Input Price Discrimination (Bans), Entry and Welfare*

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Abstract

This paper analyzes third degree price discrimination in input markets and the effects that price discrimination bans can have. In contrast to the existing literature on non-discrimination rules, our analysis focuses on the entry-deterring effects of such rules. We show that, in a static context, a price discrimination ban for an upstream monopolist reduces entry into the downstream market, and by that, such a rule can hurt consumers and reduce overall welfare. In a dynamic framework where active downstream firms decide about cost-reducing R&D expenditures, input market price discrimination can lead to larger investment activities as the "threat of entry" is stronger with input price discrimination. Hence, recently developed arguments in favor of non-discrimination rules have to be qualified when entry into the discriminated market segment is a viable threat.

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1 Introduction

Price discrimination has long been one of the more contentious issues in industrial economics, and competition policy in particular. In order to prevent price discrimination, many countries have adopted legal price discrimination bans, which require dominant firms not to charge different buyers different prices for the same product. Traditionally, the argument has been that price discrimination bans or uniform pricing rules prevent dominant firms from engaging in predatory price discrimination, which would otherwise lead to a lessening of competition in this market and, at worst, to the exclusion of rival firms from the upstream market.[1] Accordingly, antitrust concnerns have circled around the adverse effects on rival firms in the upstream market. This reasoning has been heavily criticized, for instance by Bork (1978) according to whom price discrimination is efficiency enhancing, as it allows monopolists to expand their output beyond the output level set at a uniform price. As Bork (1978, p.397) has pointed out, price discrimination has often been discussed "as though the seller were instituting discrimination between two classes of customers he already serves, but discrimination may be a way of adding an entire category of customers he would not otherwise approach because the lower price would have spoiled his existing market." According to this line of reasoning, price discrimination is efficiency enhancing. Moreover, non-discrimination rules and, similarly, most favored customer clauses have also been identified as devices to sustain collusion between firms (see, e.g., Carlton and Perloff, 1989, pp.423-424). As a consequence, the merits of price discrimination bans have become less clear following this literature.

While traditionally most of the literature on price discrimination had focussed on final product markets (see, e.g., Varian, 1989), more recently the focus has shifted towards price discrimination in input markets. Accordingly, more recent theoretical literature has started to assess the costs and benefits of non-discrimination rules by focusing on the competitive effects that price discrimination can have on downstream firms (Katz, 1987; DeGraba, 1990; O'Brian and Shaffer, 1994; Yoshida, 2000; O'Brian, 2002), and contrasting these effects with outcomes under uniform pricing rules. Our paper is connected to this latter literature, which has derived new arguments in favor of price discrimination bans without reverting to (the difficult and still unsettled) issues of predatory conduct or collusive behavior. Moreover, by evaluating the relative merits of non-discrimination rules in relation to discriminatory pricing this literature has shifted the focus of the analysis away from the delicate issue of outright "price-regulation" (e.g., in form of the Robinson-Patman Act in the US) towards the (perhaps more obvious) negative effects of price discrimination. Not too surprisingly, in the light of this new literature antitrust policies banning discriminatory pricing appear more favorable again.

Especially in the recently deregulated network industries such as airlines,

[1] Interestingly enough, the debate over price discrimination and predatory pricing has recently gained prominence again, especially with regard to deregulated industries such as airlines (see, e.g, Blair, 1999) or telecommunications (see, e.g., Miller, 2000).

telecommunications, gas and electricity, or rail transport, the debate over the "dangers" of input price discrimination have received much attention. In the context of network industries, a major debate circles around entry and appropriate pricing rules for access to essential facilities.[2] Almost all jurisdictions that have deregulated entry into network industries have at the same time started to regulate access to an incumbent's essential facilities in oder to induce entry into downstream markets. These regulations, such as the European Union's Open Network Provision (ONP) almost always prescribe that access prices have to be non-discriminatory.

In this light, the aim of this paper is to qualify some of the propositions derived in favor of non-discriminatory pricing rules again. Broadly speaking, our point is that one should take changes in the underlying market structure into account when comparing different regulatory regimes or policies, as market structure is not independent from changes in the regulatory environment. Hence, it does not suffice to evaluate the welfare effects of a uniform pricing rule by comparing prices, sales and welfare measures for a *given* market structure. Instead, one should consider the potential effects that these rules may have on market entry and, accordingly, a market's structure in order to obtain a more complete picture.[3]

More precisely, in our analysis we allow for the possibility of market entry at the secondary line (i.e., the discriminated downstream market side) under each regulatory regime. This allows us to examine the effects that different antitrust rules can have on entry. That is, market structure is not treated as exogenous in our analysis. Accordingly, we ask how input prices, innovative activity, and downstream market competition are affected, when entry is an issue, and how this affects the desirability of non-discrimination rules (or price discrimination, respectively).

For that purpose we examine a two-tier industry with an upstream monopolist and two active downstream firms and one potential (downstream) entrant, who is less efficient than the two active firms We first show that input price discrimination is generally more "entry-friendly" than non-discriminatory pricing. With uniform input prices the upstream monopolist is less likely to set an "entry-inducing" (uniform) price, which would allow a disadvantaged entrant to enter the market, as this would mean lowering the (uniform) price for all downstream firms. In sharp contrast, discriminatory pricing leads to more downstream competition, as the input monopolist can set an entry inducing price for the new entrant without altering the price for the two incumbent firms. Hence, as input price discrimination makes entry easier, it can benefit final consumers and also enhance overall welfare.

Given this static analysis, our paper proceeds by adding the analysis of in-

[2] An essential facility (or monopolistic bottleneck) is the part of an incumbent's infrastructure to which access is essential for rival firms to compete in a downstream market and which is impossible or uneconomic to duplicate for rivals (i.e., because it exhibits natural monopoly characteristics). Also see Lipsky and Sidak (1999).

[3] A similar argument has been made by Symeonides (2000) in a different context, where the benefits of regulation are considered if market structure is endogenous.

novation incentives. This is because another prominent argument in favor of price discrimination bans is that uniform pricing rules can strengthen downstream firms' incentives to invest into (marginal) cost reductions. As we will show, the entry-inducing effects of discriminatory pricing may also reverse this argument in favor of price discrimination, i.e. there exist parameter constellations such that investment incentives are larger under price discrimination than under uniform pricing.

2 Relation to the Literature

Rather surprisingly, the debate over input price discrimination and non-discrimination rules has so far neglected the effects on entry into the discriminated (downstream) market, even though there exists quite a bid of literature dealing with the relative merits of forbidding price discrimination in input markets, when entry is *not* an issue. The first formal analysis of this issue is Katz (1987), who has shown that a uniformity rule can reduce overall prices and, therefore, can increase social welfare when compared to a situation with price discrimination. In his model, Katz considers an asymmetric duopoly, where the large firm can credibly threaten to integrate backward, while this option does not exist for the small firm. In this setting, a non-discrimination rule can result in lower average input prices and thereby also lower output prices, as the small firm may benefit from the large firm's bargaining power.

More important for our work, however, are two recent papers by DeGraba (1990) and Yoshida (2000), which identify particular conditions under which non-discrimination rules serve both consumers' interests and overall welfare. Firstly, Yoshida (2000) presents a static Cournot model with linear demands, where an upstream monopolist sets input prices before downstream oligopolists choose output levels. The comparison of third-degree price discrimination and uniform pricing yields that welfare is always lower with price discrimination (see Yoshida, 2000, Proposition 2). The reason is that, even though the overall output level remains unchanged, productive efficiency is lower under discriminatory pricing since the upstream monopolist charges less from a less efficient firm, so that the less efficient firm produces more under price discrimination than under a regime where price discrimination is forbidden.[4]

In the first part of our paper, we will show that Yoshida's result does not hold any longer once the entry deterring effects that a non-discrimination rule has are taken into account. As price discrimination induces entry for a larger set of parameter constellations, it also leads to more intense competition in the downstream segment, which generally benefits consumers and can lead to higher overall welfare levels.

Secondly, our paper is related to DeGraba's (1990) result that a uniform

[4] This result only holds if it is possible to order firms according to their efficiencies. As Yoshida (2000) shows this is an issue if firms have more than one efficiency characteristic, e.g. because firms transform two inputs with two different technologies. In those cases firms cannot always be ordered unambiguously so that the above result may not hold any longer.

pricing rule will spur innovative efforts by downstream firms.[5] Intuitively, under a uniformity rule any firm's cost reduction tends to increase the (uniform) input price. However, as this is even more harmful for less productive rivals (that have not innovated) innovation incentives are stimulated under a uniform pricing rule. This because a productivity enhancing innovation does not only lower a firm's own costs, but also raises rivals' costs via the increase in the (uniform) input price, which makes them, ceteris paribus, less competitive in the downstream market. Our concerns over entry are also instructive in such a dynamic environment. As input price discrimination makes it easier for a potential entrant to actually enter a market, incumbent firms may also have larger incentives to increase their productivity to improve their position, given the "threat" of entry. More precisely, if incumbents are effectively protected from entry by the very existence of a uniformity rule, then there are reasonable constellations under which input price discrimination increases the incumbents' investment efforts, and, consequently, also both consumer surplus and aggregate social welfare.

The paper now proceeds as follows: In Section 2 we present the structure of the model before we solve for the static case in Section 3 and for the dynamic case in Section 4. Section 5 discusses the model's robustness and further applications and offers concluding remarks.

3 The Model

We consider a vertically separated two-tier industry with an upstream monopolist, M,[6] and two active incumbent firms and one potential entrant in the downstream market. The two downstream incumbents are indexed by $i = 1, 2$ and the entrant firm by $i = 3$. The upstream firm supplies an intermediate good or service to the downstream firms. Firm i's final output is denoted by q_i, and we suppose that the inverse demand for the final product is linear: $p = a - Q$, with $Q \equiv \sum_i q_i$. Let us also assume that the upstream monopolist has a constant marginal production cost, which we normalize to zero. The final good is produced with a linear technology such that one unit of the intermediary good is needed for producing one unit of the final product. The input price, w, is the same for all buyers under a uniformity rule, while it may vary between buyers if discriminatory pricing is allowed.

The overall marginal cost of transforming one unit of input into one unit of the final good is given by $k_i = w_i + c$ (for $i = 1, 2$) for the two incumbent downstream firms and by $k_3 = w_3 + c + \Delta$ for the potential entrant. The parameter c, with $0 \leq c < a$, is the marginal cost of transforming one unit of input product into one unit of the final good. In the absence of any cost-reducing

[5] A similar point has recently been made by Banerjee and Lin (2003) who have shown that fixed price contacts can induce larger investments than floating price contracts.

[6] The upstream monopolist has persistent monopoly power, and the downstream firms cannot bypass the upstream firm's input. That is, the usptream monopolist operates an essential facility to which the downstream firms need access in order to supply their products.

effort, we suppose that the two downstream incumbents are symmetric in this regard, while the potential entrant faces an additional production cost, measured by Δ. This parameter represents the incumbency advantage, and we invoke the following assumption to ensure that, while the entrant is disadvantaged vis-à-vis the incumbent firms, it would still enter the downstream market and produce a positive quantity if the upstream segment were perfectly competitive.

Assumption 1 (A1). *Let $0 < \Delta < (a-c)/3$ so that the entrant is strictly disadvantaged, but would produce a strictly positive quantity if the input were priced at marginal cost.*

Our analysis now proceeds in two steps: First, we analyze the "static" case without R&D, where the firms' production costs are exogenously given. Subsequently, we examine the "dynamic" case in a second step, where we assume that an incumbent firm can reduce its marginal cost through R&D. More precisely, we assume that one firm, say firm 1, decides whether or not to undertake an innovation project, $I(\theta)$, which would reduce the innovating firm's marginal cost by θ, with $\theta \geq 0$, at a cost of I.[7] The incentives to undertake such an innovation project are given by the firm's additional profit resulting from the implementation of the cost-reducing innovation. With innovation, the firm's marginal cost becomes $k_1 = w_1 + c - \theta$.

Now let us consider the following three-stage game: In the first stage, firm 1 decides whether or not to undertake a given investment project $I(\theta)$. In the second stage, the upstream monopolist M determines its input prices, given the competition policy regime. Either discriminatory pricing is allowed (regime D) or price discrimination is forbidden so that prices have to be uniform across different buyers (regime U). In the third stage, the two incumbent downstream firms and the potential downstream entrant simultaneously choose their output levels. Entry is blockaded if the entrant decides not to produce anything at the posted input price(s).[8] In the dynamic regime we will analyze the entire three-stage game, while the "static case" only consists of stages two and three.

4 The Static Case

In the static case firms' production technologies and costs are exogenously given. Solving the game by backward induction we derive the sub-game perfect equilibrium outcomes. Firm i's profit function ($i = 1, 2, 3$) can be written as

$$\pi_i = (a - Q)q_i - k_i q_i \tag{1}$$

[7] The assumption that only one firm can innovate alloows us to abstract from coordination problems associated with entry deterrence in oligopoly. This is also the approach adopted in other parts of the literature, see eg. Bester and Petrakis (1993).

[8] Note that we abstract from any fixed cost of entry.

Given the input prices w_1, w_2, and w_3, the downstream firms compete in Cournot fashion, which results in the following output levels:

$$q_i = \max\left(0, \left\{ \begin{array}{ll} \frac{1}{4}(a - 3k_i + k_j + k_3) & \text{if } q_3 > 0 \\ \frac{1}{3}(a - 2k_i + k_j) & \text{if } q_3 = 0 \end{array} \right\}\right), \text{ and} \tag{2}$$

$$q_3 = \max\left(0, \frac{1}{4}(a - 3k_3 + k_i + k_j)\right) \text{ for } i \neq j,\ i,j = 1,2. \tag{3}$$

With uniform input prices $w_1 = w_2 = w_3$, the entry blockading input price is given by

$$\overline{w} = a - c - 3\Delta \tag{4}$$

such that for all $w \geq \overline{w}$ the less efficient firm stays out. >From (4) it follows that the less efficient firm produces a positive quantity, whenever the input is priced at marginal cost (as assumed in A1). We now partition our analysis according to the pricing regime.

4.1 Regime D: Third-Degree Price Discrimination

Given the input demands derived from (2) and (3) the upstream monopolist maximizes its profits, $L = \sum_i w_i q_i$, by charging the monopoly input prices

$$w_i^D = \frac{1}{2}(a - MC_i) \text{ for } i = 1,2,3, \tag{5}$$

where MC_i are the firms' marginal costs given by $MC_j = c$ for $j = 1,2$ and $MC_3 = c + \Delta$. Substituting the optimal input prices into the inverse demands for the input, we obtain the equilibrium output levels

$$q_j = \frac{1}{8}(a - c + \Delta) \text{ for } j = 1,2 \text{ and } q_3^D = \frac{1}{8}(a - c - 3\Delta). \tag{6}$$

Accordingly, total output is given by

$$Q^D = \frac{3}{8}(a - c) - \frac{1}{8}\Delta. \tag{7}$$

Lemma 1. *Given A1, the unique equilibrium market structure under third-degree price discrimination is the three-firm oligopoly with the entrant being active in the market.*

Proof. The input monopolist can either sell to all three downstream firms or restict sales to the two efficient firms that are symmetric. If he would only sell to the latter two firms, whose duopoly output would be given by $q_1 = q_2 = \frac{1}{3}(a - c - w)$, the upstream monopolist's maximum profit is $L^2 = \frac{1}{6}(a-c)^2$. Selling at differentiated prices to all three downstream firms, however, secures a profit of $L^3 = \frac{3}{16}(a-c)^2 - \frac{1}{16}\Delta\left(2(a-c) - 3\Delta\right)$, which exceeds L^2 for $\Delta < \frac{1}{3}(a-c)$, which we have assumed in A1. **Q.E.D.**

Note that A1 ensures that the potential entrant does not stay out of the market, but produces a strictly positive quantity.

4.2 Regime U: Uniform (or Non-Discriminatory) Pricing

With uniform pricing we have to distinguish two cases depending on whether or not the less efficient firm enters the market. That means, the upstream monopolist can either set a comparatively high uniform input price which blockades entry for the less efficient firm so that only the two downstream incumbents buy the input. Or the upstream monopolist can set a comparatively low uniform input price which induces the disadvantaged firm to enter the market so that the upstream monopolist can sell to three firms.

Let us first consider the case where the less efficient firm is at a disadvantage so large that the upstream monopolist rather sells to the two downstream incumbents only, as the less efficient firm does not enter the market at the upstream monopolist's profit maximizing uniform input price. This input price charged to the two downstream incumbents is the same as in (5), with $w^{U2} = (a-c)/2$, so that we obtain the equilibrium output levels

$$q_1^{U2} = q_2^{U2} = \frac{1}{6}(a-c), \tag{8}$$

where the superscript $U2$ indicates that only the two incumbent firms are active in the downstream market under uniform pricing. However, the input price w^{U2} only blockades entry for the less efficient firm if $\Delta \geq (a-c)/6$. For smaller Δ, the upstream monopolist would have to charge the entry blockading input price $\overline{w}$ (see expression 4) in order to exclude the less efficient firm from the downstream market.

Now assume that the upstream monopolist's profit maximizing uniform input price is sufficiently small to induce the less efficient firm to enter the downstream market. Then the upstream monopolist sets the uniform input price

$$w^{U3} = \frac{1}{2}(a-c-\frac{\Delta}{3}), \tag{9}$$

and the equilibrium output levels are

$$q_1^{U3} = q_2^{U3} = \frac{1}{8}(a-c+\frac{7}{3}\Delta) \text{ and } q_3^{U3} = \frac{1}{8}(a-c-\frac{17}{3}\Delta), \tag{10}$$

so that the aggregate output level is given by

$$Q^{U3} = \frac{3}{8}(a-c) - \frac{1}{8}\Delta. \tag{11}$$

From (10) we can see that the less efficient downstream firm only enters the market under uniform pricing for $\Delta < 3(a-c)/17$. To decide which price to set (i.e., whether to serve two or three downstream firms), the upstream monopolist will compare its profit under the two downstream market structures. Lemma 2 gives us the monopolist's optimal pricing policy when price discrimination is not allowed.

Lemma 2. *There exists a unique threshold value* $\widetilde{\Delta} = (3-2\sqrt{2})(a-c)$ *such that for all* $\Delta \geq \widetilde{\Delta}$ *the upstream monopolist serves only the two efficient* *downstream firms at an input price of* $w^{U2} = \frac{1}{2}(a-c)$. *For all* $\Delta < \widetilde{\Delta}$ *an input price of* $w^{U3} = \frac{1}{2}(a-c-\frac{\Delta}{3})$ *is chosen so as to serve all three downstream firms.*

Proof. We have to compare the monopolist's profit depending on whether or not the less efficient downstream firm is served. The monopoly input price given by (9), yields an upstream monopoly profit of $L^{U3} = (3(a-c)-\Delta)^2/48$, if all three firms are active, which is the case for all $\Delta < 3(a-c)/17$. Note that the upstream firm's profits are strictly decreasing in Δ.

If, however, the monopolist prefers to only serve the two efficient downstream firms, then his profit maximizing input price is $w^{U2} = (a-c)/2$ for all $\Delta \geq (a-c)/6$. However, for all $\Delta < (a-c)/6$ the inefficient firm would purchase inputs at a price of w^{U2}. Hence, the input monopolist has to charge the entry-blockading input price $\overline{w}$ if he wants to ensure that only two firms are served. Clearly, the monopoly profit at $\overline{w}$ is strictly smaller than the profit at w^{U2}, which is given by $L^{U2} = (a-c)^2/6$ and independent of Δ. Comparing L^{U3} and L^{U2} we obtain the unique threshold value $\widetilde{\Delta} = (3-2\sqrt{2})(a-c)$, with $L^{U3} < L^{U2}$, for all $\Delta > \widetilde{\Delta}$, and $L^{U3} > L^{U2}$, for all $\Delta < \widetilde{\Delta}$. Note that $\widetilde{\Delta} > (a-c)/6$ so that w^{U2} is a feasible pricing option for the monopolist for all $\Delta > \widetilde{\Delta}$. In addition, $\widetilde{\Delta} < 3(a-c)/17$. That means that there is range $\Delta \in [\widetilde{\Delta}, 3(a-c)/17]$ for which the input monopolist decides to only serve two firms at w^{U2} even though it could also serrve three firms at w^{U3}. Hence, the monopolist sets the entry blockading input price, w^{U2}, for all $\Delta \geq \widetilde{\Delta}$, and the monopoly input price, w^{U3}, with all three firms being active for all $\Delta < \widetilde{\Delta}$. **Q.E.D.**

Lemma 2 shows that the less efficient firm is excluded under a uniform input pricing regulation, whenever this potential entrant is sufficiently disadvantaged, i.e. for all $\widetilde{\Delta} \geq (3-2\sqrt{2})(a-c)$. In general, input price discrimination is more "entry-friendly" than a uniform input pricing regime. More precisely, there always exists a non-negative input price $w \geq \overline{w}$, such that a firm facing a cost disadvantage of Δ does not enter the market under a uniform pricing regime, while it would enter if the monopolist were allowed to price discriminate.

4.3 Relative Merits of Input Price Discrimination (Bans)

Given our assumption that an entrant is disadvantaged vis-à-vis incumbent firms, forbidding price discrimination upstream weakens competition in the downstream market. Under a uniformity rule the less efficient firm will only enter the market if the monopolist sets a relatively low price for *all* firms in the industry. Quite obviously, lowering the input price, compared to the price at which only the two efficient incumbents are served, is the less attractive for the upstream monopolist the more disadvantaged the entrant is. Consequently, the upstream monopolist will rather serve the two efficient firms at a relatively high price than all three firms at a lower price, unless the entrant's productive efficiency is sufficiently high.

In contrast, a discriminatory pricing regime is more "entry-friendly", as any firm that would enter the downstream market if inputs were priced at marginal cost, also enters if input price discrimination is feasible. While this difference between uniform and discriminatory pricing straightforwardly follows from the upstream monopolist's optimization problem, it also means that recent welfare assessments of non-discrimination rules are less clear-cut than has been suggested in parts of the literature. Most prominently, Yoshida (2000) has shown that in a Cournot-model with linear demands input price discrimination unambiguously causes productive inefficiencies and, thereby, a welfare loss when compared to uniform pricing.[9] However, this result does not unambiguously hold once the entry blockading effects of non-discrimination rules are taken into account, as the following proposition shows.

Proposition 1. *Suppose that entry is blockaded under regime U; i.e.* $\Delta \geq \widetilde{\Delta}$. *Then, there exists a unique threshold value,* $\widehat{\Delta}$, *with* $\widehat{\Delta} \equiv 31(a-c)/141$, *such that social welfare is larger under regime D than under U, whenever* $\Delta < \widehat{\Delta}$ *holds. The opposite is true for* $\Delta > \widehat{\Delta}$ *(with equality at* $\Delta = \widehat{\Delta}$*). Moreover, for all* $\Delta \geq \widetilde{\Delta}$, *consumer surplus is strictly larger under regime D than under regime U. Finally, if entry is not blockaded under regime U, i.e.* $\Delta < \widetilde{\Delta}$, *then social welfare is higher under regime U than regime D while consumer surplus remains unchanged.*

Proof. We have to compare social welfare, W, (the sum of producer and consumer surplus) under regimes D and U. Given $\Delta \geq \widetilde{\Delta}$, then $W^D - W^{U2} = 0$ if and only if $\Delta = \widehat{\Delta}$, and the welfare ordering then follows immediately. Consumer surplus, $CS = \frac{1}{2}Q^2$, is always at least as large under regime D than under regime U, as $Q^D = Q^{U3} = (3(a-c)-\Delta)/8$ is strictly larger than $Q^{U2} = (a-c)/3$ for all $\Delta < (a-c)/3$, which is given by A1. For all $\Delta < \widetilde{\Delta}$, a comparison between W^D and W^{U3} reveals that $W^{U3} > W^D$ for all $\Delta > 0$ (due to the superior productive efficiency under regime U) while $Q^D = Q^{U3}$ so that $CS^D = CS^{U3}$. **Q.E.D.**

Proposition 1 shows that the entry blockading effects of input price discrimination bans, as provided for by the Robinson-Patman Act in the US and standard practice for most deregulated network industries, may have damaging effects on both consumer surplus and overall welfare. More generally, additional entry under price discrimination can drive down prices, which benefits consumers, while social welfare may decrease or increase, depending on the productive efficiency effects. As our model shows, in contrast to Yoshida (2000) welfare *can* be higher with a price discriminating monopolist than under a price discrimination ban. This is the more likely to be the case the less inefficient the entrant produces. However, the "efficiency gap" between the active incumbents and the potential entrant has to be sufficiently large, as otherwise the monopolist would not exclude the entrant under a uniformity rule in the first place, but already serve all three firms at a lower price.

[9] See Yoshida (2000, Proposition 2), where it is shown that a sufficient condition for this result is that firms can be ordered along the lines of their productive efficiency (as is the case in our setting). However, as pointed out above, Yoshida's analysis takes the number of active firms as exogenously given.

Having analyzed the merits of input price discrimination (bans) in a static framework, let us now turn to the analysis of uniform input pricing rules in a dynamic setting, as the (negative) effects of price discrimination on innovation incentives have been put forward as an important reason for disallowing input price discrimination (see DeGraba, 1990).

5 The Dynamic Case

Let us now augment the preceeding analysis by another stage, in which one of the two incumbents can undertake an innovation project, $I(\theta)$, which carries a fixed cost of I and reduces the innovator's marginal cost by θ. If the innovation is realized then firm 1's marginal cost is $k_1 = w_1 + c - \theta$.

In the following we analyze firm 1's innovation incentives under regimes D and U. The firm's innovation incentives can be measured by the gross gain, $\Psi^R(n_\theta, n_0) \equiv \pi_1^R(\theta, n_0) - \pi_1^R(0, n_0)$, where the index $R = D, U$ stands for the regulatory regime in place, the argument θ (0) indicates that the innovation has (not) been undertaken, while n_0 and n_θ reflect the market structure before and after the innovation has been implemented, with $n = 1, 2, 3$ being the number of active firms. This means we also allow for "drastic" innovations which result in "preemption" of the entrant and/or exit of the non-innovating incumbent firm.

The effects that a price-discrimination ban has on the firm's innovation incentives are summarized in the following proposition:

Proposition 2. *While inovation incentives can be larger under regime U than under regime D, as generally perceived in the literature, the reverse case may also hold. Firstly,* $\Psi^D(1,3) > \Psi^U(1,3)$ *and* $\Psi^D(1,3) > \Psi^U(1,2)$ *generally hold. Secondly, thre exist unique threshold values* Δ_2^*, Δ_7^* *and* Δ_9^* *such that* $\Psi^D(3,3) > \Psi^U(2,3)$ *for* $\Delta > \Delta_2^*$, $\Psi^D(2,3) > \Psi^U(1,3)$ *for* $\Delta > \Delta_7^*$ *and* $\Psi^D(2,3) > \Psi^U(1,2)$ *for* $\Delta < \Delta_9^*$. *In all other cases, innovation incentives are higher under regime U than under regime D.*

Proof. The proof follows from piecewise comparing innovation incentives under regimes D and U for different market structures. These comparisons are presented in the Appendix. **Q.E.D.**

Proposition 2 qualifies DeGraba's (1990) result that R&D incentives for cost-reductions are generally higher under a uniformity rule than under price discrimination. If the number of active firms in the downstream market is (adversely) affected by a price discrimination ban, discriminatory pricing does not unambiguously reduce firms' innovation incentives as posited in DeGraba (1990). In contrast, as Proposition 2 states, incentives for undertaking a cost-reducing innovation *can* be higher with input price discrimination than under a price discrimination ban.

Firstly, the incentive to innovate may be higher under input price discrimination than under uniformity if an innovation is drastic enough to preempt market entry by the inefficient firm under a uniformity rule but not under price discrimination ($\Psi^D(3,3) > \Psi^U(2,3)$) and the entrant's disadvantage (measured by Δ) is sufficiently high. To understand the underlying logic, note that with a high Δ an efficient incumbent heavily benefits from a low uniform price. If now, under uniformity, the innovation induces the input monopolist to forego the revenue stream obtained from selling to the inefficient entrant and rather raise its uniform input price so as to increase the revenues from the two remaining firms, the price increase for the innovating firm may be even more drastic under uniformity than under price discrimination (where the incumbents do not benefit from a high Δ). As a result, the innovation incentives may be lower under uniform input prices than under input price discrimination.

Secondly and similarly, the incentive to innovate may also be higher under input price discrimination than under uniformity if an innovation is drastic enough to preempt market entry by the inefficient firm under price discrimination but the innovation is so drastic (i.e. θ is so high) that it would would even lead to the monopolization of the market under uniformity ($\Psi^D(2,3) > \Psi^U(1,3)$) and if the entrant's disadvantage (measured by Δ) is sufficiently high. Again under uniformity the efficient firms would benefit from the entrant's inefficiency as it compresses thier own wages under uniformity, but not under input price discrimination. Hence, with uniformity the resulting wage increase after a drastic innovation would be relatively steep for the innovator (when the two other firms have left the market), while it would be more moderate under price discrimination (as the initial input price has been high already).

Thirdly, innovation incentives can be higher under input price discrimination than under uniformity if the innovation prevents entry under price discrimination and would lead to the monpolization of the market under uniformity ($\Psi^U(1,2) < \Psi^D(2,3)$). Also the potential entrant's disadvantage must not be too large, as a large Δ makes innovation under price discrimination less profitable (note that even under price discrimination firm 1's profit positively depends on Δ). If Δ is relatively small the additional profit under price discrimination of moving from a three-firm oligopoly to a duopoly can be higher than the profit of moving from a duopoly to a monopoly under uniform pricing.

And finally, the incentive to innovate may also be higher under input price discrimination than under uniformity if an innovation leads to the monopolization of the market. Since the efficient firm suffers from price discrimination its additional profit from reaching a monopoly position ae higher than for a firm facing uniform input prices, which indirectly benefits from its less efficient rivals (either though lower uniform input prices or from sofetr competition due to blockaded entry).

While one may argue that the circumstances under which innovation incentives are larger under price discrimination than under a price discrimination ban are rather specific, we feel that such reasoning is premature. First, one can think of more general models with more than two incumbents and more than one potential entrant, which lead to the same result with less drastic innovations. Secondly, the realization and the extent of the expected benefits of an R&D project are often uncertain. If this is the case, then a drastic innovation is only one possible outcome (with some probability lower than unity), while less favorable states are also likely, which give not rise too a drastic innovation, and hence, a monopoly outcome. For instance, we may re-define the investment projects as $I(\theta, \mu)$, where $\mu \in (0, 1)$ is the ex ante probability that the innovation will be successful, while the innovation project will be unsuccessful with probability $1 - \mu$. We can then determine a critical value μ^* such that for all $\mu \geq \mu^*$ the innovation incentive is larger under regime D than under regime U.

Regarding welfare and consumer surplus proposition 2 indicates that under some circumstances there are innovations, which are not undertaken under a uniform pricing regime, but only if price discrimination is allowed. It is now straightforward to conceive of parameter constellations with large marginal cost reductions where both consumer surplus and scoial welfare increase.

6 Discussion and Conclusion

Whenever regulations are imposed on businesses, the economy is shifted from one equilibrium to another. While this clearly involves adjustments of prices and sales, it can also have substantial effects on industry structure. We have accounted for this by considering a potential entrant, and have shown that entry is less likely when price discrimination is forbidden. This entry blockading effect of uniformity regulations can have dramatic consequences for the assessment of their costs and benefits both within a static and a dynamic setting.

While our model has straightforward applications for recently deregulated industries such as telecommunications, electricty, and transport industries, the model is also applicable to unionized oligopolies. As has been recently argued collective wage-setting by an industry (or even nation-wide union) may have some benefits because of the positive effects that egalitarian (i.e., non-discriminatory) wage-setting may have on firms' incentives to innovate (see Haucap and Wey, 2004). If we, however, account for the entry blockading effects of those labor market regimes, then our insights may also qualify these results. More specifically, recent trends towards more flexible wage setting at the firm-level (which we interpret as some form of wage-discrimination) may have "entry-friendly" effects, not only in a static setting but also in a more dynamic world where cost-reduction is an important aspect of industry performance.

While we have used a fairly simple model to demonstrate that the results obtained by DeGraba (1990) and Yoshida (1990) have to be qualified once market structure is not exogenously given and entry is an issue, further research should aim at generalizing the effects of input price discrimination (bans) on market entry.

7 Appendix

Explanatory Notes to Proposition 1

Under price discrimination total welfare is given by $W^D = L^D + \pi_1^D + \pi_2^D + \pi_3^D + CS^D$ or, more precisely, $W^D = \frac{39}{128}a^2 - \frac{39}{64}ac + \frac{39}{128}c^2 - \frac{13}{64}\Delta a + \frac{13}{64}\Delta c + \frac{47}{128}\Delta^2$. Similarly, with two firms active under uniform input pricing welfare is given by

$W^{U2} = L^{U2} + \pi_1^{U2} + \pi_2^{U2} + CS = \frac{5}{18}(a-c)^2$. Hence, $W^D - W^{U2} = 0$ for $\Delta = \widehat{\Delta} \equiv \frac{31}{141}(a-c)$.

Furthermore, since $W^{U3} = \frac{39}{128}a^2 - \frac{39}{64}ac - \frac{13}{64}a\Delta + \frac{39}{128}c^2 + \frac{13}{64}c\Delta + \frac{269}{384}\Delta^2$, we have $W^D - W^{U3} = -\frac{1}{3}\Delta^2 < 0$.

Proof of Proposition 2

Let us first derive the optimal production quantities and input prices under regime D. Given these, we can calculate firm 1's equilibrium profits, from which we obtain the firm's innovation incentives. Substituting the derived demands (2) and (3) into the upstream monopolist's profit function and maximizing over the input price(s) we obtain

$$w_i^D = \frac{1}{2}(a - MC_i) \text{ for } i = 1, 2, 3, \tag{S1}$$

where MC_i are the firms' marginal costs given by $MC_1 = c - \theta$, $MC_2 = c$ and $MC_3 = c + \Delta$. Substituting the optimal input prices into the inverse demands for the input, we obtain the equilibrium output levels

$$\begin{aligned} q_1^D &= \tfrac{1}{8}(a - c + 3\theta + \Delta) \\ q_2^D &= \tfrac{1}{8}(a - c + \Delta - \theta) \\ q_3^D &= \tfrac{1}{8}(a - c - 3\Delta - \theta) \end{aligned} \tag{S2}$$

for $3\Delta + \theta < a - c$. For $3\Delta + \theta > a - c$ we receive $q_3^D = 0$, and also $q_1^D = \frac{1}{6}(a - c + 2\theta)$ and $q_2^D = \frac{1}{6}(a - c - \theta)$, while the input prices w_1 and w_2 remain unchanged. Finally, for $\theta > a - c$, we obtain $q_1^D = \frac{1}{4}(a - c + \theta)$, while $q_2^D = q_3^D = 0$.

As profits are given by $\pi_i = q_i^2$ and taking into account Lemma 1, it is straightforward to calculate firm 1's innovation incentives $\Psi^D(n_\theta, n_0)$, which are given as

$$\begin{aligned} \Psi^D(3,3) &= \tfrac{1}{64}\left[(a - c + \Delta + 3\theta)^2 - (a - c + \Delta)^2\right] \text{ for } \theta < a - c - 3\Delta \\ \Psi^D(2,3) &= \tfrac{1}{36}(a - c + 2\theta)^2 - \tfrac{1}{64}(a - c + \Delta)^2 \text{ for } a - c > \theta \geq a - c - 3\Delta \\ \Psi^D(1,3) &= \tfrac{1}{16}(a - c + \theta)^2 - \tfrac{1}{64}(a - c + \Delta)^2 \text{ for } \theta \geq a - c \end{aligned} . \tag{S3}$$

Similarily, we can calculate firm 1's innovation incentives $\Psi^U(n_\theta, n_0)$ under regime U. The upstream monopolist's optimal pricing policy is given by

$$\begin{aligned} w^{U3} &= \tfrac{1}{2}(a - c - \tfrac{\Delta - \theta}{3}) \text{ for } \Delta < \Delta' \\ w^{U2} &= \tfrac{1}{2}(a - c + \tfrac{1}{2}\theta) \text{ for } \Delta \geq \Delta' \text{ and } \theta < \tfrac{2}{5}(a - c) \\ w^{U1} &= \tfrac{1}{2}(a - c + \theta) \text{ for } \theta \geq \tfrac{2}{5}(a - c), \end{aligned} \tag{S4}$$

where $\Delta' \equiv \widetilde{\Delta} - \theta(\sqrt{2} - 1)$ and $\widetilde{\Delta} \equiv (3 - 2\sqrt{2})(a - c)$ as given in Lemma 2. This leads to the following equilibrium output levels produced by firm 1

$$\begin{aligned} q_1^{U3} &= \tfrac{1}{24}(3(a - c) + 7\Delta + 17\theta) \text{ for } \Delta < \Delta' \\ q_1^{U2} &= \tfrac{1}{12}(2(a - c) + 7\theta) \text{ for } \Delta \geq \Delta' \text{ and } \theta < \tfrac{2}{5}(a - c) \\ q_1^{U1} &= \tfrac{1}{4}(a - c + \theta) \text{ for } \theta \geq \tfrac{2}{5}(a - c). \end{aligned} \tag{S5}$$

Consequently, firm 1's investment incentives are given by

$$\begin{array}{ll}\Psi^U(3,3) = \frac{1}{576}\left[(3(a-c)+7\Delta+17\theta)^2-(3(a-c)+7\Delta)^2\right] & \text{for } \theta<\widehat{\theta} \text{ and } \Delta<\Delta' \\ \Psi^U(2,3) = \frac{1}{144}(2(a-c)+7\theta)^2-\frac{1}{576}(3(a-c)+7\Delta)^2 & \text{for } \theta<\widehat{\theta} \text{ and } \widetilde{\Delta}>\Delta\geq\Delta' \\ \Psi^U(2,2) = \frac{1}{36}\left[(a-c+\frac{7}{2}\theta)^2-(a-c)^2\right] & \text{for } \theta<\widehat{\theta} \text{ and } \Delta\geq\widetilde{\Delta} \\ \Psi^U(1,3) = \frac{1}{16}(a-c+\theta)^2-\frac{1}{576}(3(a-c)+7\Delta)^2 & \text{for } \theta\geq\widehat{\theta} \text{ and } \Delta<\widetilde{\Delta} \\ \Psi^U(1,2) = \frac{1}{16}(a-c+\theta)^2-\frac{1}{36}(a-c)^2 & \text{for } \theta\geq\widehat{\theta} \text{ and } \Delta\geq\widetilde{\Delta},\end{array} \tag{S6}$$

where $\widehat{\theta} \equiv \frac{1}{2}(\sqrt{3}-1)\,(a-c)$.

To proof our proposition we have to pairwise compare $\Psi^U(n_\theta, n_0)$ and $\Psi^D(n_\theta, n_0)$ for $n_0 = 1,2,3$ and all $n_\theta \leq n_0$.

1) $\Psi^U(3,3)-\Psi^D(3,3) > 0$ if $48\theta(a-c)+184\Delta\theta+208\theta^2 > 0$, which is always fulfilled.

2) $\Psi^U(2,3) - \Psi^D(3,3) > 0$ if $7(a-c)^2 + 58\theta(a-c) + 115\theta^2 - 42d\Delta - 49\Delta^2 - 54\Delta\theta > 0$, is decreasing in Δ. The expression holds for $\Delta < \Delta_2^* \equiv -\frac{3}{7}(a-c) - \frac{27}{49}\theta + \frac{2}{49}\sqrt{\left(196(a-c)^2 + 994\theta(a-c) + 1591\theta^2\right)}$. Given S6 we have to show that there exists a $\theta < \widehat{\theta}$ such that $\widetilde{\Delta} \geq \Delta_2^* \geq \Delta'$. Since $\Delta_2^* < \widetilde{\Delta}$ for $\theta < \left(\frac{6908}{1035} - \frac{12\,728}{3105}\sqrt{2} + \frac{4}{115}\sqrt{7376-5181\sqrt{2}} - \left(-\frac{98}{27}\sqrt{2}+\frac{56}{9}\right)\right)(a-c) \approx 0.0315(a-c)$ and $\Delta_2^* > \Delta'$ for $\theta > (\frac{1}{49\sqrt{2}-76}\left(168-98\sqrt{2}\right) + \frac{2}{\left(43-76\sqrt{2}\right)\left(49\sqrt{2}-76\right)}$ $(4684 - 2685\sqrt{2} + \sqrt{2}\sqrt{59\,984\,091 - 42\,413\,620\sqrt{2}}))(a-c) \approx 0.0217(a-c)$. As the difference $\Psi^U(2,3) - \Psi^D(3,3)$ is decreasing in Δ, we obtain that $\Psi^U(2,3) > \Psi^D(3,3)$ if $\Delta < \Delta_2^*$ and $\Psi^U(2,3) < \Psi^D(3,3)$ if $\Delta > \Delta_2^*$.

3) $\Psi^U(1,3) - \Psi^D(3,3) > 0$ if $\frac{1}{32}(a-c)\theta - \frac{7}{96}(a-c)\Delta - \frac{3}{32}\Delta\theta + \frac{3}{64}(a-c)^2 - \frac{49}{576}\Delta^2 - \frac{5}{64}\theta^2 > 0$, which is decreasing in Δ. The condition may then also be reformulated as $\Delta < \Delta_3^* \equiv -\frac{27}{49}\theta - \frac{3}{7}(a-c) + \frac{6}{49}\sqrt{56(a-c)\theta + 49(a-c)^2 - 41\theta^2}$. Since for all $\theta < (a-c)$ we have $\Delta_3^* > \frac{a-c-\theta}{3}$, which is the relevant boundary for $\Psi^D(3,3)$ (see S3), we have $\Psi^U(1,3) > \Psi^D(3,3)$.

4) $\Psi^U(2,2) - \Psi^D(3,3) > 0$ if $\frac{29}{288}(a-c)\theta + \frac{115}{576}\theta^2 - \frac{3}{32}\Delta\theta > 0$. This unambiguously holds for all $\Delta < \frac{1}{3}(a-c)$ which we have assumed in A1.

5) $\Psi^U(1,2) - \Psi^D(3,3) > 0$ if $\frac{1}{32}\theta(a-c) - \frac{3}{32}\Delta\theta + \frac{5}{144}(a-c)^2 - \frac{5}{64}\theta^2 > 0$, which is decreasing in Δ. The condition can also be reformualted as $\Delta < \Delta_5^* \equiv \frac{1}{3}(a-c) - \frac{5}{6}\theta + \frac{10}{27}\frac{(a-c)^2}{\theta}$. Hence, $\Psi^U(1,2) < \Psi^D(3,3)$ if $\Delta > \Delta_5^* > \frac{a-c-\theta}{3}$, which is the relevant boundary for $\Psi^D(3,3)$ (see S3). Note that $\Delta_5^* > \frac{a-c-\theta}{3}$ holds for $\theta > \frac{2}{9}\sqrt{15}(a-c)$.If, however, $\theta > \frac{2}{9}\sqrt{15}(a-c)$, then inserting yields $\Delta_5^* < (\frac{1}{3} - \frac{2}{27}\sqrt{15})(a-c)$, which is smaller than $\widetilde{\Delta} \equiv (3-2\sqrt{2})(a-c)$. However, $\Psi^U(1,2)$ is relevant only for $\Delta > \widetilde{\Delta}$ (see S6). Hence, for all $\Delta > \widetilde{\Delta}$ we have $\Psi^U(1,2) - \Psi^D(3,3)$.

6) $\Psi^U(2,3)$ vs. $\Psi^D(2,3)$ is not a relevant comparison since $\Psi^U(2,3)$ is relevant for $\theta < \widehat{\theta}$ and $\Delta < \widetilde{\Delta}$ (see S6), while $\Psi^D(2,3)$ is relevant for $\Delta \geq \frac{a-c-\theta}{3}$ (see S3), which is mutually exclusive.

7) $\Psi^U(1,3)-\Psi^D(2,3) > 0$ if $(\frac{1}{72}\theta - \frac{1}{24}\Delta)(a-c) + \frac{5}{144}(a-c)^2 - \frac{5}{72}\Delta^2 - \frac{7}{144}\theta^2 > 0$, which is decreasing in Δ. The condition can be reformulated as $\Delta < \Delta_7^* \equiv$

$\frac{1}{10}\sqrt{20\theta(a-c)+59(a-c)^2-70\theta^2}-\frac{3}{10}(a-c)$. Note that $\Delta_7^* < \widetilde{\Delta}$, which is the relevant boundary for $\Psi^U(1,3)$ (see S6), for $\theta > (\frac{1}{7}+\frac{2}{7}\sqrt{231\sqrt{2}-320})(a-c)$. Also $\Delta_7^* \geq (a-c-\theta)/3$, which is the relevant boundary for $\Psi^D(2,3)$ (see S3), if $\theta \leq a-c$, which is always fulfilled in the relevant space. Hence, we have $\Psi^U(1,3) > \Psi^D(2,3)$ for $\Delta < \Delta_7^*$ and $\Psi^U(1,3) < \Psi^D(2,3)$ for $\Delta > \Delta_7^*$

8) $\Psi^U(2,2)-\Psi^D(2,3) > 0$ if $(\frac{1}{32}\Delta+\frac{1}{12}\theta)(a-c)-\frac{7}{576}(a-c)^2+\frac{1}{64}\Delta^2+\frac{11}{48}\theta^2$, which is increasing in Δ. This condition can be reformulated as $\Delta > \Delta_8^* \equiv \frac{2}{3}\sqrt{4(a-c)^2-12\theta(a-c)-33\theta^2}-(a-c)$. Since $\Delta > (a-c-\theta)/3$, which is the relevant boundary for $\Psi^D(2,3)$ (see S3) and $\Delta_8^* < (a-c-\theta)/3$ for $\theta > 0$, we have $\Psi^U(2,2) > \Psi^D(2,3)$.

9) $\Psi^U(1,2)-\Psi^D(2,3) > 0$ if $(\frac{1}{32}\Delta+\frac{1}{72}\theta)(a-c)+\frac{13}{576}(a-c)^2+\frac{1}{64}\Delta^2-\frac{7}{144}\theta^2 > 0$, which is increasing in Δ. This condition can be reformulated as $\Delta > \Delta_9^* \equiv \frac{2}{3}\sqrt{7\theta^2-(a-c)^2-2\theta(a-c)}-(a-c)$. Note that $\Delta_9^* > \widetilde{\Delta}$, which is the relevant boundary for $\Psi^U(1,2)$ (see S6), for $\theta > \frac{1}{7}(a-c)(1+\sqrt{2}\sqrt{193-126\sqrt{2}}) \approx 0.920(a-c) < (a-c)$, which is the relevant boundary for $\Psi^D(1,3)$ (see S3). Hence, we have $\Psi^U(1,2) > \Psi^D(2,3)$ for $\Delta > \Delta_9^*$ and $\Psi^U(1,2) < \Psi^D(2,3)$ for $\Delta < \Delta_9^*$.

10) $\Psi^U(1,3)-\Psi^D(1,3) > 0$ if $-\frac{1}{24}d\Delta-\frac{5}{72}\Delta^2 > 0$, which is never fulfilled. Hence, $\Psi^U(1,3) < \Psi^D(1,3)$.

11)$\Psi^U(1,3)-\Psi^D(1,2) > 0$ if $\frac{1}{32}(a-c)\Delta-\frac{7}{576}(a-c)^2+\frac{1}{64}\Delta^2 > 0$, whichis fulfilled for $\Delta > \frac{1}{3}(a-c)$. However, since $\Delta < \frac{1}{3}(a-c)$ due to A1, we have $\Psi^U(1,3) < \Psi^D(1,2)$.

Q.E.D.

References

Banerjee, S. and Lin, P. (2003), Downstream R&D, Raising Rivals' Costs, and Input Price Contracts, *International Journal of Industrial Organization* 21, 79-96.

Blair, R.D. and J.L. Harrison (1999), Airline Price Wars: Competition or Predation?, *The Antitrust Bulletin* 44, 489-518.

Bork, R. (1978), *The Antitrust Paradox*, New York, Basic Books.

Carlton, D.W. and Perloff, J.M. (1989), *Modern Industrial Organization*, HarperCollins Publishers.

DeGraba, P. (1990), Input Market Price Discrimination and the Choice of Technology, *American Economic Review* 80, 1246-1253.

Hart, O. and Tirole, J. (1990), Vertical Integration and Market Foreclosure, *Brookings Papers Microeconomics,* 205-286.

Haucap, J. and Wey, C. (2004), Unionisation Structures and Innovation Incentives, *The Economic Journal* 114, C149-C165.

Katz, M. (1987), The Welfare Effects of Third-Degree Price Discrimination in Intermediate Goods Markets, *American Economic Review* 77, 154-167.

Lipsky, A.B. and G.J. Sidak (1999), Essential Facilities, *Stanford Law Review* 51

Miller, F. (1997), Predatory Pricing in Deregulated Telecommunications Markets, *World Competition: Law and Economics Review* 21 (2), 65-90.

O'Brien, D.P. and Shaffer, G. (1994), The Welfare Effects of Forbidding Discriminatory Discounts: A Secondary Line Analysis of Robinson-Patman Act, *Journal of Law, Economics, and Organization* 10, 296-318.

O'Brien (2002), The Welfare Effects of Third-Degree Price Discrimination in Intermediate Goods Markets: The Case of Bargaining, Mimeo, U.S. Federal Trade Commission, Washington D.C.

Ordover, J.A., G. Saloner and S.C. Salop (1990), Equilibrium Vertical Foreclosure, *American Economic Review* 80, 127-142.

Rey, P. and J. Tirole (2003), A Primer on Foreclosure, forthcoming in: M. Armstrong and R.H. Porter (eds.), *Handbook of Industrial Organization*, Vol. 3, North Holland: Amsterdam.

Symeonidis, G. (2000), Price and Non-Price Competition with Endogenous Market Structure, *Journal of Economics and Management Strategy* 9, 53-83.

Varian, H. (1989), Price Discrimination, in: R. Schmalensee and R.Willig (eds.), *Handbook of Industrial Organization*, Vol. 1, North Holland: Amsterdam.

Vickers, J. (1995), Competition and Regulation in Vertically Related Markets, *Review of Economic Studies* 62, 1-17.

Yoshida, Y. (2000). Third-Degree Price Discrimination in Input Markets: Output and Welfare, *American Economic Review* 90, 240-246.