Retailer's choice of product variety and exclusive dealing under asymmetric information

by

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***Abstract*:** This paper considers vertical relations between an upstream manufacturer and a downstream retailer that can independently obtain a low-quality, discount substitute. The analysis reveals that under full information the retailer offers both varieties if and only if it is optimal to do so under vertical integration. However, when the retailer is privately informed about demand, it offers both varieties even if under vertical integration it is profitable to offer only the manufacturer's product. If the manufacturer can impose exclusive dealing, then under asymmetric information it will do so and foreclose the low quality substitute even if under vertical integration it is profitable to offer both varieties.

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1. Introduction

Downstream retailers sometimes enhance their product variety by offering low-quality, discount substitutes for the products produced by upscale manufacturers. Thus, for example, the market share of private labels that have been introduced by supermarkets and drugstores has been growing rapidly in recent years, and stores selling electronic goods and home appliances often offer reputable brands as well as unfamiliar, low-priced substitutes. At the same time, upstream manufacturers sometimes limit the variety that their retailers can offer by imposing exclusive dealing arrangements prohibiting the retailer from selling products that compete with those of the manufacturer.

This paper addresses three questions. First, what are retailers' incentives to enhance their variety by offering both qualities instead of just high quality? In particular, are these incentives different for vertically integrated and separated industries? This question is of special concern in the context of private labels, because it might be expected that, with their superior production capabilities, upstream manufacturers will be able to produce high-quality products at quality-adjusted costs that are lower than those of the private labels, thus making the introduction of private labels unprofitable.

The second question relates to the incentives that an upstream manufacturer may have to impose exclusive dealing on its retailer, which prohibits the sale of brands that are substitutes for the manufacturer's brands. On one hand, a manufacturer may impose exclusive dealing because of welfare enhancing reasons. For example, exclusive dealing may induce a retailer to focus its promotional activities on the manufacturer's products and thereby improve customers' service. Marvel (1982) argues that exclusive dealing can secure investments made by the manufacturer (in quality assurance and advertising, for instance) by preventing other manufacturers from free-riding on them. However, exclusive dealing may also be anticompetitive when a manufacturer that benefits from a leading position in the market imposes exclusive dealing for the sole purpose of foreclosing competing brands.[1]

[1] In the USA, exclusive dealing can be condemned in violation of the Clayton Act (Section 3) and the Sherman Act (Section 1) if it has the effect of substantially lessening competition. In *Standard Fashion v. Magrane Houston* No. 1343, 259 F. 793; 1919 U.S. App (1919), the court cited a report of the House Committee concerning Section 3 that states: "What is the motive and purpose of the manufacturer in making or entering into such exclusive contract? It is undoubtedly his purpose to drive out competition and to establish a monopoly in the sale of his commodities in that particular community or locality." The court took a firm position against exclusive dealing by arguing that "In order to condemn the negative covenant, it is not necessary that the court should find that it will lessen competition or will tend to create a monopoly; it is enough to find that it may lessen competition or may tend to create a monopoly."

This second potential anti-competitive effect of exclusive dealing has been challenged by the well-known Chicago School for two related reasons.[2] First, if offering a second brand increases the retailer's gross profit, then it will also benefit the manufacturer, which can now charge the retailer higher franchise fees. In this case the manufacturer will not profit from foreclosing the competing brand because doing so will substantially reduce the franchise fee that it can charge the retailer. Therefore, if a manufacturer finds it profitable to foreclose a competing brand then it has to be that this brand is a poor substitute to begin with. That is, the manufacturer will profit from excluding the competing brand only if it does not provide any additional value to the retailer's gross profit.[3] Second, even if a manufacturer imposes exclusive dealing, it will still need to compensate the retailer for the forgone profits from not offering the competing brand. Thus, it is not clear why exclusive dealing is any better from the manufacturer's viewpoint than offering quantity discounts such that the retailer will independently choose not to sell the competing brand. As Gilbert (2000) points out, the arguments made by the Chicago School parallel a more tolerant approach by US courts towards exclusive dealing.[4] Altogether, these arguments raise the question of whether a manufacturer will ever choose to impose exclusive dealing for the sole purpose of foreclosing a competing brand and if so what is the effect of exclusive dealing on the retailer, consumers and welfare.

The third question relates to the practice of market share contracts, in which a manufacturer provides a discount to a retailer for buying a certain percentage of its units from the manufacturer. For example, in the USA, tobacco wholesalers sued Philip Morris, a leading cigarette manufacturer, for its Wholesale Leaders program, which rewarded distributors based on their sales of Philip Morris cigarettes as a percentage of their total cigarette sales.[5] Brunswick, a

[2] For example, Posner (1976, pp. 205) argued as follows: "it is unlikely that a rational profit-maximizing firm will use exclusive dealing as a method of excluding a competitor. But one cannot be sure that it will never do so." In somewhat stronger terms, Bork (1978, pp. 309) argued that "there has never been a case in which exclusive dealing or requirements contracts were shown to injure competition."

[3] For example, commenting on the *Standard Fashion v. Magrane Houston* case, Bork (1978, pp. 307) argued that "We do not want a variety that costs more than it worth. All that has happened when Standard purchases exclusivity from such a store is that it has offered terms which make variety of the pattern offerings cost more than they are worth in comparing with Standard's terms."

[4] For example, in the recent case of *Republic Tobacco Co. v. North Atlantic Trading Company Inc.* (2004), the court remarked as follows: "Rather than condemning exclusive dealing, courts often approve them because of their procompetitive benefits." For a discussion on the potential pro- and anti-competitive effects of exclusive dealing and the history of its legal status in the US, see Areeda and Hovenkamp (2002) and Sullivan and Hovenkamp (2003).

[5] See *Smith Wholesale Company, Inc., et al. v. Philip Morris USA Inc.*, No. 2:03-CV-221 (2005).

leading manufacturer of marine engines, was sued by competing engine manufacturers for offering quantity and market share discounts to boat builders for buying its engines.[6] At first glance, this practice may appear to be a softer version of exclusive dealing, in that the manufacturer is restricting its retailer to commit to a certain percentage of exclusion, instead of the 100% exclusion of exclusive dealing. This raises the question of why manufacturers sometimes use market share contracts instead of quantity discounts or exclusive dealing, and what is the effect of market share discounts on consumers and welfare.[7]

This paper studies vertical relations between an upstream manufacturer (M) that produces a high-quality product (H) and a downstream retailer (R), when R can obtain a low-quality substitute (L) at a given cost. For example, the substitute product can be interpreted as a private label, or a low-quality product available from a perfectly competitive fringe. I compare three types of contracts: first, a simple non-exclusive contract that only specifies a quantity of H and a total price; second, an exclusive dealing contract that also prohibits R from selling L; third, a market share contract that restricts R to sell a certain quantity of L, which can be higher than zero. The model reveals that the answer to the three questions raised above depends crucially on the extent to which R is privately informed about consumers' willingness to pay for the two brands. Under full information, M can implement the first best profits by offering the non-exclusive contract. This contract induces R to sell both L and H whenever L is efficient (such that a vertically integrated monopoly chooses to offer both L and H) and only H otherwise. In the latter case, M does not need to impose exclusive dealing or to use a market share contract to obtain exclusivity. The intuition for this result is that M can use the non-exclusive contract to capture R's entire added value from selling H and therefore wishes to maximize R's gross profit. This result implies that under full information, the decision whether to offer low-quality substitutes in the form of private labels, for example, is not affected by the vertical structure. It also supports the argument that exclusive dealing does not offer any advantage in foreclosing a competing brand and shows that this argument applies also to the market share contract.

Then I turn to consider the case where R is privately informed about a parameter, θ, that measures consumers' willingness to pay for H and L. To induce R to reveal the true θ, M offers R a menu of contracts in which the total payment and the quantity of H are contingent on the θ reported by R. R has the incentive to understate the true θ because this lowers the profits that M can extract from R. To minimize this incentive, M distorts the quantity of H downwards. If M can

[6] See *Concord Boat Corp. v. Brunswick Corp.*, 207 F. 3d 1039 (2000).

[7] For a comparative analysis of the legal treatment of exclusive dealing and market share contracts, see Tom, Balto and Averitt (2000).

only use the non-exclusive contract, then the ability to sell additional units of L provides R with a degree of freedom because the supply of L is independent of R's report on θ to M. Consequently, R can understate θ and compensate itself for the low quantity of H by selling additional units of L, which M cannot limit. Moreover, R can report a θ that misleads M into believing that R intends to sell H alone, while in practice R intends to sell both brands and earn additional profit from selling L. Thus, in the non-exclusive contract, under some conditions on the model's parameters such as the marginal costs, the degree of product differentiation and the degree of the asymmetric information problem, R may offer both H and L even if L is unprofitable under full information. In this case, although L is a poor substitute for H, the degree of freedom that selling L provides R forces M to increase R's information rents.

This result indicates that under asymmetric information retailers will expand their product variety by offering brands that are unprofitable under full information, because it enables them to gain informational leverage over manufacturers.

The result also provides an explanation for why M may use the additional instrument of exclusive dealing. The model reveals that if M can use the exclusive dealing contract but not a market share contract, then in equilibrium M will impose exclusive dealing whenever L is unprofitable under full information, and, under some parameters of the model, M will impose exclusive dealing even if L is profitable. The intuition for this result is that since selling L increases R's information rents, M will impose exclusive dealing even though doing so reduces total industry profits. Clearly, exclusive dealing increases M's profit, while reducing total industry profits and consumer surplus. As far as antitrust policy is concerned, the model provides an intuitive condition on market parameters under which a dominant manufacturer will use exclusive dealing for the sole purpose of foreclosing competing brands.

Next, I consider the case where M can use a market share contract, which has the advantage over the exclusive dealing contract of enabling M to restrict but not completely prohibit R from selling L. Nonetheless, the model reveals that if L is inefficient, then in the equilibrium market share contract M requires R to completely exclude L, because by doing so M both reduces R's information rents and prevents R from selling an inefficient brand. Thus, in the case of an inefficient L, the market share contract does not provide M with any advantage over the exclusive dealing contract. If L is efficient, then M prefers the market share contract over the exclusive dealing contract because it can reduce R's information rents by conditioning the quantity of L that R can sell on R's report without the need to exclude L completely. Although the market share contract is no more than a softer version of exclusive dealing, on average, it nevertheless has a more ambiguous effect on consumers and welfare.

The rest of the paper is organized as follows. The next section surveys related literature. Section 3 presents the model. Section 4 considers a full-information benchmark. Section 5 considers asymmetric information when the manufacturer can only use a non-exclusive contract. Sections 5 and 6 consider the case of exclusive and market share contracts, respectively. Section 7 offers concluding remarks. All proofs are in the Appendix.

2. Related Literature

Previous literature on exclusive dealing has focused on three main questions. The first question is whether manufacturers and retailers will organize in competing exclusive manufacturer-retailer hierarchies or two (or more) manufacturers will prefer to sell through a common retailer. Bernheim and Whinston (1985) show that manufacturers choose to deal with a common retailer because doing so enables them to reduce intrabrand competition. Subsequent papers by Gal-Or (1991), Besanko and Perry (1993), Dobson and Waterson (1996), Martimort (1996), and Moner-Colonques, Sempere-Monerris and Urbano (2004) have provided explanations for why manufacturers may nevertheless prefer to organize in exclusive manufacturer-retailer hierarchies. Gal-Or (1991a) and Martimort (1996) are closely related to this paper because they show that two competing manufacturers will organize in two competing exclusive manufacturer-retailer hierarchies because of retailers' private information. The main difference between their results and the results of this paper are that in their papers the exclusive contract is a channel distribution choice that does not involve a binding restriction excluding competing brands from the market, which is the main focus of this paper. Thus, in their papers the motivation for exclusive hierarchies is to enhance competition between retailers, while in this paper the motivation is to exclude a competing brand.

The second question is whether an incumbent with a first-mover advantage will exploit its position by offering a contract that forecloses competing brands. In a closely related paper, Aghion and Bolton (1987) consider an incumbent and a buyer facing entry by an entrant with unknown cost. They show that the incumbent will use its first-mover advantage to offer the buyer a contract that extracts some of the surplus of a more efficient entrant, but excludes some types of efficient entrants. Although both papers predict market foreclosure, there are several differences between their paper and the present one. First, in their model, the buyer wishes to buy one indivisible unit from only one of the firms. Therefore, the incumbent cannot endogenously choose between an exclusive and a non-exclusive contract, as in this paper. Second, in this paper, the dominant firm does not have a first-mover advantage in that the competing brand is already available to R at marginal cost, which makes foreclosure more difficult for M. Third, in their paper foreclosure emerges because the incumbent and the buyer sign a contract committing themselves to act as a monopoly with respect to the entrant and therefore charge a high price from low-cost entrants while losing the sales of high-cost entrants. Consequently, in their paper, the contract increases the joint profit of the incumbent and buyer, with the incumbent being better off while the buyer is no worse off. In contrast, in this paper, since the motivation for foreclosure emerges from M's need to reduce R's information rents, exclusive dealing decreases R's profit as well as the joint profit of R and M and consumers' surplus.

Rasmusen et al. (1991), Segal and Whinston (2000), Fumagalli and Motta (2006) and Spector (2007), consider an entrant that needs to sell to a certain number of buyers to profit from entry. The incumbent offers an exclusive contract that excludes a more efficient entrant, and buyers accept it because given that all other buyers accept, a single buyer cannot encourage entry by refusing to enter into the contract. The present paper contributes to this literature by showing that exclusive contracts can emerge in the absence of coordination failure between buyers and when the competing brand does not need to fulfill a minimum efficient scale. That is, in this paper, exclusive dealing is an equilibrium behavior even though L is already available to R at marginal cost.

The third and most closely related line of literature on exclusive dealing asks why a dominant manufacturer should impose exclusive dealing when competing manufacturers simultaneously compete for the services of a single retailer. Mathewson and Winter (1987) show that a dominant firm may impose exclusive dealing under full information when firms can only use linear pricing. O'Brien and Shaffer (1997) show that Mathewson and Winter's assumption of linear pricing is essential: exclusive dealing does not offer the manufacturers any advantage that cannot be obtained with nonlinear contracts. Bernheim and Whinston (1998) show that if a dominant manufacturer and a risk-averse retailer are uncertain about the demand when they sign the contract, then the dominant manufacturer will find it optimal to provide insurance to the retailer against demand shocks. In the extreme case in which the two brands are perfect substitutes, the dominant manufacturer will also impose exclusive dealing in order to prevent the competing manufacturer from free-riding on this insurance. Thus exclusive dealing has the welfare-enhancing property of achieving a better allocation of risk between the manufacturer and the retailer. By contrast, in this paper exclusive dealing is more likely to occur if products are more differentiated, instead of less differentiated as in Bernheim and Whinston, and it is welfare reducing.

Turning to recent contributions on market share contracts, Marx and Shaffer (2004) consider two sellers that sequentially compete for a common buyer, showing that a market share contract enables the first seller to shift rents from the second seller. In their model, the market share contract only serves for rent shifting and does not affect total industry profits and consumer surplus. Greenlee and Reitman (2006) show that when two firms compete in a single market, then compared with the case where the two firms compete in linear prices, the presence of loyalty programs that make payments contingent on market shares has an ambiguous effect on consumers. The present paper contributes to their analysis by highlighting the role of asymmetric information as a motivation for a market share contract, and by comparing the market share contract to nonlinear pricing. This comparison leads to somewhat different conclusions in that compared with nonlinear prices the market share contract always decreases consumer surplus and total welfare. Mills (2006) considers a somewhat similar setting with a dominant manufacturer that competes with a competitive fringe for the services of a common retailer. The main difference is that while the present paper considers adverse selection, Mills considers moral hazard and show that the dominant manufacturer will use a market share contract to promote the retailer's selling effort. Thus, in the Mills model the market share contract improves market performance, whereas in the present paper it reduces welfare. Finally, the present paper contributes to the literature on market share contracts by providing an explanation for why manufacturer may use market shares contracts instead of exclusive dealing and by comparing the effects of a market share contract and exclusive dealing on consumers and welfare.

This paper also relates to research concerning the effects of asymmetric information on manufacturers' incentives to impose vertical restraints. Gal-Or (1991b) shows that a monopoly selling to a single retailer with private information will benefit from imposing resale price maintenance (RPM), which enhances welfare. In a similar context, Blair and Lewis (1994) show that when the retailer needs to invest in promotion efforts, RPM has an ambiguous effect on welfare. In the context of two competing retailer-manufacturer hierarchies, Jullien and Rey (2000) show that RPM enables the manufacturers to obtain collusion because it induces more uniform prices, making any potential deviation from a tacit agreement easier to detect. In the context of a monopoly selling to two identical retailers, White (forthcoming) shows that when each retailer cannot observe the contract that the monopoly signs with the other retailer, vertical foreclosure solves the asymmetric information problem but at the same time eliminates the monopoly's incentive to behave opportunistically and therefore have an ambiguous effect on welfare. These papers do not consider the possibility of a dominant manufacturer and therefore do not consider exclusive dealing.

Finally, this paper relates to literature concerning the effect of vertical relations on the product line offered to consumers. In a market structure somewhat similar to the non-exclusive contract considered in this paper, Mills (1995) considers a monopoly that sells a high-quality brand to a retailer that can also sell a low-quality substitute in a form such as a private label. Mills focuses on the case where the monopoly cannot charge franchise fees and shows that the retailer offers the low-quality brand in order to mitigate the well-known double marginalization problem. Moreover, Mills finds that the retailer is more likely to produce a private label if consumers have a high average willingness to pay for quality. In contrast, in the present paper the retailer's incentive to offer the inefficient brand emerges from asymmetric information and therefore does so when consumers has, on average, a low (rather than a high) willingness to pay for quality. Villas-Boas (1998) considers a monopoly that can sell to a retailer both the high-quality and the low-quality brands and can also set the level of the two qualities. As in Mills (1995), the monopoly cannot charge franchise fees. Villas-Boas finds that the double marginalization problem reduces the retailer's incentive to carry both brands. In order to motivate the retailer to do so, the monopoly will have to increase the difference in the qualities of the two brands (compared with the vertical integration outcome), and in some cases, will force the monopoly to sell only one brand. In contrast, in this paper asymmetric information increases R's incentive to sell L, and therefore M's problem is to write a contract that restricts this incentive.

3. The Model

Consider an upstream manufacturer (M) that produces a high-quality product (H) at marginal cost c_H. M does not have the ability to sell directly to final consumers and needs to rely on a downstream retailer (R) that can distribute H at zero retail cost. In addition to selling H, R can also sell a low-quality substitute (L) that it can obtain at a marginal cost of c_L, where $c_L < c_H$. For example, H can represent a national brand produced by a reputable manufacturer while L can represent a private label produced exclusively by the retailer. Alternatively, L can represent a low-quality product that R can buy from a competitive fringe at a given price of c_L.

On the demand side, 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 quality. Following Mussa and Rosen (1978), I assume that given the final prices of H and L, p_H and p_L respectively, the utility of a consumer whose marginal willingness to pay for quality is v, is given by

$$u = \begin{cases} v - p_H, & \text{buys from } H, \\ \gamma v - p_L, & \text{buys from } L, \\ 0, & \text{otherwise}, \end{cases} \tag{1}$$

where γ ($0 < \gamma < 1$) measures the relative perceived quality of L compared to H (the quality of H being normalized to 1), or the net substitution effect between the two brands. Suppose that v is uniformly distributed along the interval $[0, \theta]$, with density 1. Thus, θ measures the consumers' willingness to pay for the two brands, or the net income effect. In addition, θ measures the total mass of consumers, but throughout this paper R eventually serves only the high end of the market and therefore an increase in θ increases demand solely because it increases the average willingness to pay of these consumers. I assume that $\theta - c_H > \gamma\theta - c_L > 0$. This assumption implies that, priced at marginal cost, at least the highest type consumer (with $v = \theta$) has a positive utility from buying both products although this consumer prefers to buy H. As I will show in the continuation, this assumption rules out the uninteresting case in which H is never offered.

It is straightforward to show that in order to sell both L and H, p_L should be sufficiently lower than p_H in that $p_H > p_L/\gamma$. This inequality ensures that high-type consumers with $v \in [(p_H - p_L)/(1 - \gamma), \theta]$ buy H, intermediate-type consumers with $v \in [p_L/\gamma, (p_H - p_L)/(1 - \gamma)]$ buy L, and low-type consumers with $v \leq p_L/\gamma$ do not buy at all. Rearranging these terms, the inverse demand functions facing R are: [8]

$$p_H(q_L, q_H; \theta) = \theta - q_H - \gamma q_L, \qquad p_L(q_L, q_H; \theta) = \gamma(\theta - q_H - q_L). \tag{2}$$

If only H is offered, or if both H and L are offered but $p_H < p_L/\gamma$ (in which case all consumers who buy prefer to buy H), then all consumers with $v \in [p_H, \theta]$ buy H and the inverse demand function is $p_H(0, q_H; \theta) = \theta - q_H$. Likewise, if only L is offered then all consumers with $v \in [p_L/\gamma, \theta]$ buy L and the inverse demand function is $p_L(q_L, 0; \theta) = \gamma(\theta - q_L)$.

I consider these specific consumer preferences instead of a more general demand function because the analysis reveals that the question of whether R sells L and whether M imposes exclusive dealing or market share restriction depends on market parameters such as the degree of vertical differentiation, the asymmetries in production costs and the degree of asymmetric information. By considering specific consumer preferences, I can derive intuitive conditions on the parameters under which these practices will take place. Notice that a resulting feature of these preferences is that the two inverse demand functions are increasing with θ, while the effect of θ

[8] As regards the assumption of a single retailer throughout this paper, considering a quantity-setting or a price-setting retailer yields identical results. Nevertheless, considering a quantity-setting retailer facilitates the analysis and enables me to directly present the conditions for offering positive quantities of both L and H.

on the inverse demand for H is stronger than the effect on the inverse demand for L because $\gamma < 1$. Intuitively, θ measures consumers' willingness to pay for both brands (due, for instance, to an income effect) and thereby affects the demand for both brands. As I will show below, these features will engender some of the results. Moreover, as the substitution parameter, γ, increases, the inverse demand for L increases at the expense of the demand for H.

Under vertical integration (when one firm produces and distributes both qualities to final consumers), q_H and q_L are chosen to maximize the sum of industry profits,

$$\pi^{VI}(q_L, q_H; \theta) = \begin{cases} (p_H(q_L, q_H; \theta) - c_H)q_H + (p_L(q_L, q_H; \theta) - c_L)q_L, & \text{if } q_L > 0, \\ (p_H(0, q_H; \theta) - c_H)q_H, & \text{otherwise.} \end{cases} \tag{3}$$

The vertical integration quantities are

$$q_H^{VI}(\theta) = \begin{cases} \dfrac{(\theta - c_H) - (\gamma\theta - c_L)}{2(1-\gamma)}, & \text{if } c_H > c_L/\gamma, \\ \tfrac{1}{2}(\theta - c_H), & \text{otherwise,} \end{cases} \qquad q_L^{VI} = \begin{cases} \dfrac{c_H - c_L/\gamma}{2(1-\gamma)}, & \text{if } c_H > c_L/\gamma, \\ 0 & \text{otherwise.} \end{cases} \tag{4}$$

Note that since by assumption $\theta - c_H > \gamma\theta - c_L > 0$, $q_H^{VI}(\theta) > 0$. However, a vertically integrated monopoly will offer L if and only if $c_L/\gamma < c_H$. Intuitively, even though consumers always value L less than H, L is nonetheless *efficient* if its quality-adjusted cost, c_L/γ, is lower than the quality-adjusted cost of H, c_H (where, recall, the quality of H is normalized to 1). Otherwise, L is *inefficient* and a vertically integrated monopoly will not offer it. The gap $c_L/\gamma - c_H$ can be interpreted as a measure of the inefficiency of L: whenever $c_L/\gamma - c_H > 0$ (L is inefficient), as $c_L/\gamma - c_H$ increases, L becomes more inefficient, and whenever $c_H - c_L/\gamma > 0$ (L is efficient), as $c_H - c_L/\gamma$ increases L becomes more efficient.[9] In what follows, I will allow for both an efficient and an inefficient L, because this will illustrate how the decision on whether to sell L or not depends on whether L is efficient. Finally, substituting (4) back into (3) yields the vertical integration profit, $\pi^{VI}(\theta)$.

[9] Johnson and Myatt (2003) derive a similar condition in the context of a quantity-setting monopoly that can offer n different qualities, q_i, at marginal cost c_i. They show that the monopoly will offer only the highest quality if c_i/q_i is decreasing with i, and they interpret this case as an increasing return to quality.

4. Full-Information Benchmark

Now suppose that M and R are two independent firms, with M being the sole producer of H. Both M and R are perfectly informed about all the parameters of the model. The main result of this section is that under full information, M never benefits from imposing exclusive dealing or any other market share requirement. Moreover, M offers a contract that fully implements the vertical integration outcome. To demonstrate this, I first consider the case where M offers a simple non-exclusive contract, and then I show that M cannot do better by using an exclusive dealing or market share contract.

Consider the following two-stage game. In stage 1, M makes a take-it-or-leave-it offer $\{q_H,T\}$, where q_H is a fixed quantity of H and T is the associated payment from R to M. Note that in this model the manufacturer has full bargaining power over R. This assumption may not hold for large retailers (for example, Wal-Mart in the USA) or small manufacturers. However, it is unreasonable to expect that a small manufacturer will be able to impose exclusive dealing on a large retailer to begin with. Thus, this model is suitable for markets, or for product categories, in which the manufacturer has a sufficiently strong bargaining position to impose exclusive dealing. Moreover, note that R in this model is not entirely without market power because it can still choose to reject the offer altogether and sell L alone.

In stage 2, if R accepts M's offer then R chooses the optimal quantities of H and L. If R rejects M's offer, R offers only L to final consumers.

Solving the game backwards, note that in stage 2 q_H should be binding on R, because if M anticipates that R will set a lower quantity than q_H, then M can benefit from offering a lower q_H (that will allow M to save cost) without changing T. Therefore, if R accepts the offer $\{q_H,T\}$, it will sell all the units of H, and set q_L to maximize

$$\pi_R(q_L,q_H;\theta)=\begin{cases}\left(p_L(q_L,q_H;\theta)-c_L\right)q_L+p_H(q_L,q_H;\theta)q_H-T, & \textit{if } q_L>0,\\ p_H(0,q_H;\theta)q_H-T, & \textit{otherwise.}\end{cases} \tag{5}$$

Maximizing (5) with respect to q_L yields

$$q_L(q_H;\theta)=\begin{cases}\dfrac{\gamma\theta-c_L}{2\gamma}-q_H, & \textit{if } q_H<q_H^C(\theta)\equiv\dfrac{\gamma\theta-c_L}{2\gamma},\\ 0, & \textit{otherwise.}\end{cases} \tag{6}$$

Equation (6) indicates that when R accepts M's offer, there is a cutoff level of q_H, denoted by $q_H^C(\theta)$, such that R will offer L if and only if $q_H < q_H^C(\theta)$. Intuitively, since q_H should be binding in equilibrium, if M offers a small q_H, then R will offer additional units of L. For high values of q_H, R will settle for selling only H. Substituting (6) back into (5), R's profit from accepting M's contract is

$$\pi_R(q_H;\theta) = \begin{cases} \pi_{HL}(q_H;\theta) - T, & if\ q_H < q_H^C(\theta), \\ \pi_H(q_H;\theta) - T, & if\ q_H \geq q_H^C(\theta), \end{cases} \tag{7}$$

where

$$\pi_{HL}(q_H;\theta) = \left(p_L(q_L(q_H;\theta), q_H;\theta) - c_L\right) q_L(q_H;\theta) + p_H(q_L(q_H;\theta), q_H;\theta) q_H, \tag{8}$$

$$\pi_H(q_H;\theta) = p_H(0, q_H;\theta) q_H. \tag{9}$$

If R rejects M's offer, it offers only L and earns:

$$\pi_L(\theta) \equiv \max_{q_L} (p_L(q_L, 0;\theta) - c_L) q_L = \frac{(\gamma\theta - c_L)^2}{4\gamma}.$$

Therefore, in stage 2 R accepts M's offer as long as $\pi_R(q_H;\theta) > \pi_L(\theta)$.

Turning to stage 1, M's problem is to set $\{q_H, T\}$ so as to maximize $T - c_H q_H$, subject to $\pi_R(q_H;\theta) \geq \pi_L(\theta)$. Substituting the constraint into M's profit function and rearranging, yields that M will set q_H so as to maximize

$$\pi_M(q_H;\theta) = \begin{cases} \left(p_L(q_L(q_H;\theta), q_H;\theta) - c_L\right) q_L(q_H;\theta) & \\ + \left(p_H(q_L(q_H;\theta), q_H;\theta) - c_H\right) q_H - \pi_L(\theta), & if\ q_H < q_H^C(\theta), \\ \left(p_H(0, q_H;\theta) - c_H\right) q_H - \pi_L(\theta), & if\ q_H \geq q_H^C(\theta). \end{cases} \tag{10}$$

Note that (10) is identical to the profit function under vertical integration (see (3)), the only difference being that in (3) a vertically integrated monopoly sets both quantities directly, while in (10) M can only set q_H anticipating the behavior of R. Maximizing (10), I obtain the following Proposition.

Proposition 1: *Under full information, M sets* $\{q_H,T\} = \{q_H^{VI}(\theta), \pi_R(q_H^{VI}(\theta);\theta) - \pi_L(\theta)\}$ *and R sets the vertical integration quantities. In equilibrium, R earns* $\pi_L(\theta)$ *and M earns* $\pi^{VI}(\theta) - \pi_L(\theta)$.

Proposition 1 shows that under full information, R's ability to sell low-quality substitutes (such as private labels or unfamiliar imported products) changes the way profits are divided between M and R, but has no effect on market performance or product variety in that the equilibrium quantities are identical to those of a vertically integrated monopoly. Using revealed preferences, Proposition 1 indicates that M has nothing to gain by directly imposing exclusive dealing or any other restriction on R's ability to sell L. To see why, recall that in any contract R must earn at least its reservation profit, $\pi_L(\theta)$, and that the vertical integration profit is $\pi^{VI}(\theta)$. Consequently, in any exclusive dealing or market share contract, M cannot earn more than $\pi^{VI}(\theta)$ - $\pi_L(\theta)$, which is what M already earns in the non-exclusive contract, without the need to impose any restriction on R's ability to sell L. Therefore, in the context of this model, the arguments made by the Chicago School concerning the anti-competitive effects of exclusive dealing are justified under full information.

The intuition for this result is that since M can fully anticipate whether the contract induces R to offer both L and H and since M has full information regarding R's reservation utility, $\pi_L(\theta)$, M will set q_H to maximize total industry profits and will use T to capture all of R's added gross profit from selling H, regardless of whether L is efficient or not. Furthermore, M cannot benefit from imposing restrictions on R's ability to sell L for two reasons. First, if L is efficient then M finds it optimal to allow R to sell both H and L as this increases industry profits and enables M to extract higher profits from R. Second, if L is inefficient, then M can foreclose L by setting $q_H > q_H^C(\theta)$. Imposing exclusive dealing in this case does not provide M with any additional advantage because M will have to leave R with its reservation utility, $\pi_L(\theta)$, regardless of whether M imposes exclusive dealing or not.

5. Asymmetric Information and the Non-exclusive Contract

In this section, I consider the case in which R is better informed about consumers' willingness to pay than M. Moreover, I assume that due to antitrust laws, M cannot impose exclusive dealing on R or offer a market share contract, and is thus restricted to non-exclusive contracts. Unlike the full-information benchmark, the main result of this section is that under asymmetric information, in the non-exclusive contract R may offer both L and H even if L is inefficient (and not offered under full information).

In what follows, suppose that R is privately informed about consumers' willingness to pay for the two qualities, θ. Intuitively, M may deal with several retailers operating in different geographic locations, each having local monopoly power. Each retailer is thereby in a better position than M to evaluate consumers' willingness to pay within its geographic area. Likewise, demand can be subject to fluctuations due to changes in income, and retailers interacting closely with final consumers may be in a better position to recognize these changes. Note that I assume that R and M are equally informed about γ, which represents the perceived quality gap between the two brands, and may therefore be expected to depend more on the characteristics of the brands and less on the characteristics of consumers, such as their income.

Suppose that θ is distributed along the interval $[\theta_0, \theta_1]$ according to a smooth distribution function $f(\theta)$ and a cumulative distribution function $F(\theta)$. I make the standard assumption that $H(\theta) \equiv (1- F(\theta))/f(\theta)$ is non-increasing. To maintain the assumption that M is the dominant manufacturer even under asymmetric information, suppose that the gap $\theta - c_H - (\gamma\theta - c_L) > 0$ is sufficiently large such that $\theta_0 - c_H - H(\theta_0) > \gamma\theta_0 - c_L$. Intuitively, if asymmetric information is significant, then M may choose not to deal with R for which θ is low, in order to extract higher information rents from R for which θ is high. This implies that for low values of θ, H is not the dominant brand. The assumption that $\theta_0 - c_H - H(\theta_0) > \gamma\theta_0 - c_L$ rules out this possibility and ensures that H is still the dominant brand even under asymmetric information. Moreover, this assumption rules out the possibility of countervailing incentives under exclusive dealing, which I explain in the next section.

Following the revelation principle, I focus on fully revealing mechanisms. In order to induce R to truthfully reveal its private information, M offers a menu, $\{q_H(\theta), T(\theta)\}$, R reports $\tilde{\theta}$ and receives the corresponding pair $\{q_H(\tilde{\theta}), T(\tilde{\theta})\}$ from the menu (whenever necessary, I will denote R's report as $\tilde{\theta}$ in order to distinguish it from the true θ).

After R reports a $\tilde{\theta}$ and receives a contract $\{q_H(\tilde{\theta}), T(\tilde{\theta})\}$, the fee $T(\tilde{\theta})$ becomes a fixed cost and therefore R's decision on whether to sell L or not given $q_H(\tilde{\theta})$ is identical to that of the full-information case. It therefore follows from the previous section that R sells H exclusively if and only if $q_H(\tilde{\theta}) > q_H^C(\theta)$ and it sells $q_L(q_H(\tilde{\theta});\theta)$ units of L otherwise, where $q_H^C(\theta)$ and $q_L(q_H(\tilde{\theta});\theta)$ are given by (6). Therefore, R's profit given its report, $\tilde{\theta}$ and the true θ is

$$\pi_R(\tilde{\theta};\theta) = \begin{cases} \pi_{HL}(q_H(\tilde{\theta});\theta) - T(\tilde{\theta}), & if\ q_H(\tilde{\theta}) < q_H^C(\theta), \\ \pi_H(q_H(\tilde{\theta});\theta) - T(\tilde{\theta}), & if\ q_H(\tilde{\theta}) \geq q_H^C(\theta), \end{cases} \tag{11}$$

where $\pi_{HL}(q_H(\tilde{\theta});\theta)$ and $\pi_H(q_H(\tilde{\theta});\theta)$ are given by (8) and (9). M's problem is to set the optimal menu $\{q_H(\theta), T(\theta)\}$ as to maximize:

$$\max_{\{T(\theta), q_H(\theta)\}} \int_{\theta_0}^{\theta_1} \left(T(\theta) - c_H q_H(\theta)\right) f(\theta) d\theta, \tag{12}$$

$$\text{s.t.}\quad (IC)\quad \pi_R(\theta;\theta) > \pi_R(\tilde{\theta};\theta), \quad \forall \theta, \tilde{\theta} \in [\theta_0, \theta_1],$$

$$(IR)\quad \pi_R(\theta;\theta) > \pi_L(\theta), \quad \forall \theta \in [\theta_0, \theta_1],$$

where *IC* and *IR* are the incentive compatibility and individual rationality constraints. Note that R's ability to sell L affects this contract design problem in two ways. First, *IR* should take into account that by rejecting the contract R can sell L and earn $\pi_L(\theta)$, which depends on R's private information. Thus, this problem has the well-known feature of a privately informed agent with type-dependent reservation utility.[10] Second, *IC* should take into account that R has the ability to sell an additional brand, L, which is available to R regardless of its report to M. More precisely, *IC* should prevent R from reporting a $\tilde{\theta}$ such that $q_H^C(\theta) > q_H(\tilde{\theta}) > q_H^C(\tilde{\theta})$, in which case M believes that R will sell H and earn the second line in (11) (because $q_H(\tilde{\theta}) > q_H^C(\tilde{\theta})$), while in practice R will sell both H and L and earn the first line in (11) (because $q_H^C(\theta) > q_H(\tilde{\theta})$). Likewise, *IC* should prevent R from reporting a $\tilde{\theta}$ such that $q_H^C(\theta) < q_H(\tilde{\theta}) < q_H^C(\tilde{\theta})$, in which case M believes that R will sell both brands and earn the first line in (11) (because $q_H(\tilde{\theta}) < q_H^C(\tilde{\theta})$), while in practice R will sell only H and earn the second line in (11) (because $q_H^C(\theta) < q_H(\tilde{\theta})$). These two potential deviations from reporting the true θ emerge because R's decision to sell L depends on $q_H^C(\theta)$, which is a function of the true value of θ, and therefore R is privately informed on whether a certain $q_H(\tilde{\theta})$ is higher or lower than $q_H^C(\theta)$. *IC* should also take into account that even if R reports $q_H(\tilde{\theta}) < \min\{q_H^C(\theta), q_H^C(\tilde{\theta})\}$, such that M correctly anticipates that R will sell both H and L, R is still privately informed regarding the quantity of L, $q_L(q_H(q_H(\tilde{\theta});\theta)$, which depends on the true θ.

[10] See Biglaiser and Mezzetti (1993), Maggi and Rodriguze-Clare (1995), Jullien (2000) and Stole and Rochet (2002).

To solve (12), I follow previous literature on mechanism design problems in which the agent has a type-dependent reservation utility and adjust it to allow for the possibility that R may offer both H and L for some values of $\theta \in [\theta_0, \theta_1]$, while for others, $\hat{\theta} \in [\theta_0, \theta_1]$, $\hat{\theta} \neq \theta$, R offers only H. Let $U(\tilde{\theta};\theta) = \pi_R(\tilde{\theta};\theta) - \pi_L(\theta)$, and let $U(\theta) \equiv U(\theta;\theta)$ denote the information rents. Differentiating (11) and using the envelope theorem, the marginal information rents are

$$U'(\theta) = \begin{cases} q_H(\theta)(1-\gamma), & \text{if } q_H(\theta) \le q_H^C(\theta), \\ q_H(\theta) - \frac{1}{2}(\gamma\theta - c_L), & \text{if } q_H(\theta) \ge q_H^C(\theta). \end{cases} \tag{13}$$

I now turn to finding sufficient conditions to ensure *IR* and *IC*. Starting with *IR*, note that R has an incentive to understate θ in order to mislead M into believing that the benefit to R of accepting its contract and selling H are low, but at the same time R has an incentive to overstate θ in order to mislead M into believing that R's reservation utility from selling only L, $\pi_L(\theta)$, is high. Nonetheless (13) shows that the first effect always dominates in that $U'(\theta) > 0$.[11] Intuitively, since by assumption both $\pi_{HL}(q_H(\theta);\theta) > \pi_L(\theta)$ and $\pi_H(q_H(\theta);\theta) > \pi_L(\theta)$, R has little to gain from overstating $\pi_L(\theta)$, and much to lose in view of the fact that by doing so it also overstates $\pi_{HL}(q_H(\theta);\theta)$ or $\pi_H(q_H(\theta);\theta)$. Since $U'(\theta) > 0$, *IR* always binds at θ_0 and therefore there are no countervailing incentives in equilibrium and the *IR* restrictions can be replaced by $U(\theta_0) = 0$. Next consider *IC*. In Lemma 1, I show that non-decreasing $q_H(\theta)$ ensures *IC*.

Lemma 1: *If $q_H(\theta)$ is continuous, and twice differentiable except for the intersection points with $q_H^C(\theta)$, then a necessary and sufficient condition for IC is that $q_H(\theta)$ is non-decreasing in θ.*

Notice that Lemma 1 focuses on the case where $q_H(\theta)$ is continuous and piecewise differentiable. Proposition 2 below shows that doing so causes no loss of generality because ignoring these assumptions and the non-decreasing condition, the solution to M's problem yields a $q_H(\theta)$ that is indeed continuous and piecewise differentiable.

Substituting (13) into (12) and rearranging, M's problem is to maximize

[11] In the first line in (13), $U'(\theta) > 0$ follows because by assumption $1 > \gamma$ and in the second line $U'(\theta) > 0$ follows because by assumption $q_H(\theta) \ge q_H^C(\theta) > (\gamma\theta - c_L)/2$.

$$\max_{q_H(\theta)} \int_{\theta_0}^{\theta_1} \left[\pi_M(q_H(\theta);\theta) - H(\theta)U'(\theta)\right] f(\theta)d\theta, \tag{14}$$

s.t. $q_H'(\theta) \geq 0$, where $\pi_M(q_H(\theta);\theta)$ is given by (10). Thus M's problem is to maximize the full-information profits minus the information rents multiplied by their costs from M's viewpoint, $H(\theta)$. Let $q_H^{**}(\theta)$ and $q_H^{*}(\theta)$ denote the $q_H(\theta)$ that maximizes the term in the squared brackets for $q_H(\theta) < q_H^C(\theta)$ and $q_H(\theta) > q_H^C(\theta)$, respectively, where

$$q_H^{**}(\theta) = \frac{\theta - c_H - (\gamma\theta - c_L) - H(\theta)(1-\gamma)}{2(1-\gamma)}, \quad q_H^{*}(\theta) = \frac{\theta - c_H - H(\theta)}{2}, \tag{15}$$

and let $q_H^{NED}(\theta)$ denote the solution to (15). To facilitate the discussion, I present the characteristics of the optimal solution to (15) in two separate propositions for the cases of efficient and inefficient L. I begin by solving (15) under the assumption that L is inefficient:

Proposition 2: *Suppose that L is inefficient and that R is privately informed about* θ.

(i) *If* $H(\theta_0) < c_L/\gamma - c_H$, *then M offers* $q_H^{NED}(\theta) = q_H^*(\theta)$ *and R sells only H for* $\forall\theta \in [\theta_0, \theta_1]$.

(ii) *If* $c_L/\gamma - c_H < H(\theta_0) < (c_L/\gamma - c_H)/(1-\gamma)$, *then there is a cutoff,* $\overline{\theta}$, *where* $H(\overline{\theta}) = c_L/\gamma - c_H$, *such that M offers:*

$$q_H^{NED}(\theta) = \begin{cases} q_H^C(\theta), & \text{if } \theta \in [\theta_0, \overline{\theta}], \\ q_H^*(\theta), & \text{if } \theta \in [\overline{\theta}, \theta_1], \end{cases} \tag{16}$$

and R sells only H for $\forall\theta \in [\theta_0, \theta_1]$.

(iii) *If* $(c_L/\gamma - c_H)/(1-\gamma) < H(\theta_0)$, *then there is a cutoff,* $\underline{\theta}$, *where* $H(\underline{\theta}) = (c_L/\gamma - c_H)/(1-\gamma)$, *such that M offers:*

$$q_H^{NED}(\theta) = \begin{cases} q_H^{**}(\theta), & \text{if } \theta \in [\theta_0, \underline{\theta}], \\ q_H^C(\theta), & \text{if } \theta \in [\underline{\theta}, \overline{\theta}], \\ q_H^*(\theta), & \text{if } \theta \in [\overline{\theta}, \theta_1], \end{cases} \tag{17}$$

and R sells both H and L for $\theta \in [\theta_0, \underline{\theta}]$ *and offers only H for* $\theta \in [\underline{\theta}, \theta_1]$. *Moreover,* $\underline{\theta}$ *is increasing with* γ *and* c_H *and decreasing with* c_L.

The main result of Proposition 2 is that as long as $H(\theta_0) > (c_L/\gamma - c_H)/(1 - \gamma)$, asymmetric information induces R to sell an inefficient L. Note that although R sells both H and L for only a sub-interval of $[\theta_0, \theta_1]$, this sub-interval can be quite large. For example, in the extreme case in which $c_L/\gamma = c_H$, Proposition 2 implies that $\underline{\theta} = \overline{\theta} = \theta_1$, and thereby R sells L for all $\theta \in [\theta_0, \theta_1]$. In addition, note that the assumption that $\theta_0 - c_H - H(\theta_0) > \gamma\theta_0 - c_L$ (or $H(\theta_0) < \theta_0 - c_H - (\gamma\theta_0 - c_L)$) does not rule out the possibility that there is a sufficiently high $H(\theta_0)$ such that $H(\theta_0) > (c_L/\gamma - c_H)/(1 - \gamma)$.[12] Finally, note that since $f(\theta)$ is continuous, $q_H^{NED}(\theta)$ is continuous and piecewise differentiable in all three cases, which satisfies the conditions of Lemma 1.

To explain the intuition for Proposition 2, I will first describe the intuition for each of the three parts, and then move to derive the intuition for the condition for each part. Under asymmetric information, M has the well-known incentive to distort $q_H(\theta)$ downwards because doing so makes it less attractive for R to understate θ and thereby reduces R's information rents. Now, recall that under full information, if L is inefficient then $q_H^{VI}(\theta) > q_H^{C}(\theta)$ such that R chooses not to sell L. Part (i) indicates that if $H(\theta_0)$ is small such that $H(\theta_0) < c_L/\gamma - c_H$, the downward distortion in $q_H(\theta)$ is modest such that $q_H^{NED}(\theta)$ is still higher than $q_H^{C}(\theta)$ for all θ, and R offers only H, as shown in Panel (a) of Figure 1. By contrast, in parts (ii) and (iii), downwards distortion in $q_H^{NED}(\theta)$ is sufficiently high for $q_H^{NED}(\theta)$ to fall below $q_H^{C}(\theta)$ at low values of θ, which induces R to sell both H and L. This however raises a new problem for M, because the supply of L is independent of R's report to M. This provides R with the additional informational advantage of being able to understate θ and compensate itself for the low quantity of H by selling additional units of L that M does not account for, as $q_L(q_H(\tilde{\theta});\theta)$ is a function of the true value of θ. To see this informational advantage, R's information rents in (13) can be rewritten as

$$U'(\theta) = \begin{cases} q_H(\theta)\dfrac{\partial p_H}{\partial\theta} + q_L(q_H(\theta);\theta)\dfrac{\partial p_L}{\partial\theta} - \pi'_L(\theta), & q_H(\theta) \le q_H^C(\theta), \\ q_H(\theta)\dfrac{\partial p_H}{\partial\theta} - \pi'_L(\theta), & q_H(\theta) \ge q_H^C(\theta), \end{cases} \tag{18}$$

where $\partial p_i/\partial\theta$ is the direct effect of θ on the inverse demand for brand i = H, L. Under the specification of this model, it follows from (2) that $\partial p_H/\partial\theta = 1 > \partial p_L/\partial\theta = \gamma > 0$. The second line in (18) indicates that whenever $q_H(\theta) > q_H^C(\theta)$, by distorting $q_H(\theta)$ downwards M reduces the

[12] Since $\theta - c_H - (\gamma\theta - c_L)$ is increasing with θ while $(c_L/\gamma - c_H)/(1 - \gamma)$ is independent of θ, it is clear that $\theta - c_H - (\gamma\theta - c_L) > (c_L/\gamma - c_H)/(1 - \gamma)$ for high values of θ.

information rents by $\partial p_H/\partial\theta > 0$. However, if M distorts $q_H(\theta)$ such that it crosses below $q_H{}^C(\theta)$, then the information rents shift from the second to the first line in (18), which is higher than the second line since $\partial p_L/\partial\theta > 0$. Moreover, any further reduction in $q_H(\theta)$ will decrease the information rents by $\partial p_H/\partial\theta$ while at the same time increasing them by $\partial p_L/\partial\theta$, because $q_L(q_H(\theta);\theta)$ increase as a response to a reduction in $q_H(\theta)$. Since $\partial p_H/\partial\theta > \partial p_L/\partial\theta$, the second effect never offsets the first effect but nevertheless for any $q_H(\theta) < q_H{}^C(\theta)$, a stronger decrease in $q_H(\theta)$ is needed in order to achieve a given decrease in the information rents than in the case of $q_H(\theta) > q_H{}^C(\theta)$.

Now, for intermediates values of $H(\theta_0)$ such that $c_L/\gamma - c_H < H(\theta_0) < (c_L/\gamma - c_H)/(1 - \gamma)$, part (ii) shows that due to R's ability to sell L, M does not distort $q_H(\theta)$ below $q_H{}^C(\theta)$ and instead sets $q_H{}^{NED}(\theta) = q_H{}^C(\theta)$ for $\theta \in [\theta_0, \overline{\theta}\,]$, as shown in Panel (b) of Figure 1. Panel (c) illustrates the case of part (iii), in which $H(\theta_0)$ is high and M sets $q_H{}^{NED}(\theta) = q_H{}^C(\theta)$ only for $\theta\in[\underline{\theta}, \overline{\theta}\,]$, while for $\theta\in[\theta_0, \underline{\theta}\,]$ M will set $q_H{}^{NED}(\theta) < q_H{}^C(\theta)$ although doing so induces R to sell both L and H.

Note that the conditions for each of the three cases of Proposition 2 depend on the comparison between the size of $H(\theta_0)$ and a function of $c_L/\gamma - c_H$. Intuitively, the three conditions reflect a tradeoff between two conflicting effects. On one hand, L is inefficient and therefore it is not profitable to sell it. At the same time, asymmetric information creates the opposite incentive to offer L. The first effect is represented by the term $c_L/\gamma - c_H$, which measures the degree of the inefficiency of L. The higher is $c_L/\gamma - c_H$, the more L is inefficient because the gap between the quality-adjusted cost of L and H is higher, and R has a stronger incentive not to offer L. The second effect is represented by the term $H(\theta_0)$, which measures the degree of the asymmetric information problem. The higher is $H(\theta_0)$, the higher is the cost of R's marginal information rents from M's viewpoint , as indicated by (14), and the more significant is the associated distortion in $q_H{}^{NED}(\theta)$, as indicated by (15), implying that the asymmetric information problem is more significant. Consequently, part (i) holds if $H(\theta_0) < c_L/\gamma - c_H$ such that the first effect (the inefficiency of L as measured by $c_L/\gamma - c_H$) is stronger than the second effect (the asymmetric information problem as measured by $H(\theta_0)$), and R will not sell L. Part (ii) holds if $c_L/\gamma - c_H < H(\theta_0) < (c_L/\gamma - c_H)/(1 - \gamma)$ such that asymmetric information is intermediate and R's ability to sell L places a binding constraint on the contract, though R does not sell L in equilibrium. Part (iii) holds if $(c_L/\gamma - c_H)/(1 - \gamma) < H(\theta_0)$, such that asymmetric information is significant enough compared with the inefficiency of L and R will sell L in equilibrium. For example, if $c_L/\gamma - c_H$ equals zero, then the two brands have the same quality-adjusted costs and under full information

R is indifferent between offering L or not, implying that even the slightest asymmetric information problem (a small but positive $H(\theta_0)$) will satisfy the condition $(c_L/\gamma - c_H)/(1 - \gamma) < H(\theta_0)$ and R will sell L. If $c_L/\gamma - c_H$ is very large, then L is highly inefficient and even a significant asymmetric information problem may not be enough to satisfy the condition $(c_L/\gamma - c_H)/(1 - \gamma) < H(\theta_0)$ and R will not sell L.

Next, I turn to the case where L is efficient:

Proposition 3: *Suppose that L is efficient and that R is privately informed about* θ. *Then*, *M offers* $q_H^{NED}(\theta) = q_H^{**}(\theta)$ *and R offers both L and H for all* $\theta \in [\theta_0, \theta_1]$.

The intuition for Proposition 3 is that as in the case of inefficient L, M wishes to distort $q_H(\theta)$ below the full-information quantity in order to reduce R's information rents. However, since L is efficient, R sells both H and L even under full information, and the downward distortion in $q_H(\theta)$ only increases the incentive to sell both L and H and thereby both qualities are offered for all $\theta \in [\theta_0, \theta_1]$.

Proposition 3 along with parts (ii) and (iii) of Proposition 2 indicates that asymmetric information induces R to expand the use of L in the sense that R offers L whenever L is efficient and may also sell L when L is inefficient. These results have two implications. First, they provide an explanation for why retailers offer low-quality discount substitutes (such as private labels or unfamiliar imported products). In particular, the model predicts that low-quality substitutes are offered not only when they are efficient, but also when they are inefficient if asymmetric information is significant and consumers' average willingness to pay is low enough to fall onto the low end of manufacturers' expectations (since M expect that $\theta \in [\theta_0, \theta_1]$, R sells L if the actual realization of θ is on the lower part of M's expectations). Second, the results obtained in this section indicate that under asymmetric information M will not use a nonlinear contract alone to exclude an inefficient product, which implies that unlike the full-information benchmark, M may benefit from directly imposing exclusive dealing on R.

6. Exclusive Dealing Contract

In what follows, suppose that M can impose exclusive dealing by requiring R to focus solely on selling H. I assume that the exclusive dealing contract is deterministic in that M can either allow R to sell as many units of L as R wishes, or prohibit R from selling L altogether, but cannot restrict R to selling only a certain quantity of L. This assumption is reasonable in cases in which monitoring the retailer's sales of competing brands is too costly or impossible. For example, a manufacturer can send a sales representative to a supermarket to verify that it is not displaying competing brands, but even if the competing brands are present on the supermarket's shelves, the sales representative may not be able to assess how many units of these brands are actually being sold. The main result of this section is that M benefits from imposing exclusive dealing because this reduces R's information rents. Thus, M will impose exclusive dealing whenever L is inefficient and may also impose exclusive dealing when L is efficient if asymmetric information is significant enough.

With the additional instrument of exclusive dealing, suppose that M offers a menu of $\{T(\theta), q_H(\theta), ED(\theta)\}$, where $ED(\theta) = 1$ if the contract includes an exclusive dealing clause for this particular θ and $ED(\theta) = 0$ otherwise. Whenever $ED(\theta) = 1$, R is restricted to selling only H, regardless of whether $q_H(\theta)$ is higher or lower than $q_H^C(\theta)$. For $ED(\theta) = 0$, R can choose between offering both H and L or just H, and in this case R will sell L if and only if $q_H(\theta) < q_H^C(\theta)$. Notice that in this menu M can make the exclusivity clause contingent on R's report, such that the menu may offer contracts with and without the exclusive dealing restriction, from which R can choose by reporting a θ that corresponds to each of these cases. As before, R can choose to reject the contract altogether and earn its reservation utility, $\pi_L(\theta)$.

Using the calculations from the previous section, R's profit given its report $\tilde{\theta}$ and the true θ is given by (11), in which the second line now holds even if $q_H(\tilde{\theta}) < q_H^C(\theta)$ as long as $ED(\theta) = 1$. It therefore follows from Lemma 1 and the analysis of the previous section that if for a certain θ M sets $ED(\theta) = 0$, then the marginal information rents for this particular θ are given by (13). Likewise, if for a certain θ M sets $ED(\theta) = 1$, then the marginal information rents are given by the second line in (13), which holds for both $q_H(\theta) \leq q_H^C(\theta)$ and $q_H(\theta) > q_H^C(\theta)$. M's problem becomes to set $\{q_H(\theta), ED(\theta)\}$ so as to maximize (14), where now if $ED(\theta) = 1$, M earns the second line in (10), and information rents are the second term in (13), regardless of whether $q_H(\theta)$ is higher or lower than $q_H^C(\theta)$.

Let $q_H^{ED}(\theta)$ denote the optimal quantity of H that M offers in the exclusive dealing contract. As in Section 5, I distinguish between the optimal solution under efficient and inefficient L. Starting with the case in which L is inefficient, recall from Proposition 2 that if the asymmetric information problem is insignificant, then R's ability to sell L does not impose a binding constraint on the optimal contract, and thus exclusive dealing is superfluous. I therefore focus on the more interesting case in which absent exclusive dealing, R's ability to offer L is a binding constraint on the equilibrium contract.

Proposition 4: *Suppose that L is inefficient and that* $c_L/\gamma - c_H < H(\theta_0)$ (*R's ability to sell L imposes a binding constraint on the non-exclusive contract*). *Then, in equilibrium, M imposes exclusive dealing for* $\theta\in[\theta_0, \bar{\theta}]$ *and sets* $q_H^{ED}(\theta) = q_H^*(\theta)$ *for all* $\theta\in[\theta_0, \theta_1]$. *For all* $\theta\in[\theta_0, \theta_1]$, *R does not sell L and earns lower information rents than in the non-exclusive contract.*

Proposition 4 indicates that unlike the full-information case, under asymmetric information M imposes exclusive dealing on R. Intuitively, imposing exclusive dealing has two benefits from M's viewpoint. First, M prevents R from selling an inefficient brand. Second, M can reduce R's information rents because R will not be able to take advantage of the fact that the supply of L is independent of R's report on θ to M. More precisely, under exclusive dealing R's information rents are only the second line of (18) even when $q_H(\theta) < q_H^C(\theta)$, which is lower than the first line of (18) because $\partial p_L/\partial\theta > 0$. Since in the case of an inefficient L the second line in (10) yields higher profit than the first line in (10), M always imposes exclusive dealing.

Notice that at first glance, the exclusive dealing menu may not appear to be exclusionary, because M provides R with the option to choose between contracts that include an explicit exclusive dealing clause (for $\theta \in[\theta_0, \bar{\theta}]$) and contracts that do not impose such a restriction (for $\theta\in[\bar{\theta}, \theta_1]$. Both types of contracts are chosen by R for some realizations of θ. However, since for $\theta\in[\bar{\theta}, \theta_1]$ R will not sell L even without the restriction, the contract is *de-facto* exclusionary for all $\theta \in [\theta_0, \theta_1]$. In addition, note that the menu includes an exclusive dealing clause for $\theta \in[\theta_0, \bar{\theta}]$ even though in the non-exclusive menu considered in Section 5, R does not sell L for $\theta \in[\underline{\theta}, \bar{\theta}]$. Intuitively, in this case R's ability to sell L in itself imposes a binding constraint on the optimal contract even though R does not sell L in practice. Finally, notice that the assumption that $H(\theta_0) < \theta - c_H - (\gamma\theta - c_L)$ ensures that $q_H^{ED}(\theta) > (\gamma\theta - c_L)/2$ and thereby the second line in (13) is always positive and there are no countervailing incentives even under exclusive dealing.

Next, I turn to the case in which L is efficient and therefore offered under full information:

Proposition 5: *Suppose that L is efficient.*

(i) *If* $H(\theta_0) < (c_H - c_L/\gamma)/\sqrt{1-\gamma}$ *, then, in equilibrium, M sets* $q_H^{ED}(\theta) = q_H(\theta)^{**}$ *and* $ED(\theta) = 0$ *for all* $\theta \in [\theta_0, \theta_1]$*. In equilibrium, R offers both H and L for* $\forall\theta \in [\theta_0, \theta_1]$.

(ii) *If* $H(\theta_0) > (c_H - c_L/\gamma)/\sqrt{1-\gamma}$ *, then there is a cutoff,* θ^C*, such that M sets*

$$q_H^{ED}(\theta) = \begin{cases} q_H^*(\theta), & \text{if } \theta \in [\theta_0, \theta^C], \\ q_H^{**}(\theta), & \text{if } \theta \in [\theta^C, \theta_1], \end{cases} \quad \text{and} \quad ED(\theta) = \begin{cases} 1 & \text{if } \theta \in [\theta_0, \theta^C], \\ 0, & \text{if } \theta \in [\theta^C, \theta_1], \end{cases}$$

In equilibrium, R offers only H if $\theta \in [\theta_0, \theta^C]$ *and it offers both H and L if* $\theta \in [\theta^C, \theta_1]$*, where* θ^C *is decreasing with the gap* $c_H - c_L/\gamma$ *and* $\theta^C = \theta_1$ *if* $c_H - c_L/\gamma = 0$*. R's information rents under exclusive dealing are lower than they would be in the absence of exclusive dealing for all* $\theta \in [\theta_0, \theta_1]$.

(iii) *In both cases* $q_H^{ED}(\theta)$ *and* $ED(\theta)$ *satisfy IC.*

Proposition 5 shows that if asymmetric information is significant, then M may use exclusive dealing to foreclose L even though L is efficient and offered under full information. As in the case of an inefficient L, the equilibrium menu provides R with the option to choose between contracts that include an exclusive dealing clause (for $\theta \in [\theta_0, \theta^C]$), and contracts that do not restrict R from selling L (for $\theta \in [\theta^C, \theta_1]$). Nevertheless, exclusive dealing when L is efficient and when it is inefficient differ in that when L is inefficient M *de facto* forecloses L for all $\theta \in [\theta_0, \theta_1]$, whereas when L is efficient M forecloses L for low values of θ, while for $\theta \in [\theta^C, \theta_1]$, R is not restricted from selling L and indeed does so in equilibrium. Also note that $q_H^{ED}(\theta)$ is not continuous at θ^C nor is it increasing in θ, but part (iii) of Proposition 5 reveals that $q_H^{ED}(\theta)$ nevertheless satisfies *IC*.

The intuition for Proposition 5 is that imposing exclusive dealing has two conflicting effects from M's viewpoint. First, L is efficient and therefore it is profitable to allow R to sell it. Second, allowing R to sell L increases R's information rents, which by itself motivates M to impose exclusive dealing. Part (i) of Proposition 5 shows that the first effect dominates if $H(\theta_0) < (c_H - c_L/\gamma)/\sqrt{1-\gamma}$, in which case M does not impose exclusive dealing. To interpret this condition, notice that the term $(c_H - c_L/\gamma)/\sqrt{1-\gamma}$ is a measure of the first effect: as the gap between the quality-adjusted cost of H and the quality-adjusted cost of L increases, L is more efficient and M will have a stronger incentive to allow R to offer it. The term $H(\theta_0)$ is a measure of the second effect: as $H(\theta_0)$ increases, the cost of the marginal information rents from M's viewpoint increases and the asymmetric information problem is more significant, implying that M will have a stronger incentive to impose exclusive dealing. Consequently, if $H(\theta_0) < (c_H - c_L/\gamma)/\sqrt{1-\gamma}$ then the first effect (L being efficient) is stronger than the second effect (the asymmetric information problem) and M will prefer not to impose exclusive dealing. In contrast, part (ii) indicates that in the opposite case the second effect dominates and therefore M prefers to prevent R from selling an efficient brand just in order to reduce R's information rents.

Interestingly, in the latter case M will impose exclusive dealing only for low values of θ, while allowing R to sell both L and H for high values of θ. This last result is somewhat surprising since R's information rents are increasing with θ, which implies that M's incentive to reduce R's information rents is more significant for high (rather than low) θ. The intuition for this last result is that imposing exclusive dealing for $\theta \in [\theta_0, \theta^C]$ makes it less attractive for R to understate θ whenever θ is higher than θ^C, because by doing so R will not be able to offer L. As a result, imposing exclusive dealing for $\theta \in [\theta_0, \theta^C]$ reduces R's information rents for $\theta \in [\theta^C, \theta_1]$, though for $\theta \in [\theta^C, \theta_1]$ R is not deprived of the option to sell both L and H.

Proposition 5 along with Proposition 4 indicates that asymmetric information induces M to expand its foreclosure strategy in the sense that M will impose exclusive dealing whenever L is inefficient and may impose exclusive dealing even if L is efficient and profitable under full information.

Next, I turn to analyzing the effects that allowing M to use exclusive dealing have on consumer surplus and welfare. Again I focus on the case in which asymmetric information is significant enough for M to impose exclusive dealing in equilibrium.

Proposition 6: *Suppose that $H(\theta_0) > max\{(c_H - c_L/\gamma)/\sqrt{1-\gamma}, c_L/\gamma - c_H\}$ (M imposes exclusive dealing in equilibrium)). Then, exclusive dealing increases p_H and decreases total industry profits, consumer surplus and thereby social welfare.*

Proposition 6 indicates that exclusive dealing as a device for reducing R's information rents is not in the best interest of consumers: exclusive dealing both prevents R from offering the low-quality substitute and increases the price of the high-quality product. Moreover, exclusive dealing also reduces total industry profits. The intuition for this result is that by selling L, R mitigates M's ability to reduce R's information rents but it does so at the expense of decreasing total industry profits; thus, exclusive dealing enables M to achieve a larger reduction in R's information rents, which in turn results in a larger reduction in total industry profits. Notice that even though M has a stronger incentive to impose exclusive dealing in the case where L is inefficient, the results of Proposition 6 hold regardless of whether L is efficient or not. Intuitively, if L is inefficient such that it is a poor substitute for H, it is nevertheless more welfare enhancing to offer L as compensation for the low quantity of H that M sells than not to offer L at all.

As far as antitrust policy is concerned, the results of this section highlight two main points that courts should take into account when examining cases involving exclusive dealing. The first point is the issue of information. The idea that exclusive dealing may emerge because of partial information is not new and was raised in the frequently cited cases of *Standard Oil v. United States*, 337 U.S. 293, 305-06 (1949) and *Tampa Electric Co. v. Nashville Coal Co*. 365 U.S. 320 (1961). For example, in *Standard Oil*, Standard, a dominant seller of petroleum products, entered into exclusive supply contracts with independent dealers. The court acknowledged that such contracts "may well be of economic advantage to buyers as well as to sellers, and thus indirectly of advantage to the consuming public." For the buyers, these contracts may "obviate the expense and risk of storage in the quantity necessary for a commodity having a fluctuating demand." Likewise, for sellers these contracts may "give protection against price fluctuations". However, the results of this paper show that when exclusive dealing emerges because of asymmetric information rather than uncertainty regarding demand, exclusive dealing has a negative effect on consumers and welfare because it can lead to the foreclosure of efficient, as well as inefficient brands. The distinction of whether the market is characterized by uncertainty shared by both the manufacturer and the retailer, or private information possessed by the retailer, is thus crucial. Even though the court's decision in *Standard Oil v. United States* did not provide any direct evidence on the presence of asymmetric information, this cannot be ruled out as a plausible explanation. For example, the court argued that "It is common knowledge that a host of filling stations in the country are locally owned and operated." Thus, it may be plausible to expect that each of such locally owned and operated retailers will have better information than the large supplier concerning the specific demand in the retailer's geographic location.

The second point that this section underscores for antitrust policy concerns the economic literature by Aghion and Bolton (1987), Rasmusen et al. (1991) and others that have shown that exclusive dealing as a device for market foreclosure emerges when the dominant firm benefits from a first-mover advantage, or alternatively when the competing brand needs to meet a minimum efficient scale for production. However, there are several antitrust cases involving exclusive dealing in which such barriers to entry did not exist. For example, going back to *Standard Oil v. United States*, some of the exclusive contracts were terminable "at the end of the first 6 months of any contract year, or at the end of any such year, by giving to the other at least

30 days prior thereto written notice". Clearly, with relatively short-term contracts, any first-mover advantages are short termed, as retailers could easily have refused to renew their agreement with Standard, switching instead to alternative suppliers. As another example, in *Republic Tobacco v. North Atlantic,* U.S. App. 18470; 2004-2 Trade Case (2004), Republic, a manufacturer of tobacco and tobacco-related products, benefited from a dominant position in the nine-state "Southeast" region. A competing manufacturer, North Atlantic, experiencing difficulties in penetrating this market, claimed that Republic "entered into unlawful exclusive dealing agreements that substantially lessen competition", but the court dismissed the claim. The exclusive dealing contract in this case is not explainable by the first-mover advantage argument because the contracts "lasted for one year or less and were all terminated at will". Nor did the minimum efficient scale argument fit this case because the foreclosed firm, North Atlantic, had been operating in other areas of the USA, and in fact had in total a higher market share in the USA than Republic. As Areeda and Hovenkamp (2002, pp. 185) point out, courts often approve exclusive dealing contracts when the duration of the contract is less than one year.[13] Moreover, Areeda and Hovenkamp (2002, pp. 69) argue that "Exclusive dealing foreclosing upstream rivals from access to downstream markets may not produce any competitive harm at all. This would certainly be the case where economies of scale are insubstantial and entry barriers are low in the supposedly foreclosed market." Nevertheless, the results of this section show that exclusive dealing can potentially be used by M for market foreclosure even when L is already available to R at marginal cost such that the duration of the contract or the minimum efficient scale for production are irrelevant.

Finally, it is important to note that exclusive dealing may still have welfare-enhancing properties, which are beyond the scope of this paper (as indicated in the Introduction). The results of this section should be interpreted as the <u>net</u> effect that asymmetric information on θ has on the market. Thus, exclusive dealing should be condemned as illegal only if asymmetric information is significant enough for the anti-competitive effects of exclusive dealing as indicated by Proposition 6 to have the potential to offset any welfare-enhancing properties.

7. Market Share Contract

In what follows, suppose that M can write a contract that depends on R's sales from both qualities. For example, M may be able to write a contract based on R's financial or sales' reports to which it may have access and from which it can observe not only if R is offering consumers

[13] In their footnote 58, Areeda and Hovenkamp (2002, pp. 185) also provide numerous examples of legal cases in which courts approved exclusive contracts because of short duration.

competing brands but also how many units of these brands it is selling. Such contracts typically take the form of market share discounts, in which a manufacturer provides a retailer with a discount if the retailer commits to buying a certain percentage of its units from that manufacturer. However, I will not restrict M to such market share discounts, and instead consider a more general contract space of the form $\{T(\theta), q_H(\theta), q_L(\theta)\}$. This framework enables M to offer a quantity discount, a market share discount or both. As I will show below, these two features emerge as an equilibrium behavior. Note that the non-exclusive dealing contract considered in Section 5 is a particular case of the market share contract in which R is free to set any $q_L(\theta)$. The exclusive dealing contract considered in Section 6 is also a particular case of the market share contract in which for some values of θ, R is free to set any $q_L(\theta)$, while for others R is restricted to set $q_L(\theta) = 0$. The main results of this section are that M will prefer a market share contract over exclusive dealing only if L is efficient. Nevertheless, compared with the exclusive dealing contract, the market share contract has an ambiguous effect on consumer surplus and welfare.

Given a menu of contracts $\{T(\theta), q_H(\theta), q_L(\theta)\}$, R's profit from reporting some $\tilde{\theta}$ and receiving the corresponding line from the menu is

$$\pi_R(\theta,\tilde{\theta}) = p_H(q_L(\tilde{\theta}), q_H(\tilde{\theta});\theta)q_H(\tilde{\theta}) + \left(p_L(q_L(\tilde{\theta}), q_H(\tilde{\theta});\theta) - c_L\right)q_L(\tilde{\theta}) - T(\tilde{\theta}). \tag{19}$$

As before, R's information rents are defined as $U(\theta) = \pi_R(\theta) - \pi_L(\theta)$, where the marginal information rents are

$$U'(\theta) = q_H(\theta) + \gamma q_L(\theta) - \tfrac{1}{2}(\gamma\theta - c_L). \tag{20}$$

Using the envelope theorem, R will report truthfully if the following conditions hold.

Lemma 2: *Suppose that* $q_H(\theta)$ and $q_L(\theta)$ *are continuous and twice differentiable. Then, necessary and sufficient conditions for IR and IC are* $U(\theta_0) = 0$ *and* $q_H(\theta) + \gamma q_L(\theta)$ *is non-decreasing in* θ.

Substituting (20) into (19) and rearranging, M's problem under the market share contract is

$$\max_{\{q_H(\theta), q_L(\theta)\}} \int_{\theta_0}^{\theta_1} \left[\pi^{VI}(q_H(\theta), q_L(\theta);\theta) - \pi_L(\theta) - H(\theta)U'(\theta)\right] f(\theta)d\theta\,. \tag{21}$$

Let $q_H^{MS}(\theta)$ and $q_L^{MS}(\theta)$ denote the solution to (21). As before, I distinguish between the solution in the inefficient and efficient cases, and start with the former case.

Proposition 7: *Suppose that L is inefficient and that $c_L/\gamma - c_H < H(\theta_0)$ (R's ability to sell L imposes a binding constraint on the non-exclusive contract). Then, in equilibrium, the market share contract is identical to the exclusive dealing contract in that M sets $q_L^{MS}(\theta) = 0$ and $q_H^{MS}(\theta) = q_H^*(\theta)$.*

Proposition 7 reveals that in the case of an inefficient L, M's ability to directly control $q_L(\theta)$ does not change M's incentive to exclude L altogether. Intuitively, recall that in the exclusive dealing contract, M has two incentives to exclude L: it is inefficient and it increases R's information rents. Whenever L is inefficient, these two incentives are true for the market share contract in that it does not provide M with any advantage over the exclusive dealing contract. This result indicates that manufacturers may want to use a contract that completely forecloses L even when they can specify in the contract any positive quantity of L.

Next, let us consider the case in which L is efficient.

Proposition 8: *Suppose that L is efficient. Then, in the market share contract, M sets $q_H^{MS}(\theta) = q_H^{**}(\theta)$ and $q_L^{MS}(\theta) = q_L^{VI}$. In equilibrium, R offers L for all $\theta \in [\theta_0, \theta_1]$, but the contract imposes a maximum restriction on the quantity of L that R can sell in that $q_L(q_H^{MS}(\theta);\theta) > q_L^{MS}(\theta)$.*

According to Proposition 8, whenever L is efficient the market share contract is superior to the exclusive dealing contract from M's point of view. The intuition for this result is that under a market share contract, M can distort the quantity of H downwards without having to fear that R will understate θ and compensate itself for the low quantity of H by selling additional units of L, as the quantity of L is specified in the contract. Thus, the market share contract reduces R's ability to use the sales of L to enhance its informational advantage. To see this point more accurately, notice that in general terms, R's information rents under the market share contract are identical to the first line in (18), except that now R cannot set $q_L(q_H(\theta);\theta)$ and instead is restricted to $q_L(\theta)$. Thus, if M reduces $q_H(\theta)$ to decrease the first line in (18), M does not need to incur the offsetting effect of an increase in $q_L(q_H(\theta);\theta)$, because the quantity of L is now fixed. Since L is also efficient, M will therefore set a positive quantity of L.

This result provides a new understanding of the optimal contract under exclusive dealing. Accordingly, under exclusive dealing M chooses the restrictive instrument of either completely foreclosing L or allowing R to sell as many units of L as R wants, to match, as closely as possible, the more desirable outcome of a market share contract. If L is efficient, then for low values of θ in which the downwards distortion in the quantity of H is significant, imposing exclusive dealing is a better match to the market share contract than allowing R to freely choose L because the latter case will enable R to sell a high quantity of L as compensation for the low quantity of H, which in turn implies that the quantity of L will be much higher than under the market share contract. Likewise, for high values of θ in which the downwards distortion in the quantity of H is minor, allowing R to freely sell L is a better match to the market share contract than forcing R not to sell L at all. If L is inefficient, then exclusive dealing serves as a perfect match to the market share contract because in both cases L is foreclosed all together.

The rest of this section focuses on the case of an efficient L, such that the equilibrium market share contract differs from the exclusive dealing contract. I first show that the equilibrium contract includes both quantity and market share discounts. To this end, let $T(q_H) \equiv T(\theta(q_H))$, where $\theta(q_H)$ is the inverse function of $q_H^{MS}(\theta)$. $T(q_H)$ is the total price that M charges in the market share contract for the total quantity q_H and the incremental price of H is

$$\frac{dT(q_H)}{dq_H} = \frac{dT(\theta)/d\theta}{dq_H^{MS}(\theta)/d\theta} = c_H + H(\theta)\,. \tag{22}$$

From (22), the incremental price of H is always higher than c_H, but decreases with θ. Moreover, since $q_H^{MS}(\theta) = q_H^{**}(\theta)$ and $q_L^{MS}(\theta) = q_L^{VI}$, it is straightforward to see that $q_H^{MS}(\theta)$ and consequently H's market share $q_H^{MS}(\theta)/(q_H^{MS}(\theta) + q_L^{MS}(\theta))$ increases with θ. Therefore, the incremental price is decreasing with both the quantity and the market share of H.

Next, I turn to evaluate the welfare implications of the market share contract. Clearly, M always prefers the market share contract over both the non-exclusive and exclusive dealing contracts because of revealed preferences: both the non-exclusive and the exclusive dealing contracts are particular cases of the market share contract. As for consumer surplus and welfare, I first compare the market share and the non-exclusive contracts.

Proposition 9: *Suppose that L is efficient. Then, consumer surplus, the retailer's information rents, total profits and total welfare are lower under the market share contract than under the non- exclusive contract.*

Compared with the non-exclusive contract, the market share contract decreases consumer surplus, R's profit, total profit and social welfare because it restricts the quantity of L that R sells, to the detriment of both R and the consumers.

These results indicate that in the context of this model, the market share contract has effects similar to those of the exclusive dealing contract because both exclude competing brands from the market, to some degree. In fact, on average, the market share contract may be even more harmful to consumer surplus and welfare than exclusive dealing. To see this, I focus on the interesting case in which asymmetric information is significant to the degree that, from Proposition 5, the equilibrium exclusive dealing contract indeed includes an exclusive dealing clause for low values of θ.

Proposition 10: *Suppose that L is efficient and* $H(\theta_0) > (c_H - c_L/\gamma)/\sqrt{1-\gamma}$ (*so in the exclusive dealing contract M imposes exclusive dealing for* $\theta \in [\theta_0, \theta^C]$). *Then,*

- *(i)* *for* $\theta \in [\theta_0, \theta^C]$ (*so in the exclusive dealing menu R chooses a contract that includes an exclusive dealing clause*), *consumer surplus, total industry profits and social welfare are higher under the market share contract than under the exclusive dealing contract, while information rents are the same;*
- *(ii)* *for* $\theta \in [\theta^C, \theta_1]$ (*so in the exclusive dealing menu R chooses a contract that does not include an exclusive dealing clause*), *consumer surplus, information rents, total industry profits and social welfare are lower under the market share contract than under the exclusive dealing contract.*

From Proposition 10, the market share contract has an ambiguous effect on consumers and welfare because it is less restrictive than exclusive dealing. However, this advantage of the market share contract also becomes a disadvantage because, being less restrictive, R imposes a market share restriction even on values of θ for which the exclusive dealing menu does not include an exclusive dealing clause. That is, exclusive dealing may benefit consumers and welfare simply because it deters M from applying an exclusive dealing clause to all the contracts in the menu and instead allows R the choice of a contract that does or does not include such a clause.

More precisely, the first part of Proposition 10 shows that consumer surplus, profits and welfare are higher under the market share contract than under the exclusive dealing contract whenever $\theta \in [\theta_0, \theta^C]$ because the latter completely excludes L while the former only restricts it.

Note that in this case information rents are the same in both contracts because compared with the case in which M imposes $q_L(\theta) = 0$, imposing any other binding $q_L(\theta) > 0$ does not enhance R's informational advantage since R is still prevented from choosing L independently. In contrast, the second part of Proposition 10 shows that whenever $\theta \in [\theta^C, \theta_1]$, under the exclusive dealing contract R chooses a contract that does not include an exclusive dealing clause and therefore sells a higher quantity of L than under the market share contract, which increases information rents as well as total industry profits, consumer surplus and total welfare. Consequently, the welfare comparison between the contracts is ambiguous and depends on the actual realization of θ. On average, the market share contract can be more harmful than the exclusive dealing contract if θ^C is sufficiently close to θ_0, such that it is more likely that $\theta \in [\theta^C, \theta_1]$.

As far as antitrust policy is concerned, the results of this section highlight several points that should be taken into account when examining cases involving market share discounts. For example, in *Concord Boat Corp. v. Brunswick Corp*., 207 F. 3d 1039 (2000), Brunswick, a leading marine engine manufacturer, offered boat builders a menu of contracts that differed in their required market shares and discounts (from 1984 to 1994, Brunswick offered boat builders 1%, 2% or 3% discounts for buying 60%, 70% or 80% of their total requirements from Brunswick). This practice corresponds to the market share menu, in which the retailer can choose between contracts that differ in their market share and incremental price by reporting a certain θ. Boat builders filed an antitrust suit against Brunswick, contending that it had used its market share discounts to monopolize the market, in violation of antitrust laws. Raising the issue of partial information, Brunswick claimed in its defense that "discount programs served efficiency and business purposes by improving the predictability of engine demand…". However, under the assumptions of this paper, partial information as a motivation for a market share contract can be inefficient, if the retailer has better information than the manufacturer concerning demand. Another argument made by Brunswick was that "market share discount programs were not anticompetitive because they were above cost and were not unlawfully exclusionary." In contrast, this section shows that the market share contract can be anticompetitive even though the incremental price of H, as shown in equation (22), is higher than M's marginal cost, and even though the contract is not exclusionary in that it does not completely (or almost completely) foreclose the competing brand. Finally, the court argued that "The boat builders also did not show that significant barriers to entry existed in the stern drive engine market. If entry barriers to new firms are not significant, it may be difficult for even a monopoly company to control prices through some type of exclusive dealing arrangement because a new firm or firms easily can enter the market to challenge it." In contrast, this paper shows that market share contracts can be harmful even when the competing brand is already available to R at marginal cost, such that barriers to entry are irrelevant.

Nevertheless, it is again important to emphasize that these results only reflect the net effect of asymmetric information as a motivation for imposing the market share contract. As Mills (2006) points out, the market share contract may also have welfare-enhancing properties. The results of this section and the previous section merely suggest that while evaluating the potential effects of exclusive dealing or market share contracts, antitrust authorities should take into account the presence of asymmetric information.

6. Conclusion

From a theoretical point of view, this paper introduces a principal-agent problem under adverse selection, when the agent is privately informed not only regarding the payoff generated by the principal's offer, but also regarding an additional source of payoff. Moreover, the principal can choose to write contracts that limit its agent's ability to exploit this additional payoff. Such a scenario can be applied to several areas of economics. For example, in an employer-employee relationship, the employer may restrict the employee's ability to take a second job in order to reduce the employee's information rents. Likewise, a regulator may restrict a monopoly's ability to offer additional unregulated brands, because the monopoly can take advantage of these brands to enhance its informational advantage.

This paper shows that in the context of vertical relations between a dominant manufacturer and a retailer that can sell an additional low-quality substitute brand, the retailer is able to enhance its informational advantage and thereby increase its information rents. As such, asymmetric information induces the retailer to expand the use of the low-quality brand to the case where the low-quality brand is inefficient. At the same time, it also induces the manufacturer to restrict the retailer's ability to sell the low-quality substitute, insofar as this is possible, by either an exclusive dealing or a market share contract, even if the low-quality brand is efficient. These two effects of asymmetric information reflect the tension between the retailer's incentive to increase its information rents and the manufacturer's incentive to decrease them.

The results of this paper were derived under certain simplifying assumptions that warrant further attention. First, I assume that the dominant manufacturer can only offer one quality. In some cases, a manufacturer may offer a whole range of products and can make the contract contingent on the purchase of some or all of these products. This raises the question of whether such a possibility will affect the manufacturer's incentive to impose an exclusive dealing or market share contract. Second, I assume that L is available to R at a given exogenous cost. This assumption is appropriate if L is either a private label or a low quality product sold by a perfectly competitive market. However, in other scenarios, it is possible to think of a second manufacturer that sells L along with a variety of brands and therefore has the market power to price L above marginal cost. In this scenario, such a manufacturer may exercise its market power and its ability to offer several brands in order to employ countermeasures against the threat of foreclosure, especially if its market power is significant enough. Finally, the results of this paper were derived under the assumption that R has private information concerning consumer willingness to pay for both brands. In other principal-agent scenarios in which the agent has an alternative source of payoff that it can employ in addition to the principal's offer, other informational structures could be possible. One such example is the case where the agent is privately informed only regarding its alternative source of payoff, which corresponds to the case where R is privately informed only concerning its revenues from L. This raises the question of how different informational structures will affect the results of this paper. Although intriguing, I believe that the questions raised above deserve a separate and more extensive analysis that goes beyond the scope of this paper, and I therefore leave them for further research.

Appendix

Following are the proofs of Lemmas 1 and 2 and Propositions 1 - 10.

Proof of Proposition 1:

The term inside (10) can be written as:

$$\pi_M(q_H;\theta)=\begin{cases} q_H\left(\theta(1-\gamma)-c_H+c_L-(1-\gamma)q_H\right), & \text{if } q_H<\dfrac{\gamma\theta-c_L}{2\gamma}, \\ (\theta-q_H-c_H)q_H-\dfrac{(\gamma\theta-c_L)^2}{4\gamma}, & \text{otherwise.}\end{cases} \qquad \text{(A - 1)}$$

The solution to the first and second lines (10) are $q_H = ((\theta - c_H) – (\gamma\theta - c_L))/2(1 - \gamma)$ and $q_H = (\theta - c_H)/2$ respectively. If $c_L/\gamma > c_H$, then $((\theta - c_H) – (\gamma\theta - c_L))/2(1 - \gamma) > (\theta - c_H)/2 > q_H^C(\theta)$ and therefore the solution to (A - 1) is at $q_H = (\theta - c_H)/2$. If $c_L/\gamma < c_H$, then $q_H^C(\theta) > (\theta - c_H)/2 > ((\theta - c_H) – (\gamma\theta - c_L))/2(1 - \gamma)$ and therefore the solution to (A - 1) is at $q_H = ((\theta - \mathrm{c_H}) – (\gamma\theta - \mathrm{c_L}))/2(1 - \gamma)$. Thus M sets $q_H^{VI}(\theta)$. Substituting $q_H^{VI}(\theta)$ into $q_L(q_H^{VI};\theta)$, yields that R sets q_L^{VI}.

Proof of Lemma 1:

Using (11) and the definition of $U(\theta)$, M will charge

$$T(\theta)=\begin{cases} \pi_H(q_H(\theta);\theta)-\pi_L(\theta)-\displaystyle\int_{\theta_0}^{\theta}U'(\hat\theta)d\hat\theta, & \text{if } q_H(\theta)\geq q_H^C(\theta), \\ \pi_{HL}(q_H(\theta);\theta)-\pi_L(\theta)-\displaystyle\int_{\theta_0}^{\theta}U'(\hat\theta)d\hat\theta, & \text{if } q_H(\theta)< q_H^C(\theta).\end{cases} \qquad \text{(A - 2)}$$

where $U'(\theta)$ in the first and second line of $T(\theta)$ is given by the first and second lines in (13) respectively and $\pi_{HL}(q_H(\theta);\theta)$ and $\pi_H(q_H(\theta);\theta)$ can be written explicitly as:

$$\pi_{HL}(q_H(\theta);\theta) = q_H(\theta)(\theta(1 - \gamma) + c_L) – (1 - \gamma)q_H(\theta)^2 + (\theta\gamma - c_L)^2/4\gamma, \qquad \text{(A - 3)}$$

$$\pi_H(q_H(\theta);\theta) = (\theta - q_H(\theta))q_H(\theta). \qquad \text{(A - 4)}$$

Note that $\pi_H(q_H^C(\theta);\theta) = \pi_{HL}(q_H^C(\theta);\theta)$, and that the first and second lines in (13) are equal for $q_H(\theta) = q_H^C(\theta)$. Therefore, if $q_H(\theta)$ is continuous and piecewise differentiable,$\pi_R(\tilde\theta;\theta)$ is also continuous and piecewise differentiable. To find conditions that ensure *IC*, I need to distinguish between four potential cases. In the first case, R reports a $\tilde{\theta} \neq \theta$ such that $q_H^C(\theta) > q_H(\tilde{\theta}) > q_H^C(\tilde{\theta})$ and therefore M believes that R will sell only H and charges the first line of $T(\theta)$ while in practice R will sell both H and L and earn

$$\pi_R(\tilde{\theta};\theta) = \pi_{HL}(q_H(\tilde{\theta});\theta) - \pi_H(q_H(\tilde{\theta});\tilde{\theta}) + \pi_L(\tilde{\theta}) + \int_{\theta_0}^{\tilde{\theta}} U'(\hat{\theta})d\hat{\theta}. \quad \text{(A - 5)}$$

Since $q_H^C(\theta)$ is increasing in θ and $q_H^C(\theta) > q_H^C(\tilde{\theta})$ it has to be that $\tilde{\theta} < \theta$, but the derivative of (A - 1) with respect to $\tilde{\theta}$ is

$$\begin{aligned}\frac{d\pi_R(\tilde{\theta};\theta)}{d\tilde{\theta}} &= (\theta(1 - \gamma) + c_L - \tilde{\theta} + 2\gamma\, q_H(\tilde{\theta}))q_H(\tilde{\theta})' \\ &\geq (\theta(1 - \gamma) + c_L - \tilde{\theta} + 2\gamma\, q_H^C(\tilde{\theta}))q_H(\tilde{\theta})' \\ &= (1 - \gamma)(\theta - \tilde{\theta})q_H(\tilde{\theta})' \\ &> 0,\end{aligned}$$

where the first inequality follows because $q_H(\tilde{\theta}) \geq q_H^C(\tilde{\theta})$ and $q_H(\tilde{\theta})' \geq 0$ and the second inequality follows because $\gamma < 1$ and $\tilde{\theta} < \theta$. In the second case, R reports a $\tilde{\theta} \neq \theta$ such that $q_H^C(\tilde{\theta}) > q_H(\tilde{\theta}) > q_H^C(\theta)$ and therefore M believes that R will sell both H and L and M charges the second line in $T(\theta)$, while in practice R will sell only H and earn

$$\pi_R(\tilde{\theta};\theta) = \pi_H(q_H(\tilde{\theta});\theta) - \pi_{HL}(q_H(\tilde{\theta});\tilde{\theta}) + \pi_L(\tilde{\theta}) + \int_{\theta_0}^{\tilde{\theta}} U'(\hat{\theta})d\hat{\theta}. \quad \text{(A - 6)}$$

Since $q_H^C(\theta)$ is increasing in θ and $q_H^C(\tilde{\theta}) > q_H^C(\theta)$, $\tilde{\theta} > \theta$, but the derivative of (A - 2) with respect to $\tilde{\theta}$ is

$$\begin{aligned}\frac{d\pi_R(\tilde{\theta};\theta)}{d\tilde{\theta}} &= -(\tilde{\theta}(1 - \gamma) + c_L - \theta + 2\gamma\, q_H(\tilde{\theta}))q_H(\tilde{\theta})' \\ &\leq -(\tilde{\theta}(1 - \gamma) + c_L - \theta + 2\gamma q_H^C(\theta))q_H(\tilde{\theta})' \\ &= -(1 - \gamma)(\tilde{\theta} - \theta)\, q_H(\tilde{\theta})' \\ &< 0,\end{aligned}$$

where the first inequality follows because in the second line $q_H(\tilde{\theta}) \geq q_H^C(\theta)$ and $q_H(\tilde{\theta})' \geq 0$ and the second inequality follows because $\gamma < 1$ and $\tilde{\theta} > \theta$. Thus, it follows from (A - 1) and (A - 2) that $q_H(\theta)' > 0$ ensures that R will not mislead M on whether R intends to sell L or not. In the third potential case, M has a correct prediction that $q_H(\tilde{\theta})$ induces R to sell only H. In this case $q_H(\tilde{\theta})$ > max$\{q_H^C(\theta), q_H^C(\tilde{\theta})\}$, M charges the first line of $T(\theta)$ and R earns

$$\pi_R(\tilde{\theta};\theta) = \pi_H(q_H(\tilde{\theta});\theta) - \pi_H(q_H(\tilde{\theta});\tilde{\theta}) + \pi_L(\tilde{\theta}) + \int_{\theta_0}^{\tilde{\theta}} U'(\hat{\theta})d\hat{\theta}$$

The first order condition with respect to $\tilde{\theta}$ is $d\pi_R(\tilde{\theta};\theta)/d\tilde{\theta} = (\theta - \tilde{\theta})q_H(\tilde{\theta})' = 0$, hence $\tilde{\theta} = \theta$. The second order condition evaluated at $\tilde{\theta} = \theta$ is $d^2\pi_R(\tilde{\theta};\theta)/d\tilde{\theta}^2 = - q_H'(\theta) \leq 0$ which is satisfied for $q_H'(\theta) \geq 0$. Finally, in the forth case M has a correct prediction that $q_H(\tilde{\theta})$ induces R to sell both H and L. In this case $q_H(\tilde{\theta})$ < min$\{q_H^C(\theta), q_H^C(\tilde{\theta})\}$, M charges the second line of $T(\theta)$ and R earns

$$\pi_R(\tilde{\theta};\theta) = \pi_{HL}(q_H(\tilde{\theta});\theta) - \pi_{HL}(q_H(\tilde{\theta});\tilde{\theta}) + \pi_L(\tilde{\theta}) + \int_{\theta_0}^{\tilde{\theta}} U'(\hat{\theta})d\hat{\theta}$$

The first order condition with respect to $\tilde{\theta}$ is $d\pi_R(\tilde{\theta};\theta)/d\tilde{\theta} = (1 - \gamma)(\theta - \tilde{\theta})q_H(\tilde{\theta})' = 0$, hence $\tilde{\theta} = \theta$. The second order condition evaluated at $\tilde{\theta} = \theta$ is $d^2\pi_R(\tilde{\theta};\theta)/d\tilde{\theta}^2 = - (1 - \gamma)q_H'(\theta) \leq 0$ which is satisfied for $q_H'(\theta) \geq 0$ since $\gamma < 1$. If $q_H(\theta)$ is continuous such that $\pi_R(\tilde{\theta};\theta)$ is continuous, it follows from these four cases that R reports $\tilde{\theta} = \theta$.

Proof of Proposition 2:

The term inside the squared brackets in (15) can be written explicitly as

$$\pi_M^{NED}(q_H;\theta) = \begin{cases} q_H\left(\theta(1-\gamma) - c_H + c_L - (1-\gamma)q_H\right) - H(\theta)(1-\gamma)q_H, & \text{if } q_H < q_H^C(\theta), \\ (\theta - q_H - c_H)q_H - \dfrac{(\gamma\theta - c_L)^2}{4\gamma} - H(\theta)\left(q_H - \frac{1}{2}(\gamma\theta - c_L)\right), & \text{if } q_H \geq q_H^C(\theta), \end{cases} \quad \text{(A - 7)}$$

which is continuous in q_H. The q_H that maximizes the first and second line in (A – 3) is given by the left and right hand side in (16). It is straightforward to see from (16) that if for a specific θ, $H(\theta) < c_L/\gamma - c_H$, then $q_H^{**}(\theta) > q_H^*(\theta) > q_H^C(\theta)$, and thereby for this specific θ M will set $q_H^{NED}(\theta) = q_H^*(\theta)$. If however for a specific θ, $c_L/\gamma - c_H < H(\theta) < (c_L/\gamma - c_H)/(1- \gamma)$ (where $c_L/\gamma - c_H < (c_L/\gamma - c_H)/(1- \gamma)$ because by assumption $c_L/\gamma - c_H > 0$ and $\gamma < 1$), then $q_H^{**}(\theta) > q_H^C(\theta) > q_H^*(\theta)$, in which case M will set for this θ: $q_H^{NED}(\theta) = q_H^C(\theta)$. If $(c_L/\gamma - c_H)/(1- \gamma) < H(\theta)$, then $q_H^C(\theta) > q_H^{**}(\theta) > q_H^*(\theta)$, in which case M will set $q_H^{NED}(\theta) = q_H^{**}(\theta)$. From the definition of $H(\theta)$, it is clear that $H(\theta_0) > 0$, $H(\theta)' \leq 0$ and $H(\theta_1) = 0$. As shows in panel (a) of Figure 2, if $H(\theta_0) < c_L/\gamma$ -

c_H then $H(\theta) < c_L/\gamma - c_H$ for all $\theta \in [\theta_0, \theta_1]$ which yields case (i) in Proposition 2. If $c_L/\gamma - c_H < H(\theta_0) < (c_L/\gamma - c_H)/(1-\gamma)$, then from panel (b) of Figure 2 there is a cutoff, $\overline{\theta}$, such that for $\theta \in [\theta_0, \overline{\theta}]$, $c_L/\gamma - c_H < H(\theta) < (c_L/\gamma - c_H)/(1-\gamma)$ and thereby $q_H^{NED}(\theta) = q_H^C(\theta)$ while for $\theta \in [\overline{\theta}, \theta_1]$, $H(\theta) < c_L/\gamma - c_H$ and thereby $q_H^{NED}(\theta) = q_H^*(\theta)$, which yields case (ii). Finally, if $H(\theta_0) > (c_L/\gamma - c_H)/(1-\gamma)$, then from panel (c) of Figure 2 there is also going to be a cutoff, $\underline{\theta}$, such that for $\theta \in [\theta_0, \underline{\theta}]$, $H(\theta) > (c_L/\gamma - c_H)/(1-\gamma)$ and thereby $q_H^{NED}(\theta) = q_H^{**}(\theta)$, which yields case (iii). Finally, since by assumption $f(\theta)$ is differentiable and continuous, $q_H^{NED}(\theta)$ is continuous and differentiable except for the intersection points with $q_H^C(\theta)$ in all three cases, implying that there is no loss of generality in restricting attention in Lemma 1 to continuous and piecewise differentiable $q_H(\theta)$. Moreover, since $H(\theta)$ is non-increasing in θ and $\gamma < 1$, it follows from (15) that $q_H^{NED}(\theta)$ is non-decreasing in θ.

Proof of proposition 3:

As in Proposition 2, M will set $q_H(\theta)$ as to maximize (A – 3). It is straightforward to see that if $c_H - c_L/\gamma > 0$, then $q_H^C(\theta) > q_H^*(\theta) > q_H^{**}(\theta)$, $\forall\theta \in [\theta_0, \theta_1]$. Since (A – 3) is continuous at $q_H^C(\theta)$, the optimal solution is $q_H^{NED}(\theta) = q_H^{**}(\theta)$, $\forall\theta \in [\theta_0, \theta_1]$, which implies that R offers both H and L for $\forall\theta \in [\theta_0, \theta_1]$.

Proof of Proposition 4:

I begin by showing that M will set $ED(\theta) = 1$ for $\forall\theta \in [\theta_0, \overline{\theta}]$. Let $\pi_M^{ED}(ED(\theta);\theta)$ denotes M's profit in the exclusive dealing contract as a function of $ED(\theta)$. For $ED(\theta) = 0$, $\pi_M^{ED}(0;\theta) = \pi_M^{NED}(q_H^{NED}(\theta);\theta)$, where $\pi_M^{NED}(q_H;\theta)$ is given by (A – 7) and $q_H^{NED}(\theta)$ is given by (17). For $ED(\theta) = 1$, $\pi_M^{ED}(1;\theta)$ equals to the second line in (A – 7), evaluated at $q_H^*(\theta)$. M will therefore set $ED(\theta)$ as to maximize

$$\int_{\theta_0}^{\theta_1} \pi_M^{ED}(ED(\theta);\theta) f(\theta) d\theta.$$

If $H(\theta) > (c_L/\gamma - c_H)/(1-\gamma)$, then for $\theta \in [\theta_0, \underline{\theta}]$:

$$\pi_M^{ED}(1;\theta) - \pi_M^{ED}(0;\theta) = \tfrac{1}{4}\left(\gamma H(\theta)^2 - \frac{(c_L - \gamma c_H)^2}{(1-\gamma)\gamma}\right) > \tfrac{1}{4}\left(\gamma\left(\frac{c_L - \gamma c_H}{\gamma(1-\gamma)}\right)^2 - \frac{(c_L - \gamma c_H)^2}{(1-\gamma)\gamma}\right) = \left(\frac{c_L - \gamma c_H}{2(1-\gamma)}\right)^2 > 0,$$

where the first inequality follows because for $\theta \in[\theta_0, \underline{\theta}]$, $H(\theta) > (c_L/\gamma - c_H)/(1-\gamma)$. Thus M sets $ED(\theta) = 1$ for $\theta \in[\theta_0, \underline{\theta}]$. Next, for $\theta \in[\underline{\theta}, \overline{\theta}]$:

$$\pi_M^{ED}(1;\theta) - \pi_M^{ED}(0;\theta) = \frac{(c_L - \gamma c_H - \gamma H(\theta))^2}{4\gamma^2} > 0.$$

Thus for $\theta\in[\underline{\theta}, \overline{\theta}]$ M will set $ED(\theta) = 1$. Next, for $\in[\overline{\theta}, \theta_1]$, $\pi_M^{ED}(1;\theta) - \pi_M^{ED}(0;\theta) = 0$ because the optimal non-exclusive contract excludes L from the market, and therefore M is indifferent between imposing exclusive dealing or not. Note that if $c_L/\gamma - c_H < H(\theta_0) < (c_L/\gamma - c_H)/(1-\gamma)$, then the same argument holds by setting $\underline{\theta} = \theta_0$.

Next, I show that R earns lower information rents under exclusive dealing for all $\theta\in[\theta_0, \theta_1]$. Again it is sufficient to show it for $H(\theta_0) > (c_L/\gamma - c_H)/(1-\gamma)$. Substituting (16) into (13), the information rents under exclusive dealing are:

$$U^{ED}(\theta) = \tfrac{1}{2}\int_{\theta_0}^{\theta} \left(\hat{\theta}(1-\gamma) - H(\hat{\theta}) - c_H + c_L\right) d\hat{\theta}, \quad \forall\theta \in [\theta_0, \theta_1].$$

For $\theta \in[\theta_0, \underline{\theta}]$, the information rents absent exclusive dealing are

$$U^{NED}(\theta) = \tfrac{1}{2}\int_{\theta_0}^{\theta} \left((\hat{\theta} - H(\hat{\theta}))(1-\gamma) - c_H + c_L\right) d\hat{\theta}.$$

Therefore,

$$U^{NED}(\theta) - U^{ED}(\theta) = \tfrac{\gamma}{2}\int_{\theta_0}^{\theta} H(\hat{\theta}) d\hat{\theta} > 0.$$

For $\theta \in[\underline{\theta}, \overline{\theta}]$, the information rents absent exclusive dealing are

$$U^{NED}(\theta) = \tfrac{1}{2}\int_{\theta_0}^{\underline{\theta}} \left((\hat{\theta} - H(\hat{\theta}))(1-\gamma) - c_H + c_L\right) d\hat{\theta} + \tfrac{1}{2\gamma}\int_{\underline{\theta}}^{\theta} \left((\gamma\hat{\theta} - c_L)(1-\gamma)\right) d\hat{\theta}.$$

Therefore,

$$U^{NED}(\theta) - U^{ED}(\theta) = \tfrac{\gamma}{2}\int_{\theta_0}^{\underline{\theta}} H(\hat{\theta}) d\hat{\theta} + \tfrac{1}{2}\int_{\underline{\theta}}^{\theta} \left(H(\hat{\theta}) + c_H - c_L/\gamma\right) d\hat{\theta} > 0,$$

where the second term is positive since for $\theta \in[\underline{\theta}, \overline{\theta}]$, $H(\theta_0) > c_L/\gamma - c_H$ (see Figure 3).

Finally, for $\theta \in[\overline{\theta}, \theta_1]$,

$$U^{NED}(\theta) = \tfrac{1}{2}\int_{\theta_0}^{\underline{\theta}} \left((\hat{\theta} - H(\hat{\theta}))(1-\gamma) - c_H + c_L\right) d\hat{\theta}$$

$$+ \tfrac{1}{2\gamma}\int_{\underline{\theta}}^{\overline{\theta}} \left((\gamma\theta - c_L)(1-\gamma)\right) d\theta + \tfrac{1}{2}\int_{\overline{\theta}}^{\theta} \left(\theta(1-\gamma) - H(\theta) - c_H + c_L\right) d\theta.$$

Therefore,

$$U^{NED}(\theta) - U^{ED}(\theta) = \tfrac{\gamma}{2}\int_{\theta_0}^{\theta} H(\hat{\theta}) d\hat{\theta} + \tfrac{1}{2}\int_{\underline{\theta}}^{\theta} \left(H(\hat{\theta}) + c_H - c_L/\gamma\right) d\hat{\theta} > 0.$$

Proof of Proposition 5:

Since $c_H > c_L/\gamma$, M will set $ED(\theta) = 1$ if and only if

$$\pi_M^{ED}(1;\theta) - \pi_M^{ED}(0;\theta) = \frac{\gamma}{4}\left(H(\theta)^2 - \frac{(c_H - c_L/\gamma)^2}{(1-\gamma)}\right), \qquad \text{(A - 8)}$$

which is positive if and only if $H(\theta) > (c_H - c_L/\gamma)/\sqrt{1-\gamma}$. Suppose first that $H(\theta_0) < (c_H - c_L/\gamma)/\sqrt{1-\gamma}$. In this case $H(\theta) < H(\theta_0) < (c_H - c_L/\gamma)/\sqrt{1-\gamma}$ for $\forall\theta\in[\theta_0, \theta_1]$, where the first inequality follows because $H(\theta)$ is decreasing with θ. Therefore $ED(\theta) = 0$ for $\forall\theta\in[\theta_0, \theta_1]$. Next, suppose that $H(\theta_0) > (c_H - c_L/\gamma)/\sqrt{1-\gamma}$, then (A - 8) is positive at θ_0, but it is still negative at θ_1 because $H(\theta_1) = 0 < (c_H - c_L/\gamma)/\sqrt{1-\gamma}$, where the inequality follows because $c_H - c_L/\gamma > 0$. Therefore, in this case there is a cutoff, θ^C, where $H(\theta^C) = (c_H - c_L/\gamma)/\sqrt{1-\gamma}$, such that for $\theta\in[\theta_0, \theta^C]$, $H(\theta) > c_H - c_L/\gamma)/\sqrt{1-\gamma}$ and thereby $ED(\theta) = 1$, while for $\theta\in[\theta^C, \theta_1]$, $H(\theta) < (c_H - c_L/\gamma)/\sqrt{1-\gamma}$ and thereby $ED(\theta) = 0$. Since $H(\theta^C) = (c_H - c_L/\gamma)/\sqrt{1-\gamma}$ and $H(\theta)$ is decreasing with θ, θ^C is decreasing with $c_H - c_L/\gamma$. Moreover, if $c_H - c_L/\gamma = 0$ then $H(\theta^C) = 0 = H(\theta_1)$, implying that $\theta^C = \theta_1$. To show that one can find $H(\theta_0)$ such that $\theta - c_H - (\gamma\theta - c_L) > H(\theta_0) > (c_H - c_L/\gamma)/\sqrt{1-\gamma}$, note that $\theta - c_H - (\gamma\theta - c_L)$ is increasing with θ while $(c_H - c_L/\gamma)/\sqrt{1-\gamma}$ is independent of θ. Thus $\theta - c_H - (\gamma\theta - c_L) > (c_H - c_L/\gamma)/\sqrt{1-\gamma}$ if θ is sufficiently high.

Next I turn to show that the optimal contract satisfies *IC*. To facilitate notations, let $\tilde{q}_H^* \equiv q_H^{**}(\tilde{\theta})$ and $\tilde{q}_H^{**} \equiv q_H^{**}(\tilde{\theta})$. In case (i), *IC* follows directly from Lemma 1 (R's profit is only the second line in (11)). Turning to case (ii), here the optimal solution violates the continuity assumption of $q_H(\theta)$. To see that *IC* is nonetheless satisfied, suppose first that $\theta > \theta^C$. From Lemma 1 it is clear that if R chooses to report any $\tilde{\theta} > \theta^C$, then the optimal report within $\tilde{\theta} \in [\theta^C, \theta_1]$ is $\tilde{\theta} = \theta$, and R earns

$$\pi_R(\theta;\theta) = \pi_L(\theta) + \int_{\theta_0}^{\theta^C} U^{ED}{}'(\hat{\theta})d\hat{\theta} + \int_{\theta^C}^{\theta} U^{NED}{}'(\hat{\theta})d\hat{\theta},$$

where it follows from (13) that $U^{NED}{}'(\tilde{\theta}) = q_H{}^{**}(\theta)(1 - \gamma)$ and $U^{ED}{}'(\tilde{\theta}) = q_H{}^*(\theta) - (\gamma\tilde{\theta} - c_L)/2$. If R reports $\tilde{\theta} < \theta^C$ then R earns:

$$\begin{aligned}
\pi_R(\tilde{\theta};\theta) &= \pi_H(\tilde{q}_H^*;\theta) - \pi_H(\tilde{q}_H^*;\tilde{\theta}) + \pi_L(\tilde{\theta}) + \int_{\theta_0}^{\tilde{\theta}} U^{ED}{}'(\hat{\theta})d\hat{\theta} \\
&< \pi_H(q_H^*;\theta) - \pi_H(q_H^*;\theta) + \pi_L(\theta) + \int_{\theta_0}^{\theta} U^{ED}{}'(\hat{\theta})d\hat{\theta} \\
&= \pi_L(\theta) + \int_{\theta_0}^{\theta} U^{ED}{}'(\hat{\theta})d\hat{\theta} \\
&< \pi_L(\theta) + \int_{\theta_0}^{\theta} U^{ED}{}'(\hat{\theta})d\hat{\theta} + \int_{\theta^C}^{\theta} \left(U^{NED}{}'(\hat{\theta}) - U^{ED}{}'(\hat{\theta})\right)d\hat{\theta} \\
&= \pi_L(\theta) + \int_{\theta_0}^{\theta^C} U^{ED}{}'(\hat{\theta})d\hat{\theta} + \int_{\theta^C}^{\theta} U^{NED}{}'(\hat{\theta})d\hat{\theta} \\
&= \pi_R(\theta;\theta),
\end{aligned}$$

where the first inequality follows from revealed preferences (using Lemma 1), the second inequality follows because $U^{NED}{}'(\theta) > U^{ED}{}'(\theta)$ and because $\theta > \theta^C$, and the last term is R's profit from reporting $\tilde{\theta} = \theta$. Thus R will not understate θ such that $\tilde{\theta} < \theta^C$. Next, suppose that $\theta < \theta^C$. From Lemma 1 it is clear that if R chooses to report any $\tilde{\theta} < \theta^C$, then the optimal report within $\tilde{\theta} \in [\theta_0, \theta^C]$ is $\tilde{\theta} = \theta$, and R earns

$$\pi_R(\theta;\theta) = \pi_L(\theta) + \int_{\theta_0}^{\theta} U^{ED}{}'(\hat{\theta})d\hat{\theta}.$$

If R reports some $\tilde{\theta} > \theta^C$, R buys $\tilde{q}_H^{**}$, offers both brand if and only if $\tilde{q}_H^{**} < q_H{}^C$, and R earns:

$$\pi_R(\tilde{\theta};\theta) = \max\{\pi_{HL}(\tilde{q}_H^{**};\theta), \pi_H(\tilde{q}_H^{**};\theta)\} - \pi_{HL}(\tilde{q}_H^{**};\tilde{\theta}) + \pi_L(\tilde{\theta}) + \int_{\theta_0}^{\theta^C} U^{ED}{}'(\hat{\theta})d\hat{\theta} + \int_{\theta^C}^{\tilde{\theta}} U^{NED}{}'(\hat{\theta})d\hat{\theta}$$

$$= \max\{\pi_{HL}(\tilde{q}_H^{**};\theta), \pi_H(\tilde{q}_H^{**};\theta)\} - \pi_{HL}(\tilde{q}_H^{**};\tilde{\theta}) + \pi_L(\tilde{\theta}) + \int_{\theta_0}^{\tilde{\theta}} U^{NED}{}'(\hat{\theta})d\hat{\theta} - \int_{\theta_0}^{\theta^C} \left(U^{NED}{}'(\hat{\theta}) - U^{ED}{}'(\hat{\theta})\right)d\hat{\theta}$$

$$< \pi_{HL}(q_H^{**};\theta) - \pi_{HL}(q_H^{**};\theta) + \pi_L(\theta) + \int_{\theta_0}^{\theta} U^{NED}{}'(\hat{\theta})d\hat{\theta} - \int_{\theta_0}^{\theta^C} \left(U^{NED}{}'(\hat{\theta}) - U^{ED}{}'(\hat{\theta})\right)d\hat{\theta}$$

$$= \pi_L(\theta) + \int_{\theta_0}^{\theta} U^{NED}{}'(\hat{\theta})d\hat{\theta} - \int_{\theta_0}^{\theta^C} \left(U^{NED}{}'(\hat{\theta}) - U^{ED}{}'(\hat{\theta})\right)d\hat{\theta}$$

$$< \pi_L(\theta) + \int_{\theta_0}^{\theta} U^{ED}{}'(\hat{\theta})d\hat{\theta}$$

$$= \pi^R(\theta;\theta),$$

where the first inequality follows from revealed preferences (using Lemma 1) and because the last term is independent of $\tilde{\theta}$ and the second inequality follows because $U^{NED}{}'(\theta) > U^{ED}{}'(\theta)$. Thus R will not overstate θ such that $\tilde{\theta} > \theta^C$ and *IC* is satisfied.

Proof of proposition 6:

Suppose that for a certain θ, M imposes a binding constraint of $ED(\theta) = 1$, which implies that M sets $q_H^{ED}(\theta) = q_H^*(\theta)$. Consider first industry profits. If for such particular θ, M sets absent the restraint $q_H^{NED}(\theta) = q_H^{**}(\theta)$, then the gap in industry profits between the case of $ED(\theta) = 0$ and $ED(\theta) = 1$ is

$$\pi_{HL}(q_H^{**}(\theta);\theta) - c_H q_H^{**}(\theta) - (\pi_H(q_H^*(\theta);\theta) - c_H q_H^*(\theta)) = \frac{(\gamma c_H - c_L)^2}{4\gamma(1-\gamma)} + \frac{\gamma H(\theta)^2}{4} > 0,$$

where the inequality follows because $\gamma < 1$. If absent the restraint M sets $q_H^{NED}(\theta) = q_H^C(\theta)$ (as in the case of $c_L > \gamma c_H$ and $H(\theta_0) > (c_L - \gamma c_H)/\gamma$), then the gap in industry profits between the case of $ED(\theta) = 0$ and $ED(\theta) = 1$ is

$$\pi_{HL}(q_H^C(\theta);\theta) - c_H q_H^C(\theta) - (\pi_H(q_H^*(\theta);\theta) - c_H q_H^*(\theta)) = \tfrac{1}{4}\left(H(\theta)^2 - \frac{(c_L - \gamma c_H)^2}{\gamma^2}\right) > 0,$$

where the inequality follows because Proposition 2 indicates that M sets $q_H^{NED}(\theta) = q_H^C(\theta)$ only for θ such that $H(\theta) > (c_L - \gamma c_H)/\gamma$. Therefore, industry profits are higher without exclusive dealing. Next consider consumers' surplus. If absent the restraint, M sets $q_H^{NED}(\theta) = q_H^{**}(\theta)$, then the gap in the equilibrium price of H is $p_H(q_H^*(\theta);0;\theta)$ - $p_H(q_H^{**}(\theta);q_L(q_H^{**}(\theta);\theta);\theta) = (\theta + c_H + H(\theta))/2 - (\theta + c_H + H(\theta)(1 - \gamma))/2 = \gamma H(\theta)/2 > 0$. If M sets absent the restraint $q_H^{NED}(\theta) = q_H^C(\theta)$,then the gap in the equilibrium price of H is $p_H(q_H^*(\theta);0;\theta) - p_H(q_H^C(\theta);0;\theta);\theta) = (\gamma H(\theta) - (c_L - \gamma c_H))/2\gamma > 0$, where the inequality follows because from Proposition 2 M sets $q_H^{NED}(\theta) = q_H^C(\theta)$ only for θ such that $H(\theta) > (c_L - \gamma c_H)/\gamma$. Since L is not offered if $ED(\theta) = 1$, it follows that both prices are lower absent exclusive dealing, implying that consumers' surplus is higher.

Proof of Lemma 2:

Using (19) and (20), M will charge:

$$T(\theta) = p_H(q_L(\theta), q_H(\theta);\theta)q_H(\theta) + \left(p_L(q_L(\theta), q_H(\theta);\theta) - c_L\right)q_L(\theta)$$
$$- \pi_L(\theta) - \int_{\theta_0}^{\theta}\left(q_H(\hat{\theta}) + \gamma q_L(\hat{\theta}) - \tfrac{1}{2}(\gamma\hat{\theta} - c_L)\right)d\hat{\theta}. \quad \text{(A - 9)}$$

Substituting (A – 9) into (19), the first order condition with respect to $\tilde{\theta}$ is $d\pi_R(\tilde{\theta};\theta)/d\tilde{\theta} = (\theta - \tilde{\theta})(q_H'(\tilde{\theta}) + \gamma q_L'(\tilde{\theta})) = 0$, hence $\tilde{\theta} = \theta$. The second order condition evaluated at $\tilde{\theta} = \theta$ is $d^2\pi_R(\tilde{\theta};\theta)/d\tilde{\theta}^2 = -(q_H'(\theta) + \gamma q_L'(\theta)) \leq 0$ which is satisfied for $q_H'(\theta) + \gamma q_L'(\theta) \geq 0$.

Proof of propositions 7 and 8:

Maximizing (21) with respect to $q_H(\theta)$ and $q_L(\theta)$ yields:

$$q_H^{MS}(\theta) = \begin{cases} \dfrac{\theta - c_H - (\gamma\theta - c_L) - H(\theta)(1-\gamma)}{2(1-\gamma)}, & \text{if } c_H > c_L/\gamma, \\ \dfrac{\theta - c_H - H(\theta)}{2}, & \text{otherwise}, \end{cases} \qquad q_L^{MS} = \begin{cases} \dfrac{c_H - c_L/\gamma}{2(1-\gamma)}, & \text{if } c_H > c_L/\gamma, \\ 0 & \text{otherwise.} \end{cases}$$

For $c_L/\gamma > c_H$, $q_L^{MS} = 0$ implies that M imposes exclusive dealing, and since in this case $q_H^{MS}(\theta) = q_H^*(\theta)$, the contract is identical to the exclusive dealing contract. For $c_L/\gamma < c_H$, $q_L^{MS} > 0$, but $q_L(q_H^{MS}(\theta);\theta) = (c_H - \gamma c_L)/2(1 - \gamma)^2 + H(\theta)/2 > (c_H - \gamma c_L)/2(1 - \gamma)^2 = q_L^{MS}$, thus the market share contract places a maximum restriction on the quantity of L. Moreover, substituting $q_H^{MS}(\theta)$ and q_L^{MS} into (20) yields that the marginal information $U'^{MS}(\theta) = (\theta(1 - \gamma) - c_H + c_L - H(\theta))/2 > 0$, where the inequality follows because by assumption $H(\theta) < \theta - c_H - (\gamma\theta - c_L)$, implying that there are no countervailing incentives.

Proof of Proposition 9:

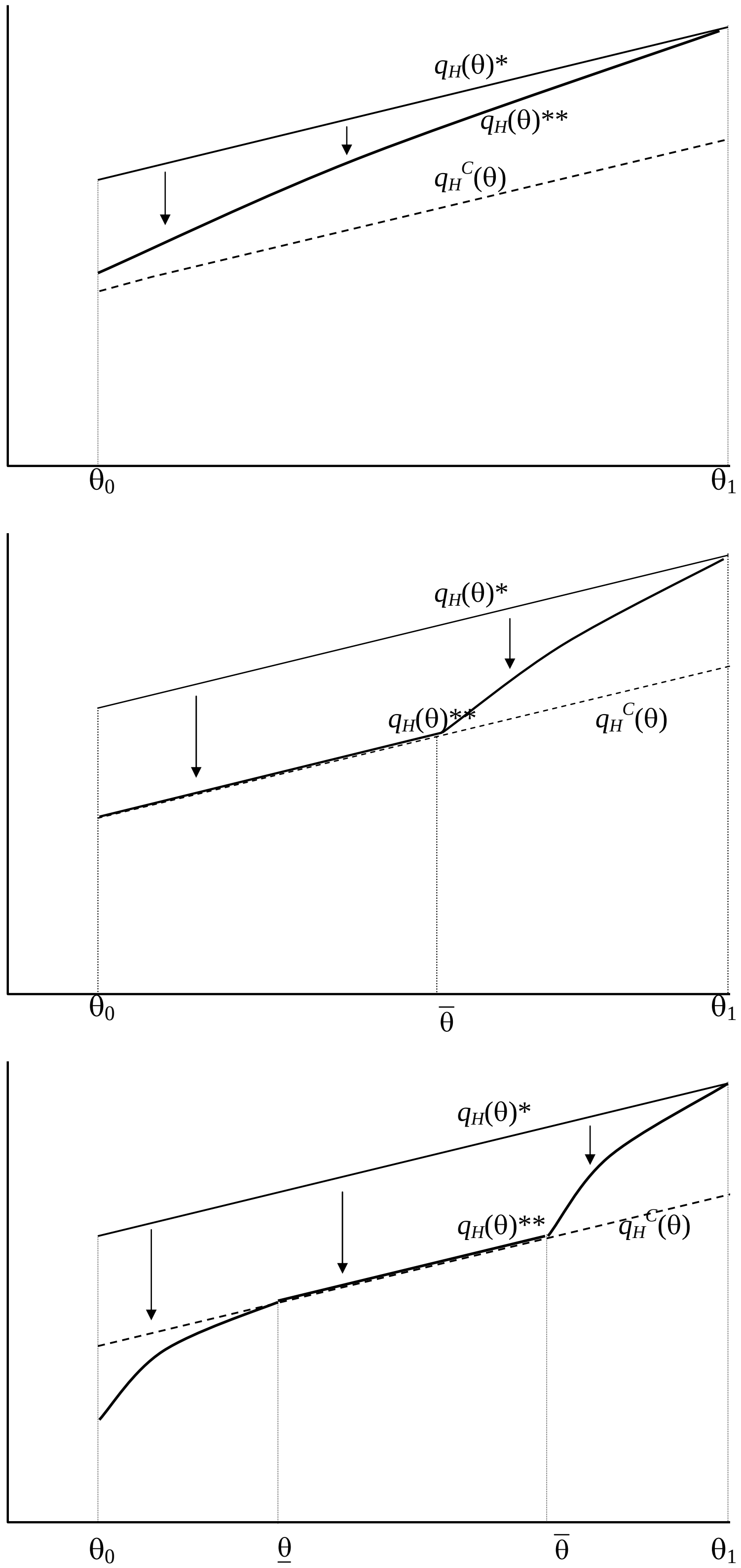
Consider first consumers' surplus. The gap in the equilibrium price of H between the market share and the non-exclusive contracts is $p_H(q_H{**}(\theta), q_L^{VI};\theta) - p_H(q_H{**}(\theta), q_L(q_H{**}(\theta);\theta)) = \gamma H(\theta)/2 > 0$. Likewise, the gap in the equilibrium price of L is $p_L(q_H{**}(\theta), q_L^{VI};\theta) - p_L(q_H{**}(\theta), q_L(q_H{**}(\theta);\theta) = \gamma H(\theta)/2 > 0$. Thus both prices are higher under market share contract implying that consumers' surplus is lower. Next consider the information rents. The marginal information rents in the market share and the non-exclusive contracts respectively are $U'^{MS}(\theta) = q_H{**}(\theta) + \gamma q_L^{VI} - \pi_L'(\theta)$ and $U'^{NED}(\theta) = q_H{**}(\theta) + \gamma q_L(q_H{**}(\theta);\theta) - \pi_L'(\theta)$ and therefore the gap is $U'^{MS}(\theta) - U'^{NED}(\theta) = - \gamma H(\theta)/2 < 0$, implying that R earns higher information rents under the non-exclusive contract. Next, the gap in total industry profits between the market share and the non-exclusive contracts is $(p_H(q_H{**}(\theta), q_L^{VI};\theta) - c_H)q_H{**}(\theta) + (p_L(q_H{**}(\theta), q_L^{VI};\theta) - c_L)q_L^{VI} - [p_H(q_H{**}(\theta),q_L(q_H{**}(\theta);\theta);\theta) - c_H)q_H{**}(\theta) + (p_L(q_H{**}(\theta),q_L(q_H{**}(\theta);\theta);\theta) - c_L)q_L(q_H{**}(\theta);\theta)] = -\gamma H(\theta)^2/4 < 0$, therefore total profits are lower under the market share contract. Since both consumers' surplus and total profits are lower under market share contract, so is total welfare.

Proof of Proposition 10:

Suppose first that $\theta < \theta^C$ (in the exclusive dealing contract M imposes exclusive dealing). The equilibrium prices of H in the market share and the exclusive dealing contracts are $p_H(q_H{**}(\theta), q_L^{VI};\theta) = (\theta + c_H + H(\theta))/2$ and $p_H(q_H{*}(\theta), 0;\theta) = (\theta + c_H + H(\theta))/2$, which are identical. However, under the market share contract R sells L implying that consumers' surplus is higher under the market share contract. R's marginal information rents in the market share and the exclusive dealing contracts respectively are $U'^{MS}(\theta) = q_H{**}(\theta) + \gamma q_L^{VI} - \pi_L'(\theta) = (\theta(1 - \gamma) - H(\theta) - c_H + c_L)/2$ and $U'^{ED}(\theta) = q_H{*}(\theta) - \pi_L'(\theta) = (\theta(1 - \gamma) - H(\theta) - c_H + c_L)/2$, implying that R earns identical information rents. The gap in total industry profits between the market share and the exclusive dealing contracts is $(p_H(q_H{**}(\theta), q_L^{VI};\theta) - c_H)q_H{**}(\theta) + (p_L(q_H{**}(\theta), q_L^{VI};\theta) - c_L)q_L^{VI} - [p_H(q_H{*}(\theta),0;\theta) - c_H)\, q_H{*}(\theta)] = \gamma(c_H - c_L/\gamma)^2/4(1 - \gamma) > 0$. Since both consumers' surplus and total profits are higher under market share contract, so is total welfare.

Next suppose that $\theta > \theta^C$. Since in the exclusive dealing contract M does not impose exclusive dealing, it follows directly from Proposition 9 that consumers' surplus, total profits and total welfare are lower under the market share contract. Total information rents are lower under market share contract because for $\theta < \theta^C$, marginal information rents are identical in both contracts and from proposition 9, for $\theta > \theta^C$ marginal information rents are lower under the market share contract.

Figure 1: Optimal $q_H(\theta)$ when L is inefficient



Panel (a):

$H(\theta_0) < (c_L/\gamma - c_H)$

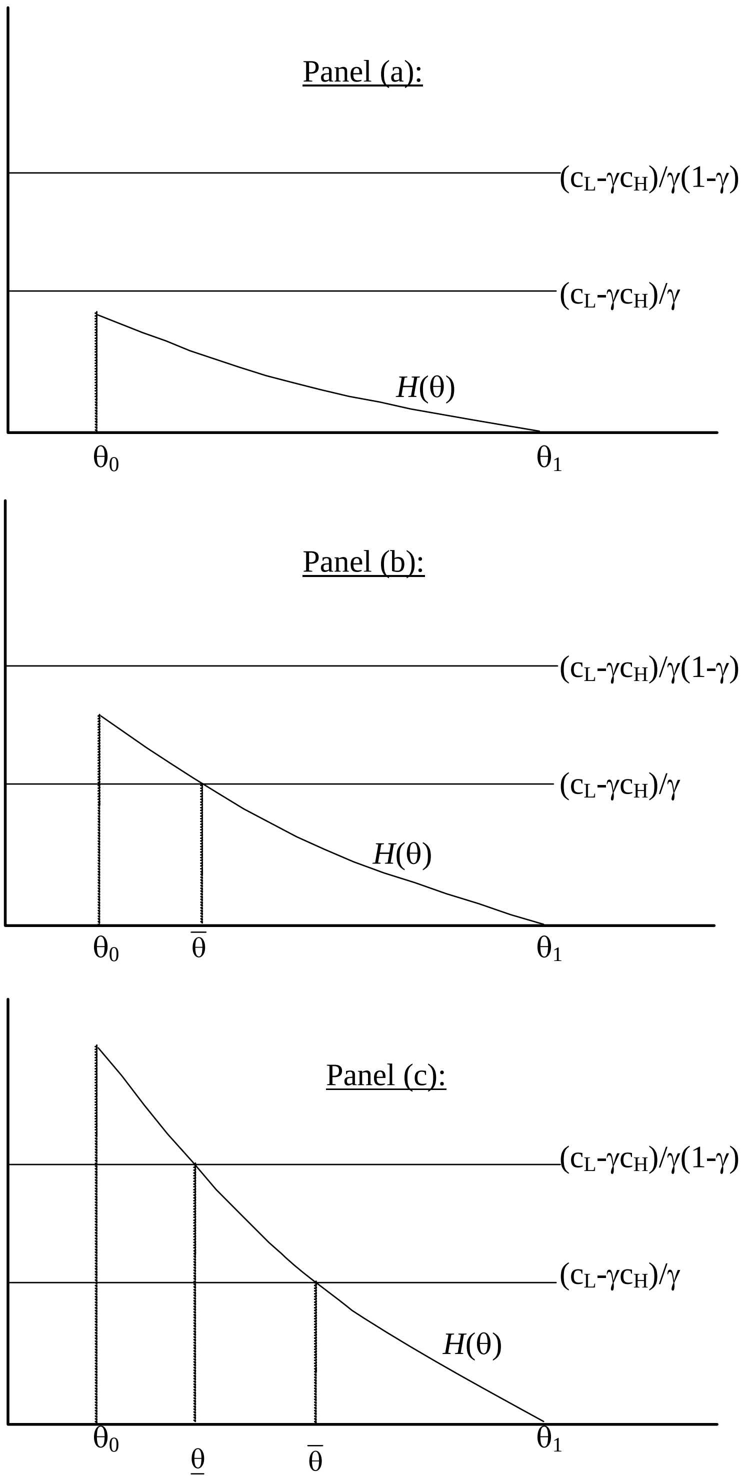
Panel (b):

$(c_L/\gamma - c_H) < H(\theta_0)$
$< (c_L/\gamma - c_H)/(1 - \gamma)$

Panel (c):

$(c_L/\gamma - c_H)/(1 - \gamma)$
$< H(\theta_0)$

Figure 2: The derivation of $\underline{\theta}$ and $\overline{\theta}$.



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