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Slotting allowances and resale price maintenance: a comparison of facilitating practices

Greg Shaffer*

Producers in a perfectly competitive industry compete to obtain shelf space at the retail level. Barring contract observability problems, slotting allowances are observed in equilibrium. Producers charge a high wholesale price, but they give back their profits via up-front payments to retailers. However, if the individual supplier-retailer wholesale price terms are unobservable by competitors, then resale price maintenance will be seen, but the coverage will not be universal. The equilibria can be ranked by the usual social welfare criteria. Resale price maintenance, though worse than simple marginal cost wholesale pricing, yields greater surplus than the slotting allowance equilibrium.

1. Introduction

■ Shelf space at the retail level is becoming increasingly scarce. Although the number of products sold by the average grocery store has grown from 11,800 to 20,000 in the last ten years, the number of new product introductions has increased from 2,600 per year in 1978 to 10,200 per year in 1987.¹ Retailers are now confronted by more product categories and more brands per category than ever before.²

Coupled with high local retailing concentration, this product proliferation has shifted the balance of power away from manufacturers and led to increased competition among producers for the limited amount of store space.³ Evidence of such competition may be inferred from the growing incidence of slotting allowances (shelf space rental fees) during the past decade. This practice, and the use of resale price maintenance (RPM) to obtain shelf space, will be the focus of this article.

Slotting allowances, also known as street money or placement allowances, are fees paid by manufacturers to obtain retailer patronage. They may be cash gifts or payments in kind, such as cases of free goods. Either way, their salient characteristic is that the fee paid does not vary with subsequent retailer sales.

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¹ Chicago Tribune (1988).

² For example, in the Los Angeles area alone, there are 15 varieties of green peas, 19 different kinds of mustard, 12 brands of frozen pizza, etc., all vying for shelf space.

³ Porter (1976) estimates that an average of two to five retailers per industry operate in any given local market. A wave of mergers since then has further increased concentration. See Johnson (1987), chapters 4 and 8.

Although payment of fees to retailers has been documented at least as far back as the A & P case in the 1930s, and free cases of goods as well as other forms of shelf space rivalry have been around for a long time, there seems to have been an increase in the magnitude of the allowances during the last ten years.⁴ Unfortunately, these fees are negotiated orally and in private, hence public data is nonexistent. However, recent trade press articles quote industry sources that suggest the practice accounts for one-third to one-half of the \$19 billion spent by producers on trade promotions in 1987. Some warehouses and grocery chains are said to be demanding up to \$100,000 for each product stocked.⁵ The shelf space shortage appears to be most acute among frozen foods, dairy products, and microwaveable shelf stable foods.

RPM, a restraint imposed by a manufacturer on his retailers that restricts the price at which his product may be resold, has been per se illegal since 1975. But because current economic theories of RPM are based on efficiency explanations such as information free-riding and dealer service repair externalities, the Department of Justice recently argued in its amicus brief in *Monsanto Co. v. Spray-Rite Service Corp.*, 465 U.S. 752 (1984) that RPM was unsuitable for per se treatment. Furthermore, the Supreme Court's recent ruling in *Business Electronics v. Sharp Electronics* (1988) tacitly allows for products to be price maintained.⁶

One of the themes of this article is that RPM is consistent with shelf space rivalry. In providing a means for retailers to commit contractually to high prices, a manufacturer can indirectly raise retailer profits by eliminating their incentive for aggressive downstream pricing. Although manufacturers would prefer lower retail prices and hence greater sales, the competition among themselves for the scarce shelf space provides the incentive for such contracts. Unlike the free-riding and dealer repair service theories, this explanation does not rely on the complexity of the product. When it was legal, the practice was used for both technical products as well as convenience goods, with the majority of items having been sold in drug stores and supermarkets.

This article provides an equilibrium analysis of both RPM and slotting allowances. Each practice serves to increase retailer profits. At first blush, shelf space rental fees appear to be innocuous, since pure transfers of profit between industries have no welfare consequence. However, this implicitly assumes that the sum of producer and retailer industry profits is fixed. In general, this will not be true. Manufacturers are in competition with each other to obtain retailer patronage, and retailers compete among themselves to obtain customer favor. Slotting allowances, by lessening competition at the retail level, serve to increase the profit pie. Since manufacturers must earn nonnegative profits, slotting allowance contracts coincide with per-unit wholesale prices which are above production marginal cost. Retailers who sign such contracts not only receive a direct up-front payment but also benefit indirectly from the reduced downstream price competition. By committing to a relatively high wholesale cost, a retail firm essentially announces its intention to be less aggressive in its pricing. Other firms are induced to raise their retail prices, and the original firm gains through the feedback effects.⁷

The main thrust of this article is that RPM and slotting allowances may have anticompetitive effects. Since both are contractual provisions that can raise retailer prices and profits,

⁴ Perhaps this is due to the Reagan administration's lenient interpretation and enforcement of the price discrimination laws.

⁵ See *Advertising Age* (1987).

⁶ The court ruled that a manufacturer's agreement with high-priced dealers to stop supplying discounters is not necessarily an antitrust violation. See *New York Times* (1988).

⁷ This is the familiar puppy-dog strategy (see Fudenburg and Tirole, 1984). I'm assuming of course, that price reaction functions are upward sloping. If not, then rivals will react by lowering their prices. Such a response would lower the profits of the firm signing the slotting allowance contract.

they may be added to the class of facilitating practices.⁸ The *sine qua non* of these practices is the profitability of the independent rational reactions of one's rivals. In the slotting allowances case, each manufacturer raises the wholesale price to his retailer, thereby committing her to less aggressive retail pricing. With legalized RPM, a retailer commits herself directly to a retail price by choosing a price-maintained product. In both cases, rivals act on this information in such a way as to raise profits for all. In a pricing game with upward-sloping reaction functions, commitment to a relatively high price induces each rival to raise her own price. Their price increases then have positive first-order feedback effects on the first firm's profit.

Similar models are found elsewhere. In the principal-agent literature, Fershtman and Judd (1987) show that noncooperative owners can write compensation contracts for their managers in such a way as to increase firm profits above the precontract Nash equilibrium. Similarly, Bonanno and Vickers (1988) have shown that vertical separation dominates integration when manufacturers can set two-part tariffs and extract all the rent. Likewise, it is well known that sham innovations can be cross-licensed to achieve the collusive outcome.⁹

In addition to identifying slotting allowances and RPM as facilitating practices, I am also able to rank the pair in terms of social welfare. Retailer prices and profits are found to be higher with slotting allowances than with RPM. Furthermore, if RPM is observed, prices and profits at the retail level will be greater when the coverage is incomplete, i.e., when not all brands are price maintained. The result that downstream prices and profits are greater when retailers commit to high marginal costs rather than to high prices directly seems somewhat surprising.

RPM is an example of a contractual provision that inhibits a firm from reacting to its competitors. Any retailer who chooses a price-maintained product has tied her hands regardless of her opponents' choice of prices. In a downstream duopoly, if both retailers choose RPM, neither can respond to the other's commitment. At equilibrium, prices and profits are at the nonstrategic Bertrand Nash outcome. If only one firm chooses RPM, the other retains pricing flexibility. Industry prices and profits increase and welfare declines.¹⁰ If neither firm chooses RPM, both retailers have the ability to react strategically to their rival. In the slotting allowances case, both firms sign contracts with high marginal costs and both firms retain their pricing flexibility. This combination accounts for the relatively higher profits and poorer welfare performance of this practice.

This article is organized in the following manner. Section 2 presents the formal model. Section 3 derives the benchmark case, where neither practice is allowed. Sections 4 through 6 examine the two practices individually and in conjunction. Here I find that shelf space rental fees lead to higher retail prices and profits, and hence lower welfare performance, than RPM. Section 7 summarizes the welfare results and explores the extent to which prices can be raised in a linear demand framework. Section 8 concludes with a policy discussion of the implications of this research.

2. The model

■ Consider a market for a homogeneous product that is produced by a perfectly competitive manufacturing industry and sold by a differentiated retail duopoly.¹¹ Retailers are differ-

⁸ See Salop (1986) for a general overview.

⁹ See Shapiro (1985).

¹⁰ The outcome is similar to a Stackelberg price leader game.

¹¹ The model would work equally well if I assumed a large number of symmetrically differentiated suppliers vying for one available slot at each store. Competition among the upstream firms would ensure that no producer could earn positive profit in equilibrium.

entiated in the sense that even though the product they sell is homogeneous, customers differ in their store preference. Thus, unequal retail prices do not cause demand at the higher-priced store to fall to zero. One familiar model in the literature is that of spatial competition. Consumers are located between the two stores and incur positive transportation costs when they buy. Here, retailers are differentiated in a spatial sense. This is one justification for the assumption, but there is no need to limit oneself to this explanation. Casual observation should confirm that consumers have store preference. They may prefer store i 's layout, parking, carpet, music, sales personnel, etc., or they may desire multiple products, only some of which store j has. However, not all consumers agree on their store preferences.¹²

Manufacturers compete to gain access to the retail level. I assume they are unable to set up shop and sell independently. This is descriptive, since most consumer goods are sold through multiproduct retail outlets, where overhead costs are diffused. Opening a single-item outlet would be prohibitively costly.

The precise form of the allowable supplier contracts will matter greatly in the ensuing game. Attention is restricted to contracts that are not contingent on rival suppliers' prices or quantities. Such contracts would almost surely be violating antitrust laws on horizontal price fixing. Quantity discounts are allowed in the form of a two-part tariff. A negative fixed fee corresponds to the slotting allowances observed in practice. In addition, each producer has the option to write a contract stipulating his product's resale price. Finally, producers may specify a clause prohibiting rival products from being sold at the same retail outlet.¹³

The game is played in three stages. In the first stage, manufacturers simultaneously announce the terms of their sales contracts. This will involve specifying the unit wholesale price, the fixed fee coupled with the sole supplier clause, and the maintained price, if any. Retailers then choose which producer to buy from, and in the last stage they compete in a noncooperative pricing game. Players at each stage choose their actions knowing the effects of such actions on all succeeding stages. All information is common knowledge.

□ Demand specification and notation.

Assumption 1. Retail demand functions $D^i(P)$ are differentiable, downward-sloping, substitutes, and they satisfy the definiteness property.

$$D_i^i < 0, \quad D_j^j > 0, \quad D_i^i D_j^j - D_j^i D_i^j \geq 0,$$

where $P = (P_1, P_2)$ is the vector of retail prices. Superscripts above the demand function denote the retailer, while subscripts indicate partial derivatives with respect to prices.

Assumption 2. Let w_i be the per-unit wholesale cost and let F_i be the fixed fee specified in the contract with retailer i 's supplier. Then retailer i 's profit is given by

$$\pi^i(P; F_i) = (P_i - w_i)D^i(P) - F_i.$$

Furthermore, let $\Delta = \pi_{ii}^i \pi_{jj}^j - \pi_{ij}^i \pi_{ji}^j$. I will assume

$$\pi_{ii}^i < 0, \quad \pi_{ij}^i > 0, \quad \Delta > D_j^i \pi_{ji}^j,$$

where the subscripts denote partial derivatives with respect to prices. The first condition is necessary for profit maximization. The second condition states that a firm's marginal profit increases with its rival's price. This is critical to the analysis, for it ensures that Bertrand reaction functions slope upward. The last condition not only guarantees uniqueness of the

¹² A large marketing literature exists on retailer differentiation strategies. See Johnson (1987) for a survey.

¹³ This last assumption is necessary to legally prohibit the retailer from accepting slotting allowances but then not stocking the manufacturer's product. Without this restriction, suppliers would not offer negative fixed fees, since in a static one-shot game retailers cannot be trusted.

Nash equilibrium,¹⁴ it also ensures that absent fixed-fee transfers between a manufacturer and his retailer, each retailer's equilibrium profit will be decreasing in her marginal cost w .¹⁵

Assumption 3. Let c be the manufacturer's constant unit production cost. Then the supplier who sells to retailer i will earn profit denoted by $(w_i - c)D^i(P) + F_i$.

3. No RPM, no slotting allowances

■ In this section I derive equilibrium prices and profits assuming that RPM is illegal and that producers are unwilling or unable to set fixed-fee transfers ($F_i = 0$). This case will be the standard for future comparisons when these assumptions are relaxed.

Consider the stage-three pricing game. Each retailer chooses a supplier with a corresponding wholesale price. The first-order conditions for profit maximization are given by $\pi_i^i = (P_i - w_i)D_i^i + D^i = 0$, where the arguments of the demand function have been omitted for brevity. From the assumptions, there exists a unique equilibrium in prices. Denote the equilibrium price and profit vector when both retailers retain their pricing flexibility as

$$P^{BB} = (P_1^{BB}(w_1, w_2), P_2^{BB}(w_1, w_2)), \quad \Pi^{BB} = (\pi^1(P^{BB}; F_1 = 0), \pi^2(P^{BB}; F_2 = 0)).$$

Now look at the first two stages. To obtain shelf space at store i , a manufacturer must offer the retailer a contract that will yield her at least as much in profit as she could get by stocking another supplier's product. At the same time, the manufacturer will not offer a contract that earns him negative profit. In equilibrium, retailer i will choose to purchase from a supplier who sets w to solve

$$\max (P_i^{BB} - w_i)D^i(P^{BB}) \quad \text{such that} \quad (w_i - c)D^i(P^{BB}) \geq 0. \quad (1)$$

Proposition 1. The equilibrium supplier contract has the transfer wholesale price equal to supplier marginal cost ($w_i = c$).

Proof. Set up the Lagrangian function and solve. It is easy to check that $w_i = c$ will satisfy the Kuhn-Tucker conditions. Using Assumption 2, it can be shown that w_i cannot exceed c . Wholesale prices less than c violate the nonnegative manufacturer profit constraint. *Q.E.D.*

Since the upstream industry is perfectly competitive, no manufacturing firm will be able to make positive profit. Any firm whose selling contract yielded it strictly positive profit would lose retailer patronage because another upstream firm would be able to offer the retailer higher profits by lowering its wholesale price. Thus the downstream firms have all of the bargaining power and will therefore be able to extract all of the channel profit.

Denote the equilibrium price vector in the benchmark case as

$$P^B = (P_1^{BB}(c, c), P_2^{BB}(c, c))$$

and the profit vector $\Pi^B = (\pi^1(P^B; F_1 = 0), \pi^2(P^B; F_2 = 0))$.

4. Slotting allowances, no RPM

■ Now allow fixed fees.¹⁶ There is no restriction on their sign. The manufacturers announce two-part tariff contracts subject only to earning nonnegative profits. The retail

¹⁴ See Friedman (1983).

¹⁵ This condition is satisfied with linear demands. In that case $\pi_{ii}^i = 2D_i^i$, $\pi_{ij}^i = D_j^i$, $\pi_{ji}^j = D_i^j$, and $\pi_{jj}^j = 2D_j^j$. Then $(D_j^j \pi_{ji}^j - \Delta) = 2D_j^j D_i^j - 4D_i^i D_j^j < 0$ by Assumption 1.

¹⁶ For a similar analysis see Bonanno and Vickers (1988). These authors have essentially derived Propositions 2 and 3 in the context of an upstream duopoly who sell to independent homogeneous retailers.

pricing game looks exactly as it did in the previous section. Retailer i 's profit is given by $(P_i - w_i)D^i(P) - F_i$, and the corresponding first-order condition is

$$\pi_i^i = (P_i - w_i)D_i^i + D^i = 0.$$

This yields $P^{BB} = (P_1^{BB}(w_1, w_2), P_2^{BB}(w_1, w_2))$.

In stage two, each retailer will purchase from the supplier who enables her to earn the highest profit. In equilibrium the supplier chosen by retailer i will be the one who has set (w, F) to maximize his retailer's profit, taking as given the other retailer's sales contract and subject to earning nonnegative profit.

$$\max_{w_i, F_i} (P_i^{BB} - w_i)D^i(P^{BB}) - F_i \quad \text{such that} \quad (w_i - c)D^i(P^{BB}) + F_i \geq 0. \quad (2)$$

Differentiating with respect to w and simplifying gives

$$[(P_i^{BB} - c)D_i^i + D^i] \frac{\partial P_i^{BB}}{\partial w_i} + (P_i^{BB} - c)D_j^i \frac{\partial P_j^{BB}}{\partial w_i} = 0. \quad (3)$$

Substituting the retailer's profit-maximizing condition for the term in brackets gives

$$(w_i - c)D_i^i \frac{\partial P_i^{BB}}{\partial w_i} + (P_i^{BB} - c)D_j^i \frac{\partial P_j^{BB}}{\partial w_i} = 0. \quad (4)$$

By Assumption 1, $D_i^i < 0$ and $D_j^i > 0$. By totally differentiating the stage-three retailer first-order conditions, one can show

$$\frac{\partial P_i^{BB}}{\partial w_i} = \frac{D_i^i \pi_{ji}^j}{\Delta} > 0, \quad \frac{\partial P_j^{BB}}{\partial w_i} = -\frac{D_i^i \pi_{ji}^j}{\Delta} > 0. \quad (5)$$

Thus (4) can be separated into the negative direct effect of the loss in profit due to firm i 's own price increase, and the positive indirect effect in firm i 's profits due to firm j 's price increase.

Proposition 2. The equilibrium supplier contract when two-part tariffs are allowed has $w_i > c$ and $F_i < 0$.¹⁷

Proof. Suppose not. Then there are two cases to consider. Suppose $w_i = c$. Then the first term in (4) equals zero. But the second term is positive. Therefore $w_i \neq c$. Suppose $w_i < c$. Then the first term in (4) is greater than zero. But this can only be a solution if $P_i^{BB} < c$, making the second term negative. If $P_i^{BB} < c$, then F_i must be less than zero for the retailer to be making profit. But then $w_i < c$ and $F_i < 0$, which violates the manufacturer's break-even constraint. *Q.E.D.*

The intuition is straightforward. By committing herself to $w_i > c$, retailer i gives retailer j an incentive to raise her price. This has a positive first-order effect on retailer i 's profit. The lost revenue from each sale is returned to the retailer through the slotting allowance she receives. Retailer j has similar incentives. In equilibrium, both retailers choose to commit themselves to $w > c$. This enables them to raise their profits above the Nash level found in the previous section. See Proposition 3.

Let $w^s = (w_1^s, w_2^s)$ and $F^s = (F_1^s, F_2^s)$ be the vector of Nash wholesale prices and fixed fees obtained in the slotting allowance equilibrium. Denote prices and profits by

$$P^S = (P_1^{BB}(w_1^s, w_2^s), P_2^{BB}(w_1^s, w_2^s)), \quad \Pi^S = (\pi^1(P^S; F_1^s), \pi^2(P^S; F_2^s)).$$

Proposition 3. Retailer prices and profits are higher when manufacturers are able to use

¹⁷ See Bonanno and Vickers (1988), proposition 1.

slotting allowances to obtain shelf space than when they are not. That is, $P^S > P^B$ and $\Pi^S > \Pi^B$.¹⁸

Proof. Since $\partial P_j^{BB}/\partial w_i$ and $\partial P_i^{BB}/\partial w_i > 0$ and w_1^s and $w_2^s > c$,

$$P_1^S = P_1^{BB}(w_1^s, w_2^s) > P_1^{BB}(w_1^s, c) > P_1^{BB}(c, c) = P_1^B,$$

and similarly $P_2^S > P_2^B$. To prove $\Pi^S > \Pi^B$, I first derive $\partial \pi^i(P^{BB})/\partial w_j$.

$$\partial \pi^i(P^{BB})/\partial w_j = [(P_i^{BB} - w_i)D_i^i + D_i^i] \frac{\partial P_i^{BB}}{\partial w_j} + (P_i^{BB} - w_i)D_j^i \frac{\partial P_j^{BB}}{\partial w_j}. \quad (6)$$

By the first-order condition for retailer profit maximization, the first term equals zero. Hence $\partial \pi^i(P^{BB})/\partial w_j > 0$ for all w . Now recall

$$\Pi_1^S = \pi^1(P_1^{BB}(w_1^s, w_2^s), P_2^{BB}(w_1^s, w_2^s); F_1^s).$$

Therefore

$$\Pi_1^S > \pi^1(P_1^{BB}(c, w_2^s), P_2^{BB}(c, w_2^s); F_1 = 0) > \pi^1(P_1^{BB}(c, c), P_2^{BB}(c, c); F_1 = 0) = \Pi_1^B,$$

where the first inequality is by the definition of Nash equilibrium and the second inequality is true because $\partial \pi^i(P^{BB})/\partial w_j > 0$, as found above. A similar calculation shows $\Pi_2^S > \Pi_2^B$. *Q.E.D.*

This analysis relies critically on the ability of retailer j to observe the details of retailer i 's contract. Formally, if w_i is not observed, then $\partial P_j^{BB}/\partial w_i = 0$ and the solution to (4) has $w_i^s = c$. The game is played as if w and P were chosen simultaneously instead of sequentially. Observability could be a serious problem, especially given the retailers' incentives to produce bogus contracts, showing artificially high w 's.¹⁹

Similarly, this analysis assumes away enforcement costs associated with retailer moral hazard. Unrestricted cash bribes permit retailers to sign multiple contracts, collecting payments but selling only those goods that yield the greatest per-unit sale incentives. To prevent this, manufacturers will insist on a sole-supplier arrangement. Even so, monitoring costs could be substantial. Explicit proof of infringement would be needed by third-party enforcers. Inferential evidence, such as a decline in the injured supplier's sales, would not be acceptable.²⁰

Thus whether slotting allowances are observed in practice depends on both the retailers' moral hazard and supplier monitoring costs as well as the observability of the supplier contracts.

5. RPM, no slotting allowances

■ In this section I allow contracts to include RPM but assume fixed fees cannot be used. There are three possibilities: RPM is not observed; RPM is used by both retailers; or RPM is used by one retailer.

If RPM is not observed, then the results from Section 3 apply. I found

$$P^B = (P_1^{BB}(c, c), P_2^{BB}(c, c)), \quad \Pi^B = (\pi^1(P^B; F_1 = 0), \pi^2(P^B; F_2 = 0)).$$

If RPM is observed at both stores, the stage-three pricing game will be trivially determined. The retailers do, however, still choose from among the suppliers. An equilibrium in stage three is one in which neither retailer has an incentive to change suppliers, given

¹⁸ See Bonanno and Vickers (1988), proposition 2.

¹⁹ See Katz (1986) for a critique of observable contracts.

²⁰ Alternatively, I could have analyzed contracts that allowed quantity forcing. Such a contract would specify a minimum sales transaction.

the other's choice. Thus the manufacturer who is stocked by retailer i will be the one who has chosen (P, w) to maximize i 's profit subject to his breakeven condition. Formally, the problem is

$$\max_{P_i, w_i} (P_i - w_i)D^i(P_i, P_j) \quad \text{such that} \quad (w_i - c)D^i(P_i, P_j) \geq 0. \quad (7)$$

Solving for the Nash equilibrium of this system yields $w_i = c$, $P = P^B$, and $\Pi = \Pi^B$. This solution is precisely the same as the retailers' benchmark Nash equilibrium in their pricing game of Section 3. Without the use of fixed fees and the opportunity for strategic play that they give, two manufacturers simultaneously and non-cooperatively maximizing their retailers' profits can do no better than the retailers can themselves. Thus the case in which RPM is used by both retailers is equivalent to the benchmark case, when neither RPM nor fixed fees were allowed.

Lastly, consider the case in which RPM is used at one store. Begin by considering the stage-three pricing game for the firm not using RPM. Suppose retailer 1 uses RPM. Retailer 2's maximization is given by $\max_{P_2} (P_2 - w_2)D^2(P_1, P_2)$. Her first-order condition is $(P_2 - w_2)D_2^2 + D^2 = 0$. Solving for retailer 2's price when retailer 1 has RPM gives $P_2^{MB} = P_2^{MB}(P_1, w_2)$.

The manufacturers' game can now be split into two parts. First, consider the producer who is chosen by retailer 2. The producer so chosen will have maximized

$$(P_2^{MB} - w_2)D^2(P_1, P_2^{MB}) \quad \text{such that} \quad (w_2 - c)D^2(P_1, P_2^{MB}) \geq 0. \quad (8)$$

It is easy to verify that $w_2 = c$ satisfies the Kuhn-Tucker conditions. The intuition behind this result is simple. It says that when faced with an opponent whose hands are tied (her price is contractually determined), the best strategy for retailer 2 is to retain maximum flexibility by buying at the lowest wholesale price available. There is no commitment value in choosing $w_2 > c$. The only reason to have done so would have been to induce P_1 to be higher. This is not possible when retailer 1 has chosen RPM.

Now consider retailer 1's supplier. To secure his place on the shelf he must choose P_1 to maximize retailer 1's profits subject to his zero-profit condition. Formally, P_1 is chosen to maximize $(P_1 - c)D^1(P_1, P_2^{MB}(P_1, w_2))$. The first-order condition gives

$$[(P_1 - c)D_1^1 + D^1] + (P_1 - c)D_2^1 \frac{\partial P_2^{MB}}{\partial P_1} = 0. \quad (9)$$

Without the second term, and with c substituted for w_2 , the solution would give P_1^B . But (9) says that 1's supplier takes into account retailer 2's price response. The second term will be positive if and only if $\partial P_2^{MB} / \partial P_1 > 0$. This can easily be verified by applying the implicit function theorem to retailer 2's first-order condition.

$$\frac{\partial P_2^{MB}}{\partial P_1} = \frac{-[(P_2 - w_2)D_{21}^2 + D_1^2]}{(P_2 - w_2)D_{22}^2 + 2D_2^2} = -\frac{\pi_{21}^2}{\pi_{22}^2} > 0. \quad (10)$$

Because of the second term, the manufacturer will choose $P_1 > P_1^{BB}(c, c)$. At

$$P_1 = P_1^{BB}(c, c), \quad P_2^{MB} = P_2^{BB}(c, c) \quad \text{and} \quad (P_1^{BB} - c)D_1^1 + D^1 = 0.$$

The positive second term indicates that profit can be increased with a higher P_1 . Therefore let P_1^{MB} solve (9). Then the downstream equilibrium prices and profits when retailer 1 chooses RPM and retailer 2 remains flexible can be denoted

$$P^M = (P_1^{MB}, P_2^{MB}(P_1^{MB}, c)), \quad \Pi^M = (\pi^1(P^M; F_1 = 0), \pi_2(P^M; F_2 = 0)).$$

The following two lemmas establish that prices and profits for both retailers will be

higher in this case than in the benchmark case. I shall use these results to show that the scenario in which neither retailer chooses RPM cannot be an equilibrium of the game.

Lemma 1. $P_2^{MB}(P_1^{MB}, c) > P_2^{BB}(c, c)$.

Proof. By the definition of a Nash equilibrium, $P_2^{BB}(c, c) = P_2^{MB}(P_1^{BB}(c, c), c)$. It was shown that $P_1^{MB} > P_1^{BB}(c, c)$. Since $\partial P_2^{MB}/\partial P_1 > 0$, $P_2^{MB}(P_1^{MB}, c) > P_2^{BB}(c, c)$. *Q.E.D.*

Lemma 2. $\Pi^M > \Pi^B$.

Proof. This is a standard result in the literature on price leader and follower games. In this model the firm choosing RPM acts as a price leader, while the uncommitted firm is the price follower. Both retailers earn higher profits than in the benchmark case with simultaneous play. *Q.E.D.*

Proposition 4. At least one retailer will choose to price maintain her product when RPM is legal and fixed fees are not allowed.

Proof. Suppose not. If retailer 2's supplier is charging $w = c$, and not maintaining her retail price, other suppliers will compete to set retailer 1's price at P_1^{MB} and charge c per unit good. By Lemma 2, the resulting profit to retailer 1, Π_1^M , is greater than Π_1^B . *Q.E.D.*

Proposition 5. Retail prices and profits are higher *vis à vis* the benchmark case when RPM is legalized and coverage is incomplete, i.e., one firm chooses not to use RPM.

Proof. This follows immediately from Lemmas 1 and 2. *Q.E.D.*

Since incomplete RPM coverage Pareto dominates price maintenance at both outlets in the two-player game, it can be argued that the former outcome will be observed. Suppose retailer 1 were forced to choose RPM, but retailer 2 had free choice. With preplay communication the reasoning is as follows: retailer 1 tells retailer 2 that she will choose $P_1 = P_1^{MB}$. If she is believed, "2" will choose no RPM and $w_2 = c$. Knowing this, "1" will play $P_1 = P_1^{MB}$. So far, this is just her half of the Nash equilibrium. But simultaneously, retailer 2 will be saying to "1" that she will choose no RPM, $w_2 = c$. Given this, "1" will choose $P_1 = P_1^{MB}$. Therefore, the case in which both retailers impose RPM is not likely to be observed.

The intuition in this section generally and in Proposition 5 in particular is that legalizing RPM is tantamount to allowing retailers to commit to prices. In their attempts to secure retail shelf space, the manufacturers act to increase downstream profits by finding the Stackelberg pricing equilibrium. Both prices and profits will be higher as a result.

6. With RPM and slotting allowances

■ In this section I allow producers to include fixed fees and RPM as part of their sales contracts. As before, there are three possibilities: either zero, one, or both firms will use RPM. Before proceeding to characterize the equilibria in this section, the following two lemmas will prove useful.

Lemma 3. If retailer 2 chooses a two-part tariff contract, retailer 1 will be indifferent between a supplier who maximizes her profit by RPM and a supplier who maximizes her profit via a two-part tariff.

Proof. I shall show that a solution to the first-order conditions of one maximization problem will also solve the first-order conditions of the second maximization problem.

Consider a supplier who maximizes retailer 1's profits by setting P_1 . His problem is $\max_{P_1} (P_1 - c)D^1(P_1, P_2^{MB}(P_1, w_2))$. The first-order condition is given by (9). Substituting the expression for $\partial P_2^{MB}/\partial P_1$ and rearranging gives

$$[(P_1 - c)D_1^1(P_1, P_2^{MB}(P_1, w_2)) + D^1(P_1, P_2^{MB}(P_1, w_2))] \pi_{22}^2 - (P_1 - c)D_2^1(P_1, P_2^{MB}(P_1, w_2)) \pi_{21}^2 = 0. \quad (11)$$

Let $P_1 = \bar{P}_1$ solve this equation.

Now consider a supplier who maximizes retailer 1's profits by setting w_1 and F_1 . His problem is

$$\max_{w_1, F_1} (P_1^{BB}(w_1, w_2) - w_1)D^1(P_1^{BB}(w_1, w_2), P_2^{BB}(w_1, w_2)) - F_1$$

such that $(w_1 - c)D^1(P_1^{BB}(w_1, w_2), P_2^{BB}(w_1, w_2)) + F_1 = 0. \quad (12)$

The first-order condition is

$$[(P_1^{BB} - c)D_1^1(P_1^{BB}, P_2^{BB}) + D^1(P_1^{BB}, P_2^{BB})] \frac{\partial P_1^{BB}}{\partial w_1} + (P_1^{BB} - c)D_2^1(P_1^{BB}, P_2^{BB}) \frac{\partial P_2^{BB}}{\partial w_1} = 0. \quad (13)$$

Substituting the expressions for $\partial P_1^{BB} / \partial w_1$ and $\partial P_2^{BB} / \partial w_1$ and rearranging gives

$$[(P_1^{BB} - c)D_1^1(P_1^{BB}, P_2^{BB}) + D^1(P_1^{BB}, P_2^{BB})] \pi_{22}^2 - (P_1^{BB} - c)D_2^1(P_1^{BB}, P_2^{BB}) \pi_{21}^2 = 0. \quad (14)$$

Now compare (11) and (14). By setting w_1 such that $P_1^{BB}(w_1, w_2) = \bar{P}_1$ and recalling that $P_2^{BB}(w_1, w_2) = P_2^{MB}(P_1^{BB}(w_1, w_2), w_2)$ by the definition of P_2^{BB} , the solution to (11) will also be a solution to (14) and vice versa. Plugging \bar{P}_1 and $P_1^{BB}(w_1, w_2)$ into their respective profit functions, it is seen that retailer 1 will be indifferent between the two cases. *Q.E.D.*

Lemma 4. If retailer 1 chooses an RPM contract, retailer 2 will be indifferent between a supplier who maximizes her profit by RPM and a supplier who maximizes her profit via a two-part tariff.

Proof. As before, I shall show that the solution to the first-order conditions of one maximization problem will also solve the first-order conditions of the second maximization problem.

Consider a supplier who maximizes retailer 2's profit by setting P_2 . His problem is $\max_{P_2} (P_2 - c)D^2(P_1, P_2)$. Let $P_2 = \bar{P}_2$ be the solution.

Now consider a supplier who maximizes retailer 2's profit by setting w_2 and F_2 . His problem is

$$\max_{w_2, F_2} (P_2^{MB}(P_1, w_2) - w_2)D^2(P_1, P_2^{MB}(P_1, w_2)) - F_2$$

such that $(w_2 - c)D^2(P_1, P_2^{MB}(P_1, w_2)) + F_2 = 0. \quad (15)$

By setting w_2 such that $P_2^{MB}(P_1, w_2) = \bar{P}_2$, the solution to the RPM maximization problem can be replicated. Similarly, by setting a maintained price equal to $P_2^{MB}(P_1, w_2)$, the solution to the two-part tariff maximization problem can be replicated. *Q.E.D.*

Proposition 6. There are three equilibrium outcomes in the game in which fixed fees and RPM are allowed.

Proof. Consider the three possibilities. If RPM is not observed, then by application of Lemma 3, the slotting allowance outcome of Section 4 is an equilibrium. It is also unique.

From Lemma 4, the outcome in which both retailers choose RPM and price at the benchmark level is an equilibrium. Allowing fixed fees when RPM is used by both stores is of no consequence, since the wholesale price set equal to supplier marginal cost is sufficient to extract producer surplus.

Using Lemmas 3 and 4, the outcome found in Section 5, in which only one retailer chooses RPM, is also an equilibrium when fixed fees are allowed. It is easy to show that the

retailer who remains price flexible will choose to buy at $w = c$ and $F = 0$. Likewise, the retailer using RPM does not need a fixed fee to capture her supplier's profit.

Therefore the three outcomes are: both retailers choose slotting allowance contracts with prices and profits (P^S, Π^S) ; both retailers choose RPM contracts with prices and profits (P^B, Π^B) ; and only one retailer chooses RPM with prices and profits (P^M, Π^M) . *Q.E.D.*

I have shown that when both retailers sign slotting allowance contracts, retail prices will be higher and sales lower relative to the benchmark case, where producer wholesale prices were set at marginal cost. I have also shown that when both retailers choose resale price maintenance, the outcome will replicate the benchmark case, whereas if only one firm uses RPM, prices and profits will be higher for both firms. The next step is to compare prices and profits in the slotting allowances equilibrium with the corresponding values when RPM is observed at only one store. The following proposition will assess this case.

Consider the case in which both retailers receive slotting allowances. Define $w_i = r_i(w_j)$ to be retailer i 's profit-maximizing wholesale price when j has chosen w_j . If $dr_i/dw_j > 0$, then i 's producer wholesale price reaction function is said to be upward sloping.²¹

Proposition 7. If producer wholesale price reaction functions are upward sloping, retailer prices and profits are higher in the slotting allowance equilibrium than they are in the equilibrium in which one retailer chooses RPM. That is, $P^S > P^M$ and $\Pi^S > \Pi^M$.

Proof. Recall that $P^M = (P_1^{MB}, P_2^{MB})$. By Lemma 3 this equals $(P_1^{BB}(\bar{w}_1, c), P_2^{BB}(\bar{w}_1, c))$, where $\bar{w}_1 = r_1(c)$. Similarly, recall that $P^S = (P_1^{BB}(w_1^s, w_2^s), P_2^{BB}(w_1^s, w_2^s))$, where $w_1^s = r_1(w_2^s)$ and $w_2^s = r_2(w_1^s)$. Since $w_2^s > c$, $w_1^s > \bar{w}_1$ if $dr/dw > 0$. Furthermore, $\partial P^{BB}/\partial w_1$ and $\partial P^{BB}/\partial w_2 > 0$ for all w , by (5). Therefore $P^S > P^M$.

Now consider retailer profits.

$$\begin{aligned} \Pi_1^M &= \pi^1(P_1^{MB}, P_2^{MB}(P_1^{MB}, c); F_1 = 0) \\ &= \pi^1(P_1^{BB}(\bar{w}_1, c), P_2^{MB}(P_1^{BB}(\bar{w}_1, c), c); \bar{F}_1) && \text{by Lemma 3} \\ &= \pi^1(P_1^{BB}(\bar{w}_1, c), P_2^{BB}(\bar{w}_1, c); \bar{F}_1) && \text{by Nash equilibrium} \\ &< \pi^1(P_1^{BB}(\bar{w}_1, w_2^s), P_2^{BB}(\bar{w}_1, w_2^s); \bar{F}_1) && \text{since } \partial \pi^1/\partial w_2 > 0, \text{ by (12)} \\ &< \pi^1(P_1^{BB}(w_1^s, w_2^s), P_2^{BB}(w_1^s, w_2^s); F_1^s) && \text{since } w_1^s = r_1(w_2^s) \\ &= \Pi_1^S. \end{aligned}$$

Similarly, an analogous proof applies for $\Pi_2^S > \Pi_2^M$. *Q.E.D.*

Since the slotting allowance equilibrium Pareto dominates both RPM equilibrium outcomes, an argument similar to the one given earlier provides an intuitive basis for predicting the observance of rental fees. With preplay communication, both players will be announcing their slotting allowance preferences. Given the other's announcement, both players will indeed choose $w = w^s$. Therefore, unless there are observability or monitoring problems associated with the high wholesale prices that come with these contracts, I would not expect to see RPM used in the two-player game when slotting allowances are legal.

RPM directly commits a firm to a retail price. If both retailers choose RPM, neither can react to her opponent's price. Any advantage of commitment in the penultimate stage is lost, since the pricing game is trivialized. With incomplete coverage, one firm commits

²¹ This will be true with linear demands. Implicitly differentiating (4) gives

$$dr_i/dw_j = (\partial P_i^{BB}/\partial w_j)D_i^j D_i^i / (2D_i^i D_i^j - (\partial P_i^{BB}/\partial w_i)D_i^j D_i^i) > 0$$

by Assumption 1. In general, the expression for dr_i/dw_j will contain third derivatives of the retail profit functions and cannot be signed.

itself to a prespecified price while the second firm is free to react accordingly. Retail prices and profits are higher in this case. With slotting allowances, both retailers commit to high marginal costs, and in the final stage both firms can react to the other's commitment. This combination leads to even higher downstream prices. Thus prices and profits will be highest if both firms are playing a puppy-dog strategy. Welfare is lowest in this case.

7. Welfare

■ So far the analysis has shown $(P^S, \Pi^S) > (P^M, \Pi^M) > (P^B, \Pi^B)$. The implication is that both slotting allowances and RPM lower welfare. But important questions remain. By how much do prices rise with RPM (slotting allowances)? In what way do the price differences depend on the perceived differentiation of the retailers? How does the magnitude of the welfare decline compare with the welfare performance of a retail cartel? As a start in answering these questions, I will need to specify a functional form of demand.

Let $D^i(P) = (1/2)(V - (1 + \gamma)P_i + \gamma P_j)$. Demand is then characterized by the substitution parameter $\gamma \geq 0$. For unit increases in P_i , firm i loses $1 + \gamma$ in sales. Of this, γ sales will be diverted to firm j . Thus $\gamma/(1 + \gamma)$ represents the increase in j 's sales as a fraction of i 's lost sales. When $\gamma = 0$, no sales will be diverted; each retailer is a monopolist. As $\gamma \rightarrow \infty$ the retailers become perfect substitutes. Demand is assumed to be symmetric, to simplify computation.

I calculate prices and profits for each scenario. These are then compared with each other and with the hypothetical cartel solution. Next I develop a simple index of price performance to gain further perspective on the magnitude of the various price markups. Finally, I look explicitly at social welfare and consider when the use of RPM and slotting allowances will lead to the worst outcomes.

Competitive case. When neither practice is allowed, noncooperative equilibrium retail prices and profits are found by the simultaneous solution to the first-order conditions $\pi_i^i = (P_i - w_i)D_i^i + D^i = 0$. Straightforward computations give

$$P^B = P^{BB}(c, c) = \frac{V + (1 + \gamma)c}{2 + \gamma}; \quad \Pi^B = \pi^i(P^B; F_i = 0) = \frac{(1 + \gamma)(V - c)^2}{2(2 + \gamma)^2}$$

for both retailers. Policy discussion should focus around this case, since it is the first best from society's viewpoint.

Slotting allowance case. If both firms choose slotting allowances, one can show that each retailer will have

$$P^S = P^{BB}(w_1^s, w_2^s) = \frac{2(1 + \gamma)V + (2 + 4\gamma + \gamma^2)c}{4 + 6\gamma + \gamma^2}$$

$$\Pi^S = \pi^i(P^S; F_i^s) = \frac{(1 + \gamma)(2 + 4\gamma + \gamma^2)(V - c)^2}{(4 + 6\gamma + \gamma^2)^2}.$$

Incomplete RPM coverage case. When RPM is observed at one retail store, the equilibrium outcome can be calculated as

$$P_1^M = P_1^{MB} = \frac{(2 + 3\gamma)V + (2 + 5\gamma + 2\gamma^2)c}{2(2 + 4\gamma + \gamma^2)}$$

$$P_2^M = P_2^{MB}(P_1^{MB}, c) = \frac{(4 + 10\gamma + 5\gamma^2)V + (4 + 14\gamma + 15\gamma^2 + 4\gamma^3)c}{4(1 + \gamma)(2 + 4\gamma + \gamma^2)}$$

$$\Pi_1^M = \pi^1(P^M; F_i = 0) = \frac{(2 + 3\gamma)^2(V - c)^2}{16(1 + \gamma)(2 + 4\gamma + \gamma^2)}$$

$$\Pi_2^M = \pi^2(P^M; F_i = 0) = \frac{(4 + 10\gamma + 5\gamma^2)^2(V - c)^2}{32(1 + \gamma)(2 + 4\gamma + \gamma^2)^2}.$$

Cartel case. This case was not considered earlier, but it is useful to derive it for comparison's sake. Suppose both firms could cooperate and achieve the collusive outcome. They would find the optimal P^c and Π^c to be

$$P^c = \frac{V + c}{2} ; \quad \Pi^c = \frac{(V - c)^2}{8} .$$

I shall now compare the alternative cases. Some simple conclusions can be summarized in the following proposition.

Proposition 8. When $\gamma = 0$, all prices and profits are equal to the cartel outcome. For given $\gamma > 0$, $(P^c, \Pi^c) > (P^S, \Pi^S) > (P^M, \Pi^M) > (P^B, \Pi^B)$. With the exception of the cartel outcome, all prices and profits are monotonically decreasing in γ . Finally, marginal cost pricing and zero profits prevail as $\gamma \rightarrow \infty$.

These results can be easily verified. As the retailers become more homogeneous, their non-cooperative ability to sustain $P > c$ and $\Pi > 0$ declines. At the extreme points the expected cartel and Bertrand pricing homogeneous product outcomes arise, while for intermediate γ , the cases can be unambiguously ranked as found in the earlier theory.

What about the magnitude of the price markups? For given V, c , and γ , the exact prices can be determined for each case. Price differences and percentage markups could then be found. This is, however, a cumbersome method. By constructing a simple price index, the need to consider V and c is eliminated, thereby allowing one to focus on how the markups change with respect to γ . Define $I = \frac{P - c}{P^c - c}$, where $P = (P^B, P^M, P^S)$. This index looks at the absolute markup of the equilibrium price over supplier marginal cost divided by the markup of the collusive price over supplier marginal cost. Since $P < P^c$, $0 \leq I \leq 1$. As $\gamma \rightarrow \infty, I \rightarrow 0$, and as $\gamma \rightarrow 0, I \rightarrow 1$. This formulation is convenient to use since it abstracts from V and c . As I increases, industry performance decreases.

Table 1 presents results from selected γ . The numbers at the top of the table correspond to individual values of γ . The rows correspond to the respective index calculations. I^B represents the competitive case. I_i^M represents firm i in the nonuniversal coverage RPM case. I^S corresponds to the slotting allowance case.

When $\gamma = 18$ (95% of firm i 's lost sales are diverted to firm j when i 's price increases), noncooperative competition, barring both practices, leads to prices that are 10% of the distance between the perfect competition and cartel points. With RPM the price-maintained firm extends this to 14.1%, while her competitor has a scaled markup of 11.9%. With slotting allowances the equilibrium prices are marked up by 17.4%. When $\gamma = 38$ (97% sales diversion), the benchmark case has a scaled markup of 5%. Slotting allowances would lead to a 9.3% markup, while the RPM case leads to a 7.3% and 6.1% markup for the RPM firm and her rival respectively.

Such calculations are meant to be illustrative of the magnitude of price rises one could expect under different regimes. Alternatively, one could focus on the precise welfare differences among the various scenarios. Price rises in themselves only signal decreases in welfare.

TABLE 1 Percent Scaled Markups

Index Calculations	Values of γ				
	1	2	10	18	38
I^B	.667	.500	.167	.100	.050
I_1^M	.714	.571	.225	.141	.073
I_2^M	.679	.524	.193	.119	.061
I^S	.727	.600	.268	.174	.093

One may ask, When is the resulting welfare decline greatest? Are the gains to challenging these shelf space practices more when retailers have a high product substitution or a low one?

To answer this, I need to consider the form of the utility function. Ignoring income effects, and aggregating the preferences of consumers, the linear demands used in this article can be derived from the following quadratic function.²²

$$U = Vq - \frac{1}{2}q^2 - \frac{2\sigma^2}{1 + 2\gamma} - \sum_{i=1}^2 P_i q_i,$$

where $q = D_1 + D_2$ and $\sigma^2 = \left(\frac{D_1 - D_2}{2}\right)^2$. Defining social welfare as the sum of consumer

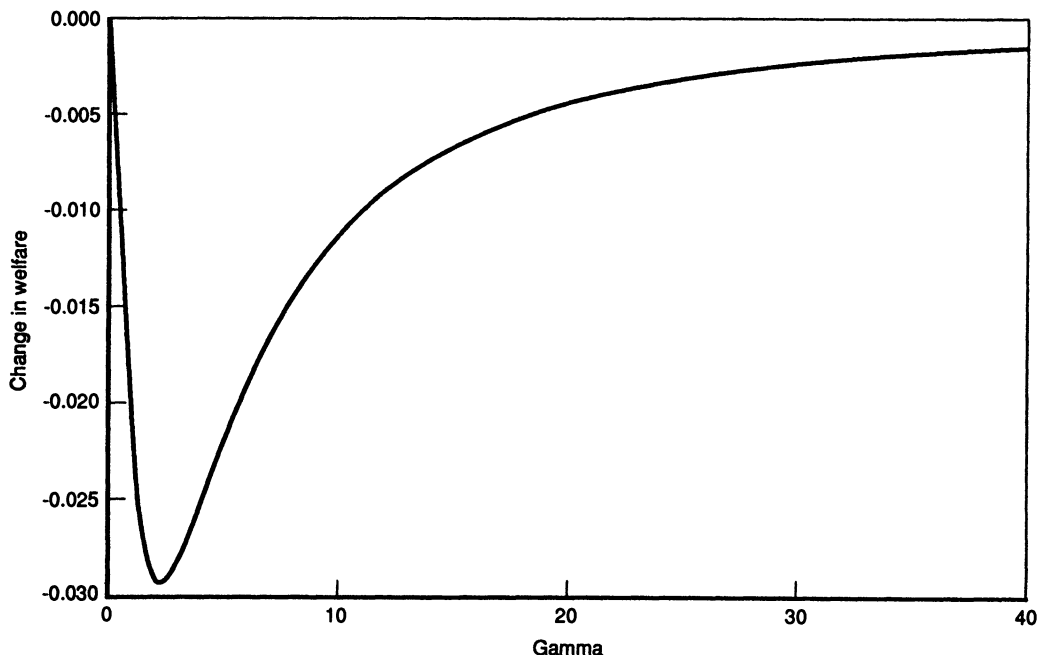
surplus and profits gives $SW = Vq - \frac{1}{2}q^2 - \frac{2\sigma^2}{1 + 2\gamma} - c \sum_{i=1}^2 q_i$. Let ΔSW be the percent change in welfare when moving from the competitive case to either the slotting case (ΔSW_S) or RPM case (ΔSW_M).

Proposition 9. $\Delta SW_S \leq \Delta SW_M \leq 0$ with equality at $\gamma = 0$ and $\gamma = \infty$.

These results can be verified by straightforward algebra. For all γ between 0 and ∞ , welfare declines when either or both practices are allowed. The change in welfare is zero when $\gamma = 0$ or $\gamma = \infty$. At $\gamma = 0$, the retailers are already able to reach the monopoly outcome. The price-enhancing features of slotting allowances or RPM are not needed. At $\gamma = \infty$, price increases above cost cannot be sustained as consumers view the two retailers as perfect substitutes.

When will society be hurt most by the shelf space practices? Minimizing ΔSW with respect to γ , one can show that welfare decline is greatest when $\gamma \approx 2$. This is true for both the slotting allowance and RPM cases. Figures 1 and 2 depict ΔSW when $0 \leq \gamma \leq 40$. The

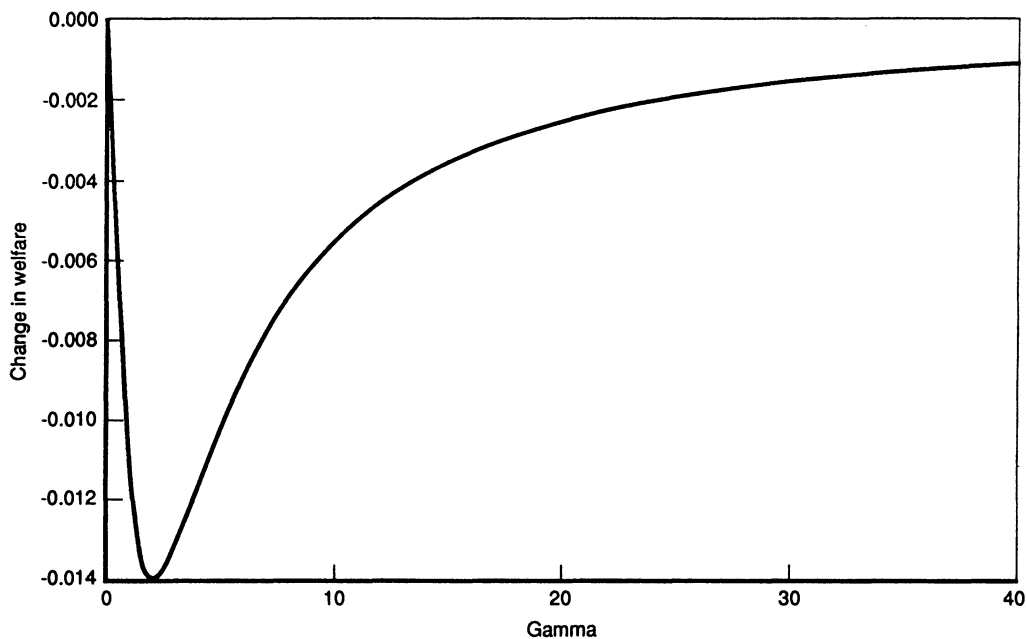
FIGURE 1
SLOTGING ALLOWANCES



²² See Shubik (1980).

FIGURE 2

RPM

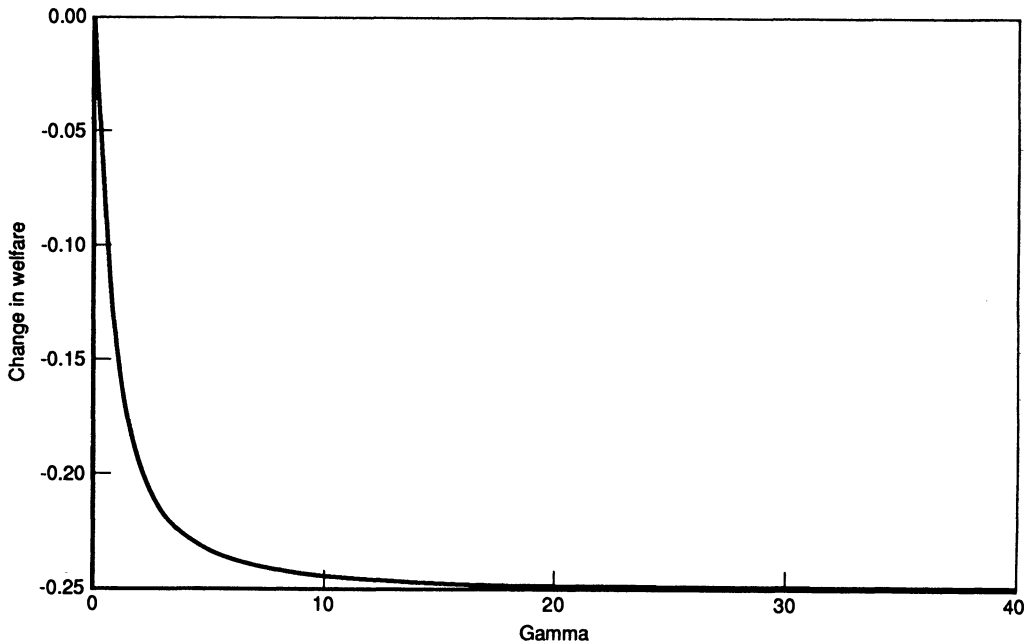


vertical axes measure the change in welfare. With linear demands the gains to barring both practices increase rapidly as γ goes from 0 to 2 and thereafter decline in a logarithmic fashion. At their worst, the social welfare loss relative to the competitive case is 3% and 1.4% for the slotting allowance and RPM cases respectively.

By comparison, Figure 3 shows the percent welfare loss of the cartel case relative to

FIGURE 3

CARTEL



the competitive case. This loss can reach as high as 25%. Thus, although RPM and slotting allowances increase retail prices, their loss is small by comparison.

8. Conclusion

■ I have analyzed slotting allowances and RPM in a model where producers in a perfectly competitive industry compete to obtain shelf space at the retail level. Barring contract observability problems, slotting allowances will be observed in equilibrium. Producers charge a high wholesale price, but they give back their profits via up-front payments to retailers. However, if the individual supplier-retailer wholesale price terms are unobservable by rivals, then resale price maintenance will be seen, but the coverage will not be universal. If neither RPM or slotting allowances are available, then the equilibrium entails marginal cost wholesale pricing.

The three equilibria can be ranked by the usual social welfare criteria. Marginal cost wholesale pricing without RPM yields the greatest surplus, while the slotting allowance equilibrium gives the worst performance.

Policy issues are usually complex. Slotting allowances are now legal. RPM is currently per se illegal. One theme of this article is that the two practices are substitutable. It contributes to the policy debate by demonstrating that both RPM and slotting allowances can be thought of as facilitating practices.

Conventional wisdom suggests that RPM may correct for service externalities and protect against information free-riding and that slotting allowances may help to improve product selection by downstream retailers who are uncertain of demand. It is shown here that these efficiency claims must be balanced against the possible price-raising potential of these practices through their strategic use.

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