

NONLINEAR SUPPLY CONTRACTS, EXCLUSIVE DEALING, AND EQUILIBRIUM MARKET FORECLOSURE

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We examine how the feasibility of both nonlinear pricing and exclusive dealing arrangements affect incentives for market foreclosure when two manufacturers contract with a retail monopolist. Surprisingly, we find that although market foreclosure equilibria exist, they are Pareto-dominated (from each manufacturer's perspective) by all nonforeclosure equilibria. If one believes that Pareto-dominated equilibria are unlikely to arise, then the difference between our results and those of Mathewson and Winter (1987), who do not allow for nonlinear pricing, suggests an ironic twist on the notion that quantity discounts and other kinds of nonlinear pricing can provide an additional way for a manufacturer to foreclose a rival. By providing a manufacturer with increased flexibility (beyond linear pricing) to extract a retailer's surplus, nonlinear pricing may instead have the effect of reducing the incidence of observed market foreclosure.

1. INTRODUCTION

An exclusive dealing arrangement is a contractual agreement between a manufacturer and retailer prohibiting the latter from selling the products of rival manufacturers. While such arrangements can promote effi-

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ciencies¹ and thus can be procompetitive, they can also lead to market foreclosure. If a substantial fraction of the retail market has been foreclosed, exclusive dealing may be found to “substantially lessen competition” under the Clayton Act §3,² to be “an unfair method of competition” under the FTC Act §5, and to be conduct in violation of the Sherman Act §2 (American Bar Association Antitrust Section, 1992).³

If a manufacturer wants to foreclose its rivals, however, there may be other ways of doing so that run less risk of antitrust violation. For instance, it can offer price breaks such as quantity discounts and other promotional incentives to induce retailers to favor its product. If the price breaks are sufficiently large, retailers may even choose not to sell competing products in order to qualify for the maximum discount.⁴ As long as the price breaks are neither below-cost nor discriminatory,⁵ and the supply contract contains no sanctions for selling the products

1. Several efficiency motivations for exclusive dealing have been given in the literature. A long-term exclusive dealing arrangement can assure buyers (sellers) of a dependable supply (demand) of a product at a given price. Exclusive dealing arrangements can also foster interbrand competition by encouraging retailers to promote a manufacturer's product more aggressively than otherwise. Lastly, exclusive dealing can prevent free-riding on a manufacturer's noncontractible demand-increasing promotions. Marvel (1982) argues that such promotions will be underprovided in the absence of exclusive dealing if retailers can influence consumers to purchase instead the brands of rival manufacturers from which higher retail margins are earned. See Besanko and Perry (1993) for further discussion and analysis of this point.

2. Exclusive dealing arrangements are also covered by the Sherman Act §1. This was a necessary extension by the courts, because Section 3 of the Clayton Act only covers “goods” and not “services.” We are indebted to an anonymous referee for bringing this point to our attention.

3. In *Standard Oil Co. v. United States*, 337 U.S. 293, 314 (1949), the Court held that a violation of the Clayton Act §3 “is satisfied by proof that competition has been foreclosed in a substantial share of the line of commerce affected.” Similarly, in *Brown Shoe Co.*, 62 F.T.C. 679 (1963), the Commission held that the FTC Act §5 prohibits exclusive dealing arrangements when foreclosure occurs in a “significant number” of outlets. In subsequent cases, both the Court, in *Tampa Electric Co. v. Nashville Coal Co.*, 365 U.S. 320 (1961), and the Commission, in *Beltone Electronics Corp.*, 100 F.T.C. 68 (1982), have broadened their scope of inquiry to include consideration of additional factors such as the duration of the exclusive dealing agreement, the ease of entry, and whether there exists a procompetitive justification for the exclusion.

4. According to Steuer (1993), quantity discounts offered to induce exclusive dealing are commonplace in the US and Canada. For example, Microsoft Corp.'s discounts on its MS-DOS operating system have allegedly had this effect. As another example, we know of several restaurants in Ann Arbor, MI, that decline to handle Discover and American Express credit cards so as to qualify for the maximum rebates offered by Visa and MasterCard.

5. Price breaks that are below cost may violate the Sherman Act §2. Price breaks offered to some retailers but not to all may violate the Clayton Act §2 as amended by the Robinson-Patman Act of 1936.

of competitors,⁶ such incentives offered to induce exclusive dealing are presumed lawful and often viewed as procompetitive because of the "likelihood that the discount(s) will ultimately inure to the benefit of the consumer."⁷

Antitrust law distinguishes between discounts that may have the practical effect of inducing a competitor's product to be dropped and an explicit exclusive dealing arrangement, on the grounds that the latter constrain a retailer's freedom of choice.⁸ But this distinction does not provide a compelling economic rationale for the legal asymmetry. As Bork (1978, p. 304) and Director and Levi (1956) observe, a manufacturer seeking exclusivity must compensate the retailer for not selling competing products whether or not it restricts the retailer's freedom of choice. Bork concludes that, for the purpose of foreclosing a rival (as opposed to an efficiency reason), an exclusive dealing arrangement offers a manufacturer no advantage it would not have had without the arrangement.

Since quantity discounts are often feasible, and offer an additional (and potentially substitute) way to foreclose rivals, a complete investigation of Bork's claim requires a model in which nonlinear pricing is

6. An example of what could get firms into trouble is offering discounts on condition of exclusivity, which the courts have recognized may be a thin disguise for an exclusive dealing arrangement. For instance, United Shoe Machinery once offered lower prices to shoe manufacturers on condition that they purchase their machinery exclusively from United. This prompted the Court in *United Shoe Machinery Corp. v. United States*, 258 U.S. 451 (1922) to observe that "while the clauses enjoined do not contain specific agreements not to use the machinery of a competitor of the lessor, the practical effect of these drastic provisions is to prevent such use." More recently, Microsoft has come under scrutiny by the Federal Trade Commission and US Department of Justice for offering discounts of up to 60 percent on licenses for its MS-DOS operating system conditional on computer manufacturers paying the licensing fee on *every* machine they sell. See also *Antitrust Law Developments 3rd Ed.* (1992, p. 176) and the cases cited therein.

7. See *Fedway Associates, Inc. v. United States*, 976 F.2d at 1423 (D.C. Cir. 1992). See also *Barry Wright Corp. v. ITT Grinnell Corp.*, 724 F.2d 227 (1st Cir. 1983), in which the court found that Grinnell's decision to purchase all of its expected needs from Pacific Scientific Company (and thus none from Barry Wright) to qualify for special 30-percent/25-percent price discounts was lawful. To challenge such price cuts, the Court said, would threaten to "chill highly desirable procompetitive price cutting."

8. Areeda and Kaplow (1988, p. 775) draw the distinction as follows: "while all buyers might conceivably choose to make each purchase from the large firm in any event, that possibility does not dissolve our concern with the contractual limitation on their future freedom of choice." See also the opinion in *Fedway*, where the D.C. circuit court ruled that "to exclude a rival does not usually mean taking some action that merely leads someone else—here, a retailer—to make a free economic choice not to purchase the rival" (976 F.2d at 1421). And, in *FTC v. Brown Shoe*, 384 U.S. at 321 (1966), the Supreme Court found that Brown's exclusive dealing arrangement conflicted with "section 3 of the Clayton Act against contracts which take away freedom of purchasers to buy in an open market."

allowed. Surprisingly, the literature on exclusive dealing and market foreclosure (e.g., Comanor and Frech, 1985; Aghion and Bolton, 1987; Mathewson and Winter, 1987; Rasmusen et al., 1991; Besanko and Perry, 1994) typically restricts attention to linear pricing, thereby ruling out quantity discounts (and other kinds of price breaks) a priori as a means of exclusion.

In this paper, by contrast, we allow for both nonlinear pricing and exclusive dealing arrangements in a model of complete information when two manufacturers contract with a retail monopolist. We first derive necessary and sufficient conditions for nonlinear supply contracts (which may or may not contain exclusive dealing provisions) to arise in equilibrium. We then use these conditions to examine the profitability of market foreclosure, defined as a situation in which one manufacturer is excluded from the market even though a fully integrated (horizontally and vertically) firm would sell both goods. In addition, we ask what advantage, if any, exclusive dealing arrangements offer manufacturers over nonlinear pricing alone, and hence, what effect, if any, banning these arrangements would have on equilibrium prices and profits.

We find that exclusive dealing arrangements offer manufacturers no advantage. If a fully integrated firm would sell only one good (because the incremental revenue from the second good would be insufficient to cover its costs), the unique equilibrium outcome replicates the integrated solution and can be supported by nonlinear pricing alone. Exclusive dealing arrangements are then redundant. If a fully integrated firm would sell both goods, there exist foreclosure and nonforeclosure equilibria. Exclusive dealing arrangements are not redundant in this case, since they widen the set of foreclosure equilibria to include circumstances in which foreclosure would otherwise not be possible. Nevertheless, manufacturers would be better off without these arrangements, since each earns weakly higher profit in all nonforeclosure equilibria than in all foreclosure equilibria. Thus, if foreclosure occurs, it must be due to a coordination failure among manufacturers. For it does not arise in the usual sense of a dominant firm leveraging its market power.

Our results contrast sharply with those of Mathewson and Winter (1987), who demonstrate—also with two manufacturers and one retailer—that a dominant manufacturer can be better off with an exclusive dealing arrangement when nonlinear pricing is *infeasible*. If one believes that Pareto-dominated equilibria (from the viewpoint of the manufacturers) are unlikely to arise, then the difference between our results and those of Mathewson and Winter suggests an ironic twist on the notion that nonlinear pricing provides an additional way for a

manufacturer to foreclose a rival. Rather than making foreclosure more likely to occur, nonlinear pricing may instead have the paradoxical effect of reducing its observed incidence.

We follow Bernheim and Whinston (1985), Katz (1989), Anton and Yao (1989), Gal-Or (1991), and Zhang (1993) in considering delegated agency (a retailer can choose not to deal with both manufacturers).⁹ Of these authors, all but Anton and Yao, however, assume a competitive supply of alternative retailers through which an excluded manufacturer can distribute its goods, and thus do not consider the possibility of market foreclosure.¹⁰ By contrast, our model corresponds to situations in which patronage by certain retailers is critical to each manufacturer's survival, which is precisely when manufacturers have the most to gain by excluding their rivals. Our approach also allows us to examine upstream rivalry in nonlinear supply contracts when foreclosure does not arise, but when manufacturers nonetheless must guard against it. The work most closely related to ours is Bernheim and Whinston (1996). Using a similar framework with two manufacturers and one retailer, they have independently derived some of our Pareto-dominance results and also conclude that something more is needed for exclusive dealing arrangements to arise.¹¹

The rest of the paper is organized as follows. Section 2 presents the model and derives necessary and sufficient conditions for a subgame perfect equilibrium. Section 3 characterizes the set of one-good and two-good equilibria. Section 4 focuses on the profitability of market foreclosure and discusses the implications of our results for manufacturers and retailers. Section 5 asks what advantage, if any, exclusive dealing arrangements offer manufacturers over nonlinear pricing alone and contrasts our findings with those of Mathewson and Winter. Section 6 concludes.

9. Bernheim and Whinston (1986) and Martimort (1996) focus on intrinsic agency, where a retailer either deals with both manufacturers or does not participate.

10. Anton and Yao (1989) analyze split-award auctions in which the government solicits bids from two producers of homogeneous goods for the right to supply some or all of the government's fixed demand requirement. Because of this requirement, each producer's bid in their model is implicitly contingent not only on the amount the government purchases from it, but also on the amount the government purchases from its rival. This differs from our model, where nonlinear supply contracts, in the absence of an explicit exclusive dealing provision, are functions only of own quantity (the retailer's demand is not fixed). We also differ from them by allowing goods to be imperfect substitutes.

11. One possibility they consider is the use of exclusive dealing arrangements to mitigate incentive conflicts that arise when the retailer is risk-averse and can take unobservable actions that affect manufacturer sales. They also consider exclusive dealing when there are externalities across retail markets, à la Rasmusen et al. (1991).

2. THE MODEL AND NOTATION

Suppose firms X and Y respectively produce goods X and Y , which are substitutes in the sense that an increase in the retail price of one increases consumer demand for the other. Suppose also that the goods are distributed to consumers through a retail monopolist and that the technology of distribution precludes a firm from entering the downstream market to sell only its good. We have in mind a situation in which the economies of scope achieved by spreading overhead costs over multiple products are too high to warrant opening a single-product outlet. These assumptions ensure that manufacturers must secure independent retailer patronage and also permit examination of exclusive dealing under conditions seemingly most conducive to market foreclosure.

We consider a two-stage model of pricing and distribution. In the initial stage, each firm simultaneously and independently chooses a pricing schedule and whether to require exclusive dealing. The pricing schedules, $T_x(X)$ and $T_y(Y)$, specify for each firm the retailer's payment as a function of how much it purchases from that firm.¹² We place two additional weak restrictions on pricing schedules. First, we assume a manufacturer cannot coerce the retailer into making a payment. If the retailer does not purchase from a given firm, its payment to that firm is zero. That is, $T_i(0) = 0, i = X, Y$. Second, we assume that the payment asked for any quantity is no less than the *total* cost of producing that quantity.¹³ Let $C_i(\cdot)$ be firm i 's cost function, with $C_i(0) = 0$. Then we assume $T_x(X) \geq C_x(X)$ and $T_y(Y) \geq C_y(Y) \forall X, Y$. To complete the description of supply contracts, denote firm i 's decision whether to require exclusive dealing by the indicator variable ED_i , which equals one if exclusive dealing is required and zero otherwise.

Faced with the first-stage supply-contract choices by firms X and Y , the retailer chooses how much of each good to purchase in stage 2. We let $R(X, Y)$ denote the retailer's resale revenue as a function of its purchases and assume, for simplicity, that the retailer incurs no costs

12. Pricing schedules contingent on the amount the retailer purchases from a rival may not be enforceable in court and, in addition, may increase the risk of an antitrust challenge. One such example is a percentage quantity discount, where the size of the discount is a function of the percentage of its total purchases a retailer buys from a manufacturer.

13. This restriction allows us to rule out equilibrium payoffs that are supported by incredible threats. Moreover, if otherwise, the contract may run afoul of the Sherman Act §2, which prohibits below-cost pricing.

of distribution other than its payments for X and Y .¹⁴ Then the retailer's profit is $R(X, Y) - T_x(X) - T_y(Y)$. Firm X 's profit is $T_x(X) - C_x(X)$. Firm Y 's profit is $T_y(Y) - C_y(Y)$.

2.1 NECESSARY AND SUFFICIENT CONDITIONS FOR SUBGAME-PERFECT EQUILIBRIUM

Since our solution concept is subgame perfection, we begin by solving for retailer optimality in the second stage. The retailer chooses X and Y to maximize its profit given the supply contracts offered in the first stage. If neither manufacturer requires exclusive dealing, the retailer may choose $X, Y \geq 0$. The retailer might still opt to sell only one product in this case, but this would be its free choice. If either manufacturer requires exclusive dealing, however, the retailer maximizes its profit subject to the constraint that $XY = 0$. To keep track of the possibilities, define \mathcal{A}_i and \mathcal{A} as follows:

$$\mathcal{A}_i(ED_j) \equiv \begin{cases} \{(X, Y) \mid XY \geq 0\} & \text{if } ED_j = 0, \\ \{(X, Y) \mid XY = 0\} & \text{if } ED_j = 1 \end{cases} \quad \text{and} \quad \mathcal{A}(ED_x, ED_y) = \mathcal{A}_x \cap \mathcal{A}_y.$$

The retailer's optimal stage-two quantity pair(s) is then given by the set

$$\begin{aligned} \Omega(T_x(\cdot), ED_x, T_y(\cdot), ED_y) \\ \equiv \{(X, Y) \in \arg \max_{X,Y} \{R(X, Y) - T_x(X) - T_y(Y) \mid (X, Y) \in \mathcal{A}\}\}. \end{aligned}$$

Now proceed back to the first stage and let $(T_x^e(\cdot), ED_x^e)$ and $(T_y^e(\cdot), ED_y^e)$ be a pair of supply contracts that induce the retailer to purchase $(X^e, Y^e) \in \Omega$, yielding a maximized profit for the retailer of $\Pi_{x,y} \equiv R(X^e, Y^e) - T_x^e(X^e) - T_y^e(Y^e)$. Furthermore, let the retailer's maximized profit if it is constrained to sell only good X be $\Pi_x \equiv \max_X [R(X, 0) - T_x^e(X)]$, and let $\Pi_y \equiv \max_Y [R(0, Y) - T_y^e(Y)]$ be its maximized profit if it is constrained to sell only good Y . Then, by definition, $\Pi_{x,y} \geq \Pi_i$, with equality if and only if an unconstrained retailer is indifferent between selling both goods and good i only. The following lemma, proved in Section A.1 of the Appendix, gives the necessary and sufficient conditions for subgame perfect equilibrium.

14. Our results hold equally well if the retailer is the final consumer. In that case, the revenue function should be reinterpreted as the utility the retailer receives from consumption of X and Y . We assume free disposal in the event the retailer buys more than it wishes to consume (resell).

LEMMA 1: $(T_x^e(\cdot), ED_x^e)$ and $(T_y^e(\cdot), ED_y^e)$ arise in a subgame perfect equilibrium if and only if the following three conditions hold:

$$\max_{(X,Y) \in \mathcal{A}_x} R(X, Y) - C_x(X) - T_y^e(Y) = R(X^e, Y^e) - C_x(X^e) - T_y^e(Y^e), \quad (1)$$

$$\max_{(X,Y) \in \mathcal{A}_y} R(X, Y) - C_y(Y) - T_x^e(X) = R(X^e, Y^e) - C_y(Y^e) - T_x^e(X^e), \quad (2)$$

$$\Pi_{x,y} = \Pi_x = \Pi_y. \quad (3)$$

The expression on the right-hand side of condition (1) is the joint profit of the retailer and firm X evaluated at the equilibrium quantities (X^e, Y^e) . Its equality with the left-hand side of (1) means that (X^e, Y^e) maximize the joint profit of the retailer and firm X , subject to any exclusive dealing constraint imposed by firm Y . This implies that $X^e = \arg \max_X \{R(X, Y^e) - C_x(X) \mid (X, Y^e) \in \mathcal{A}_x\}$, and so, either $X^e = 0$, or X^e equates marginal revenue and firm X 's marginal cost. Intuitively, if X^e were anything else, firm X could deviate by offering *only* the bilateral joint profit maximizing quantity of X to the retailer (quantity forcing contract) at terms that would allow both of their profits to increase. Condition (2) is interpreted similarly.

These two conditions imply that in every subgame perfect equilibrium, the retail price of any good sold is efficient in the sense that there is no double-markup distortion. Thus, the well-known result that nonlinear pricing eliminates double markups for the case of successive monopoly also extends to the case of upstream rivalry. The absence of double markups, however, does *not* imply that upstream rivalry yields the same quantities a fully integrated (horizontally and vertically) firm would choose, since rivalry may lead to a different number of goods being sold.¹⁵ Manufacturers will seek exclusivity even when a fully integrated firm would sell both goods—for instance, when (as we will show is sometimes the case) the induced decrease in overall joint profit

15. Bernheim and Whinston (1985) also show that a retail monopolist selling both goods facilitates coordination of the independent pricing decisions of the manufacturers so as to maximize joint profit. In their model, however, if the common retailer drops one of the goods, the excluded firm simply contracts with an independent, and equally efficient, retailer and remains a viable competitor. As a consequence, manufacturers do not seek exclusivity, for if they were to succeed, the downstream market structure would become a duopoly and the upstream firms would lose the coordination benefits provided by the common retailer. But see Gal-Or (1991) for a different perspective.

is more than offset by the gain to the excluding firm and retailer from sharing the remaining surplus with one less firm.

Condition (3) determines the division of surplus among the three firms. It requires that the retailer be indifferent in equilibrium between buying both goods, only good X , and only good Y . This means that each manufacturer will just extract the incremental contribution of its good to joint profit with the retailer. Attempting to extract more would cause the retailer not to buy the manufacturer's product, and extracting less would leave surplus on the table. In other words, each manufacturer will allow the retailer to keep what it could make if it just sold the rival's good.

3. TWO-GOOD AND ONE-GOOD EQUILIBRIA

In what follows, assume overall joint profit (collective profit of all three firms) is single-peaked on \mathfrak{R}_+^2 , and define $(X^I, Y^I) \equiv \Omega(C_x(\cdot), 0, C_y(\cdot), 0)$ as the quantity pair that would be chosen by a fully integrated firm. Furthermore, let $X^m \equiv \arg \max_X [R(X, 0) - C_x(X)]$ be the monopoly quantity of good X , and $Y^m \equiv \arg \max_Y [R(0, Y) - C_y(Y)]$ be the monopoly quantity of good Y .

Define a *two-good equilibrium* as an equilibrium in which $X^e Y^e > 0$, and a *one-good equilibrium* as an equilibrium in which $X^e Y^e = 0$. Among the set of one-good equilibria, define a *foreclosure equilibrium* as a situation in which rivalry leads to exclusion, even though a fully integrated firm would sell both goods. That is, a foreclosure equilibrium is a situation in which $X^e Y^e = 0$ but $X^I Y^I > 0$. We now use Lemma 1 to characterize two-good and one-good equilibria.

3.1 TWO-GOOD EQUILIBRIA

We know from conditions (1) and (2) that if a fully integrated firm would sell both goods, the equilibrium quantity pair chosen by the retailer in any two-good equilibrium is (X^I, Y^I) . It remains to derive necessary and sufficient conditions for two-good equilibria to exist.

PROPOSITION 1: *Two-good equilibria exist if and only if it is optimal for a fully integrated firm to sell both goods. All such equilibria replicate the fully integrated solution.*

Proof. The sufficiency part of the proof is by construction. Suppose it is optimal for a fully integrated firm to sell both goods, and consider a pair of supply contracts in which neither manufacturer requires exclu-

sive dealing and the retailer is allowed to purchase each good at cost plus a fixed amount. Formally, let firm X and Y 's pricing schedules be

$$T_x^*(X) = \begin{cases} 0 & \text{if } X = 0, \\ F_x^* + C_x(X) & \text{if } X > 0 \end{cases} \quad \text{and} \quad (4)$$

$$T_y^*(Y) = \begin{cases} 0 & \text{if } Y = 0, \\ F_y^* + C_y(Y) & \text{if } Y > 0, \end{cases}$$

where $F_x^* = R(X^I, Y^I) - C_x(X^I) - C_y(Y^I) - [R(0, Y^m) - C_y(Y^m)]$ is a lump-sum transfer from the retailer to firm X , and $F_y^* = R(X^I, Y^I) - C_x(X^I) - C_y(Y^I) - [R(X^m, 0) - C_x(X^m)]$ is a lump-sum transfer from the retailer to firm Y . Each firm sets its fixed payment equal to its product's incremental contribution to overall joint profit and sells marginal units at cost to the retailer. With these contracts, it is straightforward to show that $(X^I, Y^I) \in \Omega(T_x^*, 0, T_y^*, 0)$ and Lemma 1 is satisfied. This proves the existence of two-good equilibria if a fully integrated firm would sell both goods. The necessity part of the proof is by contradiction and is given in Section A.2 of the Appendix. \square

Proposition 1 implies that if an unintegrated environment yields a two-good equilibrium, one can infer that the equilibrium is efficient (from the viewpoint of the firms) and hence replicates the fully integrated outcome. It is not possible, for instance, for a two-good equilibrium to exist when a fully integrated firm would sell but one good. Proposition 1 also implies that if a fully integrated firm would sell both goods, there exist equilibria in which unintegrated rivalry yields the same solution.

With the pair of pricing schedules given in (4), each firm offers to sell at cost plus a fixed amount equal to the incremental contribution made by the firm's product to overall joint profit. These pricing schedules make the retailer the residual claimant to overall joint profit and thus induce it to purchase the same quantities as would be chosen by a fully integrated firm. Other pricing schedules may also support the fully integrated outcome.¹⁶ But, in each instance, the key elements of all two-good equilibria remain the same: (a) overall joint profit is maximized (both goods are sold in the efficient amounts), (b) neither manufacturer extracts more than its product's incremental contribution to joint profit

16. We have shown in O'Brien and Shaffer (1992), for example, that if cost functions are convex, two-part tariff contracts in which each firm sets its wholesale price to induce (X^I, Y^I) and its fixed fee to divide surplus can support two-good equilibria, as long as the firms do not attempt to extract more than their product's incremental contribution to joint profit with the retailer.

with the retailer, and (c) the retailer is just indifferent to selling each good. Starting from this situation, there is no way for a firm to deviate profitably. The reason is that if a firm is to foreclose its rival, it must allow the retailer to earn at least as much profit as it could earn in the proposed two-good equilibrium. Otherwise, from (c), the retailer would be induced to drop the wrong product. But this doesn't leave enough surplus for a firm to strictly increase its own profit, because, from (a) and (b), the decrease that would occur in overall joint profit exceeds (weakly) the decrease that would occur in the rival's profit.

3.2 ONE-GOOD EQUILIBRIA

Turning to the existence of one-good equilibria, assume firm X is the *dominant* manufacturer in the sense that its maximized standalone profit with the retailer is weakly higher than firm Y 's maximized standalone profit. That is, assume $R(X^m, 0) - C_x(X^m) \geq R(0, Y^m) - C_y(Y^m)$. Then if the inequality is strict, and using $T_y^e(Y) \geq C_y(Y)$, it follows immediately from condition (1) that good Y will never be sold in any one-good equilibrium. Intuitively, since firm X has the greater standalone profit, it can afford to compensate the retailer by more than firm Y and thus can never be excluded from the market. In the event the two firms' standalone profits are equal, either firm may be the one excluded in a one-good equilibrium. For expositional ease, however, we will continue to speak of firm Y as being the excluded firm even in that case.

Given that we assume good X will always be sold, condition (1) requires $X^e = X^m$ in any one-good equilibrium. Furthermore, in any such equilibrium, conditions (2) and (3) imply the following strong restriction on the equilibrium offer of the excluded firm.

LEMMA 2: *In any one-good equilibrium, the offer of firm Y is such that $T_y^e(Y^m) = C_y(Y^m)$.*

Proof. Suppose not. Then a one-good equilibrium exists in which $T_y^e(Y^m) > C_y(Y^m)$. But using condition (3), this implies $R(0, Y^m) - C_y(Y^m) > \Pi_y = \Pi_x$, which violates condition (2). \square

In other words, in any one good equilibrium, firm Y must offer to sell its monopoly quantity at cost. If it attempted to extract more from the retailer, the best response of firm X would then also be to extract more [by condition (3)]; but then firm Y could undercut firm X and displace it from the market. It should be noted that Lemma 2 does not place any restrictions on the rest of firm Y 's pricing schedule. It need not be the case, for instance, that firm Y must offer to sell *all* units

of good Y to the retailer at cost. This observation will have important consequences below.

3.3 ONE-GOOD EQUILIBRIA SUPPORTED BY EXCLUSIVE DEALING

We now use Lemma 1 to characterize the set of one-good equilibria supported by exclusive dealing.

PROPOSITION 2: *One-good equilibria exist in which at least one firm requires exclusive dealing.*

Proof. The proof is by construction. Consider a pair of supply contracts in which both manufacturers require exclusive dealing and their respective pricing schedules are

$$T_x^{**}(X) = \begin{cases} 0 & \text{if } X = 0, \\ F_x^{**} + C_x(X) & \text{if } X > 0 \end{cases} \quad \text{and} \quad (5)$$

$$T_y^{**}(Y) = \begin{cases} 0 & \text{if } Y = 0, \\ C_y(Y) & \text{if } Y > 0, \end{cases}$$

where $F_x^{**} = R(X^m, 0) - C_x(X^m) - [R(0, Y^m) - C_y(Y^m)]$ is a lump-sum transfer from the retailer to firm X . Firm X sets its fixed payment equal to its advantage in standalone monopoly profit and sells marginal units at cost to the retailer. With this contract, it is straightforward to show that $(X^m, 0) \in \Omega(T_x^{**}, 1, T_y^{**}, 1)$ and Lemma 1 is satisfied. This proves the existence of one-good equilibria in which at least one firm requires exclusive dealing. \square

Since firm X can always exclude its rival directly by requiring exclusive dealing, it should not be surprising that one-good equilibria exist whether or not a fully integrated firm would sell both goods. The intuition is that if one firm requires exclusive dealing, the other firm is "forced into it," and therefore loses nothing by also requiring it. When both firms require exclusive dealing, the manufacturers can be stuck in a one-good equilibrium even if the collective profit of all firms would be maximized if both goods were sold.

3.4 ONE-GOOD EQUILIBRIA SUPPORTED BY NONLINEAR PRICING ALONE

We now use Lemma 1 to characterize the set of one-good equilibria that arise in the absence of any exclusive dealing arrangements, where the exclusion is induced through nonlinear pricing alone. By offering

price breaks such as quantity discounts and other promotional incentives, for instance, firm X can raise the retailer's opportunity cost of selling good Y . If the discounts are sufficiently large, the retailer may be induced to sell only good X to qualify for the maximum possible discount. Firm Y can thus be dropped from the market even without an explicit exclusive dealing arrangement. The following lemma, proved in Section A.3 of the Appendix, gives structural conditions on demand and cost parameters that are necessary and sufficient for such one-good equilibria to exist.¹⁷

LEMMA 3: *One-good equilibria supported by nonlinear pricing alone exist if and only if the following two conditions hold:*

$$\max_Y [R(X^m, Y) - C_Y(Y) - C_X(X^m)] = R(X^m, 0) - C_X(X^m), \quad (6)$$

$$\max_X [R(X, Y^m) - C_X(X) - C_Y(Y^m)] \leq R(X^m, 0) - C_X(X^m). \quad (7)$$

Condition (6) holds if and only if the overall joint profit when evaluated at X^m and any feasible Y is maximized at $Y = 0$. In that case the cost of producing good Y everywhere exceeds good Y 's incremental contribution to a fully integrated firm's revenue when the latter is evaluated at X^m . This situation is analogous to what Bain (1959) referred to as "blockaded entry," where it is unprofitable for a firm to enter even when the incumbent produces its monopoly quantity. Condition (6) is satisfied, for instance, if a fully integrated firm would sell only one good.¹⁸

Condition (7) holds if and only if the overall joint profit when evaluated at Y^m and any feasible X is less than or equal to the overall joint profit when evaluated at $(X^m, 0)$. In that case good Y 's incremental contribution to overall joint profit is not sufficiently large that a fully integrated firm would want to sell both goods if, in doing so, it were constrained to sell Y^m of good Y . Like condition (6), this condition is also satisfied if a fully integrated firm would sell only one good.¹⁹ The following proposition is therefore implied by Lemma 3.

17. The relationship between Lemma 3 and Lemma 1 can be stated as follows. Nonlinear supply contracts that simultaneously satisfy the three conditions of Lemma 1, that induce $X^c Y^c = 0$, and in which neither manufacturer requires exclusive dealing exist if and only if the demand and cost parameters are such that conditions (6) and (7) hold.

18. The left-hand side of (6) cannot be less than the right-hand side of (6), since $Y = 0$ can always be chosen. And since the right-hand side of (6) is by definition the overall joint profit maximum when a fully integrated firm would sell only one good, the left-hand side cannot be larger than the right-hand side. Thus, condition (6) holds whenever a fully integrated firm would sell one good.

19. Since the right-hand side of (7) is by definition the overall joint profit maximum when a fully integrated firm would sell only one good, it must be greater than or equal to the left-hand side of (7).

PROPOSITION 3: *One-good equilibria supported by nonlinear pricing alone exist if a fully integrated firm would sell only one good.*

Proposition 3 ensures that an efficient product mix from the firms' perspective will arise in equilibrium (irrespective of governmental policy on exclusive dealing arrangements) if a fully integrated firm would sell only one good. For, if a product would not survive in a fully integrated market, there exist equilibria in which it would also not survive with upstream rivalry in nonlinear pricing alone. All that firm X needs to do is to structure its contract to induce the retailer to purchase its monopoly quantity, knowing that at that quantity, firm Y cannot compete. Consider, for instance, the pricing schedules in (5). Firm X allows the retailer to buy marginal units at cost and sets its fixed fee to extract its product's incremental contribution to joint profit with the retailer. Given these terms, and assuming a fully integrated firm would not want to sell both goods, the retailer will choose not to purchase from firm Y, despite being able to purchase at cost. In essence, the retailer is made the residual claimant to overall joint profit, and thus its incentives exactly mimic the incentives of a fully integrated firm, with F_x^{**} serving to divide the surplus.

Upstream rivalry in nonlinear pricing alone does not, however, ensure an efficient product mix when both products would survive in a fully integrated market. The condition that must hold when it is strictly optimal for a fully integrated firm to sell both goods,

$$\max_Y [R(X^I, Y) - C_y(Y) - C_x(X^I)] > R(X^m, 0) - C_x(X^m), \quad (8)$$

does not preclude conditions (6) and (7) in Lemma 3, because X^m and Y^m will in general differ from X^I and Y^I . Formally, let $\Sigma \equiv \{(C_x(\cdot), C_y(\cdot), R(\cdot, \cdot)) \mid (6), (7), \text{ and } (8) \text{ hold}\}$ be the set of revenue functions and cost functions such that conditions (6), (7), and (8) simultaneously hold.

PROPOSITION 4: *Foreclosure equilibria supported by nonlinear pricing alone exist $\forall \sigma \in \Sigma$. Furthermore, $\Sigma \neq \emptyset$.*

Proof. The first sentence follows immediately from Lemma 3 and the interpretation of (8). To show that $\Sigma \neq \emptyset$, suppose consumer preferences can be summarized by the surplus function

$$U = X + Y - \frac{(X + Y)^2}{2} - \frac{(X - Y)^2}{2(1 + 2\gamma)} - P_x X - P_y Y, \quad (9)$$

where P_x and P_y are the retail prices of goods X and Y respectively,

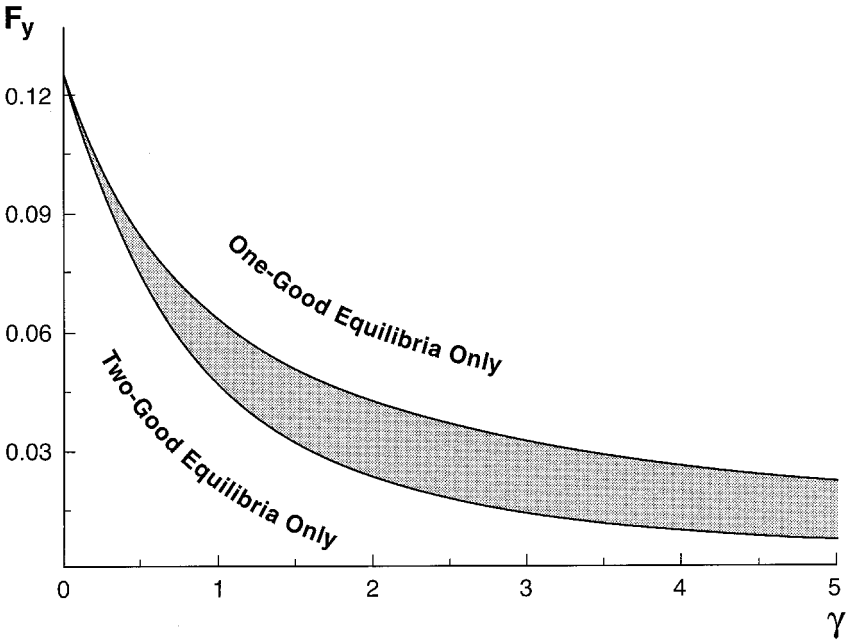


FIGURE 1. EQUILIBRIA WITH NONLINEAR PRICING ALONE (FORECLOSURE EQUILIBRIA EXIST IN SHADED REGION).

and $\gamma \geq 0$ is a demand substitution parameter.²⁰ Suppose also that each firm’s production technology is characterized by a constant marginal cost (assumed zero for simplicity) and a fixed cost \mathcal{F}_i of producing good i , with $\mathcal{F}_y \geq \mathcal{F}_x$. Then we show in Section A.4 of the Appendix that a fully integrated firm would sell both goods [condition (8) is satisfied] if and only if

$$\mathcal{F}_y \leq \frac{1 + 2\gamma + \gamma^2}{8(1 + \gamma)^3}. \tag{10}$$

We represent this restriction as the set of combinations of γ and \mathcal{F}_y below the uppermost downward-sloping line in Figure 1.²¹ We also show in Section A.4 that Lemma 3 is satisfied if and only if

20. At $\gamma = 0$, the goods are independent in demand. As γ increases, the goods become less differentiated and approach perfect substitutes in the limit.

21. As the products become closer substitutes (increasing γ), good Y’s incremental contribution to joint revenue declines, and thus the level of \mathcal{F}_y at which a fully integrated firm would be indifferent to selling good Y also declines.

$$\mathcal{F}_y \geq \frac{1 + 2\gamma}{8(1 + \gamma)^3}. \tag{11}$$

We represent this second restriction as the set of combinations of γ and \mathcal{F}_y above the bottommost downward-sloping line in Figure 1.²² As Figure 1 reflects, the region where both restrictions simultaneously hold (the shaded region) is nonempty. \square

Proposition 4 states that for combinations of revenue and cost functions in Σ , it may be profitable for a manufacturer to exclude its rival in equilibrium by nonlinear pricing alone, even though it would be strictly optimal for a fully integrated firm to sell both goods. That the dominant manufacturer can profitably induce the retailer to refrain from accepting the other firm’s offer in that case, even when such an offer would leave the other firm with zero profit, may seem counterintuitive. After all, wouldn’t the dominant manufacturer and retailer have the same incentives as a fully integrated firm? The answer is that they would if the firm with zero profit offered to sell *all* units to the retailer at cost. But this need not be so.

To illustrate, suppose demand and cost parameters are such that conditions (6), (7), and (8) simultaneously hold. Suppose also that neither manufacturer requires exclusive dealing and the retailer faces the following pair of “quantity forcing” pricing schedules:

$$T_x^{***}(X) = \begin{cases} 0 & \text{if } X = 0, \\ F_x^{**} + C_x(X) & \text{if } X = X^m, \text{ and} \\ \infty & \text{otherwise} \end{cases} \tag{12}$$

$$T_y^{***}(Y) = \begin{cases} 0 & \text{if } Y = 0, \\ C_y(Y) & \text{if } Y = Y^m, \\ \infty & \text{otherwise.} \end{cases}$$

With these pricing schedules, the retailer’s choice is between $(X^m, 0)$, $(0, Y^m)$, and (X^m, Y^m) . Of these combinations, the retailer will choose $(X^m, 0)$, foreclosing firm Y from the market. Firm Y cannot improve on its supply contract, in which it earns zero profit, because when firm X commits to selling X^m or nothing, we know from condition (6) that firm Y is essentially blockaded from the market. Firm X cannot improve on its supply contract, because when firm Y commits to selling Y^m or nothing, we know from condition (7) that foreclosing firm Y is profitable, and thus firm X can do no better than induce the retailer to purchase

22. As the products become closer substitutes (increasing γ), entry of good Y is blocked at lower levels of \mathcal{F}_y .

X^m . Since both supply contracts are best responses to each other, a foreclosure equilibrium arises even though exclusive dealing is not required.

4. COMPARING PROFITS ACROSS EQUILIBRIA

Having characterized the set of two-good and one-good equilibria, we now turn to a comparison of profits across equilibria. We have two motivations for this exercise. First, it is important to understand what advantage exclusive dealing arrangements offer manufacturers over nonlinear pricing alone, and hence, what effect a legal prohibition against exclusive dealing arrangements would have on equilibrium prices and profits. Second, the exercise can provide guidance in predicting conduct with multiple equilibria. We will show, for instance, that foreclosure equilibria are Pareto-dominated (from the manufacturers' point of view) by all two-good equilibria.

4.1 PROFIT IN ONE-GOOD EQUILIBRIA

We have established that the retailer purchases $(X^m, 0)$ in any one-good equilibrium. This means that the total profit to be split between firm X and the retailer is $R(X^m, 0) - C_x(X^m)$. Of this amount, condition (3) requires that the retailer earn its opportunity cost of selling good X , which from Lemma 2, is equal to $R(0, Y^m) - C_y(Y^m)$. Thus, firm X 's profit in any one-good equilibrium, whether or not exclusive dealing is required, is given by

$$[R(X^m, 0) - C_x(X^m)] - [R(0, Y^m) - C_y(Y^m)]. \quad (13)$$

Since the retailer is on the receiving end of a take-it-or-leave-it contract offer, its equilibrium share of profit will equal the minimum amount necessary to prevent it from selling good Y instead. And since firm Y is constrained to earn zero profit in any one-good equilibrium, it can do no better than to offer its monopoly quantity to the retailer at cost. As a consequence, firm X must allow the retailer to earn firm Y 's standalone monopoly profit, keeping the rest for itself. How much profit, if any, is left over for firm X will depend on the extent of its cost advantage and/or the degree to which consumers favor its product over good Y .

4.2 PROFIT IN TWO-GOOD EQUILIBRIA

In any two-good equilibrium, the retailer purchases (X^I, Y^I) , leaving a profit of $R(X^I, Y^I) - C_x(X^I) - C_y(Y^I)$ to be split three ways. For a given contract pair $(T_x^e(X), T_y^e(Y))$ that satisfies Lemma 1, firm Y earns

$T_y^e(Y^I) - C_y(Y^I)$, and the retailer earns its opportunity cost of selling good X , which, from condition (3), is Π_y . Thus, firm X 's profit in any two-good equilibrium is given by

$$R(X^I, Y^I) - C_x(X^I) - T_y^e(Y^I) - \Pi_y. \quad (14)$$

The interpretation is that firm X 's profit in any two-good equilibrium equals the joint profit of the retailer and firm X minus the retailer's maximized profit if it were to sell only good Y . The latter amount depends, of course, on the precise form of firm Y 's supply contract, as does $T_y^e(Y^I)$. As an example, consider firm Y 's half of the supply-contract pair $(T_x^*(X), T_y^*(Y))$, which was used to demonstrate the existence of two-good equilibria in the proof of Proposition 1. Since the retailer purchases (X^I, Y^I) in all two-good equilibria, its payment to firm Y under $T_y^*(Y)$ is

$$[R(X^I, Y^I) - C_x(X^I)] - [R(X^m, 0) - C_x(X^m)], \quad (15)$$

and its maximized profit if it were to sell only good Y , $\max_Y[R(0, Y) - T_y^*(Y)]$, is

$$[R(0, Y^m) - C_y(Y^m)] + [R(X^m, 0) - C_x(X^m)] - [R(X^I, Y^I) - C_x(X^I) - C_y(Y^I)]. \quad (16)$$

Substituting (15) and (16) respectively for $T_y^e(Y^I)$ and Π_y in (14) yields

$$[R(X^I, Y^I) - C_x(X^I) - C_y(Y^I)] - [R(0, Y^m) - C_y(Y^m)], \quad (17)$$

which is firm X 's two-good equilibrium profit under the supply-contract pair $(T_x^*(X), T_y^*(Y))$. With this division of surplus, firm X earns exactly its product's incremental contribution to overall joint profit, an amount that varies considerably depending on the closeness of goods X and Y as substitutes and on the properties of the cost functions. If goods X and Y are independent in demand, firm X will extract its monopoly profit, $R(X^m, 0) - C_x(X^m)$, since in that case $(X^I, Y^I) = (X^m, Y^m)$ and $R(X^I, Y^I) = R(X^m, 0) + R(0, Y^m)$. On the other hand, if goods X and Y are close substitutes, firm X may not be able to extract much from the retailer. With homogeneous goods and identical constant marginal production costs, for instance, firm X 's profit in any two-good equilibrium is zero. The following proposition may therefore come as a surprise.

PROPOSITION 5: *In the case where both foreclosure and two-good equilibria exist, firms X and Y earn at least as much profit in all two-good equilibria as they earn in all foreclosure equilibria. The retailer, by contrast, weakly prefers its profit in all foreclosure equilibria to all two-good equilibria.*

Proof. Since $T_y^e(Y) \geq C_y(Y)$ in any two-good equilibrium, it follows that $R(0, Y^m) - C_y(Y^m) \geq \max_Y [R(0, Y) - T_y^e(Y)] = \Pi_y$, and thus the retailer will be weakly better off in all foreclosure equilibria. Firm Y on the other hand is worse off under foreclosure, since it earns zero profit when foreclosed. To show that firm X earns weakly higher profit in all two-good equilibria, we subtract its one-good equilibrium profit in (13) from its two-good equilibrium profit in (14). This yields

$$[R(X^I, Y^I) - C_x(X^I) - T_y^e(Y^I)] - [R(X^m, 0) - C_x(X^m)] + [R(0, Y^m) - C_y(Y^m)] - \Pi_y.$$

To see that this is nonnegative, note that $[R(X^I, Y^I) - C_x(X^I) - T_y^e(Y^I)] - [R(X^m, 0) - C_x(X^m)]$ is nonnegative by condition (1), and $[R(0, Y^m) - C_y(Y^m)] - \Pi_y$ is nonnegative because more surplus must be left to the retailer in a one-good equilibrium. \square

Even though foreclosure can be a profitable strategy for the dominant manufacturer under some circumstances, and thus can appear in equilibrium, a surprising conclusion of Proposition 5 is that these foreclosure equilibria are Pareto-dominated (from the manufacturers' perspective) by all two-good equilibria. Intuitively, since overall joint profit is maximized in every two-good equilibrium, the only way firm X could earn higher profit in a foreclosure equilibrium would be if (a) in at least one two-good equilibrium, dropping good Y would decrease the overall joint profit by less than the decrease that would occur in firm Y 's profit (so that the profit pie to be split between firm X and the retailer would be larger) or (b) foreclosure were to entail lower profit for the retailer. To see why (a) fails, note that firm Y can never command as its share of joint profit more than its product's incremental contribution; otherwise it would be dropped by the retailer. In other words, the joint profit of firm X and the retailer must be weakly higher when both goods are sold than when only good X is sold. To see why (b) fails, note that foreclosure creates competition between firms X and Y to determine whose product will be sold. Since the loser (firm Y) necessarily earns zero profit, it can do no better than to offer to sell its monopoly quantity at cost. This increases the retailer's opportunity cost of selling good X —not only will firm X not be able to extract more from the retailer, it will often have to settle for less.

Another surprising implication of Proposition 5 is that the retailer can be strictly better off with a limited product selection. Normally one thinks of retailers as being worse off, or at least no better off, if required to deal exclusively in one good. The notion that retailers must be compensated to accept exclusivity gives rise to this thinking, as does the idea, expressed in Scherer (1980, p. 586), that exclusive territories are

sometimes granted by manufacturers as a *quid pro quo* for exclusive dealing. Yet one of the insights of this paper is that when nonlinear contracting efficiently divides surplus, a retailer suffers no direct loss from foreclosure (since it is otherwise indifferent to selling each manufacturer's product anyway) and may even gain if it thereby secures more favorable contract terms in the ensuing competition for its patronage.

Thus, to the extent our model is an accurate depiction of reality, we would expect to observe the retailer trying to exploit a potential lack of coordination among the upstream firms by convincing each that its rival has offered or will offer an exclusive dealing arrangement.²³ For, if successful, the retailer would stand to gain from the increased competition that is created upstream. Failing this, however, the retailer might resort to other ways to achieve the same end. For example, the retailer might try to limit its product selection with its shelf-space allocation.²⁴ In our model, as long as the retailer can credibly limit its shelf space, and hence the number of brands it sells, it would want to do so. Such an advance commitment would force an auctionlike bidding between manufacturers, thereby providing additional leverage for the retailer to extract surplus.²⁵

5. EXCLUSIVE DEALING ARRANGEMENTS AND MARKET FORECLOSURE

The evolution of the legal analysis of exclusive dealing has been a slow and awkward transition from nearly per se illegality to a nearly rule-of-reason standard. Yet antitrust law still treats exclusive dealing ar-

23. For evidence that retailers sometimes seek exclusive dealing arrangements from manufacturers, even against their will, see *U.S. v. Eastman Kodak Company*, 93-MC-45, at p. 61 (Western District of New York, 1994), in which the defendant stated "Kodak has no intention of, or interest in, coercing retailers to carry only Kodak film. However, it is on occasion asked to bid or may wish to bid to become an exclusive supplier at a particular location."

24. We have in mind a situation in which each good requires a minimum amount of shelf space (at least one shelf facing) for display to consumers. In that case, it is the width of the shelf space that matters, and not the depth, as units of the same good can be stacked one behind the other.

25. In this paper we have modeled a particular bargaining process in which manufacturers make the take-it-or-leave-it offers to retailers. If, on the other hand, a retailer can dictate terms to its suppliers, it will have no incentive to limit its shelf space. O'Brien and Shaffer (1992) specify a Nash bargaining model with two manufacturers and one retailer and show that a level of bargaining power exists above which the retailer has no incentive to limit its shelf space and below which it does. This may explain why large retail chains, which are presumably the ones with the most bargaining power vis-à-vis suppliers, tend to offer a larger product selection than their smaller counterparts.

rangements, which constrain a retailer's freedom of choice, less favorably than nonlinear pricing that may happen to induce exclusive dealing but does not require it. The latter is viewed more favorably because it does not restrict the retailer's freedom of choice and because of the "likelihood that the discount(s) will ultimately inure to the benefit of the consumer."

But as Bork (1978), Director and Levi (1956), and many others have observed, a manufacturer seeking exclusivity must compensate the retailer for its acquiescence, whether or not it restricts the retailer's freedom of choice. The dominant manufacturer cannot leverage its market power to demand exclusivity and injure rivals, Bork (1978, pp. 306–307) argues, because it cannot both "extract in the prices it charges retailers" all that its product is worth and then "charge it again in exclusivity the retailer does not wish to grant." He adds that if a manufacturer "must forego the higher prices it could have demanded in order to get exclusivity, then exclusivity is not an imposition, it is a purchase." And if the retailer chooses to take advantage of the lower prices, well, that "sounds like competition," and surely rivals can be relied upon to meet competition. If they cannot, "the market is destined for monopoly anyway," and the exclusive dealing arrangement has nothing to do with it. Bork concludes that, in terms of foreclosing a rival, an exclusive dealing arrangement offers a manufacturer no advantage it would not have had without the arrangement.

5.1 DO EXCLUSIVE DEALING ARRANGEMENTS OFFER AN ADVANTAGE?

Bork's claim that an exclusive dealing arrangement offers a manufacturer no advantage over nonlinear pricing would be true in our model if either (a) nonlinear pricing alone were equally capable of achieving foreclosure (same set of circumstances and same profit), or (b) requiring exclusive dealing for the purpose of foreclosing a rival were never profitable (because the manufacturer's other contractual terms sufficed to extract all that its product was worth). Neither is the case.

Consider the first possibility, and begin by focusing on the set of one-good equilibria. Here we find that if one-good equilibria exist with nonlinear pricing alone, the equilibria look identical in every respect to one-good equilibria that are achieved by arrangement: the division of surplus is the same, and so are the retailer's equilibrium price and quantity sold. This supports Bork's observation that a dominant manufacturer cannot simply leverage its market power and impose exclusivity. Rather it must compensate the retailer for agreeing not to sell competing products, whether or not it restricts the retailer's freedom of

choice. In addition, for the case in which a fully integrated firm would sell only one good, upstream rivalry always leads to exclusive dealing even when it is not required of the retailer. This corresponds to Bork's depiction of a scenario in which the "market is destined for monopoly anyway," and exclusive dealing arrangements have nothing to do with it.

But nonlinear pricing alone is *not* equally capable of achieving foreclosure for the case in which a fully integrated firm would sell both goods. Although foreclosure equilibria may exist (depending on demand and cost parameters) with nonlinear pricing alone,²⁶ exclusive dealing arrangements substantially widen the set of foreclosure equilibria to include all circumstances in which foreclosure cannot arise otherwise. The technical reason for this is that firm *X*'s exclusive dealing arrangement restricts the domain of maximization in condition (2). Since the retailer does not have the option of selling both goods, the particulars of demand and cost do not constrain whether foreclosure can arise. Thus, our findings do not support Bork's assertion, in the sense that restricting the retailer's freedom of choice by requiring exclusive dealing can indeed be of consequence.

Moreover, since foreclosure equilibria exist, we know that exclusive dealing can be a profitable strategy. Bork's reasoning is flawed in this regard because the dominant firm's desire to foreclose its rival cannot be analyzed apart from the mix of strategies adopted by all firms. In other words, it is not possible to determine *a priori* whether the dominant firm will want to foreclose its rival without knowing its rival's intentions. If a fully integrated firm would want to sell both goods, and if the rival were to offer its good at cost to the retailer without requiring exclusive dealing, for instance, the dominant firm would not find it profitable to foreclose. And yet if the rival were to insist on trying to sell its monopoly quantity to the retailer, and if the market were not big enough to profitably support both firms selling their monopoly quantities, then the dominant firm would seek foreclosure. In that case, an exclusive dealing arrangement would be profitable, even if a fully integrated firm would want to sell both goods, because it leads to an *increase* in joint profit with the retailer, given the contract offered the retailer by firm *Y*.

Nevertheless there is an important sense in which Bork's assertion

26. This result calls into question the assertion sometimes made that the "discounts will ultimately inure to the benefit of consumers." Although a multiproduct monopolist's incentives do not always align with a social planner's incentives, it is easy to construct linear-demand examples for which foreclosure equilibria are bad for welfare.

is correct. In any two-good equilibrium, it is not profitable for a manufacturer to require exclusive dealing to foreclose its rival, since the manufacturer cannot both extract all that its product is worth and at the same time compensate the retailer for dropping its rival's product. Moreover, since two-good equilibria Pareto-dominate foreclosure equilibria, it would be somewhat misleading to say that exclusive dealing arrangements offer an advantage over nonlinear pricing alone just because they enlarge the set of foreclosure equilibria. Indeed, the dominant manufacturer would prefer that the foreclosure set not be enlarged and thus would be weakly better off if exclusive dealing were banned. If foreclosure occurs in our model, it is due either to a coordination failure among manufacturers, or possibly to an advance commitment by the retailer to sell the product of only one manufacturer.

5.2 RELATION TO MATHEWSON AND WINTER (1987)

Mathewson and Winter (1987) were among the first to model exclusive dealing as a foreclosure device. Using a similar setup to ours with two manufacturers and one retailer, they derived conditions under which a dominant manufacturer would be better off with an exclusive dealing arrangement even though the overall joint profit would be higher without it. Their model differs from ours in one important dimension. They assume nonlinear pricing is infeasible.²⁷ This difference is critical, since linear pricing does not suffice to extract all that a product is worth. In the absence of an exclusive dealing arrangement, for instance, the retailer in their model earns profit strictly in excess of its opportunity cost of selling good X. As a result, exclusive dealing serves as a rent extraction device, shifting profit (albeit inefficiently) from the retailer and rival manufacturer to firm X. Bork's insights do not apply here, since exclusive dealing really does then become an imposition.

Another way to understand the difference between our results and those of Mathewson and Winter is to observe that with linear pricing, the dominant manufacturer's profit depends solely on its own sales. This leads to a double-markup distortion and lower joint profit than in the integrated solution. By requiring exclusive dealing, thereby capturing some of the sales that would have otherwise gone to a rival, a manufacturer can sometimes increase its own profit even when doing

27. In addition to not allowing nonlinear pricing, Mathewson and Winter also consider a different extensive form. Whereas firms in our model choose whether to require exclusive dealing at the same time as they choose the rest of their supply contract terms, firms in their model make these decisions in two stages. We have shown in O'Brien and Shaffer (1992), however, that this difference in timing is not essential.

so reduces the overall joint profit. Both rival and retailer are worse off in this instance. Under nonlinear pricing, by contrast, there is no double-markup distortion. The retailer internalizes all pricing externalities, and the manufacturer's profit depends on the incremental contribution of its product to the joint profit with the retailer. For reasons discussed previously, it is simply not possible for the manufacturer to increase its own profit at the same time the joint profit decreases.²⁸

6. CONCLUSION

An important issue that arises when manufacturers sell to retailers is how surplus from sales to final consumers will be shared. While this issue is frequently resolved in practice with nonlinear supply contracts, the literature on exclusive dealing typically restricts attention to linear pricing. This restriction is not innocuous when retailers have market power. Not only does it lead to contracting inefficiencies such as the well-known double-markup distortion, it also rules out a priori other ways that manufacturers may have to foreclose their rivals. As a result, we believe the literature has tended to overemphasize the use of exclusive dealing arrangements for this purpose.

We have analyzed a static model in which two manufacturers simultaneously offer nonlinear supply contracts, which may or may not contain exclusive dealing provisions, to a retail monopolist. This framework allowed us to examine the profitability of market foreclosure with exclusive dealing arrangements when substitute means of achieving foreclosure were also available. At the same time, it allowed for an efficient sharing of surplus to be had through nonlinear pricing. Paradoxically, we found that the availability of these other means of achieving foreclosure may actually mitigate a dominant manufacturer's incentive to foreclose, reducing the incidence of observed market foreclosure. The intuition is that nonlinear supply contracts offer increased flexibility (over linear pricing) to extract a retailer's surplus, and so manufacturers can extract their product's incremental contribution to joint profit with the retailer without resorting to less efficient means.

Although retailers cannot be relied upon to agree to exclusive dealing arrangements only when they are in the public interest (as some have asserted), our findings do not justify an antitrust policy critical of exclusive dealing. In the event a fully integrated firm would sell only one good, a dominant manufacturer can induce a one-good equi-

28. Recall that when foreclosure is profitable in our model, it increases joint profit given the rival's contract.

librium by nonlinear contracting alone and achieve the same profit it would receive if it required exclusive dealing. In this instance, nonlinear supply contracts provide an equally good substitute, and so banning exclusive dealing arrangements would have no effect. In the event a fully integrated firm would sell both goods, the foreclosure equilibria are Pareto-dominated by all nonforeclosure equilibria. If one believes that Pareto-dominated equilibria (for the manufacturer) are unlikely to arise, then banning exclusive dealing in this case would also have little effect on social welfare.²⁹

One important direction for future research is to delineate more fully the circumstances in which an antitrust policy critical of exclusive dealing would and would not have a significant effect on consumer surplus and social welfare, while allowing for alternative ways to foreclose rivals. Our model has considered a contracting game of complete information between two manufacturers and a local retail monopolist, with no externalities across retail markets. One extension would be to allow for externalities across markets in the sense that more than one market would need to be served before a manufacturer could realize its scale economies [see Rasmusen et al. (1991), which assumes linear pricing, and Bernheim and Whinston (1996), for a start in this direction]. Another extension would be to introduce contracting externalities within a retail market by assuming the downstream monopolist could take unobservable actions that would affect upstream demand [again, see Bernheim and Whinston (1996)]. Finally, a third extension would be to analyze foreclosure in markets with competing retailers, where the combined upstream and downstream rivalry would be unlikely to maximize joint profit [see Besanko and Perry, (1994)].

APPENDIX

A.1 PROOF OF LEMMA 1

Necessity: The proof is by contradiction. Consider first the necessity of condition (3). By definition, $\Pi_{x,y} \geq \Pi_x, \Pi_y$. Suppose one of the inequalities were strict. Then the firm failing to extract all of the incremental

29. The danger of an antitrust policy critical of exclusive dealing in practice, of course, is that it may discourage efficiency-based exclusive dealing arrangements for which there may be no good substitutes. For example, Besanko and Perry (1993) consider exclusive dealing in a model in which manufacturers distribute their products through perfectly competitive retailers. Because downstream competition in their model yields marginal cost pricing, nonlinear supply contracts offer manufacturers no gain relative to contracts with linear pricing. There is thus no way to mitigate the interbrand externality that arises in the absence of exclusive dealing when noncontractible promotional activities cannot otherwise be made product-specific.

surplus from its good could increase its profit by raising the fixed component of its supply contract. Next, consider the necessity of condition (1). Suppose $(T_x^e(\cdot), ED_x^e)$ and $(T_y^e(\cdot), ED_y^e)$ arise in a subgame perfect equilibrium, but that

$$\begin{aligned} \max_{X,Y} \{R(X, Y) - C_x(X) - T_y^e(Y) \mid (X, Y) \in \mathcal{A}_x(ED_y^e)\} \\ \neq R(X^e, Y^e) - C_x(X^e) - T_y^e(Y^e). \end{aligned}$$

Using $\Pi_{x,y} = \Pi_y$, this inequality becomes

$$\begin{aligned} \max_{X,Y} \{R(X, Y) - C_x(X) - T_y^e(Y) - T_x^e(X^e) \\ + C_x(X^e) \mid (X, Y) \in \mathcal{A}_x(ED_y^e)\} \neq \Pi_y. \end{aligned} \quad (18)$$

If the left-hand side of condition (18) were less than the right-hand side, the retailer would earn less by buying X^e and Y^e than by buying only good Y , a contradiction. Suppose the left-hand side were greater than the right-hand side. Then for some positive ω ,

$$\begin{aligned} \max_{X,Y} \{R(X, Y) - C_x(X) - T_y^e(Y) - T_x^e(X^e) \\ + C_x(X^e) - \omega \mid (X, Y) \in \mathcal{A}_x(ED_y^e)\} > \Pi_y. \end{aligned} \quad (19)$$

But consider the pricing schedule

$$\tilde{T}_x(X) = \begin{cases} 0 & \text{if } X = 0, \\ T_x^e(X^e) + C_x(X) - C_x(X^e) + \omega & \text{if } X > 0. \end{cases}$$

Substituting this pricing schedule into condition (19) gives

$$\max_{X,Y} \{R(X, Y) - \tilde{T}_x(X) - T_y^e(Y) \mid (X, Y) \in \mathcal{A}_x(ED_y^e)\} > \Pi_y,$$

which means that it is strictly profitable for the retailer to purchase a positive amount of good X under $\tilde{T}_x(\cdot)$. Since firm X earns ω more profit under $(\tilde{T}_x(\cdot), ED_x^e)$ than under $(T_x^e(\cdot), ED_x^e)$, the latter cannot be a best response to $(T_y^e(\cdot), ED_y^e)$, a contradiction. The necessity of condition (2) is similarly established.

Sufficiency: Suppose conditions (1) through (3) hold, but that $(T_x^e(\cdot), ED_x^e)$ and $(T_y^e(\cdot), ED_y^e)$ do not arise in a subgame perfect equilibrium. This means that at least one firm can alter its strategy and increase its profit. Without loss of generality, suppose firm X can do so. Then there exists $(\hat{T}_x(\cdot), \hat{ED}_x)$ that induces the retailer to choose $X > 0$ and makes firm X better off. That is,

$$\max_{X,Y} \{R(X, Y) - \hat{T}_x(X) - T_y^e(Y) \mid (X, Y) \in \mathcal{A}(\hat{ED}_x, ED_y^e)\} > \Pi_y, \quad (20)$$

and $\hat{T}_x(X) > T_x^e(X^e) - C_x(X^e) + C_x(X) \forall (X, Y) \in \Omega(\hat{T}_x(\cdot), \hat{ED}_x, T_y^e(\cdot), ED_y^e)$. Let (\hat{X}, \hat{Y}) be the retailer's choice of (X, Y) . Then there exists some $\hat{\omega} > 0$ such that

$$\hat{T}_x(\hat{X}) = T_x^e(X^e) - C_x(X^e) + C_x(\hat{X}) + \hat{\omega}.$$

Substituting this expression into condition (1) and using $\Pi_{x,y} = \Pi_y$ yields

$$\max_{X,Y} \{R(X, Y) - C_x(X) - T_y^e(Y) - \hat{T}_x(\hat{X}) + C_x(\hat{X}) + \hat{\omega} \mid (X, Y) \in \mathcal{A}_x(ED_y^e)\} = \Pi_y. \quad (21)$$

Since $\mathcal{A}(\hat{ED}_x, ED_y^e) \subset \mathcal{A}_x(ED_y^e)$, and so $(\hat{X}, \hat{Y}) \in \mathcal{A}_x(ED_y^e)$, the left-hand side of condition (21) can be evaluated at (\hat{X}, \hat{Y}) to yield $R(\hat{X}, \hat{Y}) - T_y^e(\hat{Y}) - \hat{T}_x(\hat{X}) + \hat{\omega} \leq \Pi_y$, which means that

$$R(\hat{X}, \hat{Y}) - T_y^e(\hat{Y}) - \hat{T}_x(\hat{X}) < \Pi_y. \quad (22)$$

But by the definition of (\hat{X}, \hat{Y}) , condition (22) contradicts condition (20).

A.2 PROOF OF PROPOSITION 1

To complete the proof begun in the text, suppose a two-good equilibrium exists, but it is not optimal for a fully integrated firm to sell both goods. That is, suppose there exist $(T_x^e, 0)$ and $(T_y^e, 0)$ that induce $(X^e, Y^e) \in \Omega(T_x^e, 0, T_y^e, 0)$ such that $X^e Y^e > 0$ and conditions (1)–(3) are satisfied, but that a fully integrated firm would strictly want to sell good X only, i.e.,

$$R(X^I, 0) - C_x(X^I) > \sup_{x,y>0} [R(X, Y) - C_x(X) - C_y(Y)]. \quad (23)$$

Using $T_y^e(Y) \geq C_y(Y) \forall Y$, condition (23) implies

$$R(X^I, 0) - C_x(X^I) > R(X^e, Y^e) - C_x(X^e) - T_y^e(Y^e),$$

which violates condition (1).

A.3 PROOF OF LEMMA 3

Necessity: This part of the proof is by contradiction. Suppose first there exist $(T_x^e, 0)$ and $(T_y^e, 0)$ that induce $(X^e, Y^e) \in \Omega(T_x^e, 0, T_y^e, 0)$ such that $X^e Y^e = 0$ and conditions (1)–(3) are satisfied, but $\max_Y [R(X^m, Y)$

– $C_y(Y) - C_x(X^m)] \neq R(X^m, 0) - C_x(X^m)$. Subtracting $T_x^e(X^m) - C_x(X^m)$ from both sides, and noting that the left-hand side of this inequality cannot be less than the right-hand side, we have

$$\max_Y [R(X^m, Y) - C_y(Y) - T_x^e(X^m)] > R(X^m, 0) - T_x^e(X^m), \quad (24)$$

which is a direct violation of condition (2), given that $X^e = X^m$ and $Y^e = 0$ in any equilibrium in which only good X is sold. Now suppose there exist $(T_x^e, 0)$ and $(T_y^e, 0)$ that induce $(X^e, Y^e) \in \Omega(T_x^e, 0, T_y^e, 0)$ such that $X^e Y^e = 0$ and conditions (1)–(3) are satisfied, but $\max_X [R(X, Y^m) - C_x(X) - C_y(Y^m)] > R(X^m, 0) - C_x(X^m)$. Using Lemma 2, this implies

$$\max_X [R(X, Y^m) - C_x(X) - T_y^e(Y^m)] > R(X^m, 0) - C_x(X^m), \quad (25)$$

which is a direct violation of condition (1) in any equilibrium in which only good X is sold.

Sufficiency: This part of the proof is by construction. Suppose conditions (6) and (7) hold, i.e.,

$$\begin{aligned} \max_X [R(X, Y^m) - C_x(X) - C_y(Y^m)] \\ \leq \max_Y [R(X^m, Y) - C_y(Y) - C_x(X^m)] = R(X^m, 0) - C_x(X^m), \end{aligned}$$

and consider a pair of supply contracts in which neither firm requires exclusive dealing and firm X and Y 's pricing schedules are

$$\bar{T}_x(X) = \begin{cases} 0 & \text{if } X = 0, \\ \bar{F}_x + C_x(X) & \text{if } X = X^m, \text{ and} \\ \infty & \text{otherwise} \end{cases}$$

$$\bar{T}_y(Y) = \begin{cases} 0 & \text{if } Y = 0, \\ C_y(Y) & \text{if } Y = Y^m, \\ \infty & \text{otherwise,} \end{cases}$$

where $\bar{F}_x = R(X^m, 0) - C_x(X^m) - [R(0, Y^m) - C_y(Y^m)]$. Then it is straightforward to verify that there exists $(X^m, 0) \in \Omega(\bar{T}_x, 0, \bar{T}_y, 0)$ and Lemma 1 is satisfied.

A.4 PROOF OF PROPOSITION 4

We conclude the proof of Proposition 4 by deriving the upper and lower bounds on F_y , as given in (10) and (11). The first step is to maximize the surplus function

$$U = X + Y - \frac{(X + Y)^2}{2} - \frac{(X - Y)^2}{2(1 + 2\gamma)} - P_x X - P_y Y.$$

This yields the inverse demand system

$$P_x = 1 - (X + Y) - \frac{X - Y}{1 + 2\gamma} \quad \text{and} \quad P_y = 1 - (X + Y) - \frac{Y - X}{1 + 2\gamma}.$$

Next we calculate a series of constrained maximization problems.

1. If a fully integrated firm were to sell only good X, it would choose $X > 0$ to maximize

$$\left(1 - X - \frac{X}{1 + 2\gamma}\right) X - \mathcal{F}_x. \tag{26}$$

Solving (26) yields $X^m = (1 + 2\gamma)/[4(1 + \gamma)]$ for a maximized profit of

$$\Theta_x = \frac{1 + 2\gamma}{8(1 + \gamma)} - \mathcal{F}_x. \tag{27}$$

2. If a fully integrated firm were to sell only good Y, it would choose $Y > 0$ to maximize

$$\left(1 - Y - \frac{Y}{1 + 2\gamma}\right) Y - \mathcal{F}_y. \tag{28}$$

Solving (28) yields $Y^m = (1 + 2\gamma)/[4(1 + \gamma)]$ for a maximized profit of

$$\Theta_y = \frac{1 + 2\gamma}{8(1 + \gamma)} - \mathcal{F}_y. \tag{29}$$

3. If a fully integrated firm were to sell both goods, it would choose $(X > 0, Y > 0)$ to maximize

$$\begin{aligned} &\left(1 - (X + Y) - \frac{X - Y}{1 + 2\gamma}\right) X \\ &+ \left(1 - (X + Y) - \frac{Y - X}{1 + 2\gamma}\right) Y - \mathcal{F}_x - \mathcal{F}_y. \end{aligned} \tag{30}$$

Solving (30) yields $X = Y = \frac{1}{4}$ for a maximized profit of

$$\Theta_{xy} = \frac{1}{4} - \mathcal{F}_x - \mathcal{F}_y. \tag{31}$$

4. If a fully integrated firm were constrained to choose $(X^m, Y > 0)$, it would maximize

$$\left(1 - (X^m + Y) - \frac{X^m - Y}{1 + 2\gamma}\right) X^m + \left(1 - (X^m + Y) - \frac{Y - X^m}{1 + 2\gamma}\right) Y - \tilde{\mathcal{F}}_x - \tilde{\mathcal{F}}_y. \quad (32)$$

Solving (32) yields $Y = (1 + 2\gamma)/[4(1 + \gamma)^2]$ for a maximized profit of

$$\frac{(1 + 2\gamma)(2 + 2\gamma + \gamma^2)}{8(1 + \gamma)^3} - \tilde{\mathcal{F}}_x - \tilde{\mathcal{F}}_y. \quad (33)$$

5. If a fully integrated firm were constrained to choose $(X > 0, Y^m)$, it would maximize

$$\left(1 - (X + Y^m) - \frac{X - Y^m}{1 + 2\gamma}\right) X + \left(1 - (X + Y^m) - \frac{Y^m - X}{1 + 2\gamma}\right) Y^m - \tilde{\mathcal{F}}_x - \tilde{\mathcal{F}}_y. \quad (34)$$

Solving (34) yields $X = (1 + 2\gamma)/[4(1 + \gamma)^2]$ for a maximized profit of

$$\frac{(1 + 2\gamma)(2 + 2\gamma + \gamma^2)}{8(1 + \gamma)^3} - \tilde{\mathcal{F}}_x - \tilde{\mathcal{F}}_y. \quad (35)$$

The final step is to compare profits under each of these constrained maximization problems. From Lemma 3, we know that foreclosure equilibria in which neither firm requires exclusive dealing exist if and only if

$$\max_Y [R(X^m, Y) - C_y(Y) - C_x(X^m)] = R(X^m, 0) - C_x(X^m) = \Theta_x \quad (36)$$

and

$$\Theta_x = R(X^m, 0) - C_x(X^m) \geq \max_X [R(X, Y^m) - C_x(X) - C_y(Y^m)]. \quad (37)$$

Given (27), (33), (35), and $\tilde{\mathcal{F}}_y \geq \tilde{\mathcal{F}}_x$, it is straightforward to show that (36) and (37) are satisfied if and only if

$$\tilde{\mathcal{F}}_y \geq \frac{1 + 2\gamma}{8(1 + \gamma)^3}. \quad (38)$$

This is condition (11) in the text.

Given (27), (29), (31), and $\tilde{\mathcal{F}}_y \geq \tilde{\mathcal{F}}_x$, it is straightforward to show that a fully integrated firm would sell both goods if and only if

$$\bar{y}_y \leq \frac{1 + 2\gamma + \gamma^2}{8(1 + \gamma)^3}. \quad (39)$$

This is condition (10) in the text.

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