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Price and non-price restraints when retailers are vertically differentiated

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Abstract

We consider an intrabrand competition model with a single manufacturer (M) and two vertically differentiated retailers. We show that when markets cannot be vertically segmented and the cost difference between the retailers is not too large, M will foreclose the low quality retailer. When markets can be vertically segmented, M will impose customer restrictions and assign consumers with low (high) willingness to pay to the low (high) quality retailer. This restriction benefits M and consumers with low willingness to pay (including some who are forced to switch to the low quality retailer), but harms consumers with high willingness to pay.

JEL classification: L42; K21

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1. Introduction

Vertical restraints in the relationship between manufacturers and distributors or retailers, such as resale price maintenance (RPM), exclusive territories, and

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customer restrictions are the subject of ongoing legal and academic debate. On one side of the debate, advocates of the Chicago school like Bork (1978) and Easterbrook (1984) argue that the main purpose of vertical restraints is to improve the efficiency of vertical relationships and hence should pose no antitrust concerns. On the other side of the debate, those like Baxter (1984), Pitofsky (1978, 1983), and Comanor and Frech (1985) discount the welfare enhancing properties of vertical restraints and emphasize their potential anticompetitive effects. Traditionally, the courts in the US have treated price restraints as per se illegal, while the treatment of non-price based restraints has varied sharply over the years, thereby reflecting the lack of consensus regarding the competitive effects of these practices.[1]

In this paper we study the role of vertical restraints in the context of an intrabrand competition model. We consider a single manufacturer (M) and two vertically differentiated retailers facing a continuum of potential consumers with varying degrees of willingness to pay for customer services. This setting is motivated by the observation that in practice, manufacturers can distribute their products through upscale retailers as well as through no-frills discount retailers. The former offer a higher level of cum-sales services (highly trained sales staff, technical advice, demonstrations, ambient atmosphere, quick delivery), and/or post-sale services (extended in-store warranties, generous return policies, reliable maintenance and repair services) than the latter. We, therefore, assume that M faces one retailer who provides a high level of customer services (H), and one who provides a low level of customer services (L). For instance, H could be an upscale department or a specialty store with a highly trained sales staff who can provide technical advice and demonstrations, whereas L could be a discount warehouses that lacks trained staff and ambiance, or an internet retailer who cannot provide direct technical advice and demonstrations. We then ask what kinds of vertical restraints M would like to impose in its relationship with the two types of retailers and what are the implications of these restraints.

We establish two main results. The first result concerns anonymous markets in which consumers cannot be identified according to their willingness to pay for customer services. We show that so long as the cost difference between the two

[1] The per se illegality of price restraints was first established by the US Supreme court in *Dr. Miles Medical Co. v. John D. Park Sons Co.* 220 US 373 (1911). In recent years, the Court has progressively narrowed the scope of the per se illegality rule in *Monsanto Co. v. Spray-Rite Service Corp.* 465 US 752, 761 (1984) and in *Business Electronics Corp. v. Sharp Electronic Corp.* 485 US 717, 724 (1988). In *State Oil Co. v. Khan*, 66 L.W. 4001 (1997), the Court declared that maximum RPM should be judged under the rule of reason. With regard to non-price restraints, the Court has ruled in *United States v. Arnold Schwinn & Co.* 388 US 365 (1967) that territorial restrictions are also illegal per se, but reversed this decision in *Continental T.V. Inc. v. GTE Sylvania* 433 US 36 (1977). For excellent surveys of the law and economics of vertical restraints, see Matheweson and Winter (1985, 1998) and Comanor and Rey (1997). A historical perspective on the legal treatment of RPM in the US is offered in McCraw (1996).

retailers is not too big (in the sense that if both retailers sell at marginal costs, all consumers who wish to buy will choose to buy from H), it is optimal for M to foreclose L. This can be achieved by either (i) making H an exclusive distributor, (ii) setting a sufficiently high wholesale price along with a maximum RPM, or (iii) setting a sufficiently high franchise fee. Although the foreclosure of L means that only the high end of the market is served, the absence of competition from L enables H to earn higher profits, which in turn allows M to charge a higher franchise fee.[2,3] M's ability to foreclose L by setting a sufficiently high franchise fee suggests that vertical restraints like exclusive distribution agreements or RPM are not used, in the context of our model, with the sole purpose of foreclosing discount retailers who provide low level of customer services and hence should not be condemned on that basis alone.[4]

There are many examples for refusal of manufacturers to deal with low service, discount retailers. Matheweson and Winter (1985) report that in the 1970s, H.D. Lee of Canada refused to deal with Army and Navy stores that were known for their low prices and low services. Greening (1984) reports that in the 1970s, Florsheim shoes attempted to secure exclusive dealings with medium to high quality specialty retailers that kept a full line inventory and provided ample sales clerk assistance, good return policies, and a high level of ambiance (which Florsheim viewed as an important element of the package it offered to customers). Moreover, Florsheim tried to prevent its retailers from raising or lowering their prices during the regular non-clearance sale period. Utton (1996) reports that manufacturers of fine fragrances (expensive brand name perfumes) in the UK refused to sell to certain retailers like Tesco and Superdrug on the grounds that they failed to meet special standards of display, service, and ambiance (an important factor in the sale of fine fragrances). In addition, the manufacturers

[2] A similar point has been made in a 1970 report on *Refusal to Sell* by the UK Monopolies and Mergers Commission cited in Utton (1996). According to this report, ' . . . a supplier may estimate that he does better by catering for a limited class of customer who will pay for exclusiveness than by extending his outlets and risking the loss of his exclusive trade.'

[3] The incentive to foreclose L will only be strengthened if the level of customer services is endogenous provided that we maintain the realistic assumption that one retailer is more upscale than the other (e.g. an upscale department store vs. a discount warehouse). This is because the familiar free-rider problem implies that H has the strongest incentive to enhance its sales efforts when it is an exclusive distributor. Our first result shows that M wishes to foreclose L even if this consideration is absent.

[4] Traditionally, the legal standard in the US has been that an outright refusal to deal does not violate antitrust law so long as it is unilateral: 'a manufacturer of course generally has a right to deal, or refuse to deal, with whomever it likes, as long as it does so independently,' *Monsanto Co. v. Spray-Rite Service Corp.,* 465 US 752, 104 S. Ct. 1464, 1469, 79 L. Ed. 2d 775 (1984); *United States v. Colgate & Co.,* 250 US 300, 307, 63 L. Ed. 992, 39 S. Ct. 465 (1919). Recently however, the Supreme Court of the US has qualified this standard in *Eastman Kodak Co. v. Image Service Inc*. 504 US 451 (1992) by ruling that a firm's right to refuse to deal 'is not absolute, and it exists only if there are legitimate competitive reasons for the refusal.' For a criticism of this ruling and an economic analysis of refusals to deal, see Carlton (2001).

established recommended prices for their products which most leading authorized retailers followed. And, in a recent antitrust case, Xerox Corporation was sued, among other things, for refusing to sell copier parts to independent service organizations (ISOs).[5] Xerox viewed the ISOs as a competitive threat in the copier service market, and viewed the quality of its own service as superior to that of the ISOs due to its ability to locate and deliver parts overnight, and due to the high skills and training level of its technicians.[6] Our model suggests that manufacturers may have refused to deal with discount retailers in these cases because they wanted to ensure that consumers will buy their products from more profitable upscale retailers who provided a high level of customer services.[7]

The second main result of the paper concerns markets in which consumers can be vertically segmented according to their willingness to pay for customer services (or some signal on this willingness to pay). We show that in these markets, M will impose customer restrictions by requiring L to serve consumers whose willingness to pay is below some threshold while requiring H to serve consumers whose willingness to pay is above the threshold. For example, M can assign one retailer to serve individual customers and assign another to serve corporate customers. Other types of vertical segmentation of customers include small businesses vs. large corporations, private customers vs. the government, and shopping through the internet vs. shopping at stores. According to Caves (1984), customers

[5] See *Creative Copier Services v. Xerox Corp.,* civil action no. MDL-1021, United States District Court for the District of Kansas, 85 F. Supp. 2d 1130, 2000 US.

[6] Other examples for foreclosure of low quality discount retailers include *Bostick Oil Company, Inc., v. Michelin Tire Corporation, Commercial Division*, No. 81-1985, US Court of Appeals for the 4th circuit, 702 F.2d 1207 (1983) (Michelin terminated Bostick as a distributor of its truck tires after Bostick began to ship tires directly to customers without providing any initial mounting or other service and at prices much below those charged by other Michelin dealers), *Glacier Optical, Inc. v. Optique du Monde, Ltd.,* and *Safilo America, Inc.,* Civil No. 91-985-FR, US District Court for the District of Oregon, 816 F. Supp. 646, (1993) (Glacier was terminated as a distributor of Ralph Lauren/Polo eyewear for Optique du Monde (ODM) after selling eyewear to discount warehouses, like Costco, Shopko, and Wal-Mart that did not provide optometrists', ophthalmologists', or opticians' services and at prices below ODM's suggested resale price list), and *Pants 'N' Stuff Shed House, Inc., v. Levi Strauss & Co.,* No. CIV-84-1375T, US District Court for the Western District of NY, 619 F. Supp. 945, (1985), (Levi's refused to deal with Pants 'N' Stuff on the grounds that it violated Levi's long-standing policy of selling only to retailer customers of suitable quality and against wholesaling its products).

[7] There are other explanations for why manufacturers may refuse to deal with discount retailers. Matheweson and Winter (1985) argue that the Lee case is consistent with Telser's (1960) special services hypothesis and with Marvel and McCafferty's (1984) quality certification hypothesis, and Greening (1984) argues that Florsheim's RPM and dealer selection can be best explained by the firm's desire to efficiently signal the high quality of its shoes to customers. Morita and Waldman (2000) argue that by monopolizing the service market for durable goods like copier machines, a manufacturer can induce consumers to make optimal decisions on whether to maintain or replace their used machines (without monopolization, consumers tend to maintain their machines even if it is socially more efficient to replace them). We view these explanations and ours as complementary.

restrictions have been present in mechanics' tools and truck markets, passenger automobiles, drugs, and lightbulbs. This kind of restrictions is also common in cosmetics, hair products, and newspaper distribution.[8] As far as we know, our paper provides the first formal analysis of customer restrictions.

From *M*'s point of view, customer restrictions have two benefits: first they shield *H* from competition from *L* (without the restriction some of *H*'s consumers would have switched to the less profitable *L*). Consequently, unlike exclusive distribution or RPM, customer restrictions lead to a dual distribution system whereby *M* deals with both *H* and *L* rather than just with *H*. These results suggest that contrary to the common presumption of courts in the US, customer restrictions may have very different competitive effects from exclusive distribution agreements.[9] The difference between the two restraints stems from the fact that customer restrictions segment the market vertically while exclusive distribution agreements segment the market horizontally. The second benefit of customer restrictions is that they force *H* to focus on the high end of the market and raise its retail price (without the restriction, *H* would charge a lower price to boost its market share). This in turn benefits *M* because it makes it possible to discriminate between consumers with low and high willingness to pay for customer services. Although customer restrictions eliminate competition between *L* and *H*, they nonetheless benefit consumers with a relatively low willingness to pay, including

[8] Clairol Inc. marketed hair coloring 'salon' products through distributors to beauty salons and beauty schools, and sold a separate 'retail' product at almost double the price through large retail chains or wholesalers. Unlike the 'salon' product, the 'retail' product was enclosed in an individual carton that protected the ingredients from deterioration, contained detailed printed instructions, and allowed customers to easily identify the product and preview the shade range expected upon applying a particular hair color. Clairol did not allow the beauty salons and beauty schools to sell its 'salon' products to the general public (*Clairol, Inc. v. Boston Discount Center of Berkeley, Inc. et al.,* US Court of Appeals, Sixth Circuit, 608 F.2d 1114 (1979)). Similar customer restrictions were imposed by Wella (*Tripoly Co. Inc. v. Wella Corp.* US Court of Appeals, Third Circuit, 425 F.2d 932 (1970)) and by Jhirmack (*JBL Enterprises, Inc., et al., v. Jhirmack Enterprises, Inc., et al.,* 509 F. Supp. 357, (1981)). The Washington Post Company, distributed its newspapers through a dual system of independent dealers; one group of dealers served home subscribers, and the other served single sales outlets. The company required each dealer to confine his sales to a prespecified area and class of customer and barred home delivery dealers from selling to single-copy sales outlets like hotels, newsstands, drug and convenience stores, and street vending machines (*Alfred T. Newberry, Jr., et al., v. The Washington Post Co.,* 438 F. Supp. 470, (1977)).

[9] Customer restrictions were first examined by US courts in *White Motor Co. v. United States* 372 US 253 (1963). White Motor Co. was accused of imposing exclusive territories and of preventing its ordinary distributors from selling its trucks to public customers, such as Federal or state government agencies. The Supreme Court treated both practices under the rule of reason. In *Continental T.V. Inc. v. GTE Sylvania* 433 US 36 (1977), the Supreme Court addressed customer and territorial restrictions and ruled that: 'In both cases the restrictions limited the freedom of the retailer to dispose of the purchased products as he desired. The fact that one restriction was addressed to territory and the other to customers is irrelevant to functional antitrust analysis.'

some who due to CR must switch from H to L, but harm consumers at the top end of the market. The mixed welfare results indicate that it is justified to apply the rule of reason in cases that involve customer restrictions.

Most of the literature on vertical restraints has focused on the case where retailers are horizontally differentiated (see for example the literature surveys in Matheweson and Winter, 1985; Chapter 4 in Tirole, 1988; and Katz, 1989). Notable exceptions are Bolton and Bonanno (1988) and Winter (1993). Bolton and Bonanno (1988) consider a model with one manufacturer and two retailers who can choose the level of their services. They show that although RPM and franchise fees are more profitable than a uniform wholesale price, they do not restore the profits under vertical integration. Winter (1993) considers vertical restraints in a model with both vertical and horizontal differentiation. In his model, a manufacturer deals with two retailers located at the opposite ends of a line segment and can choose the quality of their services which is associated with the speed with which consumers can purchase the product. Winter shows that RPM and Exclusive Territories implement the vertical integration outcome. In both papers, the retailers can choose the level of service, so unlike in our paper, there is no foreclosure in equilibrium. Moreover both papers do not consider customer restrictions and are mainly interested in whether vertical restraints are sufficient for replicating the vertical integration outcome.

The rest of the paper is organized as follows: in Section 2 we describe the model. In Section 3 we solve for the vertical integration outcome; this outcome serves as a useful benchmark because it characterizes the optimal outcome from M's view point. In Section 4 we show that in markets that cannot be segmented vertically according to the willingness of consumers to pay for customer services, M can replicate the vertically integrated outcome by using two part tariffs, exclusive distribution agreements, or by imposing RPM. In Section 5 we study customer restrictions in markets that can be vertically segmented. We consider both the case in which this segmentation can be done perfectly and when it can be done only on the basis of signals that are imperfectly correlated with consumers' types. In Section 6 we offer concluding remarks. All proofs are in Appendix A.

2. The model

Consider a manufacturer (M) who produces a single product. M does not have the capability to sell directly to consumers and needs to rely on downstream retailers. There are two downstream retailers, one that provides high level of customer services (H) and one that provides low level of customer services (L). The services are either cum-sales services like highly trained sales staff, technical advice, demonstrations (e.g. fitting rooms for clothes or listening rooms for stereo), ambient atmosphere (which enhances the consumption value of shopping), quick delivery, and convenient financing plans, or post-sale services like extended in store warranties, generous return policies, and reliable maintenance and repair services.

We assume that there is a continuum of potential consumers with a total mass of one, each of whom buys at most one unit. Consumers differ from one another with respect to their marginal valuations of customer services. Following Mussa and Rosen (1978), we assume that given the retail prices p_H and p_L set by retailers H and L, the utility of a consumer whose marginal willingness to pay for customer services is θ is given by:

$$U(\theta) = \begin{cases} \theta - p_H, & \text{buy from } H \\ \gamma\theta - p_L, & \text{buy from } L \\ 0, & \text{otherwise} \end{cases} \tag{1}$$

where $0 < \gamma < 1$. The parameter γ measures the degree to which the services of the two retailers are differentiated, with lower values of γ being associated with a greater degree of vertical differentiation.

In what follows, we shall refer to θ as the consumer's type. We assume that consumers' types are drawn from a smooth distribution function $f(\theta)$ on the interval $[\underline{\theta}, \overline{\theta}]$, where $0 \leqslant \underline{\theta} < \overline{\theta} \leqslant \infty$, with a cumulative distribution function $F(\theta)$. In addition, we make the standard assumption that the distribution of types has a monotone hazard rate, i.e. $(1 - F(\theta))/f(\theta)$ is nonincreasing. This assumption is satisfied by many continuous distributions (e.g. uniform, exponential, chi-squared); it ensures that the second order conditions for the different maximization problems that we consider below are satisfied.

The per unit costs of retailers H and L are c_H and c_L, where $c_L \leqslant c_H$. We assume that $c_H < \overline{\theta}$ and $c_L < \gamma\overline{\theta}$, so that both retailers are viable in the sense that high type consumers wish to buy from either retailer at marginal cost.

In order to derive the demands for the two retailers, we illustrate the consumers' utilities in Fig. 1. When $p_H \leqslant p_L/\gamma$ (panel a), all consumers who get a positive utility buy from H. Hence, only H sells and serves all consumers with $\theta > p_H$. When $p_H > p_L/\gamma$ (panel b), consumers with $\theta \geqslant (p_H - p_L)/(1-\gamma)$ buy from H, consumers with $\theta \in (p_L/\gamma, (p_H - p_L)/(1-\gamma))$ buy from L, and consumers with $\theta \leqslant p_L/\gamma$ do not buy. Denoting by θ_H the lowest type of consumer served by H and by θ_L the lowest type of consumer served by L, the demands faced by the two retailers are:

$$Q_H = 1 - F(\theta_H), \quad Q_L = \mathrm{Max}\{F(\theta_H) - F(\theta_L), 0\} \tag{2}$$

where

$$\theta_H \equiv \mathrm{Max}\left\{\frac{p_H - p_L}{1-\gamma}, p_H\right\}, \quad \theta_L \equiv \frac{p_L}{\gamma} \tag{3}$$

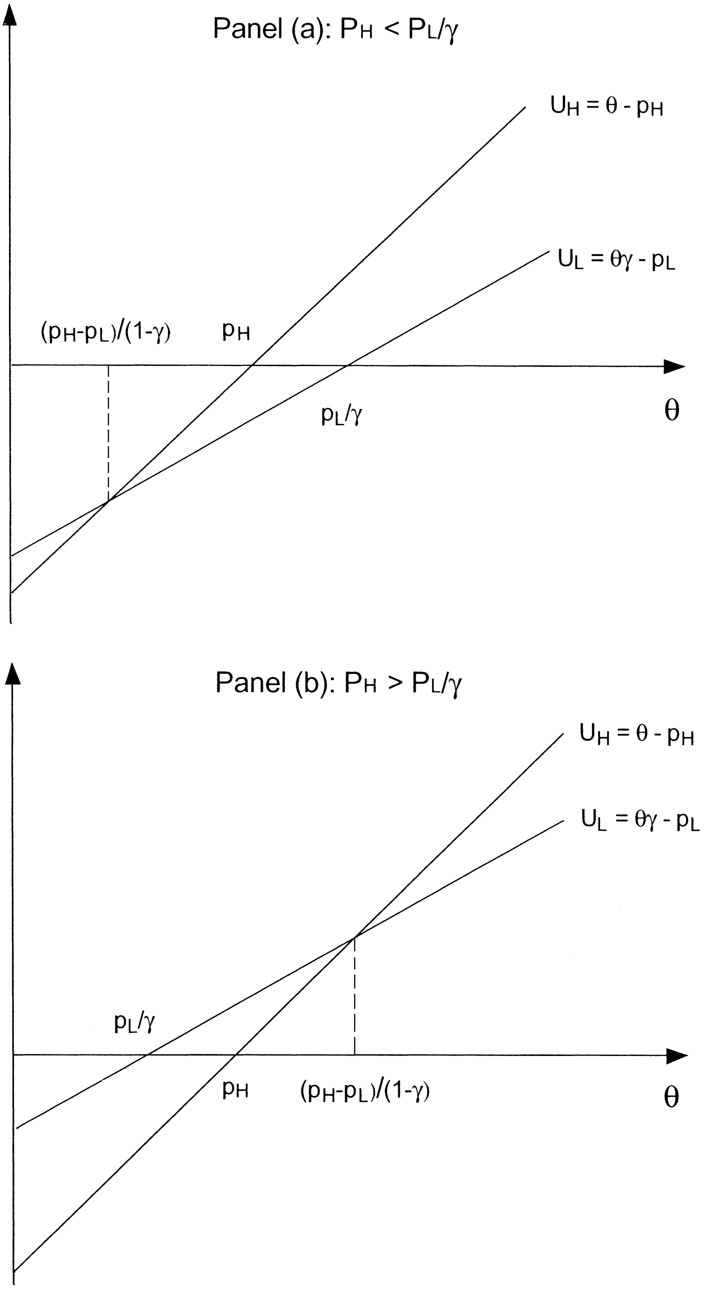

Fig. 1. The utility of consumers if they buy from retailers L and H.

3. The vertical integration benchmark

In this section we consider the benchmark case in which M is vertically integrated with both retailers. We begin with the following result (the proof, like all other proofs, is in Appendix A).

Proposition 1. *Under vertical integration with the two retailers, M offers*:

(i) *only high level of customer services if* $c_H \leqslant c_L/\gamma$,
(ii) *both high level and low level of customer services if* $c_L/\gamma < c_H < c_L + (1-\gamma)\bar{\theta}$,
(iii) *only low level of customer services if* $c_H \geqslant c_L + (1-\gamma)\bar{\theta}$.

To interpret Proposition 1, note that under vertical integration, M can offer both services and engage in second degree price discrimination. However, when both services are offered, some high type consumers will switch to service L, so M will not be able to extract as much money from them as in the case where only service H is offered. Proposition 1 shows that which effect dominates depends only on c_H and c_L/γ (i.e. the costs per unit of customer services). Intuitively, if both services are offered at marginal costs, then all consumers who buy, prefer service H to service L if $c_H \leqslant c_L/\gamma$. A vertically integrated manufacturer will then offer only service H in order to prevent consumers from switching away to the less profitable service L. The situation is completely reversed when $c_H \geqslant c_L + (1-\gamma)\bar{\theta}$. In the intermediate case, where $c_L/\gamma < c_H < c_L + (1-\gamma)\bar{\theta}$, low type consumers prefer service L if both services are offered at marginal costs, while high type consumers prefer service H. In this case, M offers both services and engages in second degree price discrimination.

In what follows we focus exclusively on the case where $c_H \leqslant c_L/\gamma$.[10] This is because the salient feature of vertical differentiation is that all consumers rank products/services similarly. But if $c_L < c_H$, at least some consumers may prefer service L only because it is cheaper. The assumption that $c_H \leqslant c_L/\gamma$ ensures that when offered at marginal costs, all consumers prefer to buy service H, and therefore it seems like a natural way to preserve the unanimity of consumers regarding the ranking of the two services. With this assumption, a vertically integrated manufacturer will offer only service H.[11]

[10] This assumption is analogous to Condition F in Shaked and Sutton (1983) which is necessary and sufficient for the 'finiteness property' that says that a vertically differentiated industry with free entry can have a finite number of active firms.

[11] Using the same proof as in Proposition 1, it is easy to show that even if there are more than two levels of customer services, M will still offer only the highest level so long as $c_H < c_i/\gamma_i$ for all i, where c_i/γ_i is the cost per unit of customer services for service i.

Before proceeding, we wish to relate Proposition 1 to existing literature. First, the idea that a monopoly may sometimes prefer to provide only a high quality product (which corresponds to service H here) rather than both high and low quality products is not new (see e.g. the example in Mussa and Rosen, 1978). The contribution of Proposition 1 is to establish the precise conditions under which this occurs for any combination of retail costs and for any distribution of consumers' types that has a monotone hazard rate. In particular, when $c_L = c_H$, a vertically integrated manufacturer will only offer service H, no matter how wide is the support of the distribution of consumers' types (we only require that $\bar{\theta} > c_H$). This result is in contrast with Bolton and Bonanno (1988) and Gabszewicz et al. (1986), where a vertically integrated manufacturer with no retail costs offers only a high quality product when the support of distribution of consumers' types is relatively narrow, but otherwise offers both high and low quality products.[12] The reason for the difference is that while we assume that consumers' preferences are of the Mussa and Rosen (1978) type, Bolton and Bonanno and Gabszewicz et al. (1986) assume that consumers' preferences are of the Gabszewicz and Thisse (1979) type, where the utility of a θ type consumer who buys quality q at a price p is $U(\theta) = q(\theta - p)$.[13] With these preferences and no retail costs, the benefit from second degree price discrimination outweighs the cost of inducing some high type consumers to switch to the low quality, if and only if the range of consumers' types is sufficiently wide. In our model in contrast, the second negative effect always dominates if $c_L = c_H$, so M will never offer both services, no matter how wide is the range of consumers' types.

Second, Deneckere and McAfee (1996) show in a closely related model that a vertically integrated manufacturer may offer both an original version of a product as well as a costly inferior version (a 'damaged' good) in order to price discriminate. This is in contrast with Proposition 1 that shows that when $c_L > c_H$, M will offer only service H. The difference stems from the fact that in Deneckere and McAfee, the valuation of the damaged good is $\lambda(\theta)$, where $\lambda(\theta) \leqslant \theta$ and $0 \leqslant \lambda'(\theta) < 1$. Lemma 3 in their paper shows that a necessary condition for introducing a damaged good is that $\lambda(\theta)/\theta$ is strictly decreasing; since we assume

[12] In Gabszewicz et al., the manufacturer can offer $n \geqslant 2$ quality levels. They show that the manufacturer offers all n quality levels if the support of the distribution of consumers' types is sufficiently wide, but offers only the highest available quality otherwise. In an earlier version of this paper (Spiegel and Yehezkel, 2001) we showed that if retail costs are introduced into the Bolton and Bonanno model, then a vertically integrated manufacturer may offer only a high quality even if the support of consumers' types is 'sufficiently' wide.

[13] That is, in our model, consumers' preferences are quasi-linear in income and θ represents the marginal utility of customer services or quality, whereas in Bolton and Bonanno they are Cobb–Douglas with θ representing the consumers' income, so $\theta - p$ represents the expenditure on 'all other goods' while q is the utility from consuming the good in question.

that $\lambda(\theta)=\gamma\theta$, $\lambda(\theta)/\theta$ is a constant in our paper and hence it is never optimal to introduce a damaged good.[14]

In the next lemma we solve the vertically integrated manufacturer's problem.

Lemma 1. *A vertically integrated manufacturer will offer only service H and will serve all consumers with a willingness to pay above θ^* at a price $p_H^*=\theta^*$, where θ^* is defined implicitly by*:

$$M(\theta_H)=c_H; \quad M(\theta_H)\equiv\theta_H-\frac{1-F(\theta_H)}{f(\theta_H)}.$$

If $M(\underline{\theta})<0$ (e.g. $\underline{\theta}=0$), θ^* is defined uniquely and $\underline{\theta}<\theta^*<\overline{\theta}$. M's profit is $\pi_H^*=(1-F(\theta^*))(\theta^*-c_H)$.

Following Mussa and Rosen (1978), we can interpret $M(\theta)$ as the marginal revenue function associated with incremental customer services. Viewed in this way, θ^* is defined by usual monopoly solution according to which marginal revenue equals marginal cost.

4. Vertical restraints when the market cannot be vertically segmented

In this section we consider vertical restraints in markets that cannot be vertically segmented according to consumers' types. We show that in such markets where M cannot prevent consumers from buying from the 'wrong' retailer, M will foreclose L and will deal only with H.

The next result shows how M can replicate the vertically integrated outcome characterized in Lemma 1 with vertical restraints.

Proposition 2. *M can replicate the vertically integrated outcome by either*:

(i) *making H an exclusive distributor and charging a* 0 *wholesale price and a franchise fee of π_H^*,*

[14] Fudenberg and Tirole (1998) consider a two-period model in which the manufacturer produces a basic version of a durable good in period 1 and offers an improved version in period 2. They show that if the manufacturer can lease the good in period 1 rather than sell it, then in period 2 it will offer both versions, although it will not produce new units of the basic version. The manufacturer offers both versions because the basic units are already available in period 2 at no cost. This is consistent with Proposition 1 above that shows that it is optimal to offer both types of service if $c_H>0=c_L$.

(ii) *imposing a maximum RPM of* p_H^* *on both retailers and charging a wholesale price of* $p_H^* - c_H$*, or*
(iii) *setting a* 0 *wholesale price and a uniform franchise fee of* π_H^*.

Proposition 2 suggests that manufacturers can boost their overall profits by not dealing with discount retailers and thereby preventing consumers from switching away from more profitable upscale retailers.[15] This result may shed light on why manufacturers often refuse to deal with low services, discount retailers (see the examples mentioned in the Introduction). The last part of Proposition 2 implies that exclusive distribution (ED) agreements with upscale retailers and RPM are neutral as far as welfare is concerned since *M* can foreclose discount retailers even without using these arrangements. This suggests in turn that ED and RPM are not used, in the context of our model, with the sole purpose of foreclosing discount retailers and hence should not be condemned on that basis alone.

Proposition 2 is somewhat surprising given that Bolton and Bonanno (1988, Proposition 3) show in a closely related model that franchise fees and RPM are insufficient to implement the vertically integrated outcome. The reason for this difference is that in the Bolton and Bonanno model, where $c_L = c_H = 0$ and the range of consumers types is 'wide,' a vertically integrated manufacturer always prefers to offer both services. RPM fails to implement the vertically integrated outcome because it eliminates the retailers' incentives to differentiate their services. Franchise fees fail to implement the vertically integrated outcome because they induce an excessive price competition which dissipates some of the profits that *M* can capture via the franchise fees. In our model, it is optimal to offer only service *H*, so RPM and franchise fees which lead to *L*'s foreclosure, implement the vertically integrated outcome.

Next, we examine the robustness of Proposition 2 to the assumption that *M* can use various instruments, including franchise fees, RPM, and ED. To this end, consider the extreme case where *M* can use only one instrument, namely a uniform wholesale price. To facilitate the analysis, we shall assume that θ is distributed uniformly on the interval $[0,\bar{\theta}]$. Then we can prove the following:[16]

Proposition 3. *Suppose that the distribution of consumers' types is uniform on the interval* $[0,\bar{\theta}]$. *Then, if M can only charge a uniform wholesale price per unit (but*

[15] Interestingly, the result that *M* will not deal with *L* is independent of the assumption that *M* has all the bargaining power vis-a-vis the retailers. To see this, note from the proof of part (iii) of Proposition 2 that *H*'s profit as an exclusive distributor, π_H^*, exceeds *L*'s profit as an exclusive distributor, π_L^*. Hence, if the retailers can make *M* take-it-or-leave-it offers, *H* will offer *M* an exclusive distributorship agreement with a 0 wholesale price and a franchise fee of π_L^* which *L* cannot beat.

[16] The proof of the following proposition appears in a supplementary note, available at http://www.people.virginia.edu/~sa9w/ijio/eosup.htm.

not franchise fees), the equilibrium wholesale price will be set at a point at which L will be effectively foreclosed. In equilibrium, M's sales are less than in the vertical integration case.

One might suspect that if *M* cannot fully extract the retailers' profits via franchise fees and cannot impose vertical restraints, then he may wish to deal with both retailers. First, dealing with both *H* and *L* may boost sales and thereby the revenue from wholesale. Second, setting a positive wholesale price creates a double marginalization problem which may be alleviated by creating competition between *H* and *L* which diminishes their markups. However, Proposition 3 shows that in fact, *M* is better-off raising the wholesale price to the point where *L* cannot profitably operate in the market. The high margin that *M* earns on sales to *H* outweighs the corresponding loss from not dealing with *L*.

Proposition 3 lends additional support to the conclusion that vertical restraints are not used, in the context of our model, with the sole purpose of foreclosing discount retailers. In fact, since the wholesale price creates a double marginalization problem which leads to an excessive retail price, a maximum RPM will improve welfare by eliminating the distortion.

5. Customer restrictions

This section considers markets in which consumers can be vertically segmented according to their types. In this kind of markets, *M* may impose Customer Restrictions (CR) by requiring *H* to deal with high types and *L* to deal with low types. For instance, many business customers value quick delivery or reliable maintenance and repair services more than individuals and hence have a higher willingness to pay for customer services. Therefore, *M* can require *H* to deal exclusively with business customers and *L* to deal exclusively with individuals. Likewise, if consumers who buy at upscale stores care more about demonstrations and personal sales assistance than consumers who buy through the internet, *M* can require *L* to sell only through the internet and *H* to sell only in department or specialty stores. The advantage of CR from *M*'s point of view is that it facilitates price discrimination without inducing high type consumers to switch to the less profitable *L*. As mentioned in the Introduction, CR intended to facilitate price discrimination have been present in such various industries as mechanics' tools and trucks, passenger automobiles, drugs, lightbulbs, cosmetics and hair products, and newspapers distribution.

We begin by considering the case where *M* can perfectly observe each consumer's type and can impose CR on the basis of this observation. We then relax this assumption and consider the case where *M* can only use an imperfect signal on consumers' types to impose CR.

5.1. Perfect customer restrictions

When M can perfectly observe the type of each consumer, he can choose a critical value of θ, denoted θ_{CR}, and assign consumers with $\theta \geqslant \theta_{CR}$ to H and consumers with $\theta < \theta_{CR}$ to L. The two retailers become monopolists in their respective market segments and choose retail prices to maximize their profits.[17] Assuming that M can fully extract the retailers' profits via franchise fees, it is optimal to set a 0 wholesale price to avoid double marginalization.

As it turns out, it is more convenient to express the retailers' profits in terms of θ_H and θ_L instead of p_H and p_L. To this end, note that in equilibrium, the choice of θ_{CR} must be binding on H, otherwise consumers in the interval $[\theta_{CR}, \theta_H]$ are not served at all; M can then do better by raising θ_{CR} at least up to θ_H and thereby allowing L to serve these consumers (who are in fact the most profitable for L). Since the utility of the lowest type who buys from H is $\theta_{CR} - p_H$, the price that H can charge is θ_{CR}. H's profit, gross of the franchise fee, is therefore:

$$\pi_H^{CR}(\theta_{CR}) = (1 - F(\theta_{CR}))(\theta_{CR} - c_H) \tag{4}$$

Since the utility of the lowest type who buys from L is $\gamma\theta - p_L$, L can charge a price of $\gamma\theta_L$. Therefore, L's profit, gross of the franchise fee, is:

$$\pi_L^{CR}(\theta_L; \theta_{CR}) = (F(\theta_{CR}) - F(\theta_L))(\theta_L \gamma - c_L) \tag{5}$$

Now recall from Section 4 that if H is an exclusive distributor, its retail price is $p_H^* = \theta^*$, where θ^* is defined implicitly by Lemma 1. If $c_L/\gamma > \theta^*$, L cannot enter the market because all consumers would prefer to buy from H even when $p_L = c_L$.[18] In what follows we therefore restrict attention to cases where $c_L/\gamma < \theta^*$ so that L's entry is not blockaded. Given this assumption and noting that since θ_{CR} is binding on H, then $\theta_{CR} \geqslant \theta^*$, it is easy to see from (5) that the equilibrium value of θ_L will be below θ_{CR}. That is, L will be active in the market, implying that CR gives rise to a dual distribution system in which H serves the upper end of the market and L serves the lower end of the market.[19]

[17] We assume though that both retailers must set uniform prices for their services and cannot price discriminate. Clearly, if price discrimination was possible, M would have preferred to deal exclusively with H and allow him to engage in price discrimination.

[18] To see why, note that the utility from buying from L at $p_L = c_L$ is $\gamma\theta - c_L$ whereas the utility from buying from H is $\theta - \theta^*$. However, $\gamma\theta - c_L = \gamma(\theta - c_L/\gamma) < \theta - c_L/\gamma < \theta - \theta^*$, where the first inequality follows because $\gamma < 1$ and the second follows because $c_L/\gamma > \theta^*$.

[19] In an earlier version of this paper (Spiegel and Yehezkel, 2001) we showed that this conclusion need not hold if M cannot extract the retailers' profits via franchise fees. In particular, if M cannot use franchise fees at all, say due to the presence of demand or cost uncertainties coupled with extreme retailers' risk-aversion (Rey and Tirole, 1986), then it may be optimal to deal exclusively with H, especially if γ is small (L is a poor substitute for H).

Proposition 4. *Under CR, M will set $w=0$ and will segment the market vertically by requiring H to deal with consumers with $\theta \geqslant \theta^*_{CR}$ and L to deal with consumers with $\theta < \theta^*_{CR}$. In the resulting equilibrium, H serves consumers with $\theta \in [\theta^*_{CR}, \bar{\theta}]$ and charges $p_H^{CR} = \theta^*_{CR}$, whereas L serves consumers with $\theta \in [\theta_L^{CR}, \theta^*_{CR})$ and charges $p_L^{CR} = \gamma\theta_L^{CR}$. Moreover, $\theta_L^{CR} < \theta^* \leqslant \theta^*_{CR} < \bar{\theta}$, implying that under CR, H will serve fewer customers than under optimal two-part tariffs, ED, and RPM, although the total size of the market becomes larger.*

CR induce M to deal with both retailers because they prevent L from selling to H's customers. Hence, M can make at least the same amount of money as under optimal two-part tariffs, RPM, and ED, from sales to the high end of the market, while also selling to the low end of the market through L.

It is worth noting that in order to implement the CR outcome, M does not need to impose CR on both retailers: the restriction on H can be replaced with a minimum RPM of θ^*_{CR} on service H. This minimum RPM will be binding since absent any restriction, H would lower p_H below θ^*_{CR} and serve some of the consumers that were assigned to L. As for L, note that since $p_L^{\mathrm{CR}} = \gamma\theta_L^{\mathrm{CR}}$, the utility of a consumer who buys from L is $U_L(\theta) = \gamma\theta - \gamma\theta_L^{\mathrm{CR}}$. If the consumer buys from H, his utility is $U_H(\theta) = \theta - \theta_{\mathrm{CR}}$. Since $U_H(\theta) - U_L(\theta)$ is increasing with θ and since $U_H(\theta_{\mathrm{CR}}) = 0 < U_L(\theta_{\mathrm{CR}})$, it is clear that consumers with $\theta \leqslant \theta_{\mathrm{CR}}$ will never wish to buy from H, whereas some consumers with $\theta > \theta_{\mathrm{CR}}$ would be better-off switching to L. Hence, given the minimum RPM on H, M only needs to ensure that L does not serve consumers that were assigned to H but does not need to worry about H serving some of L's customers.

Next, we turn to the implications of CR on M and on consumers.

Proposition 5. *M always prefers CR over two-part tariffs, ED or RPM. As for consumers, relative to optimal two-part tariffs, ED, and RPM:*

(i) *consumers with $\theta \in [\theta^*_{CR}, \bar{\theta}]$ are harmed by CR,*
(ii) *consumers with $\theta \in [\theta_L^{CR}, \theta^*]$ benefit from CR, and*
(iii) *consumers with $\theta \in [\theta^*, \theta^*_{CR}]$ benefit from CR if $\theta^* > \gamma\theta_L^{CR} + (1-\gamma)\,\theta^*_{CR}$. Otherwise, CR benefits consumers in the lower end of the interval $[\theta^*, \theta^*_{CR}]$ but harms consumers in the upper end.*

Intuitively, CR benefit M because they shields the high end of the market against competition from L who is not allowed to sell to consumers with $\theta \geqslant \theta^*_{\mathrm{CR}}$. This makes it possible to raise prices at the high end of the market without having to foreclose L and lose the business of lower type consumers. CR harm high type consumers because they induce H to charge higher prices. Low type consumers benefit from CR because they are not served at all under two-part tariffs, ED, and RPM, but served by L under CR. Intermediate types are served by H under optimal two-part tariffs, ED, and RPM, and pay a relatively high price, whereas under CR, they are served by L, and pay a lower price. As a result, consumers with a low willingness to pay within this group become better-off while those with a high willingness to pay may or may not benefit from CR. In any event, the fact that at least some intermediate types benefit from CR is somewhat surprising given that CR forces these consumers to switch from H to L.

To examine the welfare implications of CR, we shall define social welfare as the sum of consumer surplus and profits. Absent CR, M deals exclusively with H. Since H serves consumers with $\theta \geqslant \theta^*$, social welfare is given by:

$$W^* = CS^* + \pi^* = \int_{\theta^*}^{\bar{\theta}} [\theta - c_H]\, \mathrm{d}F(\theta) \tag{6}$$

Under CR, M deals with both retailers and social welfare is given by:

$$W^{\mathrm{CR}} = CS^{\mathrm{CR}} + \pi^{\mathrm{CR}} = \int_{\theta_L^{\mathrm{CR}}}^{\theta^*_{\mathrm{CR}}} [\gamma\theta - c_L]\, \mathrm{d}F(\theta) + \int_{\theta^*_{\mathrm{CR}}}^{\bar{\theta}} [\theta - c_H]\, \mathrm{d}F(\theta) \tag{7}$$

Eqs. (6) and (7) indicate that CR has two opposing effects on welfare. First, since $\theta_L^{\mathrm{CR}} < \theta^*$, CR enhances welfare because it expands the total size of the market. Second, since $\theta^*_{\mathrm{CR}} > \theta^*$, some consumers who buy from H without CR, buy from L under CR and hence the social surplus on their purchases falls from $\theta - c_H$ to $\gamma\theta - c_L$. To examine which effect dominates, we will now examine the case where the distribution of consumers types is uniform on the interval $[0,\bar{\theta}]$.

Proposition 6. *Suppose that the distribution of consumers' types is uniform on the interval* $[0,\bar{\theta}]$. *Then CR is welfare enhancing if* c_L *is sufficiently below* c_H *in the sense that*:

$$c_L < \hat{c}_L \equiv \frac{\gamma\big((20 - 3\gamma)\, c_H + (4 + \gamma)\, \bar{\theta}\big)}{2(12 - \gamma)} \tag{8}$$

If the inequality is reversed, CR is welfare reducing.

Intuitively, when c_L is low, the social benefit from L's entry into the market exceeds the social cost associated with the fact that some consumers who would have bought from H absent CR must now buy from L.

5.2. Imperfect customer restrictions

In this subsection we assume that M can vertically segment the market only according to some imperfect signal on each consumer's type, $z = \theta + \tilde{\varepsilon}$, where $\tilde{\varepsilon}$ is independent of θ and distributed on the interval $[-\varepsilon, \varepsilon]$ according to a cumulative distribution $G(\tilde{\varepsilon})$ and density $g(\tilde{\varepsilon})$. There are two interpretations for this assumption. First, the variable $\tilde{\varepsilon}$ could represent a measurement error. Alternatively, the consumer's willingness to pay for customer services, θ, could depend on two variables, z and $\tilde{\varepsilon}$, of which only z is observable. For instance, z could be the scale of a business customer's operation while $\tilde{\varepsilon}$ reflects other, unobservable, factors that affect the willingness to pay for customer services.

Suppose that M imposes CR and assigns consumers with z above a critical value, z_{CR}, to H and consumers with z below z_{CR} to L. Since θ and $\tilde{\varepsilon}$ are independent, the joint probability distribution of z is $g(\tilde{\varepsilon})f(\theta)$. Therefore, the demands that the two retailers face are:

$$Q_H(z_{CR}) = \int_{\theta_H}^{\bar{\theta}} \int_{\mathrm{Max}\{z_{CR}-\bar{\theta},-\varepsilon\}}^{\varepsilon} \mathrm{d}G(\tilde{\varepsilon})\,\mathrm{d}F(\theta), \tag{9}$$

and

$$Q_L(z_{CR}) = \int_{\theta_L}^{\mathrm{Min}\{z_{CR}+\varepsilon,\bar{\theta}\}} \int_{-\varepsilon}^{\mathrm{Min}\{z_{CR}-\bar{\theta},\,\varepsilon\}} \mathrm{d}G(\tilde{\varepsilon})\,\mathrm{d}F(\theta) \tag{10}$$

where θ_H and θ_L are the lowest types that H and L, respectively, serve. The demand functions are illustrated in Fig. 2: the demand that H faces is represented by the integral of $g(\tilde{\varepsilon})\,f(\theta)$ over the area that lies above z_{CR} and to the right of θ_H. The demand that L faces is represented by the integral of $g(\tilde{\varepsilon})\,f(\theta)$ over the area that lies below z_{CR} and to the right of θ_L.

Given θ_H and θ_L, the retail prices are $p_H=\theta_H$ and $p_L=\gamma\theta_L$. As before, we assume that M can fully extract the retailers' profits via franchise fees. Consequently, it is optimal to set a 0 wholesale price to avoid double marginalization. Given a 0 wholesale price, the profits of the two retailers, gross of franchise fees, are $\pi_H(\theta_H;\, z_{CR}) = Q_H(\theta_H;\, z_{CR})(\theta_H - c_H)$ and $\pi_L(\theta_L;\, z_{CR}) = Q_L(\theta_L;\, z_{CR})(\gamma\theta_L - c_L)$. Let $\theta_H(z_{CR})$ and $\theta_L(z_{CR})$ be the optimal choices of retailers H and L, respectively. M then chooses z_{CR} to maximize $\pi(z_{CR}) = \pi_H(\theta_H(z_{CR});\, z_{CR}) + \pi_L(\theta_L(z_{CR});\, z_{CR})$. The optimal solution is denoted by z^*_{CR}. We now ask whether M will still wish to segment the market vertically, and if yes, what are the properties of z^*_{CR}.

To provide an answer, note that it is never optimal to set z^*_{CR} above $\bar{\theta}+\varepsilon$, since then H is foreclosed; M can then earn more by foreclosing L instead. Moreover, it is also not optimal to set z^*_{CR} below $\theta^*-\varepsilon$, where θ^* defined by Lemma 1, otherwise z_{CR} is not binding on H; H will then serve all consumers with $\theta \geqslant \theta^*$, while consumers in the interval $[\theta^*,\, z_{CR}-\varepsilon]$ will not be served at all. This however is not optimal because M can raise z_{CR} at least up to $\theta^*-\varepsilon$, and thereby increase the demand for L without lowering the demand for H. Hence, z^*_{CR} must be between $\theta^*-\varepsilon$ and $\bar{\theta}+\varepsilon$.

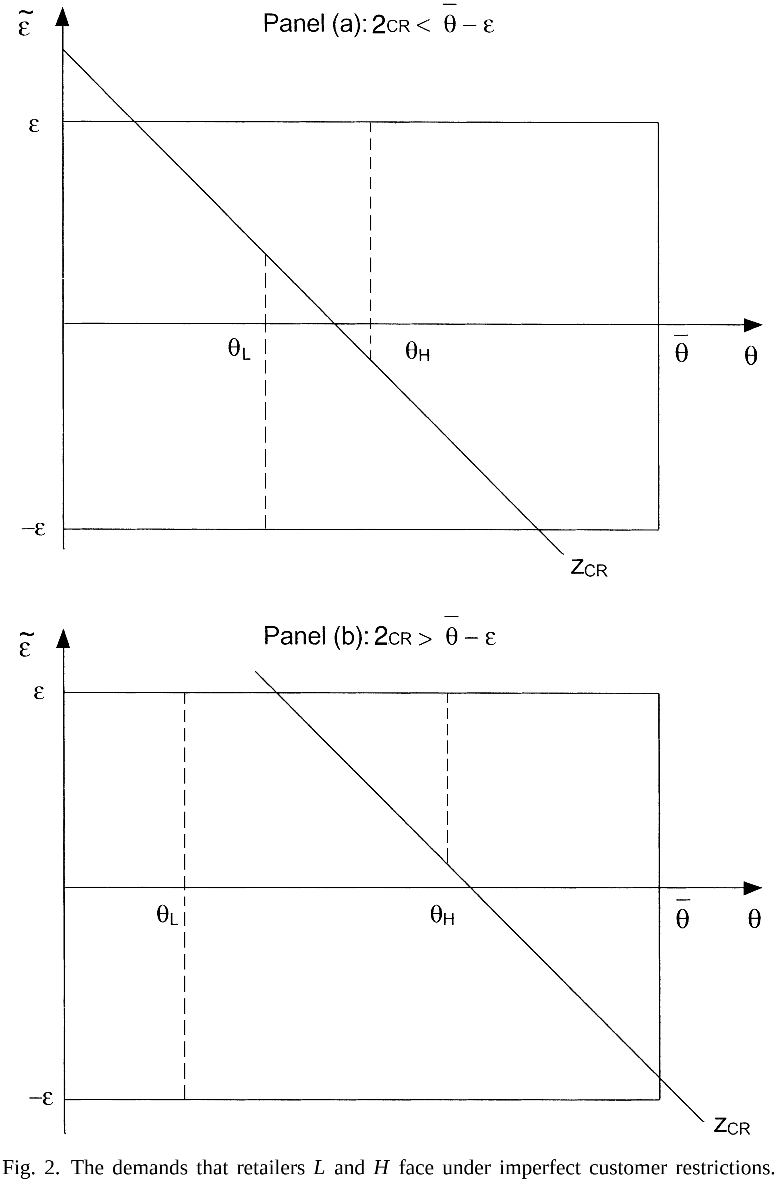

Fig. 2. The demands that retailers L and H face under imperfect customer restrictions.

Proposition 7. *Under imperfect CR, M will set* $w = 0$ *and will segment the market vertically by requiring H to deal with consumers with* $z \geqslant z^*_{CR}$ *and L to deal with consumers with* $z < z^*_{CR}$*, where* z^*_{CR} *is between* $\theta^* - \varepsilon$ *and* $\theta + \varepsilon$*. In the resulting equilibrium, both retailers will be active in the market.*

Proposition 7 shows that CR induce M to adopt a dual distribution system even when consumers' types cannot be perfectly observed. The market segmentation will now be imperfect because L may end up serving some customers that should have been served by H and vice versa.

To obtain further insights about imperfect CR, we shall assume that the distribution of θ is uniform on the interval [0,1] and the distribution of $\tilde{\varepsilon}$ is uniform on the interval $[-\varepsilon, \varepsilon]$. Although it is impossible to solve the model in closed-form even under these simplifying assumptions (M's profit is a complex polynomial expression), we can obtain numerical solutions. The results show the following:[20]

(i) CR is always profitable for M although its profitability falls as the signal z becomes less informative about θ (i.e. M's profit decreases with ε).

(ii) M's aggregate sales decrease with ε while H's sales increase with ε (i.e. z^*_{CR} falls with ε).

Intuitively, the worst case scenario if z_{CR} is set too low is that L will end up being foreclosed, in which case M's profit is as in Section 4; if z_{CR} is set too high, H may end up being foreclosed in which case M's profit is even lower. Hence, from M's point of view, the 'danger' is to set z_{CR} too high. This danger is more pronounced when ε increases so M responds by lowering z_{CR}. This leads to a bigger cut in L's sales than it increases H's sales and as a result, M's aggregate sales fall.

(iii) Consumers are better off under imperfect CR than under perfect CR although they are worse off than in the case where L is foreclosed. Moreover, consumers' surplus is increasing with ε so consumers become better-off as M can observe their types less accurately.

Result (iii) is somewhat surprising given that M's aggregate sales fall with ε. However, since more consumers are served by H, the overall quality of service in the market increases. This 'quality' effect dominates the reduction in aggregate sales.

(iv) Relative to the case where H is an exclusive distributor, CR is welfare increasing when ε is small but welfare decreasing otherwise.

Result (iv) supports the conclusion from Proposition 7 that CR may or may not be socially desirable and therefore should be considered under the rule of reason.

[20] The numerical solutions of the model are reported in more detail in a supplementary note, available at http://www.people.virginia.edu/~sa9w/ijio/eosup.htm.

6. Conclusion

We considered an intrabrand competition model with two vertically differentiated retailers and established two main results. First, in anonymous markets that cannot be vertically segmented according to the willingness of consumers to pay for customer services, manufacturers may wish to foreclose low services discount retailers in order to shield retailers with a high level of customer services from a competitive pressure that dissipates their retail profits. This provides a new explanation for why manufacturers of such diverse products like jeans, shoes, fine fragrances, copiers services, tires, and eyewear, often refuse to deal with low services, discount retailers. To foreclose these retailers, manufacturers can use either vertical restraints like an exclusive distribution agreement with upscale retailers, or an RPM, or set a sufficiently high franchise fee. The fact that foreclosure can be achieved even without vertical restraints suggests that exclusive distribution agreements or RPM are not used primarily to foreclose low services discount retailers and hence should not be condemned on that basis.

We then showed that in markets that can be vertically segmented according to consumers' types, manufacturers will impose customer restrictions by requiring discount retailers to serve low type consumers while requiring the upscale retailer to serve high type consumers. This conclusion holds even if the manufacturers can only observe an imperfect signal about consumers' types. The advantage of this restriction is that it shields upscale retailers from competition from discount retailers, while still enabling the manufacturers to reach the low end of the market through the discount retailers. Consequently, customer restrictions allow more consumers to be served and may therefore enhance welfare especially if the costs of the discount retailers are low.

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Appendix A

Following are the proofs of Propositions 1, 2 and 4–7, and Lemma 1.

Proof of Proposition 1. Let p_H and p_L be the prices of services H and L. From (2), M's profit under vertical integration is:

$$\pi^{VI} = \begin{cases} (1 - F(\theta_H))(p_H - c_H) + (F(\theta_H) - F(\theta_L))(p_L - c_L), & p_H > p_L/\gamma \\ (1 - F(\theta_H))(p_H - c_H), & p_H \leqslant p_L/\gamma \end{cases} \tag{A.1}$$

Now, suppose that both services are offered in equilibrium, so that $\theta_L < \theta_H < \bar{\theta}$. Using (3), we can express the services' prices as $p_L = \theta_L \gamma$ and $p_H = \theta_L \gamma + \theta_H(1 - \gamma)$. Substituting these equalities into (A.1), M's problem is to find θ_L and θ_H to maximize his profit (which is now expressed in terms of θ_L and θ_H). The first order conditions for M's problem are:

$$\frac{\partial \pi^{VI}}{\partial \theta_H} = (1 - \gamma)(1 - F(\theta_H)) - f(\theta_H)((1 - \gamma)\,\theta_H - c_H + c_L) = 0 \tag{A.2}$$

and

$$\frac{\partial \pi^{VI}}{\partial \theta_L} = \gamma(1 - F(\theta_L)) - f(\theta_L)(\gamma\theta_L - c_L) = 0 \tag{A.3}$$

These first order conditions can be also written as:

$$M(\theta_H) = \frac{c_H - c_L}{1 - \gamma}, \quad M(\theta_L) = \frac{c_L}{\gamma} \tag{A.4}$$

where $M(\theta) \equiv \theta - (1 - F(\theta))/f(\theta)$. Since $(1 - F(\theta))/f(\theta)$ is nonincreasing, we have $M'(\theta) > 0$. Consequently, both equations in (A.4) have unique solutions. Now suppose that $c_H < c_L/\gamma$. Since $M'(\theta) > 0$, it follows that $\theta_L > \theta_H$. This contradicts the hypothesis that both services are offered. Next suppose that $c_H > c_L/\gamma$. Then (A.4) implies that $\theta_L < \theta_H$. Since $M(\bar{\theta}) = \bar{\theta}$ (note that $F(\bar{\theta}) = 1$) and $M'(\theta) > 0$, (A.4) implies that $\theta_H < \bar{\theta}$ so long as $c_H < c_L + (1 - \gamma)\bar{\theta}$. When $c_H > c_L + (1 - \gamma)\bar{\theta}$, $\theta_H = \bar{\theta}$ so H is foreclosed. □

Proof of Lemma 1. Since $c_H < c_L/\gamma$, Proposition 1 implies that the profit of a vertically integrated manufacturer is given by the second line of (A.1). The first order condition for M's problem is:

$$\frac{\partial \pi^{VI}}{\partial p_H} = (1 - F(\theta_H)) - f(\theta_H)(p_H - c_H) = 0 \tag{A.5}$$

where $\theta_H = p_H$. Substituting $p_H = \theta_H$ into (A.5), the equation can be rewritten as follows:

$$M(\theta_H) = c_H; \quad M(\theta_H) \equiv \theta_H - \frac{1 - F(\theta_H)}{f(\theta_H)} \tag{A.6}$$

The solution to this equation is denoted θ^*. Since $(1 - F(\theta))/f(\theta)$ is nonincreasing, $M'(\theta) > 0$. Moreover, since $c_H < \bar{\theta}$ implies that $c_H < \bar{\theta} = M(\bar{\theta})$ and since by assumption $M(\underline{\theta})<0$, it follows that θ^* is unique and is such that $\underline{\theta}<\theta^*<\overline{\theta}$. Given θ^*, M charges a price of $p_H^*=\theta^*$ for service H and its profit is $\pi_H^*=(1-F(\theta_H^*))(\theta^*-c_H)$. □

Proof of Proposition 2.

(i) H's profit when it is an exclusive distributor and $w=0$, is given by the second line of (A.1). Therefore at the optimum, H will charge $p_H^*=\theta^*$ and will earn π_H^*. M can fully extract this profit via a franchise fee.
(ii) Suppose that M sets $w=p_H^*-c_H^*$ along with a maximum RPM of p_H^* on both services. Then only H will be able to operate in the market and the maximum RPM will be binding. Since H breaks even, the entire industry profits accrues to M.
(iii) Suppose that M imposes a two-part tariff with $w=0$ and a franchise fee π_H^* on both retailers. Using (3), L's profit, gross of the franchise fee, can be written as:

$$\pi_L^*=\operatorname*{Max}_{\theta}(F(\theta_H)-F(\theta))(\gamma\theta-c_L) \tag{A.7}$$

Since $c_H<c_L/\gamma$, it follows by revealed preferences that:

$$\begin{aligned}\pi_L^* &< \operatorname*{Max}_{\theta}(1-F(\theta))(\gamma\theta-c_L)\\ &< \operatorname*{Max}_{\theta}(1-F(\theta))(\gamma\theta-\gamma c_H)\\ &< \operatorname*{Max}_{\theta}(1-F(\theta))(\theta-c_H)\equiv\pi_H^*\end{aligned} \tag{A.8}$$

Therefore, L cannot pay π_H^* even if he is an exclusive distributor and will therefore stay out of the market. Since $w=0$, the resulting outcome coincides with the vertically integrated outcome. □

Proof of Proposition 4. Let θ_L^{CR} denote the maximizer of $\pi_L(\theta_L;\ \theta_{\mathrm{CR}})$. The first order condition for θ_L^{CR} can be written as:

$$\theta_L-\frac{F(\theta_{\mathrm{CR}})-F(\theta_L)}{f(\theta_L)}=\frac{c_L}{\gamma} \tag{A.9}$$

Since $(1-F(\theta))/f(\theta)$ is nonincreasing, the left side of (A.9) is strictly increasing in θ so θ_L^{CR} is unique.[21]

[21] To see why, note that

$$\frac{\mathrm{d}}{\mathrm{d}\,\theta}\left[\theta-\frac{F(\theta_{\mathrm{CR}})-F(\theta)}{f(\theta)}\right]=\frac{2f^2(\theta)+f'(\theta)(F(\theta_{\mathrm{CR}})-F(\theta))}{f^2(\theta)}$$

If $f'(\theta)\geqslant 0$, the derivative is positive as required. If $f'(\theta)<0$, then:

$$\frac{\mathrm{d}}{\mathrm{d}\theta}\left[\theta-\frac{F(\theta_{\mathrm{CR}})-F(\theta)}{f(\theta)}\right]>\frac{2f^2(\theta)+f'(\theta)(1-F(\theta))}{f^2(\theta)}\equiv M'(\theta)>0$$

Since M can fully extract the retailers' profits through the franchise fees, θ_{CR} is set to maximize

$$\pi(\theta_{\mathrm{CR}}) = \pi_H^{\mathrm{CR}}(\theta_{\mathrm{CR}}) + \pi_L\left(\theta_L^{\mathrm{CR}}; \theta_{\mathrm{CR}}\right) \tag{A.10}$$

Let θ^*_{CR} denote the maximizer of $\pi(\theta_{\mathrm{CR}})$. By the envelope theorem, the first order condition for θ^*_{CR} is:

$$\frac{\mathrm{d}\pi(\theta_{\mathrm{CR}})}{\mathrm{d}\theta_{\mathrm{CR}}} = (1 - F(\theta_{\mathrm{CR}})) - f(\theta_{\mathrm{CR}})\left(\theta_{\mathrm{CR}} - \gamma\theta_L^{\mathrm{CR}} - (c_H - c_L)\right) = 0 \tag{A.11}$$

Using the definition of $M(\theta)$, this condition can also be written as follows:

$$M(\theta_{\mathrm{CR}}) = c_H + \gamma\theta_L^{\mathrm{CR}} - c_L \tag{A.12}$$

Since $M'(\theta) > 0$, θ^*_{CR} is unique. Note that $\theta^*_{\mathrm{CR}} < \overline{\theta}$, otherwise H is foreclosed; this outcome however is not optimal since M would rather foreclose L, say by setting $\theta^*_{\mathrm{CR}} = 0$, and deal exclusively with H. Hence, H serves consumers with $\theta \in \left[\theta^*_{\mathrm{CR}}, \overline{\theta}\right]$ and charges $p_H^{\mathrm{CR}} = \theta^*_{\mathrm{CR}}$, whereas L serves consumers with $\theta \in \left[\theta_L^{\mathrm{CR}}, \theta^*_{\mathrm{CR}}\right)$ and charges $p_L^{\mathrm{CR}} = \gamma\theta_L^{\mathrm{CR}}$.

Next, since $\gamma\theta_L^{\mathrm{CR}} - c_L$ is the equilibrium price–cost margin of L and hence is nonnegative, the right side of (A.12) is at least as large as the right side of (A.6). Hence, $\theta^*_{\mathrm{CR}} \geqslant \theta^*$. Finally, since the left side of (A.9) is increasing with θ, θ_L^{CR} must be decreasing with γ. Given our assumption that $c_L/\gamma < \theta^*$, the lowest permissible value of γ is c_L/θ^*. Together with the definition of θ^* and with (A.12), Eq. (A.9) implies that at $\gamma = c_L/\theta^*$, we have $\theta_L^{\mathrm{CR}} = \theta^*_{\mathrm{CR}} = \theta^*$. Since θ^* is independent of γ while θ_L^{CR} is decreasing with γ, it follows that $\theta_L^{\mathrm{CR}} < \theta^*$. □

Proof of Proposition 5. We begin with M. If $\theta^*_{\mathrm{CR}} = \theta^*$, H's profit is at least as high as under optimal two-part tariffs, ED, and RPM. Since L is also active in the market, the industry profits and hence M's profit are higher under CR. By revealed preferences, M's profit is even higher than that since in general, it is optimal to set θ_{CR} above θ^*.

Next consider consumers. High types with $\theta \in \left[\theta^*_{\mathrm{CR}}, \overline{\theta}\right]$ are served by H under both CR, optimal two-part tariffs, ED, and RPM. But since $p_H^{\mathrm{CR}} > p_H^*$, this group is made worse-off under CR. Low types with $\theta \in \left[\theta_L^{\mathrm{CR}}, \theta^*\right]$ are not served at all under two-part tariffs, ED, and RPM, but are served under CR by L. Hence, CR benefits this group. Intermediate types with $\theta \in [\theta^*, \theta^*_{\mathrm{CR}}]$ are served by H under optimal two-part tariffs, ED, and RPM, pay $p_H^* = \theta^*$, and their utility is $U^*(\theta) = \theta - \theta^*$. Under CR, these consumers are served by L, pay $p_L^{\mathrm{CR}} = \gamma\theta_L^{\mathrm{CR}}$, and their utility is $U^{\mathrm{CR}}(\theta) = \gamma\theta - \gamma\theta_L^{\mathrm{CR}}$. Since $U^*(\theta^*) = 0$, CR surely benefits intermediate types with θ close to θ^*. Moreover, since $U^{\mathrm{CR}}(\theta) - U^*(\theta)$ is decreasing with θ, it follows that if evaluated at $\theta = \theta^*_{\mathrm{CR}}$, $U^{\mathrm{CR}}(\theta^*_{\mathrm{CR}}) - U^*(\theta^*_{\mathrm{CR}}) = \theta^* - \gamma\theta_L^{\mathrm{CR}} - (1 - \gamma)\,\theta^*_{\mathrm{CR}} > 0$, then CR benefits all intermediate types. Otherwise, there is some cutoff point, such that CR benefits consumers with θ below the cutoff point and harms consumers above it.

Proof of Proposition 6. Since we restrict attention to cases where $c_L/\gamma \leqslant \theta^*$ (L is not blockaded) and $c_H \leqslant c_L/\gamma$ (the ranking of the two services is preserved), the permissible values of c_L are between γc_H and $\theta^*\gamma$. When θ is distributed uniformly on the interval $[0,\bar{\theta}]$, $\theta^* = (\bar{\theta} + c_H)/2$. Hence, $\gamma c_H \leqslant c_L \leqslant \gamma(\bar{\theta} + c_H)/2$. Now let $\Delta_W \equiv W^{\mathrm{CR}} - W^*$ be the difference between social welfare with and without CR. Straightforward calculations reveal that $\partial^2\Delta_W/\partial c_L^2 = (12-\gamma)/(\gamma(4-\gamma)^2) > 0$; hence Δ_W is a U-shaped function of c_L. Moreover, Δ_W has two roots: the small root, $\hat{c}_L$, is defined in the proposition, and the large root is $\gamma(\bar{\theta} + c_H)/2$ which is the largest permissible value of c_L. Hence, $W^{\mathrm{CR}} > W^*$ for $c_L < \hat{c}_L$ and conversely when $c_L > \hat{c}_L$. □

Proof of Proposition 7. Given z^*_{CR}, the highest type that L is allowed to serve is $z^*_{CR} + \varepsilon$. But if $z^*_{\mathrm{CR}} \geqslant \theta^* - \varepsilon$ and $\theta^* > c_L/\gamma$, then $z^*_{\mathrm{CR}} + \varepsilon > c_L/\gamma$, implying that L can profitably sell at least to the top group of customers in its market segment (i.e. in equilibrium, $\theta_L(z^*_{\mathrm{CR}}) < z^*_{\mathrm{CR}} + \varepsilon$). Since $z^*_{\mathrm{CR}} < \bar{\theta} + \varepsilon$ and recalling that $c_H < \bar{\theta}$, it is clear that H will also be active in the market. □

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