which contradicts beliefs and therefore that cannot be supported by a PBE. (L, L) may be mutual best replies because if the opponent chooses L, then choosing H will lead to the subgame equilibrium where firm H applies for intermediation (firm L does not) and the intermediary takes in firm H, but then firm H obtains payoffs $\pi_1([H], L)$. By contrast, choosing L leads to the subgame equilibrium where both firms at stage 2 propose an exclusive contract (this strategy weakly dominates given the state (L, L)) and the intermediary randomizes with equal probability her choice of firm. Then the payoff obtained is $\frac{1}{2}\pi_1([h], L) + \frac{1}{2}\pi_1(L, [h])$, which may exceed $\pi_1([H], L)$. (L, L) are not mutual best replies only if the condition $\pi_1([H], L) > \frac{1}{2}\pi_1([h], L) + \frac{1}{2}\pi_1(L, [h])$, holds, which means that unmasking a low quality brand (without certification) is more profitable than partly exploiting the (misleading) signal of the intermediary.

The following two remarks complete this section with a brief account of outcomes under different belief combinations.

- After the elimination of weakly dominated strategies only the outcome $([(H, N), (H, N)])$ can be supported as a PBE given belief systems obtained by the combination of (B.D) (full) and (B.S) (neutral) or by (B.D) (full) and (B.S) (conditional punishment) or by (B.D) (full) and (B.S) (unconditional punish). Both outcomes $([(H, N), (H, N)])$ and $((H, C), (H, C))$ can be supported as a PBE using strategy S.1 (given (B.S) (neutral) or S.1' (defined in the appendix, given (B.S) (conditional punish) or a different strategy for (B.S) (unconditional punish). This is so because, given (H, H) at stage 2 offering no contract and offering joint contracts are both mutual best replies— offering no contract is weakly dominated by offering the joint contract[14]. Given (B.S) (neutral) and (B.S) (conditional punish) strategies S.1 and S.1',

---

[13]In this case one also obtains the equilibrium outcome $([(H, N), (H, N)])$ under the additional assumption that $\pi_1([H], L) - \pi_1([H, h]) > \pi_1([H, h]) - \Pi_1(H, [h])$. If intermediation costs are negligible this assumption says that the gains from unmasking are greater than the cost of certification.

[14]If there is an ε probability for each firm that it offers a joint contract then offering a joint

respectively, have to be modified. In particular, if $I(a_1, a_2) = \{[1], [2], quit\}$ then the intermediary prefers participation and a contract is signed with one of the firms: quality H is chosen in the asymmetric states (H, L) or (L, H), because if quality H is excluded then full revelation obtains. Given belief systems with (B.D) (full) and (B.S) (neutral) or (B.D) (full) and (B.S) (conditional punish) or (B.D) (full) and (B.S) (unconditional punish) only the outcome $([(H, N), (H, N)])$ resists elimination of weakly dominated strategies; both firms offer joint contracts in equilibrium. Contrary to (B.S) (conditional prize) the intermediary does not play an active role in subgames (H, L) and (L, H).

- Consider Game 2 with the belief system obtained by (B.D) (full) with (B.S) (unconditional prize), in which $b((H, H)|([.], C)) = 1$ and $b((H, L)| ([.], N)) = 1$. After the elimination of weakly dominated strategies the outcome $([(H, N), (H, N)])$ is supported as the unique PBE if $\pi_1([H], H) < \pi_1([H, H])$ holds. Also in this case the intermediary actively selects the high quality brand among $\{[1], [2], quit\}$ in the subgame (H, L). In the subgame (H, H) firms offer open contracts (see remark below).

4. INTERMEDIATION AS A PARTIAL REPLACEMENT OF CERTIFICATION

The results of this section show that intermediation can partially replace certification under moral hazard.

It is possible that consumers interpret intermediation of two goods as a signal of the state (H, H) only if it is accompanied by certification of at least one good. This means that the belief system is (B.D) (partial), in particular $b((L, L)|([N, N]) = 1$ and full replacement of certification cannot occur. We shall show in the present section that paying only one certification cost instead of both is sufficient to separate the state (H, H). This we call "partial replacement".

The case of partial replacement can also be interpreted as intermediation of an established brand with certified high quality together with a brand of unknown quality. If this unknown brand were not of high quality, joint intermediation would

---

contract is a strict best reply against no contract. In addition, if there is an ε probability for each firm that it offers no contract, offering a joint contract is a strict best reply against an open contract (chosen with probability $1 - \varepsilon$).

not occur. In order to make this interpretation work the unknown brand has to make a side-payment to the established brand because otherwise the established brand has no incentive to join the intermediary.[15]

Firms will use joint intermediation if the costs of intermediation are sufficiently small compared to the cost of certification. We assume that

- **A.7.** $\pi_1([H, H]) - \Pi_1(H, H) > \Pi_1(H, H) - \Pi_1([H, H])$.

The assumption says that the gain from intermediation without certification instead of certifying outside the intermediary overcompensates the gain from avoiding the intermediary when certifying. Since we assume that the intermediary does not affect the pricing decision, we also have $\pi_1([H, H]) - \Pi_1(H, [H]) > \Pi_1(H, [H]) - \Pi_1([H, H])$. If profits are additively separable in intermediation costs and certification costs and these costs are constant then A.7 says that certification costs are less than twice the intermediation costs. A.7 replaces A.5.

Under moral hazard we show that firms choose high quality and that intermediation can partially replace certification. To define, the outcomes $([(H, C), (H, N)])$ and $([(H, N), (H, C)])$ are called *partial replacement outcomes*.

Proposition 6. *Given (B.D) (partial) and either (B.S) (neutral) or (B.S) (conditional punish), there exists a PBE which supports the partial replacement outcome in Game 1 and Game 2.*

When firms have chosen (H, H) they get to play a coordination game at the last stage because one of them must certify. We implicitly assumed that they are able to coordinate and that they do not play the mixed strategy equilibrium. Alternatively, one may assign the coordination role to the intermediary at stage 3. At stage 2 firms do not know who has to certify in case they both join the intermediary and in our symmetric setup, it is natural to assume that they assign equal probability to the two pure-strategy equilibria of the coordination game at stage 4. The following remarks consider other belief systems.

---

[15]In Wernerfelt (1988) a firm uses an established brand name for umbrella branding (in a two period model). A high quality good looses reputation if a low quality good is introduced under the same umbrella brand. In our interpretation an intermediary takes in an established brand name in order to signal the quality of a different brand. The established brand cannot loose its reputation.

- With belief system (B.D) (partial) and (B.S) (unconditional punish), in Game 1 only the outcome $((H, C), (H, C))$ can be supported by a PBE. In Game 2 under the full contract space there exists a PBE which supports the partial replacement outcome.

  With beliefs (B.D) (partial) and either (B.S) (conditional prize) or (B.S) (unconditional prize) there does not exist a PBE in pure strategies in Game 1 because there does not exist a pure strategy equilibrium in the subgames which follow (H, L) and (L, H). There does exist a PBE with beliefs (B.D) (partial) and (B.S) (conditional prize) with pure strategies in Game 2 in which firms choose high quality and sell through the intermediary.[16]

5. CONCLUSION

In a market with asymmetric information firms may use intermediation as a signal of product quality instead of certification. Since certification is a costly activity whereas intermediation only implies a redistribution of profits between producers and intermediary, intermediation is socially preferable to certification. Intermediation can occur under different judicial environments which legalize certain forms of contracts offered by producers and signed by the intermediary. In moral hazard environments, contracts which are conditioned on the behavior of the competitor improve the role of intermediation in the sense that intermediation occurs for a wider set of beliefs than if contracts are forced to be unconditioned. In this sense our results imply no negative effects of contract specifications such as exclusivity clauses. Under adverse selection the argument in favor of a particular

---

[16]A different pattern of partial replacement of certifiaction cost can emerge in Game 2 according to which one high quality product is sold through the intermediary. Under moral hazard the outcome $([(H, N)], (H, C))$ with probability $\frac{1}{2}$ and $((H, C), [(H, N)])$ with probability $\frac{1}{2}$ can be supported a PBE when firm choose from the full contract space. The system of beliefs has to be such that intermediation of both products has no signaling role or at least one product must be certified, i.e. (B.D)(no signal) or (B.D)(partial). In addition, a single intermediated product is perceived to be of high quality, i.e. (B.S)(unconditional prize). In this case firms choose exclusive contracts. Since the intermediary chooses the high quality product in the case (H, L), firms choose high quality at the first stage. Under the extension of the intermediary's strategy space there exist two PBE $([(H, N)], (H, C))$ and $((H, C), [(H, N)])$ with contracts (O_1, E_2) and (E_1, O_2) respectively if the intermediary has preferences $O_i \succ E_j$ and vice versa if $E_i \succ O_j$.

set of admissible contracts between producers and intermediary is however not compelling.[17]

In order to translate our analysis into the real world we should point out that our model is highly selective. We modelled intermediation as a pure signaling device. Our conclusions have to be reconsidered when intermediation is socially costly (e.g. via price distortions such as double marginalization). This seems possible in markets where intermediaries have great market power. There it might be desirable to guarantee producers the right to access consumer markets via an intermediary or alternatively to exclude the possibility of intermediation by enforcing vertical integration.

We only considered the case of a single intermediary. However, our results can also be obtained in a richer setup of competing intermediaries in which several intermediaries coexist.

---

[17]Clearly, the role of contracts in vertical relations does not only depend upon the signaling effect. The literature on the competitive effects of contracts is large, see Katz (1989) for a survey.

Appendix 1: Adverse Selection

Full replacement of certification

We now analyze the games with adverse selection. First, only open contracts are allowed. Nature, player N, chooses qualities at the first stage. Otherwise strategy spaces are the same as for Game 1 with moral hazard. Now the state (L, L) has positive probability whatever is the strategy profile adopted by firms and by the intermediary.

Take (B.D) (full) as the system of beliefs when both firms are at the intermediary and construct strategies (S.1.a.s).

Strategies (S.1.a.s.)
Stage 4: as for strategies S.1. *Stage 3*: as for strategies S.1. *Stage 2*: Firm 1, $(H, H) \Longrightarrow O_1$; $(H, L) \Longrightarrow Z_1$; $(L, H) \Longrightarrow Z_1$; $(L, L) \Longrightarrow Z_1$. Firm 2 as firm 1, analogously. *Stage 1*: Nature's choice.

Proposition 7. *The strategies S.1 (a.s.) and the belief systems (B.D) (full) and either (B.S) (neutral) or (B.S) (conditional punish) form a PBE of Game 1 (a.s.). Therefore at the subgame starting after the choice (H, H) by Nature the outcome is $[(H, N), (H, N)]$.*

Proof of Proposition 3 and proof of remark 3 in Appendix 3 imply Proposition 7.

- $((H, C), (H, C))$ following the choice of state (H, H) can also be supported by a PBE with beliefs (B.S) (neutral) or (B.S) (conditional punish). This weakens the result.

Under adverse selection in Game 2 there are equilibria where intermediation fully replaces certification in the state (H, H). However, as argued below these equilibria do not survive the elimination of weakly dominated strategies.

First, (B.S) (conditional prize) and (B.S) (unconditional prize) cannot be part of an equilibrium system of beliefs since $b((H, L) \mid ([N], N)) = 1$. This implies that in state (L, L) each firm has an incentive to deviate from the equilibrium prescription and to offer an exclusive contract. The intermediary signs an exclusive contract if the actions at stage 2 are (E_1, Z_2) or (Z_1, E_2) (and randomizing with equal probability between the two firms if they are (E_1, E_2)). The brand at the

intermediary is seen by the consumers as a high quality brand, which contradicts beliefs.

Second, under (B.S)(neutral) or (B.S)(conditional punish) there is no belief inconsistency of this kind. Consider the strategies S.1 modified so that the first stage choice is made by Nature, while at all the other stages the firms and the intermediary behave as prescribed by strategies; denote these as strategies S.1 (a.s.). The beliefs (B.S)(neutral) or (B.S)(conditional punish) and the strategies S.1 (a.s.) prescribe the following equilibrium paths under adverse selection. If Nature's choice results in the state (H, H) then both firms choose to propose the joint contract (J_1, J_2) the intermediary signs with both and both avoid certification costs. If the state is (H, L) or (L, H) then both firms choose no-contract and no one is intermediated; the high quality firm then pays the certification costs. If the state is (L, L) both firms sell directly because they choose (Z_1, Z_2) at stage 2. For each of the systems of beliefs (B.D)(full) and either (B.S)(neutral) or (B.S)(conditional punish) or (B.S)(unconditional punish) a strategy can be constructed such that this strategy and the belief system form a PBE of Game 2 (a.s.).

Remark that there is something, however, of a disturbing feature in the prediction given by all equilibria with intermediation. Consider indeed the subgame starting after Nature has chosen the state (L, L) in Game 2 (a.s.). The equilibrium strategies prescribe the couple of mutual best replies (Z_1, Z_2), and the equilibrium payoffs are $\pi_i(L, L)$. However, given the belief systems from above the strategy pair (J_1, J_2) is also a pair of mutual best replies; consider firm 1: if the other firm also offers the joint contract then the strategy of the intermediary at stage 3 is that of signing with both firms, and the belief system is such that $b((H, H), [N, N]) = 1$, both firms will then be believed to be of high quality. The payoff following (J_1, J_2) is $\pi_1([h, h])$. Against J_2 all choices different from J_1 lead to payoffs that do not exceed $\pi_1([h, h])$ (indeed only O_1 against J_2 leads to the same outcome and payoff) therefore (J_1, J_2) does constitute a couple of mutual best replies. Although by definition of a Bayesian equilibrium the choice of (J_1, J_2) cannot be part of a PBE because it invalidates the belief system, and therefore although the equilibrium as such is not upset by the fact that (J_1, J_2) is a couple of mutual best replies, we find it disturbing[18] to accept the prediction of (Z_1, Z_2)

---

[18]It may be noted that in the subgame starting after Nature has chosen (L, L), given beliefs (B.S)(neutral) or (B.S)(punish), the (J_1, J_2) pair cannot be dismissed by using elimination of dominated strategies. Indeed, it is easy to show that O_i is weakly dominated by J_i; but then,

as a satisfactory one in the state (L, L).

Partial replacement of certification

Also under adverse selection some systems of beliefs support partial replacement of certification. Proposition 8 shows that intermediation can partly replace certification when Nature chooses (H, H). The equilibrium survives the elimination of weakly dominated strategies.

Proposition 8. *In the setup with adverse selection, there exists a PBE which supports partial replacement when Nature's choice gives (H, H) in each of the following cases: given (B.D)(partial) and either (B.S)(neutral) or (B.S)(conditional punish) under the restricted or the unrestricted contract space; and given (B.D)(partial) and (B.S)(unconditional punish) only under the unrestricted contract space. When Nature's choice gives state (H, L) then the outcome implies certification by the high quality and no intermediation, namely it is $((H, C), (L, N))$ (symmetrically for (L, H)). If Nature's choice gives state (L, L) then $((L, N), (L, N))$ obtains.*

The proof follows easily from the proof of Proposition 6 (see Appendix 3). Note that there is no difference between the partial certification PBE of Game 1 (a.s.) and that of Game 2 (a.s.) except that the same remarks apply as those in section 3.2 and 3.3 about the existence of two PBE, one where the outcome is $((H, C), (H, C))$ and another where it is the partial replacement outcome and that in Game 2 (a.s.) partial replacement is supported by an additional belief system.

- (B.S)(conditional prize) and (B.S)(unconditional prize) cannot support a PBE under adverse selection. Given these beliefs each of two low-quality

the couple (J_1, J_2) resists the application of iterated weak dominance in that subgame. By contrast, it is (Z_1, Z_2) that does not. Again, although this does not mean that (J_1, J_2) is part of a Bayesian Equilibrium, it weakens the equilibrium prediction. (To show that O_i is weakly dominated by J_i note that against the exclusive contract choice by firm 2 it is better to choose J_1 which leads to payoff $\pi_1(h, [L])$—since the intermediary takes the opponent in but cannot take both in—rather than choose O_1 which allows him to take both firms in and leads to payoff $\pi_1([h, h]) < \pi_1(h, [L])$. The same payoff inequality follows from the choice of O_1 instead of J_1 against the no-contract option Z_2. Against strategy J_2 or O_2 the choice of J_1 or O_1 leads to the same payoff since both firms are going to be intermediated.)

firms has an incentive to be traded alone by an intermediary. This either violates beliefs or rules out the existence of mutual best replies in a subgame.

Appendix 2: All systems of beliefs

In this appendix we summarize the results for all systems of beliefs in which shared intermediation can be a signal. Given single intermediation there are 16 different fully separating beliefs. The table reads as follows. If in column $[N], N$ the pair (L, L) appears this means that $b((L, L)|([N], N)) = 1$.

#	$[N], N$	$[C], N$	$[N], C$	#	$[N], N$	$[C], N$	$[N], C$
1	(L, L)	(H, L)	(H, H)	9	(L, H)	(H, L)	(H, H)
2	(L, L)	(H, L)	(L, H)	10	(L, H)	(H, L)	(L, H)
3	(L, L)	(H, H)	(H, H)	11	(L, H)	(H, H)	(H, H)
4	(L, L)	(H, H)	(L, H)	12	(L, H)	(H, H)	(L, H)
5	(H, L)	(H, L)	(H, H)	13	(H, H)	(H, L)	(H, H)
6	(H, L)	(H, L)	(L, H)	14	(H, H)	(H, L)	(L, H)
7	(H, L)	(H, H)	(H, H)	15	(H, H)	(H, H)	(H, H)
8	(H, L)	(H, H)	(L, H)	16	(H, H)	(H, H)	(L, H)

Beliefs 2 correspond to (B.S)(neutral) in the main text, beliefs 6 to (B.S) (conditional prize), beliefs 5 to (B.S) (un conditional prize), beliefs 10 to (B.S) (conditional punish), and beliefs 12 to (B.S) (unconditional punish). Assumptions A.1-A.7 are supposed to hold. We characterize pure strategy PBE after the elimination of weakly dominated strategies. With 'full' we denote the full replacement outcome $([(H, N), (H, N)])$ and with 'partial' we denote the partial replacement outcome. The outcome $((H, C), (H, C))$ is denoted by 'certify'. A 'no' sign means that there is no pure strategy PBE for the particular system of beliefs. In two cases marked with a star single intermediation with the outcomes $([(H, N)], (H, C))$ and $((H, C), [(H, N)])$ occur with equal probability. The following table summarizes the results for all possible separating systems of beliefs for which shared intermediation is not neutral.

| | (B.D)(full) | | (B.D)(partial) | |
#	Game1	Game 2	Game 1	Game 2
1	*no*	full	*no*	partial
2	full,certify	full	partial, certify	partial
3	*no*	*no*	*no*	*no*
4	certify	full	certify	partial
5	*no*	full	*no*	*
6	*no*	full	*no*	partial
7	*no*	full	*no*	*
8	*no*	*no*	*no*	*no*
9	*no*	*no*	*no*	*no*
10	full, certify	full	partial, certify	partial
11	certify	full	certify	partial
12	certify	full	certify	partial
13	*no*	*no*	*no*	*no*
14	full, certify	full	partial, certify	partial
15	*no*	*no*	*no*	*no*
16	*no*	*no*	*no*	*no*

Appendix 3: Proofs

Proof of Proposition 1

Moral hazard case: In subgame (H, H), (C, C) are mutual best replies given beliefs (B.N). In subgame (L, H) firm 2 certifies. A deviation at stage 1 to (L, H) affords profits $\pi_1(L, H) < \Pi_1(H, H)$.

Adverse selection case: Given (B.N) high quality brands are always certified as such at stage 2. At stage 1B firms with the technology to produce high quality have an incentive to stay in the market and not to downgrade their brand. ■

Discussion of A.4

Under A.4 (adverse selection) for a type H firm certification costs do not prevent the revelation of state (H, L) to be more profitable than leaving consumers with the belief that the quality of its brand is average.

Given our assumptions there are only two possible equilibrium outcomes in the moral hazard case: either $((H, C), (H, C))$ or $((L, N), (L, N))$ are chosen along the equilibrium path. In particular, $((H, N), (H, N))$ cannot be supported as a PBE

(see proof of Proposition 2 below). A.4 (moral hazard) implies that high quality firms certify in any PBE under moral hazard.

Since it is also true that $\Pi_1(H, L) > \pi_1(l, L)$ and since beliefs symmetry holds under the action pair (N, N) A.4 (moral hazard) implies that in state (H, L) firm H chooses to certify irrespective of what beliefs prevail if it does not certify. Under A.4 (moral hazard) $((L, N), (L, N))$ cannot be an equilibrium outcome.

It is easy to show that if a separating PBE exists then consumers' beliefs are such that a firm which does not certify is believed to be of quality L in the presence of a high quality firm which certifies. The only other belief system apart from (B.N) which can support a fully separating PBE is (B.N)' with $b((H, H)|(C, C)) = 1$, $b((H, L)|(C, N)) = 1$, $b((H, H)|(N, N)) = 1$.

Proof of Proposition 2
Adverse selection case: First note that low quality firms always enter the market. The state (L, H) cannot have a zero posterior given that it is chosen by Nature and both firms stay in. By A.5 the high quality firm certifies if it stays in the market. Since the associated profit is positive it stays in the market, so does the low quality firm. Consequently, $b((L, H)|(N, C)) > 0$. Since states are chosen with equal probability and only high quality firms can certify, the observation of (N, C) implies that $\frac{1}{2} \geq b((H, H)|(N, C)) \geq 0$. Hence, if a firm does not certify it can at most be believed to be of average quality. In the state (H, L) when firm 2 is believed to be of quality q certification gives $\Pi_1(H, q)$ whereas N gives $\pi_1(q, q)$. By A.4 C is a best reply to N because $\pi_1(q, q) \leq \pi_1(\overline{q}, q)$. This implies that $b((L, L)|(N, N)) = 1$. If Nature has chosen (H, H), C is a best reply to N by the same argument as above. C is also a best reply to C because $\Pi_1(H, H) > \pi_1(\overline{q}, H)$. Hence, both firms certify in state (H, H). Therefore, the observation (C, N) perfectly reveals the state (H, L) and $b((H, L)|(C, N)) = 1$. At stage 1B high quality firms always enter the market because $\Pi_1(H, H) > 0$. Similar argument for the case when firms can downgrade from high to low quality.

Moral hazard case: In subgame (H, H) if N is best reply to C then at stage 1 L is best reply to H. This implies that $b((H, H)|(N, C))$ has to be sufficiently small in order to support $((H, C), (H, C))$. (N, C) cannot be mutual best replies in subgame (H, H). In order to support $((H, N), (H, N))$, (N, N) have to be mutual best replies, i.e. $\pi_1(q, q) > \Pi_1(H, q)$ where q is the perception of a high quality brand. This outcome cannot be supported because a deviation at stage 1 to L is profitable. Also, $((H, N), (H, C))$ with some probability α and $((H, C), (H, N))$ with probability $1 - \alpha$ cannot be supported: to support this outcome beliefs must

satisfy $b((H,H)|(N,C)) = 1$. Consider a deviation to L at stage 1. By A.4, the high quality firm certifies at the last stage and the low quality firm makes profits $\pi_1(h,H)$. Hence, a deviation is profitable. In order to have equilibrium qualities (H,L) and (L,H) beliefs have to satisfy $b((H,H)|(N,C)) = 0$. Given this belief, (C,C) are mutual best replies in the subgame (H,H) and a deviation from L to H at stage 1 (with certification at stage 2) is profitable. There exists a unique equilibrium in the subgame (H,H) if $\Pi_1(H,L) > \pi_1(q,q)$. If this inequality is violated, (N,N) are also mutual best replies and we do not have a unique prediction for a deviation from L to H at stage 1 but in this case a deviation from H to L by the other firm is profitable. Hence, qualities (H,L) and (L,H) cannot be chosen in equilibrium. Because of A.4 $((L,N),(L,N))$ can be ruled out as equilibrium outcomes. Consequently, the only possible equilibrium outcome is $((H,C),(H,C))$. ∎

Proof of Proposition 3

Stage 4

0) If firm 1 is L then it cannot certify.

1) Firm 1 is H.

1.a) $([H,.])$. According to the system of beliefs (B.D) (full) certification is redundant if $([.,.])$ and firm 1 does not certify even if its opponent is L as this is a waste of resources.

1.b) If $([H],.)$ or $(H,[.])$ then certification is a dominant strategy for firm 1 because single intermediation is no signal under (B.S) (neutral). To be precise, if $([H],H)$, i.e. firm 1 is H and is *in* and Firm 2 is H and *out* then since $b((L,L) \mid ([N],N)) = b((L,H) \mid ([N],C)) = 1$ no-certification is dominated by certification because $\pi_1([l],H) < \Pi_1([H],H)$ and $\pi_1([l],l) < \Pi_1([H],l)$. If $([H],L)$, then firm 1 certifies because $\pi_1([l],L) < \Pi_1([H],L)$. If $(H,[H])$, it is a dominant strategy for firm 1 to certify and it obtains $\Pi_1(H,[H]) > \pi_1(l,[H])$ or $\Pi_1(H,[l]) > \pi_1(l,[l])$.

1.d) If $(H,[L])$, then firm 1 certifies since firm 2 is L it cannot certify and no-certification by firm 1 leads to beliefs $b((l,L) \mid (N,[N])) = 1$, which affords firm 1 with payoff $\pi_1(H,[L])$ while certification would reduce it by the certification costs.

1.c) $(H,.)$, i.e. both firms are *out* then the game has the same outcomes as Game 0, without intermediation, and certification is a dominant strategy for firm 1.

Stage 3. Intermediary's choices.

(a) Whenever $I(a_1,a_2)$ is a singleton then the intermediary's choice is trivial. (b) Whenever $[12] \in I(a_1,a_2)$ then the intermediary signs with both because of

the assumption that $\pi_I([q_1, q_2]) > \max\{\pi_I([q_1], q_2), \pi_I(q_1, [q_2])\}$. (c) If $I(a_1, a_2) = \{[i], quit\}$ then participation is preferred.

Stage 2

State (H, H). Then firm 1's choice of O_1 against O_2 gives $\pi_1([H, H])$; the choice of Z_1 leads to the situation $(H, [H])$ given the intermediary's strategies at stage 3, and both firms and firm 1 gets $\Pi_1(H, [H])$ which according to A.5 is lower than $\pi_1([H, H])$. Therefore O_1 is a best reply to O_2.

State (H, L). The unique firm 1's best reply to Z_2 is Z_1 because O_1 would lead to the situation $([H], L)$ but then the only way to unmask the opponent is to certify since otherwise $b((L, L) \mid ([N], N)) = 1$; but then certification and intermediation add up and are redundant, i.e. $\Pi_1(H, L) > \Pi_1([H], L)$.

State (L, H). Firm 1's best reply to Z_2 is Z_1 because $\pi_1(L, H) > \pi_1([L], H)$.

(Joined deviation) State (L, L). Then firm 1's unique best reply to Z_2 is Z_1 since proposing O_1 leads to the intermediary taking in firm 1 and, since no firm can certify firm 1 would obtain payoff $\pi_1([L], L)$. But the equilibrium strategy Z_1 affords payoff $\pi_1(L, L) > \pi_1([L], L)$.

Stage 1

Since Firm 2 is choosing H then choice of L would lead to $\pi_1(L, H)$ while choice of H leads to intermediation of both firms and no certification, i.e. to a payoff equal to $\pi_1([H, H]) > \pi_1(L, H)$. ∎

Proof of Remark 4 (B.S)(conditional punish)

We show that (B.D)(full) and (B.S)(conditional punish) and the following strategy S.1' form a PBE.

Strategies S.1'

Stage 4: (consider firm 1) (a) if firm 1 is L then $c_1 = N$. (b) If $([H, .])$ then $c_1 = N$; if $([H], .)$ then $c_1 = C$. In the case $(H, [.])$, if firm 2 is H then $c_1 = C$, while if firm 2 is L then $c_1 = N$. In the case $(H, .)$ then C. Same for firm 2, analogously.

Stage 3: The intermediary chooses *quit* if $(a_1, a_2) = (Z_1, Z_2)$, chooses [12] if $(a_1, a_2) = (O_1, O_2)$ finally she chooses $[i]$ whenever $a_i = O_i$ and $a_j = Z_j$.

Stage 2: Firm 1 (and analogously for firm 2) chooses according to the state that prevails after stage 1 quality choices:$(H, H) \Longrightarrow O_1$; $(H, L) \Longrightarrow Z_1$; $(L, H) \Longrightarrow Z_1$; $(L, L) \Longrightarrow Z_1$.

Stage 1: $q_i = H$ for $i = 1, 2$.

Stage 4

0) If firm 1 is L then it cannot certify.

1) Firm 1 is H.

1.a) $([H,.])$. According to the system of beliefs (B.D)(full) certification is redundant if $([.,.])$ and firm 1 does not certify even if its opponent is L as this is a waste of resources.

1.b) If $([H],H)$, i.e. firm 1 is H and is *in* and Firm 2 is H and *out* then since $b((L,H) \mid ([N],N)) = b((L,H) \mid ([N],C)) = 1$ no-certification is dominated by certification because $\pi_1([l],H) < \Pi_1([H],H)$.

1.c) If $([H],L)$, then firm 1 certifies because $\pi_1([l],H) < \Pi_1([H],L)$.

1.d) If $(H,[H])$, since $c_2 = C$ is prescribed to firm 2 by the equilibrium strategy (and it is a dominant strategy for firm 2 by 1.b.above) then firm 1 certifies and obtains $\Pi_1(H,[H]) > \pi_1(l,[H])$.

1.e) If $(H,[L])$, then since firm 2 is L it cannot certify and no-certification by firm 1 leads to beliefs $b((H,L) \mid (N,[N])) = 1$, which affords firm 1 with payoff $\pi_1(H,[L])$ while certification would reduce it by the certification costs.

1.f) $(H,.)$, i.e. both firms are *out* then the game has the same outcomes as Game 0, without intermediation, and certification is a dominant strategy for firm 1.

Stage 3. Intermediary's choices.
(a) Whenever $I(a_1,a_2)$ is a singleton then the intermediary's choice is trivial. (b) Whenever $[12] \in I(a_1,a_2)$ then the intermediary signs with both because of the assumption that $\pi_I([q_1,q_2]) > \max\{\pi_I([q_1],q_2), \pi_I(q_1,[q_2])\}$. (c) If $I(a_1,a_2) = \{[i], quit\}$ then participation is preferred.

Stage 2

State (H,H). Then firm 1's choice of O_1 against O_2 gives $\pi_1([H,H])$; the choice of Z_1 leads to the situation $(H,[H])$ given the intermediary's strategies at stage 3, and firm 2 must then certify so that firm 1 also must certify and it gets $\Pi_1(H,[H])$ which according to A.5 is lower than $\pi_1([H,H])$. Therefore O_1 is a best reply to O_2.

State (H,L). It is a dominant strategy of firm 1 to offer Z_1 because O_1 would either lead to the situation $([H],L)$ and $\Pi_1(H,L) > \Pi_1([H],L)$ or to the situation $([H,h])$ and $\pi_1(H,[L]) > \pi_1([H,h])$.

State (L,H). Firm 1's best reply to Z_2 is Z_1 because $\pi_1(L,H) > \pi_1([L],H)$.

State (L,L). Then firm 1's unique best reply to Z_2 is Z_1 since proposing O_1 leads to the intermediary taking in firm 1 and, since no firm can certify firm 1 would obtain payoff $\pi_1([L],H)$. But the equilibrium strategy Z_1 affords payoff $\pi_1(L,L) > \pi_1([L],H)$.

Stage 1

Since Firm 2 is choosing H then choice of L would lead to $\pi_1(L, H)$ while choice of H leads to intermediation of both firms and no certification, i.e. to a payoff equal to $\pi_1([H, H]) > \pi_1(L, H)$. ∎

Sketch of proof of second part of Remark 6 (B.S) (unconditional prize)

First notice that (H, H) is upset because L is a best reply to H; indeed if the opponent chooses H then it is optimal to choose L at the first stage and to propose an open contract at the second stage: then the opponent of type H will prefer to offer an open contract to the intermediary if $\Pi_1(H, [h]) < \pi_1([H, h])$. (With a different argument one can take care of the reverse inequality.) Then firm L will get profits $\pi_2([H, h])$. This exceeds the profit $\pi_2([H, H])$ which follows after the proposed equilibrium path is followed, i.e. after the choice of (H, H). By contrast, if the opponent chooses L then it is a best reply to choose L. Indeed under the above inequality the choice of H would lead to a subgame where the equilibrium payoff is $\pi_1([H, h])$, (as shown in the argument showing that L is a best reply to H) while the choice of L leads to a subgame where both firms are L and both propose an open contract, the intermediary has an incentive to accept both and will do so, and the final payoff shall be $\pi_1([h, h])$ for each firm. ∎

Proof of Proposition 4

Stage 4

0) If firm 1 is L then it cannot certify.

1) Firm 1 is H.

a) $([H, .])$. According to the system of beliefs certification is redundant if $([., .])$ and firm 1 does not certify even if its opponent is L as this is a waste of resources.

b) If $(H, [.])$, i.e. firm 1 is H and is *out* and Firm 2 is *in* then certification is a dominant strategy because $\pi_1(l, [H]) < \Pi_1(H, [H])$ and $\pi_1(l, [h]) < \Pi_1(H, [L])$.

c) If $([H], .)$ then if firm 2 is L then do not certify because firm 2 cannot certify and good 1 is recognized as H independent of certification. In the other case where firm 2 is H, firm 2 will certify by (b) above. Consequently, in this case firm 1 also certifies because $\pi_1([l], H) < \Pi_1([H], H)$.

d) If $(H, .)$, i.e. both firms are *out* then the game has the same outcomes as Game 0, without intermediation, and certification is a dominant strategy for firm 1.

Stage 3

Intermediary's choices.

A) (H, H)

a.1) If $[12] \in I(a_1, a_2)$ then she signs with both brands since she prefers to trade two high quality products rather than only one high quality brand because $\pi_I([H], H) < \pi_I([H, H])$. She also prefers to trade than not to trade in this case.

a.2) If $[1]$ and $[2] \in I(a_1, a_2)$ the intermediary is indifferent and randomizes with equal probabilities.

a.3) If $\{[i], quit\} = I(a_1, a_2)$, then she chooses $[i]$, because she prefers to be active.

B) (H, L) (and (L, H) analogously).

b.1) under the assumption that $\pi_I([H], L) < \pi_I([H, h])$ and $\pi_I([L], H) < \pi_I([h, H])$ the intermediary takes in both brands if $[12] \in I(a_1, a_2)$. Note that if the first inequality is reversed the intermediary actively selects H (if element of the choice set) even though she might trade both brands, and the proposition remains valid.

b.2) If $[1]$ and $[2] \in I(a_1, a_2)$ the intermediary actively selects the high quality product. This is the main difference of the consequences of the change in the belief system. Choosing the high quality is more profitable because $\pi_I([H], L) > \pi_I(H, [L])$.

b.3) $\{[i], quit\} = I(a_1, a_2) \Longrightarrow [i]$, because she prefers to be active.

C) (L, L).

c.1) If $[12] \in I(a_1, a_2)$ then she signs with both brands. She prefers to trade two low quality brands rather than only one low quality brand because $\pi_I([h], L) < \pi_I([h, h])$. She also prefers to trade than not to trade in this case.

c.2) If $[1]$ and $[2] \in I(a_1, a_2)$ the intermediary is indifferent and randomizes with equal probabilities.

c.3) $\{[i], quit\} = I(a_1, a_2) \Longrightarrow [i]$, because she prefers to be active.

Stage 2

Case (H, H). If firm 2 plays J_2 according to the equilibrium prescription then playing J_1 leads to $\pi_1([H, H])$. It is a (weak) best reply to play J_1 because otherwise the outcome would be $(., .)$ and certification would be needed but $\Pi_1(H, H) < \pi_1([H, H])$.

Case (H, L). Then firm 1 chooses E_1. Note that this also holds under reversed inequality in (b.1) in this proof. Given E_1 it holds that $[1] \in I(a_1, a_2)$ and $[12] \notin I(a_1, a_2)$. From (b.2) and (b.3) it follows that the intermediary chooses E_1. This contract is a dominant strategy because $\pi_1([H], L) > \Pi_1(H, L)$ and $\pi_1([H], L) > \Pi_1(H, [L])$ and $\pi_1([H], L) > \pi_1([H, h])$.

Case (L, H). Then since the opponent is choosing E_2 as a dominant strategy and given the equilibrium following the subgame where $(q_1, q_2) = (L, H)$ and $[2] \in I(a_1, a_2)$ then $\pi_1(L, [H])$ follows from any choice by 1 at this stage (indifference).

Case (L, L). Then if firm 2 follows the equilibrium prescription it chooses E_2 and then E_1 gives profits $\frac{1}{2}\pi_1([h], L) + \frac{1}{2}\pi_1(L, [h])$. This is a strict best reply because *no contract*, O_1 and J_1 give profits $\pi_1(L, [h])$. However, this subgame can only be reached by joint deviations.

Stage 1

If firm 2 chooses H then if firm 1 chooses L it shall obtain $\pi_1(L, [H])$ while if it chooses H it shall obtain $\pi_1([H, H])$. Hence, H is a best reply to L. Note that H is a dominant strategy at stage 1 if $\pi_1([H], L) > \frac{1}{2}\pi_1([h], L) + \frac{1}{2}\pi_1(L, [h])$ holds.[19] ∎

Sketch of proof of Proposition 5

(L, L) cannot be supported by a PBE because firms choose exclusive contracts at stage 2. Single intermediation of a low quality product violates beliefs. With the arguments of the proof of Proposition 4 it is shown that (H, L) and (L, H) are not chosen in equilibrium.

Subgame (H, H). $(O_1, J_2), (J_1, O_2), (O_1, O_2), (J_1, J_2)$ are weak mutual best replies. J_i weakly dominates O_i. Consider (E_1, E_2). For firm 1 a deviation to Z_1 is profitable because $\Pi_1(H, [H]) > \Pi_1([H], H)$. Also, (E_1, Z_2) and (Z_1, E_2) are not mutual best replies because $\Pi_1(H, H) > \Pi_1([H], H)$. Clearly, E_1 is neither a best reply to J_2 nor to O_2. (Z_1, Z_2) are weak mutual best replies but J_i weakly dominates Z_i. Clearly, Z_1 is neither a best reply to J_2 nor to O_2. ∎

Proof of Proposition 6

We proof the result with (B.S) (conditional punish) in Game 1. Strategies are similar to S.1. The only difference is at the certification stage (stage 4) when a brand is high quality.

If H then (b1) if $([H, H])$ then either one of the firms certifies (firms solve the coordination problem), (b2) if $([H, L])$ then certify, (b.3) else certify.

We modify the proof of proposition 3 as follows. At stage 4 in the analysis of (0), (1.b) and (1.c) remains. (1.a) is different. If $([H, .])$ at least one firm has to certify in order to make consumers believe that brands are of high quality. If

---

[19]Hence, (L, L) are not mutual best replies if $\pi_1([H], L) - \pi_1(L, [H]) > \pi_1([h], L) - \pi_1([H], L)$ which holds if the production of high quality is not too costly.

$([H, L])$, only firm 1 can certify. This is profitable if $\Pi_1([H, h]) > \pi_1([l, L])$. This follows from A.4. Since $\pi_1(L, L) > \pi_1(l, L)$ and intermediation does not affect the profit ranking we have $\Pi_1([H, h]) > \pi_1([l, L])$. If $([H, H])$, firms face a coordination game with two pure strategy equilibria which they are supposed to solve (where e.g. the intermediary takes the role of a coordination device). *Ex ante* each firm pays half the certification cost, i.e. firm 1 makes profits $\frac{1}{2}\pi_1([H, H]) + \frac{1}{2}\Pi_1([H, H])$, if they follow the "fair" coordination device. A deviation leads to *ex ante* profits $\frac{1}{2}\pi_1([l, l]) + \frac{1}{2}\pi_1([H, H])$. By A.4 $\Pi_1(H, H) > \pi_1(L, L)$. Since $\pi_1(L, L) > \pi_1(l, l)$ and intermediation does not affect the profit ranking, a deviation is not profitable.

Stage 3 in the proof of proposition 3 remains unchanged. At Stage 2 no changes have to be made except for the state (H, H). Firms offer open contracts O_i if the qualities are (H, H). These are mutual best replies because a deviation to Z_1 gives profits $\Pi_1(H, [H])$ which is strictly less than $\frac{1}{2}\pi_1([H, H]) + \frac{1}{2}\Pi_1([H, H])$ by A.7. At stage 1 firms choose high quality because according to A.3 and A.7 $\frac{1}{2}\pi_1([H, H]) + \frac{1}{2}\Pi_1([H, H]) > \pi_1(L, H)$. ∎

.

References

[1] Bernheim, B.D. and M.D. Whinston (1998), Exclusive dealing, Journal of Political Economy 106, 64-103.

[2] Besanko, D. and M. Perry (1993), Equilibrium incentives for exclusive dealing in a differentiated industry, Rand Journal of Economics 24, 646-667.

[3] Biglaiser, G. (1993), Middlemen as experts, Rand Journal of Economics 24, 212-223.

[4] Biglaiser, G. and J.W. Friedman (1994), Middlemen as guarantors of quality, International Journal of Industrial Organization 12, 509-533.

[5] Bonanno, G. and Vickers (1988), Vertical separation, Journal of Industrial Economics, 36, 257-265.

[6] Chu, W. and W. Chu (1994), Signaling quality by selling through a reputable retailer: an example of renting the reputation of another agent, Marketing Science 13, 177-189.

[7] Economides, N. (1989), Quality variations and maximal variety differentiation, Regional Science and Urban Economics 19, 21-29.

[8] Fudenberg, D. and J. Tirole (1991), Game Theory, Cambridge, Mass.: MIT Press.

[9] Gabszewicz, J. and J.-F. Thisse (1979), Price competition, quality and income disparities, Journal of Economic Theory, 20, 340-359.

[10] Katz, M.L. (1989), Vertical contractual relations, in: Schmalensee, R. and R. Willig (eds.), Handbook of industrial economics, vol. 1, Amsterdam: North Holland.

[11] Kihlstrom, R. and M. Riordan (1984), Advertising as a signal, Journal of Political Economy 92, 427-450.

[12] Lin, J. Y. (1990), The dampening of competition effect of exclusive dealing, Journal of Industrial Economics, 39, 209-223.

[13] Mannering, F. and C. Winston (1991), Brand loyalty and the decline of the American automobile industry, Brookings Papers on Economic Activity, 0(0) Microeconomics, pp. 67-103.

[14] Martimort, D. (1996), Exclusive dealing, common agency, and multiprincipals incentive theory, Rand Journal of Economics 27, 1-31.

[15] Marvel, H.P. (1982) Exclusive dealing, Journal of Law and Economics 30, 1-25.

[16] Marvel, H. and S. McCafferty (1984), Resale price maintenance and quality certification, Rand Journal of Economics 15, 346-359.

[17] Mathewson, G.F. and R.A. Winter (1987), The competitive effects of vertical agreements: a comment, American Economic Review 77, 1057-1068.

[18] Milgrom P. and J. Roberts (1986), Price and advertising signals of product quality, Journal of Political Economy, 94, 796-821.

[19] Nelson, P. (1974), Advertising as information, Journal of Political Economy 81, 729-754.

[20] Ornstein, S.I. (1989) Exclusive dealing and antitrust, Antitrust Bulletin 34, 65-98.

[21] Shaked A. and J. Sutton (1982), Relaxing price competition through product differentiation, Review of Economic Studies, 49, 1-13.

[22] Spulber, D. (1996), Market microstructure and intermediation, Journal of Economic Perspectives 10, 135-153.

[23] Wernerfelt, B. (1988), Umbrella branding as a signal of new product quality: an example of signalling by posting a bond, Rand Journal of Economics 19, 458-466.