

# RENDERING ALTERNATIVE OFFERINGS LESS PROFITABLE WITH RESALE PRICE MAINTENANCE

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*When it was legal, resale price maintenance (RPM) was commonly observed on items such as aspirin, pens, pencils, toothpaste, soap, shaving cream, and milk. In providing a theory that is based on compensating retailers for their opportunity cost of shelf space, and that does not hinge on the existence of externalities in nonprice competition, this article explains why a manufacturer might impose RPM on these and many other products. By contrast, the use of RPM on food, grocery, and drug store items is not easily explained by standard theories such as free riding on presale services and quality certification by high-priced retailers.*

*The typical supermarket has room for fewer than 25,000 products. Yet there are some 100,000 available, and between 10,000 and 25,000 items are introduced each year.<sup>1</sup>*

## 1. INTRODUCTION

It can be costly for a manufacturer to obtain retail distribution. This is evident from, among other things, the incidence and magnitude of slotting allowances, lump sum fees paid by manufacturers to retailers.<sup>2</sup> Given the limited number of items that individual retailers can

I thank Robert Willig, Mike Winston, seminar participants at Harvard, and especially the coeditor and two anonymous referees for their help in improving this article.

1. Tim Hammonds, Vice President of the U.S. Food Marketing Institute, Hammonds and Radtke (1990, p. 48).

2. Slotting allowances are a catch-all term for several closely related payments. These include "slotting fees" to secure a spot on a retailer's shelf and in its warehouse, "pay to stay" fees to remain on the shelf, "facing allowances" to buy improved shelf positioning, "street money" to pay for end-aisle displays, and "market development funds" to subsidize retailer advertising and promotional programs. In the United States, slotting allowances may have accounted for as much as half of the \$22 billion spent by manufacturers on trade promotions during 1989. See Shaffer (1991) and the references cited therein.

carry, these slotting payments reflect, in part, direct compensation to retailers for their scarce shelf space. While it is obvious that manufacturers must compensate retailers for the opportunity cost of their shelf space, it is not obvious that manufacturers are best served by two-part pricing. The theme of this article is that a manufacturer can often earn strictly higher profit by imposing resale price maintenance (RPM), which acts as a "reservation profit squeeze" by rendering retailers' alternative offerings less profitable.

When it was legal, RPM was commonly observed on frequently purchased items such as aspirin, pens, pencils, toothpaste, soap, shaving cream, and milk.<sup>3</sup> In providing a theory that is based on compensating retailers for their opportunity cost of shelf space, and that does not hinge on the existence of externalities in nonprice competition, this article explains why a manufacturer might impose RPM on these and many other kinds of products. By contrast, the use of RPM on food, grocery, and drug store items is not easily explained by standard theories such as free riding on presale services (Bowman, 1955; Telser, 1960), quality certification by high-priced retailers (Marvel and McCafferty, 1984), and quality control assurance (Klein and Murphy, 1988).

To model the reservation profit squeeze motive for RPM, I examine the implications of scarce retail shelf space on a manufacturer's profit-maximizing choice of contract in a simple model in which the manufacturer seeks to control both its retail price and the number of retailers that sell its product (the distribution density). The analysis depends crucially on whether the manufacturer obtains its shelf space at the expense of a different brand in the same product category or at the expense of an entirely different product.

At issue is whether an individual retailer's reservation profit, defined as the profit a retailer can earn by selling its most profitable alternative to the manufacturer's product, depends on the manufacturer's contract terms. If it does not, because the retailer's most profitable alternative is not a demand-side substitute for the manufacturer's product, the manufacturer can maximize its profit either by choosing a wholesale price to induce its desired retail price and employing a lump-sum transfer to divide the surplus (two-part pricing), or by controlling the retail price directly and dividing the surplus with its wholesale price (resale price maintenance). On the other hand, if a

3. See Overstreet (1983) and Bowman (1955) for examples of products that were price maintained prior to RPM's prohibition in 1975. Since then numerous FTC cases and private antitrust suits have alleged RPM. Ippolito (1988) has compiled a list of these products.

retailer's most profitable alternative is a demand-side substitute for the manufacturer's product, the manufacturer's profit maximizing choice of contract turns on whether, in the absence of RPM, the equilibrium retail price of its product would rise or fall if a single retailer were to drop its product and instead sell a competing brand. If the equilibrium retail price would rise, the manufacturer strictly prefers its profit-maximizing RPM contract over all two-part pricing contracts.

A manufacturer can use RPM to prevent a retailer's dropping of its product from causing the retail price for the same good at other stores to rise. Since the retailer's profit from selling its alternative offering is increasing in the price of the manufacturer's product at other stores, such a strategy renders the retailer's alternative offering less profitable. Thus, the manufacturer is able to appropriate more surplus from each retailer without causing its product to be dropped. In a linear demand example with two downstream firms, I show that RPM leads to lower equilibrium retail prices when the distribution density remains constant, and higher equilibrium retail prices when the distribution density increases, vis-à-vis two-part pricing. The manufacturer's RPM contract may entail either fixing the retail price or specifying a price floor.

The notion that a manufacturer might employ RPM to achieve its desired distribution density was first conjectured by Gould and Preston (1965). Subsequent formalization of this idea (Mathewson and Winter, 1983b; Bittlingmayer, 1983; Gallini and Winter, 1983; Perry and Groff, 1985) models RPM as a solution to the vertical control problem of a manufacturer selling to a downstream industry in which retailers incur fixed setup costs to enter and their number is determined by a zero-profit condition. This explanation for RPM is not convincing, however, because two-part pricing is also a solution to the same vertical control problem. In effect, assuming that retailers incur fixed setup costs to enter the downstream market is formally equivalent to assuming they have an opportunity cost of shelf space independent of the products being examined, that is, that each retailer's most profitable alternative to the manufacturer's product is not a demand-side substitute. If retailers' opportunity costs of shelf space are endogenized, as in this paper, the equivalence of RPM and two-part pricing disappears.

That the qualitative insights for RPM are significantly different when retailer reservation profits are endogenous has been noted in a complementary analysis by Perry and Besanko (1991). They find that RPM can be strictly preferred to two-part pricing in a model in which upstream firms compete for retailer patronage and the number of downstream firms is large. However, for simplicity, they assume

the retail price of a product is independent of the number of retailers selling it, and, thus, the reservation profit squeeze motive for RPM does not arise in their model.

Shaffer (1991) provides an equilibrium analysis of RPM and slotting allowances in the context of shelf space rivalry when retailers have monopsony power and manufacturers produce homogeneous goods. Because the upstream firms lack market power, however, there is no conflict within the vertical structure over the distribution of surplus. Slotting allowances and RPM in that model arise solely for strategic reasons to mitigate the downstream pricing externality.

The rest of the article proceeds as follows. After presenting the model and notation, Section 2 discusses the benchmark case in which retailers' reservation profits are exogenous. Section 3 demonstrates that the equivalence of RPM and two-part pricing disappears when retailers' reservation profits are endogenous. Section 4 illustrates the results in a linear demand example, and Section 5 concludes.

## 2. MODEL AND NOTATION

Consider the vertical control problem of a manufacturer selling product A to at most two retailers. I model this situation as a three-stage game. In stage one, the manufacturer offers one or both retailers a supply contract that specifies a per unit wholesale price ( $w$ ), a lump sum transfer fee ( $F$ ), and possibly a restriction on the retail price ( $P$ ), for a product produced at constant marginal cost  $c$ . Retailers choose whether to carry the manufacturer's product in stage two. Any retailer that chooses not to carry the manufacturer's product instead sells its most profitable alternative. Retailers who are unconstrained in their pricing engage in Bertrand competition in stage three. All information is common knowledge, and the equilibrium concept is subgame perfection.

Let the retail price at store  $i$  be  $P_i$ , and let demand at store  $i$  when both retailers sell product A be given by  $D_i^A(P_1, P_2)$ ,  $i = 1, 2$ . I assume that for all positive values of  $D_i^A$ , demand is downward sloping in  $P_i$  and nondecreasing in the rival's price. I further assume that retailers are symmetrically differentiated. Formally,  $D_i^A(a, b) = D_i^A(b, a)$ ,  $\forall a, b, j \neq i$ . Let retailer  $i$ 's profit when both retailers sell product A be given by  $\pi_i^A = (P_i - w)D_i^A(P_1, P_2) - F$ , and assume that  $\pi_i^A$  is concave in  $P_i$  and that  $|\partial^2 \pi_i^A / \partial P_i^2| > |\partial^2 \pi_i^A / \partial P_i \partial P_j|$ . Then there is a unique Nash equilibrium price,  $P^A(w)$ , which is upward sloping in  $w$ . If retail pricing is unconstrained in stage three, retailer  $i$ 's stage-three equilibrium profit can be written as  $\Pi_i^A = (P^A(w) - w)D_i^A(\bar{P}^A(w)) - F$ , where  $\bar{P}^A(w) = (P^A(w), P^A(w))$ .

Retailer  $i$ 's reservation profit, or opportunity cost of shelf space, is defined as the profit retailer  $i$  can earn if instead of selling the manufacturer's product, it sells its most profitable alternative. For the remainder of this section, I assume this alternative offering is not a demand-side substitute for product A and, hence, that retailer  $i$ 's reservation profit, denoted  $SS$ , can be taken as exogenous. To obtain distribution, the manufacturer must ensure that retailer  $i$  earns at least this amount.

It is useful to begin by establishing, as a benchmark, the profit that a vertically integrated firm can earn if it sells its product at both retail stores and rents shelf space at a cost of  $SS$ . Define

$$\Pi^I = \max_{P_1, P_2} \sum_{i=1}^2 (P_i - c)D_i^A(P_1, P_2) - 2SS,$$

and let  $P_1 = P_2 = P^I$  be its argmax. I now demonstrate that  $\Pi^I$  is reachable via contract.

From the retailers' stage-two decisions, there are four possible subgames, depending on who sells or does not. Of these, I focus on the subgame in which both retailers sell product A. If the manufacturer is to replicate its vertically integrated profit, it must not only induce this subgame in stage two but also induce  $P^I$  in stage three. Both retailers selling the manufacturer's product is an equilibrium in stage two if and only if each retailer earns at least its reservation profit, so the manufacturer's problem if it specifies the retail price is<sup>4</sup>

$$\max_{P, w} (w - c) \sum_{i=1}^2 D_i^A(\tilde{P}) \quad \text{such that} \quad (P - w)D_i^A(\tilde{P}) \geq SS, \quad i = 1, 2.$$

Solving yields  $P = P^I$ , and  $w = \tilde{w}$  such that  $(P^I - w^r)D_i^A(\tilde{P}^I) = SS$ , for a maximized profit of  $\Pi^I$ . If the manufacturer does not specify the retail price, its problem is

$$\max_{w, F} (w - c) \sum_{i=1}^2 D_i^A(\tilde{P}^A(w)) + 2F \quad \text{such that} \\ (P^A(w) - w)D_i^A(\tilde{P}^A(w)) - F \geq SS, \quad i = 1, 2.$$

Solving yields  $w = w^I$  such that  $P^A(w^I) = P^I$ , and  $F = F^I =$

4. Once the retail price is specified, the manufacturer has an extra instrument with which to extract surplus. It can set  $w = 0$  and extract surplus with a fixed fee only, it can set  $F = 0$  and extract surplus with the wholesale price only, or it can extract surplus with a combination of the two instruments. In this paper, I follow the convention that when there is a redundancy between the wholesale price and fixed fee, the manufacturer uses only its wholesale price to extract retail surplus. Such a convention simplifies the exposition.

$(P^i - w^i)D_i^A(\tilde{P}^i) - SS$ , for a maximized profit of  $II^i$ . Hence, both two-part pricing and RPM can generate the vertically integrated outcome.

**PROPOSITION 1:** *When retailers' reservation profits are exogenous, two-part pricing and RPM are equivalent in the sense that either one suffices to maximize the manufacturer's profit.*

This result is well known for the formally equivalent vertical control problem of a manufacturer selling to a downstream industry in which retailers incur fixed setup costs to enter and their number is determined by a zero-profit condition, for example, Mathewson and Winter (1983b) and Perry and Groff (1985). By reinterpreting retailers' fixed setup costs as an exogenous opportunity cost of shelf space, the two analyses are essentially the same. To explain why a contractual restriction such as resale price maintenance is sometimes strictly preferred to two-part pricing, the vertical control literature has extended the basic model to include such things as demand uncertainty (Rey and Tirole, 1986), unobservable contracts and bargaining (O'Brien and Shaffer, 1992), and externalities in nonprice competition (Mathewson and Winter, 1984; Perry and Porter, 1990; and Winter, 1993). In the next section, I show that endogenizing retailers' reservation profits will also engender instances in which RPM yields strictly higher profit than two-part pricing.

### 3. ENDOGENOUS RESERVATION PROFIT

Suppose reservation profits now depend on the manufacturer's contract terms in the sense that each retailer's most profitable alternative, product B, is a demand-side substitute for product A. For simplicity, assume that product B is produced by a competitive fringe of upstream firms and is available at cost  $c_b$  to each retailer. If the manufacturer is to induce the subgame in which both retailers sell product A, it must compensate retailer  $i$  with sufficient profit to equal or exceed the profit retailer  $i$  can earn by unilaterally dropping product A and instead selling product B. To determine this amount, let demand at store  $i$  when retailer 1 sells product B and retailer 2 sells product A be given by  $D_i^{B,A}(P_1, P_2)$ . I assume that for all positive values of  $D_i^{B,A}$ , demand is downward sloping in own price and upward sloping in the rival's price. Define similar notation and make analogous assumptions in the event retailer 1 sells product A and retailer 2 sells product B. Since retailers are symmetrically differentiated,  $D_1^{B,A}(a, b) = D_2^{A,B}(b, a)$ ,  $\forall a, b$ .

If retailer 1 sells product B and retailer 2 sells product A, retailer 1's profit is given by  $\pi_1^{B,A} = (P_1 - c_b)D_1^{B,A}(P_1, P_2)$  and retailer 2's profit is given by  $\pi_2^{B,A} = (P_2 - w)D_2^{B,A}(P_1, P_2) - F$ . Assume that  $\pi_i^{B,A}$  is concave in  $P_i$  and that  $|\partial^2 \pi_i^{B,A} / \partial P_i^2| > |\partial^2 \pi_i^{B,A} / \partial P_i \partial P_j|$ , so there is a unique Nash equilibrium price vector denoted by  $(P_1^{B,A}(c_b, w), P_2^{B,A}(c_b, w))$ . As long as both retailers make strictly positive sales, it can be verified that retailer 2's price is increasing in  $w$ .

Define a retailer's reservation profit when both retailers sell product A as the maximized profit it would earn if it unilaterally dropped product A and instead sold product B. These profits for retailers 1 and 2 are

$$\Pi_1^{B,A}(P_2) = \max_{P_1} (P_1 - c_b)D_1^{B,A}(P_1, P_2), \text{ and}$$

$$\Pi_2^{A,B}(P_1) = \max_{P_2} (P_2 - c)D_2^{A,B}(P_1, P_2).$$

By using the envelope theorem, and by assuming both retailers make positive sales, each retailer's reservation profit can be shown to be increasing in the rival retailer's price, that is,  $d\Pi_1^{B,A}/dP_2 > 0$  and  $d\Pi_2^{A,B}/dP_1 > 0$ . Since retailers are symmetrically differentiated,  $\Pi_1^{B,A}(P) = \Pi_2^{A,B}(P), \forall P$ .

The analysis proceeds by comparing the manufacturer's maximized profit if it chooses a two-part pricing contract with its maximized profit if it chooses RPM. In the former event, if the manufacturer is to induce both retailers to sell its product, its problem is given by

$$\max_{w,F} (w - c) \sum_{i=1}^2 D_i^A(\tilde{P}^A(w)) + 2F \text{ such that} \tag{1}$$

$$\Pi_1^A \geq \Pi_1^{B,A}(P_2^{B,A}(c_b, w)), \quad \Pi_2^A \geq \Pi_2^{A,B}(P_1^{A,B}(w, c_b)).$$

Let  $(w^*, F^*)$  denote the profit-maximizing wholesale price and fixed fee. Since the constraints bind at  $F^*$ , the manufacturer's maximized profit with two-part pricing can be written as

$$\Pi_M^* = 2[(P^A(w^*) - c)D_1^A(\tilde{P}^A(w^*)) - \Pi_1^{B,A}(P_2^{B,A}(c_b, w^*))]. \tag{2}$$

If one assumes both retailers make positive sales in the event one retailer sells product A and the other retailer sells product B, reservation profits are increasing in the manufacturer's wholesale price. The greater is the manufacturer's wholesale price, the greater is the corresponding Nash equilibrium retail price of its product, and, hence, the greater is each retailer's reservation profit. It follows that

$w^* < w^l$ , implying that  $P^A(w^*) < P^A(w^l) = P^l$ . That is, the induced equilibrium retail price when both retailers sell product A is strictly less than the retail price that would be chosen by a vertically integrated firm. The reason is that at  $w = w^l$ , a small decrease in the wholesale price has only a second-order effect on joint profit, but a negative first-order effect on each retailer's reservation profit. Hence, for a small decrease away from  $w^l$ , the manufacturer's share of maximized joint profit necessarily increases.<sup>5</sup>

If  $P_2^{B,A}$  and  $P_1^{A,B}$  were somehow fixed, and, hence, each retailer's reservation profit were fixed, the manufacturer could increase its profit by *increasing* its wholesale price to  $w^l$ . On the other hand, if  $P^A$  were somehow fixed, and, hence, joint profit were fixed, the manufacturer could increase its profit by *decreasing* its wholesale price, thereby reducing each retailer's reservation profit. It is this inherent tension in setting the wholesale price when the manufacturer induces both retailers to sell its product and does not restrict the retail price that suggests a possible role for RPM.

If the manufacturer chooses to constrain retailers' independent pricing, it has three choices of contract type. It can fix the retail price at  $P$  (fixed-price RPM), specify a price floor at  $P$  (min RPM), or specify a price ceiling at  $P$  (max RPM). In the first case, retailers that sell product A have no pricing discretion. They must charge  $P_1 = P_2 = P$ . In the second (third) case, retailers that sell product A must charge a price greater (less) than or equal to  $P$ . This gives rise to several possibilities. First, the price restraint can be superfluous in the sense that it has no effect on retail prices. Second, the price restraint may affect retail prices if both retailers sell product A but not if only one retailer sells product A. Third, the price restraint may affect retail prices if only one retailer sells product A, but not if both retailers sell product A. Finally, the price restraint may bind whether or not both retailers sell product A. The following lemma simplifies the analysis.

**LEMMA 1:** *There does not exist a min or max RPM contract that induces both retailers to sell product A and yields strictly higher profit than in all two-part pricing and fixed-price RPM contracts.*

*Proof.* See Appendix A. □

Lemma 1 ensures there is no loss of generality in restricting attention to a comparison of  $\Pi_M^*$  with the maximum profit available

5. Formally, this can be shown by substituting the inequality constraints into the objective function in eq. (1), writing out the first-order condition with respect to  $w$  and then verifying it is negative when evaluated at  $P^l$ .

from a fixed-price RPM contract when the manufacturer induces both retailers to sell its product. The fixed-price RPM maximization problem is

$$\max_{P,w} (w - c) \sum_{i=1}^2 D_i^A(\tilde{P}) \quad \text{such that} \quad (3)$$

$$(P - w)D_1^A(\tilde{P}) \geq \Pi_1^{B,A}(P), \quad (P - w)D_2^A(\tilde{P}) \geq \Pi_2^{A,B}(P).$$

Let  $(\bar{P}, \bar{w})$  denote the profit-maximizing retail and wholesale price. Since the wholesale price is chosen such that the constraints bind, the manufacturer's maximized profit can be written as

$$\bar{\Pi}_M = 2[(\bar{P} - c)D_1^A(\bar{P}) - \Pi_1^{B,A}(\bar{P})]. \quad (4)$$

If one assumes both retailers make positive sales in the event one retailer sells product A and the other retailer sells product B, reservation profits are increasing in product A's fixed retail price. It follows that  $\bar{P} < P^I$  for the same reason that the induced retail price with two-part pricing is strictly less than the retail price that would be chosen by a vertically integrated firm.<sup>6</sup> If each retailer's reservation profit were fixed, the manufacturer could increase its profit by *increasing* its retail price to  $P^I$ . On the other hand, if joint profit were fixed, the manufacturer could increase its profit by *decreasing* its retail price, thereby reducing each retailer's reservation profit.

### 3.1 COMPARING TWO-PART PRICING AND RESALE PRICE MAINTENANCE

When retailers' reservation profits are endogenous, an additional target of control is introduced. Not only is the manufacturer concerned with its distribution density and retail price in equilibrium, it is also concerned with what its retail price would be if one of the retailers were to drop its product. One might think that fixed-price RPM necessarily yields strictly higher profit than two-part pricing in this situation, since it provides a means to control retail prices directly. However, fixed-price RPM also adds the constraint that the retail price is constant across product market configurations. It is not obvious, then, which will be the manufacturer preferred choice. In this section, I give sufficient conditions under which each type of contract is profit maximizing.

6. Formally,  $\bar{P} < P^I$  is established by substituting the inequality constraints into the objective function in eq. (3), writing out the first-order condition with respect to  $P$  and then verifying it is negative when evaluated at  $P^I$ .

The manufacturer's profit maximizing choice of contract if it induces both retailers to sell its product is determined by comparing  $\Pi_m^*$  and  $\bar{\Pi}_m$  as given in eqs. (2) and (4). Notice that if the manufacturer fixes the retail price at  $P^A(w^*)$ , joint profit with RPM is identical to joint profit with the manufacturer's profit-maximizing two-part pricing contract. Yet retailer reservation profits are strictly lower with the proposed RPM contract whenever an unconstrained retailer would raise the price of product A if the rival retailer were to sell product B. Thus, if

$$P_2^{B,A}(c_b, w^*) > P^A(w^*), \quad (5)$$

the profit-maximizing RPM contract enables the manufacturer to extract more surplus from each retailer without causing its product to be dropped.

**PROPOSITION 2:** *When retailers' reservation profits are endogenous, the manufacturer can sometimes earn strictly higher profit with fixed-price RPM than with two-part pricing.*

The intuition for why RPM sometimes yields strictly higher profit is straightforward: By preventing a retailer's dropping of product A from causing the rival store's price on product A to rise, the manufacturer renders a retailer's alternative product B less profitable. This is so because the maximum profit available from selling product B necessarily decreases, the lower is the rival retailer's price on product A. Consequently, the manufacturer can increase its wholesale price to each retailer without causing its product to be dropped.<sup>7</sup>

Intuition suggests that RPM is more attractive the less differentiation there is between the two retailers and the more differentiation there is between the two products. In the polar case in which retailers are perfect substitutes and all of the differentiation is between products A and B,  $P^A(w^*) = w^* < P_2^{B,A}(c_b, w^*)$ , and condition (5) is satisfied.

Note that RPM does not always arise in equilibrium; the manufacturer's profit-maximizing two-part pricing contract sometimes yields strictly higher profit than in all RPM contracts for which the

7. Perry and Besanko (1991) also examine a model in which reservation profits are endogenous. They consider two upstream firms, each vying for exclusive retail distribution with a fixed, but large, number of retailers. To maintain tractability, they essentially assume that in the absence of RPM, each retailer's profit-maximizing retail price is a constant markup over the wholesale price of the brand they carry. Thus, equilibrium retail prices in their model are *independent* of the number of retailers selling each brand. If the same assumption were made in the present paper, the profit-maximizing RPM and two-part pricing contracts would always yield identical profit.

pricing constraint is binding. For instance, an RPM contract cannot be profitable for the manufacturer if at the wholesale price that would induce the profit-maximizing retail price under RPM, an unconstrained retailer would decrease the price of the manufacturer's product were the rival retailer to drop it and instead sell a competing good. Constraining the retail price in this instance would render a retailer's alternative product more profitable, and consequently the manufacturer would be able to appropriate less surplus from each retailer than it could in the absence of RPM.<sup>8</sup>

### 3.2 COMPARING ALTERNATIVE FORMS OF RESALE PRICE MAINTENANCE

To determine the manufacturer's profit-maximizing contract, the preceding subsection compared the manufacturer's profit-maximizing two-part pricing contract with its profit-maximizing fixed-price RPM contract. In this subsection, I focus on situations in which this form of RPM yields strictly higher profit, that is,  $\bar{\Pi}_m > \Pi_m^*$ , and ask whether other forms of RPM can also maximize the manufacturer's profit. In short, the answer is yes, with some qualification.

**LEMMA 2:** *When  $\bar{\Pi}_m > \Pi_m^*$ , the profit-maximizing min (max) RPM contract yields identical profit to the profit-maximizing fixed-price RPM contract if and only if the contract specifies a price floor (ceiling) at  $\bar{P}$  and a wholesale price at  $\bar{w}$ , and it happens that  $\bar{P} \geq (\leq) P^A(\bar{w}), P_2^{B,A}(c_b, \bar{w})$ .*

*Proof.* See Appendix B.<sup>9</sup> □

For a min or max RPM contract to be observed in equilibrium, it must mimic the profit-maximizing fixed-price RPM contract in the sense that the constrained retail price of product A must equal  $\bar{P}$  and be constant across product market configurations. Such a contract may not always exist. In Section 4, I give an example in which the conditions of Lemma 2 are sometimes satisfied for min RPM but are never satisfied for max RPM.

**PROPOSITION 3:** *When  $\bar{\Pi}_m > \Pi_m^*$ , the manufacturer's maximized profit with fixed-price RPM is strictly higher than in all min and max RPM contracts if and only if  $P^A(\bar{w}) < \bar{P} < P_2^{B,A}(c, \bar{w})$ .*

8. To verify that such a situation can exist, define  $\hat{w}$  such that  $P^A(\hat{w}) = \bar{P}$  and consider the polar case in which products A and B are perfect substitutes and all differentiation occurs between retailers. Then  $\bar{P} = P^A(\hat{w}) = P_2^{B,A}(\hat{w}, \hat{w}) > P_2^{B,A}(c_b, \hat{w}), \forall \hat{w} > c_b$ , which is sufficient for two-part pricing to be more profitable than RPM.

9. In an earlier version of this paper, I showed that if the manufacturer's maximized profit is strictly higher with two-part pricing than with fixed-price RPM, it is also strictly higher than in all min and max RPM contracts.

*Proof.* Given Lemma 1, sufficiency follows immediately on observing that the conditions of Lemma 2 are violated. Necessity follows by noting that if the pair of inequalities do not hold, either the conditions of Lemma 2 are satisfied or  $P^A(\bar{w}) > \bar{P} > P_2^{B,A}(c, \bar{w})$ , in which case replacing the fixed-price  $\bar{P}$  with a price ceiling at  $\bar{P}$  yields strictly higher profit.  $\square$

The intuition for Proposition 3 is that fixed-price RPM is strictly preferred to all min and max RPM contracts if and only if the manufacturer must prevent retailers from selling below  $\bar{P}$  when both retailers are selling product A, and yet at the same time, prevent retailer 2 from selling above  $\bar{P}$  if retailer 1 were to drop product A and sell product B instead. Neither a min or max RPM contract can achieve this dual feat. By fixing the retail price, both roles are simultaneously filled.

During the period of time prior to RPM's prohibition in the United States and in Europe,<sup>10</sup> min RPM was the most prevalent form of RPM contract in the United States, and fixed-price RPM was the most prevalent form of RPM in Europe (Gammelgaard, 1958). Surprisingly, the reasons for this difference have been largely unexplored in the literature.<sup>11</sup> Typically, the manufacturer's profit-maximizing retail and wholesale price with RPM is derived and then checked to see whether, at that wholesale price, retailers want to deviate by undercutting or imposing a surcharge on the profit maximizing RPM price. If the former (latter) is the case, the manufacturer is presumed to set a retail-price floor (ceiling). That the manufacturer can almost always achieve the same outcome by fixing the retail price is ignored. In this paper, I have gone a step further by showing that fixed-price RPM can sometimes be strictly preferred to other forms of RPM. Since local retail market power is essential for this to occur, I conjecture that the difference in the incidence of RPM contract type between Europe and the United States may have been due to the generally acknowledged higher retail concentration in Europe.<sup>12</sup>

10. RPM was banned in France in 1953, in Sweden in 1954, in Denmark in 1956, in Norway in 1957, in the United Kingdom and the Netherlands in 1964, and in the United States in 1975. Major anti-RPM legislation was enacted in Germany in 1957.

11. Rey and Tirole (1986) note that fixed-price RPM, though equivalent to max RPM, yields higher profit than min RPM in their model. Another exception is Mathewson and Winter (1983a), who model uninformed consumers seeking product and price information. In the absence of RPM, an asymmetric equilibrium arises in which some low-price retailers free ride on the informational services of high-price retailers. By fixing the retail price, the manufacturer perfectly resolves the downstream externalities. Price floors (ceilings) do not always (never) suffice in their model.

12. Other major differences pertain to the overall popularity of RPM. During its heyday, RPM was enforced on an estimated 4–10% of U.S. retail sales (Scherer and Ross, 1990). By contrast, RPM was at one time enforced on more than 40% of consumer

#### 4. RETAIL PRICES, PROFITS, AND DISTRIBUTION DENSITY

The discussion so far has focused on the manufacturer's profit-maximizing choice of contract in the subgame in which both retailers sell its product. Using a linear-demand example, I will extend the analysis to consider the effect of RPM on distribution density, retail prices, and division of surplus. The example explains why retailers might lobby against RPM legislation and supports why the empirical evidence concerning the effect of RPM on retail prices is mixed.

The main difficulty in explicitly solving the model is finding a tractable functional form of demand that specifies the degree of differentiation not only between products A and B but also between the two retailers. The obvious candidate demand systems, CES and Logit, are of little use when demand for products A and B is asymmetric.<sup>13</sup> I simplify by considering a polar case in which products A and B are differentiated, but retailers are not. Bertrand pricing then ensures marginal cost pricing in the event both retailers sell product A. This means  $P^A(w) = w, \forall w$ , which implies  $P^A(w^*) < P_2^{B,A}(c_b, w^*)$ , and, thus, from condition (5), the manufacturer strictly prefers RPM.

Assume that aggregate utility is given by

$$U = V \sum_{i=A,B} q_i - \frac{1}{2(1 + 2\gamma)} \left[ \frac{q_A^2}{s} + \frac{q_B^2}{(1 - s)} + 2\gamma \left( \sum_{i=A,B} q_i \right)^2 \right] + M,$$

where  $M$  is aggregate income,  $\gamma > 0$  is a demand substitution parameter,  $s > 0$  is a measure of product asymmetry, and  $q_i$  is the quantity consumed of the  $i$ th product,  $i = A, B$ . In the event both retailers sell product A,  $q_B = 0$ , and the demand facing the manufacturer is given by

$$D_1^A(P_1, P_2) + D_2^A(P_1, P_2) = \frac{(1 + 2\gamma)s}{1 + 2\gamma s} (V - P_A),$$

---

goods expenditures in England (Yamey, 1966). The relatively low percentage in the United States may have been due to adverse legal developments (a number of state courts declared their state RPM laws unconstitutional) and the growth of mail order houses, which circumvented the law by operating from the shelter of non-RPM areas and selling below the contractual maintained price in RPM states. In addition, the United States never sanctioned collective manufacturer policing of RPM, a common method of enforcement in Europe. It has been estimated that from the time between the United Kingdom's prohibition of collective enforcement agencies in 1956 and their abolition of RPM in 1964, the extent of the practice in that country declined by 25% (Pickering, 1974).

13. See Perry and Besanko (1991) for an example using CES and Logit when products and retailers are symmetrically differentiated.

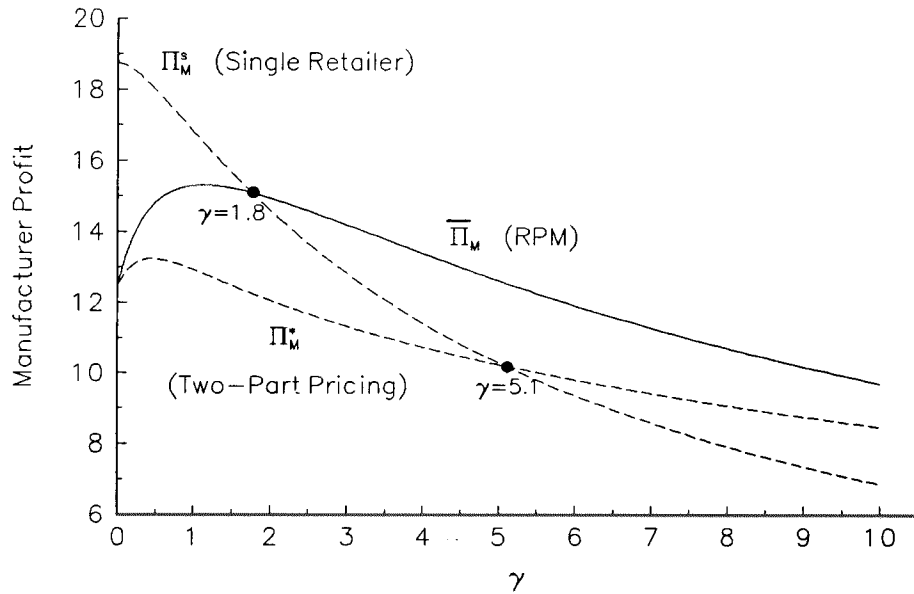


FIGURE 1. DETERMINING DISTRIBUTION DENSITY ( $V = 10$ ,  $c = 0$ ,  $s = \frac{3}{4}$ ).

where  $P_A = \min(P_1, P_2)$ . In the event only retailer 2 sells good A, the demand system can be found by differentiating  $U$  with respect to quantity and inverting to obtain

$$D_1^{B,A} = (1 - s)(V - (1 + 2\gamma s)P_1 + 2\gamma s P_2),$$

$$D_2^{B,A} = s(V - (1 + 2\gamma(1 - s))P_2 + 2\gamma(1 - s)P_1).$$

The parameter  $\gamma$  is a measure of the degree of substitution between products A and B. When  $\gamma = 0$ , consumer demands are independent. As  $\gamma \rightarrow \infty$ , A and B become perfect substitutes. The parameter  $s$  is a measure of the degree of asymmetry between A and B in the sense that equal prices give rise to a market share of  $s$  for good A and  $(1 - s)$  for good B. The manufacturer's product is the dominant brand for all  $s > \frac{1}{2}$ .

The manufacturer can always induce symmetric subgames in which a single retailer sells its product. Denoting its maximized profit and induced retail price in this case as  $\Pi_M^s$  and  $P^s$ , respectively, it can be shown that  $\Pi_M^s$  can be achieved with both two-part pricing and fixed-price RPM. I now solve for the manufacturer's desired distribution density and profit-maximizing contract. The algebra when  $V = 10$ ,  $c = c_b = 0$ , and  $s = .75$ , is given in Appendix C.<sup>14</sup>

14. The restriction on  $V$ ,  $c$ ,  $c_b$ , and  $s$  is made for illustrative purposes only and does not affect any qualitative results.

**4.1 DISTRIBUTION DENSITY**

Figure 1 illustrates the manufacturer's maximized profit if it were to sell to one retailer, to both retailers with two-part pricing, or to both retailers with RPM. For  $\gamma < 1.8$ , the manufacturer maximizes its profit by selling to one retailer. In this region,  $\Pi_M^s > \bar{\Pi}_M > \Pi_M^*$ . For  $1.8 < \gamma < 5.1$ , the manufacturer maximizes its profit by selling to both retailers if RPM is feasible, and to one retailer if RPM is not feasible. In this region,  $\bar{\Pi}_M > \Pi_M^s > \Pi_M^*$ . Finally, for  $\gamma > 5.1$ , the manufacturer maximizes its profit by selling to both retailers regardless of whether RPM is feasible. In this region,  $\bar{\Pi}_M > \Pi_M^* > \Pi_M^s$ .

When the manufacturer sells to both retailers it always prefers to use RPM. This is a consequence of the assumption that all of the differentiation is between products A and B. The percentage increase in profit with RPM vis-à-vis two-part pricing varies from 0% at  $\gamma = 1.8$ , to 23.2% at  $\gamma = 5.1$ , to 14.6% at  $\gamma = 10$ . It may seem surprising that the manufacturer would ever want to sell to both retailers given they are undifferentiated. Yet, by doing so, the manufacturer can avoid direct price competition with product B and realize a gain that is larger the more substitutable are A and B.

**4.2 RETAIL PROFITS AND PRICES**

Figure 2 illustrates the effect of RPM on equilibrium retail prices in the region  $1.8 < \gamma < 10$ . Throughout this region, RPM yields strictly

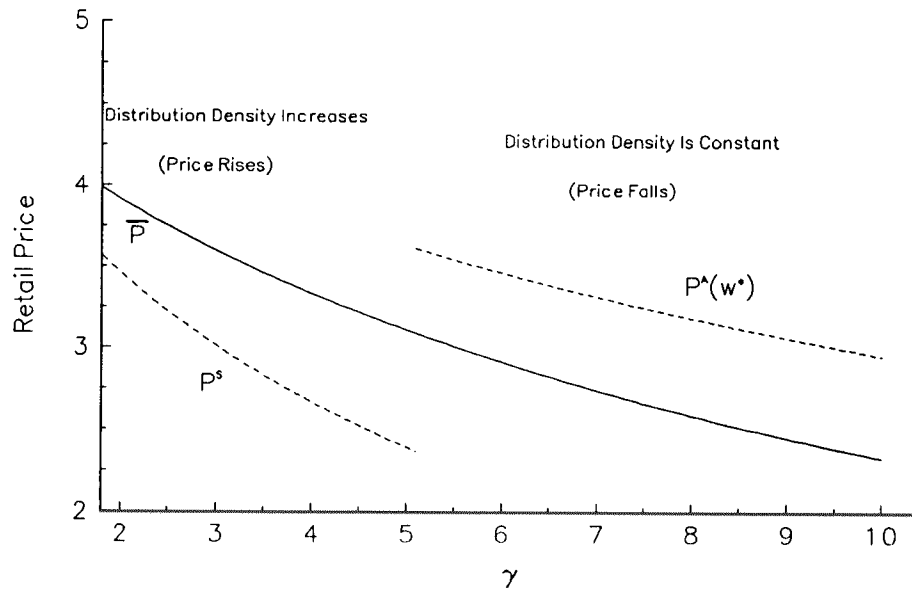


FIGURE 2. EQUILIBRIUM RETAIL PRICES ( $V = 10, c = 0, s = \frac{3}{4}$ ).

higher profit for the manufacturer than two-part pricing. For  $\gamma < 5.1$ , the effect of RPM is to *increase* the distribution density and to *raise* retail prices vis-à-vis what they would be with two-part pricing.

By selling to both retailers, the manufacturer avoids direct price competition with product B and, therefore, is less constrained in raising prices. The result is higher retail prices and, since  $\bar{P} < P^I$ , higher joint industry profits as well. Moreover, each retailer is better off with RPM since reservation profits necessarily increase with the higher retail prices. Thus, for  $\gamma < 5.1$ , the reservation profit squeeze motive for RPM is consistent with the observed behavior of those manufacturers and retailers who lobbied in favor of legislation for RPM during its early history.<sup>15</sup>

By contrast, for  $\gamma > 5.1$ , the distribution density is unchanged and the sole effect of RPM is to *lower* retail prices vis-à-vis what they would be with two-part pricing. In this case, RPM lowers industry joint profits and, thus, squeezes retailers' reservation profits.<sup>16</sup> This finding is consistent with the observed historical lobbying of large retailers against resale price maintenance. It also accords with present-day lobbying by retail discounters to codify RPM as per se illegal.<sup>17</sup>

The vertical control literature, for example, Mathewson and Winter (1984), O'Brien and Shaffer (1992), and Winter (1993), tends to focus on the use of RPM to correct for externalities that reduce joint profits. These models can explain why manufacturers and retailers lobby for RPM but not why some retailers have lobbied against RPM. By contrast, the reservation profit squeeze motive for RPM centers on an inherent conflict within the vertical structure over the distribution of surplus and the attempt by the manufacturer to alter this distribution in its favor. In choosing its contract, terms, and distribution density, the manufacturer is cognizant of the endogenous nature of retailers' reservation profits. One implication of this endogeneity is that changes in the manufacturer's profit no longer coincide one for

15. In addition to the American Fair Trade League, an association of manufacturers of branded articles, the National Association of Retail Druggists also lobbied for legislation to overturn the Supreme Court's decision in *Dr. Miles Medical Co. v. John D. Park & Sons Co.*, 220 U.S. 373 (1911), which outlawed RPM.

16. In general, it is not possible unambiguously to sign how retail prices and profits change when RPM is imposed and the distribution density remains constant. In an earlier version of this paper, I showed that a sufficient condition for equilibrium retail profits to fall with RPM is  $dP^A(w^*)/dw > \partial P^B_A(c, w^*)/\partial w$ . The interested reader is referred to Shaffer (1989, pp. 159–163) for a discussion of the conditions under which retail prices are likely to fall with RPM.

17. In the past the drive against legalizing RPM came from chain stores and department stores such as R.K. Macy, Kroger, and A&P. Presently, the National Mass Retailers Association is lobbying Congress for passage of a bill to codify the per se illegality of RPM. Among their members are K-Mart and Walmart.

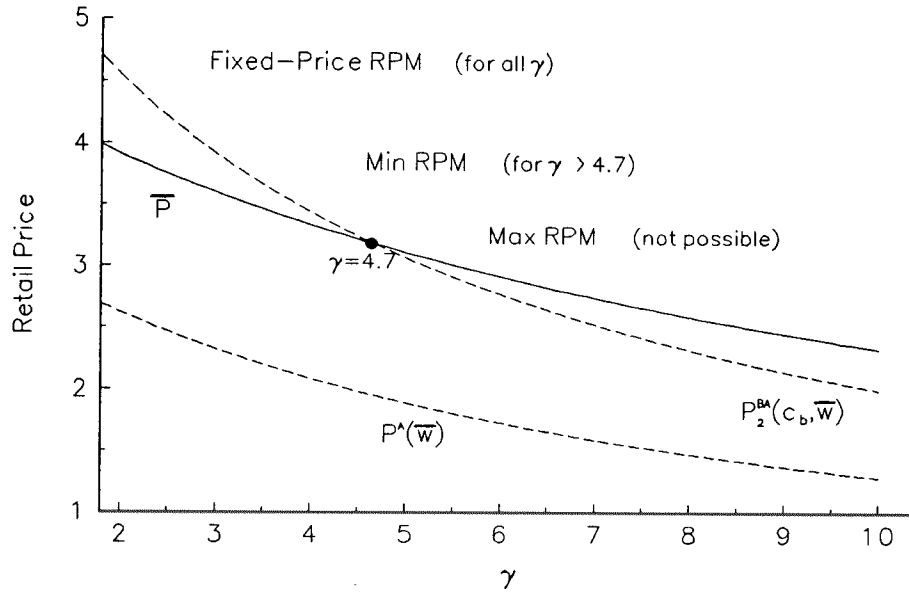


FIGURE 3. TYPE OF RPM CONTRACT ( $V = 10, c = 0, s = \frac{3}{4}$ ).

one with changes in joint profit, and so its profit-maximizing contract will not in general maximize joint profits. It then becomes an open question whether retailers stand to gain or lose from RPM.<sup>18</sup>

**4.3 TYPE OF RPM CONTRACT**

Figure 3 determines which types of RPM contracts are consistent with equilibrium in the region for which RPM yields strictly higher profit than two-part pricing for the manufacturer. For  $\gamma < 4.7$ , the conditions in Proposition 3 are satisfied and, hence, only fixed-price RPM is observed. For  $\gamma > 4.7$ , the conditions in Lemma 2 for min RPM are satisfied. In this region, both fixed-price RPM and min RPM may arise in equilibrium.

In comparing Figures 2 and 3, it is seen that, depending on the value of  $\gamma$ , both fixed-price RPM and min RPM can lead to a rise or fall in retail prices vis-à-vis what would occur with two-part pricing. In light of these findings, it is not surprising that the empirical evidence

18. Conflict within the vertical structure also prevents joint profit maximization in Blair and Lewis (1994). They examine the control problem of a manufacturer selling to a single retailer who is better informed about demand at the time of contracting. By making its contract contingent on price and quantity, the manufacturer is able to monitor more closely the retailers' provision of service and thereby extract more surplus from the vertical relationship.

concerning the effect of RPM on retail prices is mixed. For instance, Ostlund and Vickland (1940) surveyed a large sample of drug stores and found that in a sample of 50 items, 30 had a lower average price than before, 2 were unchanged, while 18 items were priced higher in 1939 than before RPM was established. The price changes varied from 3.3% to -4.9%.<sup>19</sup>

That min RPM can be associated with lower retail prices may seem surprising, for at any given wholesale price, a binding price floor necessarily elevates retail prices above what they would be in its absence. Therefore, it is often assumed that min RPM results in higher retail prices. This intuition is fallacious, for it implicitly assumes a constant wholesale price across regimes. It is entirely possible, as happens in this model, that the wholesale price falls with RPM, and, thus, despite the price floor imposed by the manufacturer, retail prices may be lower than they would be in the absence of RPM.<sup>20</sup>

## 5. CONCLUSION

Agreements between manufacturers and retailers that restrict resale prices are considered "combinations in restraint of trade" and therefore per se violations of section 1 of the Sherman Act. Recent Supreme Court decisions, however, have substantially narrowed the evidentiary standards necessary to prove a per se illegal RPM agreement.<sup>21</sup> By allowing manufacturers to terminate retailers unilaterally, current antitrust practice borders on a tacit acceptance of a manufacturer's right to choose an RPM policy. This shift in the Supreme Court's thinking is based on the view that RPM may be socially beneficial if it is used to elicit increased retail services, to prevent shirking on product quality, or to obtain quality certification from reputable deal-

19. Pickering (1974) estimates that prices in the United Kingdom were, on average, likely reduced in most trades after the demise of RPM. As reported in Gammelgaard (1958), a Swedish survey of 76 commodities found that the effect of RPM on prices was ambiguous.

20. As Perry and Besanko (1991, p. 538) state, "The key insight is that the form of RPM depends only on the relationship between the wholesale price and retail prices in the RPM equilibrium. As such, whether RPM is a minimum or a maximum has nothing to do with whether the RPM equilibrium will result in a higher or lower retail price than the equilibrium without RPM."

21. In *Monsanto Co. v. Spray Rite Service Corp.*, 465 U.S. 752 (1984), the Supreme Court ruled that evidence that a manufacturer had terminated a price-cutting retailer after having received complaints from competing retailers was not enough to infer a price-fixing agreement. More recently, in *Business Electronics Corp. v. Sharp Electronics Corp.*, 485 U.S. 717 (1988), the Supreme Court distinguished an agreement between a manufacturer and its active retailers to terminate a discounteer that did not obligate the retailers to maintain a given retail price on the one hand, from an agreement that did obligate the active retailers to maintain a given retail price.

ers. Nonetheless, there is a growing frustration, evident in recent academic literature, textbooks, and even Supreme Court opinions,<sup>22</sup> over the failure of the traditional efficiency explanations to account for a wide range of observed instances of RPM.<sup>23</sup>

In this article, I have provided a theory of RPM that is based on compensating retailers for the opportunity cost of their shelf space and that does not hinge on the existence of externalities in nonprice competition. Yet the theory does not go so far as to predict universal coverage of RPM on all products. Rather, RPM emerges as a solution to the manufacturer's vertical control problem only if, in the absence of RPM, the equilibrium retail price of its product would rise if a single retailer were to drop its product and instead sell a competing brand. This suggests that RPM is less apt to arise the closer are competing brands as substitutes. It is also essential for the theory that retailers have some (local) market power. If competition among downstream firms were to constrain retailers always to price at marginal cost, there would be no role for RPM.

The reservation profit squeeze motive for RPM generalizes to the case of many retailers and is not limited to situations in which retail shelf space is scarce. The assumption that retailers could only sell a single brand was made for simplicity. More generally, of course, individual retailers may sell any number of brands in a given product category. Yet, the same insights extend to this setting as well, as long as the retailer's profit on its substitute brands is increasing in the price of the manufacturer's product at rival retail stores. If so, the crucial determinant of when the manufacturer can profitably impose RPM as a reservation profit squeeze once again depends on what would happen to the equilibrium retail price of its product if a single retailer were to cease carrying it. If it would rise, RPM is profitable. If it would fall, the manufacturer may be better off compensating retailers via two-part pricing.

#### APPENDIX A

*Proof of Lemma 1.* The proof proceeds by first supposing the contrary, deriving a set of implications from this supposition and then establishing a contradiction.

22. See Winter (1993), Scherer and Ross (1990), and the Supreme Court's opinion in *Business Electronics v. Sharp Electronics*, cited in footnote 21.

23. In the past, the extent and coverage of RPM was widespread (Overstreet, 1983, pp. 113, 151–155). In the United States, RPM was enforced on an estimated 4–10% of U.S. retail sales. In England, RPM was at one time enforced on more than 40% of consumer goods expenditures. In Canada, 20% of grocery sales and 60% of drug store sales were price maintained.

If Lemma 1 is false, at least one min or max RPM contract exists that induces both retailers to sell product A and yields strictly higher profit than all two-part pricing and fixed-price RPM contracts. Without loss of generality, let  $w^*$  denote the wholesale price in such a contract, and consider either a price floor or ceiling at  $P^*$ . There are three cases to consider.

*Case 1:*  $P^* \geq P^A(w^*)$ ,  $P_2^{B,A}(c, w^*)$  or  $P^* \leq P^A(w^*)$ ,  $P_2^{B,A}(c, w^*)$ . In this case, the price restraint either always binds or never binds. If it binds, a fixed-price RPM contract at  $(w^*, P^*)$  yields identical profit. If it never binds, a two-part pricing contract with wholesale price at  $w^*$  and no lump-sum transfer yields identical profit. Hence, the existence of a min or max RPM contract that violates Lemma 1 cannot arise in this case.

*Case 2:*  $P^A(w^*) > P^* > P_2^{B,A}(c, w^*)$ . Establishing a contradiction in this case is more subtle and requires explicit consideration of the profit-maximizing min and max RPM contract. The maximum profit that can be obtained with min RPM while still inducing both retailers to sell product A is

$$2[(P^A(w^*) - c)D_1^A(\tilde{P}^A(w^*)) - \Pi_1^{B,A}(P^*)]. \quad (6)$$

By contrast, the maximum profit that can be obtained with two-part pricing when  $w = w^*$  is

$$2[(P^A(w^*) - c)D_1^A(\tilde{P}^A(w^*)) - \Pi_1^{B,A}(P_2^{B,A}(c, w^*))]. \quad (7)$$

By comparing eqs. (6) and (7), it is seen that eq. (7) yields strictly higher profit since joint profit is the same under the two contracts, and retailers' reservation profits are strictly higher with min RPM. Hence, the existence of a min RPM contract that violates Lemma 1 cannot arise in this case.

The maximum profit that can be obtained with max RPM while still inducing both retailers to sell product A is

$$2[(P^* - c)D_1^A(\tilde{P}^*) - \Pi_1^{B,A}(P_2^{B,A}(c, w^*))]. \quad (8)$$

By comparing eqs. (7) and (8), it is seen that retailers' reservation profits are the same under the two contracts. However, if  $P^l \geq P^A(w^*)$ , joint profits are strictly lower with max RPM, and, hence, profit in eq. (7) is strictly higher than in eq. (8).

On the other hand, if  $P^l < P^A(w^*)$ , the manufacturer can improve on eq. (8) by choosing a two-part pricing contract with  $w = w^l < w^*$ . The maximum profit that can be obtained with such a contract while

still inducing both retailers to sell product A is

$$2[(P^I - c)D_1^A(\tilde{P}^I) - \Pi_1^{B,A}(P_2^{B,A}(c, w^I))]. \quad (9)$$

By comparing eqs. (8) and (9), it is seen that joint profits are strictly higher and retailers' reservation profits are strictly lower in eq. (9). Thus, profit in eq. (9) is strictly higher than in eq. (8), and, hence, the existence of a max RPM contract that violates Lemma 1 cannot arise in this case.

*Case 3:*  $P_2^{B,A}(c, w^*) > P^* > P^A(w^*)$ . In this case, the maximum profit that can be obtained with min RPM while still inducing both retailers to sell product A is given by eq. (8). By contrast, the maximum profit that can be obtained with a fixed-price RPM contract at  $P = P^*$  is

$$2[(P^* - c)D_1^A(\tilde{P}^*) - \Pi_1^{B,A}(P^*)]. \quad (10)$$

By comparing eqs. (8) and (10), it is seen that eq. (10) yields strictly higher profit, since joint profit is the same under the two contracts, and retailers' reservation profits are strictly higher with min RPM. Hence, the existence of a min RPM contract that violates Lemma 1 cannot arise in this case.

The maximum profit that can be obtained with max RPM while still inducing both retailers to sell product A is given by eq. (6). By comparing eqs. (6) and (10), it is seen that retailers' reservation profits are the same in the two contracts. However, if  $P^I \geq P^*$ , joint profits are strictly lower with max RPM, and, hence, profit in eq. (10) is strictly higher than in eq. (6).

On the other hand, if  $P^I < P^*$ , the manufacturer can improve on eq. (6) by choosing a fixed-price RPM contract at  $P = P^I$ . The maximum profit that can be obtained with such a contract while still inducing both retailers to sell product A is

$$2[(P^I - c)D_1^A(\tilde{P}^I) - \Pi_1^{B,A}(P^I)]. \quad (11)$$

By comparing eqs. (6) and (11), it is seen that joint profits are strictly higher and retailers' reservation profits are strictly lower in eq. (11). Thus, profit in eq. (11) is strictly higher than in eq. (6), and, hence, the existence of a max RPM contract that violates Lemma 1 cannot arise in this case.

The three cases exhaust the full range of possibilities. I have shown that in each case, there does not exist a max or min RPM contract that violates Lemma 1. This establishes a contradiction to the supposition that such a contract exists. Hence, Lemma 1 is proved.  $\square$

## APPENDIX B

*Proof of Lemma 2:* Recall from Lemma 1 that when  $\bar{\Pi}_m > \Pi_m^*$ , there does not exist a profit-maximizing min or max RPM contract that yields strictly higher profit than in the manufacturer's profit-maximizing fixed-price RPM contract. Thus, sufficiency is established by verifying that the set of conditions in Lemma 2 ensure profit equal to  $\bar{\Pi}_m$ . To prove necessity, I first suppose Lemma 2 to be false, derive a set of implications from this supposition, and then establish a contradiction. Thus, I begin by positing the existence of a min (max) RPM contract that yields profit equal to  $\bar{\Pi}_m$  and yet does not satisfy the required conditions when  $\bar{\Pi}_m > \Pi_m^*$ . Without loss of generality, let  $w^*$  denote the wholesale price in such an RPM contract, and consider either a price floor or ceiling at  $P^{**}$ . There are three cases to consider.

*Case 1:*  $P^{**} \geq P^A(w^{**})$ ,  $P_2^{B,A}(c, w^{**})$  or  $P^{**} \leq P^A(w^{**})$ ,  $P_2^{B,A}(c, w^{**})$ . In this case, the price restraint either always binds or never binds. If it never binds, a two-part pricing contract with wholesale price at  $w^{**}$  and no lump-sum transfer yields identical profit and, thus, is necessarily less than  $\bar{\Pi}_m$ . If it binds, a fixed-price RPM contract at  $(w^{**}, P^{**})$  yields identical profit. By the definition of  $\bar{w}$  and  $\bar{P}$ , however, unless  $w^{**} = \bar{w}$  and  $P^{**} = \bar{P}$ , there exists a fixed-price RPM contract that yields strictly higher profit. But if  $w^{**} = \bar{w}$  and  $P^{**} = \bar{P}$ , the conditions of Lemma 2 are satisfied. Hence, there does not exist a min or max RPM contract that violates Lemma 2 in this case.

Cases 2 and 3, the same as in Appendix A, can also be ruled out, since I have already shown that all min and max RPM contracts in these cases yield profit strictly less than  $\max\{\bar{\Pi}_m, \Pi_m^*\}$ . Thus, since Cases 1–3 exhaust the full range of possibilities, there does not exist a max or min RPM contract that violates Lemma 2. This establishes Lemma 2.  $\square$

## APPENDIX C

For the linear demand example introduced in Section 4, straightforward calculations using Mathematica software yield the following manufacturer profits and retail prices with two-part pricing and RPM for the case in which  $V = 10$ ,  $c = c_b = 0$ , and  $s = \frac{3}{4}$ .

*Manufacturer Sells to One Retailer*

$$\Pi_m^s = \frac{75(4 + 7\gamma)^2}{4(2 + 3\gamma)(8 + 16\gamma + 3\gamma^2)}, \quad P^s = \frac{10(4 + 7\gamma)}{8 + 16\gamma + 3\gamma^2}.$$

Manufacturer Sells to Both Retailers (RPM)

$$\bar{\Pi}_m = \frac{100(1 + 2\gamma)(4 + 9\gamma)}{(2 + 3\gamma)(16 + 32\gamma + 3\gamma^2)}, \quad \bar{P} = \frac{20(4 + 7\gamma)}{16 + 32\gamma + 3\gamma^2},$$

$$P_2^{B,A}(c_b, \bar{w}) = \frac{20(128 + 520\gamma + 582\gamma^2 + 117\gamma^3)}{3(8 + 18\gamma + 3\gamma^2)(16 + 32\gamma + 9\gamma^2)},$$

$$P^A(\bar{w}) = \frac{20(4 + 9\gamma)}{3(8 + 18\gamma + 3\gamma^2)}.$$

Manufacturer Sells to Both Retailers (Two-Part Pricing)

$$\begin{aligned} \Pi_m^* &= \frac{50(1 + 2\gamma)(512 + 3008\gamma + 6272\gamma^2 + 5400\gamma^3 + 1683\gamma^4 + 216\gamma^5)}{(2 + 3\gamma)(1024 + 6144\gamma + 13488\gamma^2 + 12992\gamma^3 + 5196\gamma^4 + 792\gamma^5 + 27\gamma^6)}, \\ P^A(w^*) &= \frac{20(8 + 13\gamma)(4 + 9\gamma + 3\gamma^2)(8 + 16\gamma + 3\gamma^2)}{1024 + 6144\gamma + 13488\gamma^2 + 12992\gamma^3 + 5196\gamma^4 + 792\gamma^5 + 27\gamma^6}. \end{aligned}$$

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