The Strategic Use of Early Bird Discounts for Dealers

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Abstract

We study a widely used ordering process ("Early Bird Discounts") whereby a profit-maximizing manufacturer permits his dealers to place advance orders at a discount before they set retail prices. We show that such discounts may be used to shift just enough channel profits to dealers to enable them to cover their fixed costs and stay in business. If the manufacturer instead simply cut his wholesale price in order to generate gross margins for his dealers, these margins would soon dissipate as price competition among dealers selling the same product forced retail prices back down to the per-unit cost. We show that when dealer fixed costs are low, the manufacturer offers an Early Bird Discount to his multiple dealers that induces all but two of them to exit; when fixed costs are high, the manufacturer offers no preorder discount (i.e. switches to linear pricing) and induces all but one dealer to exit. Although uniform slotting allowances could also be used to reward dealers, a sales-based alternative like an Early Bird Discount sometimes has a key advantage when the manufacturer has dealers in cities of different sizes. If the *same* Early Bird Discount is offered, dealers in markets with more consumers, who typically have larger fixed costs, will preorder larger amounts and will automatically receive higher gross margins. To duplicate such payments with slotting allowances, non-uniform allowances would have to be offered to firms in different markets, which is divisive and possibly illegal. (JEL codes: D43, L13, M31)

Keywords: Distribution Channels; Sales Discounts; Advance Purchase; Slotting Allowances; Two-Part Pricing; Constrained-Capacity Oligopoly Games

1. Introduction

Profit-maximizing manufacturers often depend on one or more dealers to distribute their product (Coughlan et al. 2006). To stay in business, these dealers must cover their fixed costs. Dealer fixed costs may include rents, charges for renovations, advertising and business development expenses, and other operational expenses that do not depend on sales volume in the short run. These fixed costs are typically larger in markets with more customers.

Trade practices shifting profits to dealers, such as linear pricing and slotting allowances, have been frequently studied (e.g., Shaffer 1991; Ingene and Parry 1995; Desai 2000; Kuksov and Pazgal 2007). However, when competing dealers sell a homogenous product (i.e., a *perfect substitute*), reducing the wholesale price — or linear pricing — does not help dealers cover their fixed costs because they will sell at the marginal cost of acquiring the merchandise. While two-part pricing with non-uniform slotting allowances[1] ("non-uniform slotting allowances" hereafter) can be used to redistribute profits differentially to dealers in different markets, they may generate discord among dealers and be subject to legal scrutiny (Shaffer 1991; Viscusi et al. 2005, pp. 343-352; Coughlan et al. 2006, pp. 390-393).

We investigate here an alternative trade practice profit-maximizing manufacturers sometimes utilize to enable downstream dealers to cover their fixed costs. Under this practice, the manufacturer offers each dealer a discount from the wholesale price for preorders prior to a specified date but prohibits the return of merchandise unless it is defective. We call this practice "Early Bird Discounts." The objective of our paper is to analyze this mechanism formally and to show that in *some cases* using an Early Bird Discount is more profitable to the manufacturer than alternative mechanisms.

We envision the ordering process as occurring in three distinct phases. In the first, the manufacturer sets the wholesale price and Early Bird Discount for a homogeneous product. In the second, each of his many dealers observes these prices and either preorders or, if he anticipates that his profit would be strictly negative, exits to avoid paying the fixed cost. In the third, each dealer observes the mean preorder of his rivals and sets his retail price, if necessary augmenting his preorder to satisfy unmet demand.

Early Bird Discounts are used by fruit farms as well as manufacturers of fabrics (e.g., Mod Green Pod), pet supplies (e.g., wholesalepet.com), household electrical products (e.g., Toshiba), air conditioners (e.g., Carrier, Hitachi), comic books (e.g., Azteca), higher-education

[1] Slotting allowances are lump-sum transfers or negative access fees in a two-part pricing scheme between a manufacturer and a retailer (e.g., Shaffer 1991; Kuksov and Pazgal 2007). When a manufacturer offers the same amount of slotting allowance to dealers, we call it a "uniform slotting allowance." This is to distinguish it from the notion of "non-uniform slotting allowances" defined in the text.

textbooks, consumer staples (e.g., Colgate-Palmolive), and computer accessories (e.g., Kaspersky). In fact, we suspect *many* manufacturers use this mechanism, although documentation is sometimes tightly guarded.

Whereas in some case the offer of preorder discounts permits the manufacturer to avoid stockouts or the high cost of bunched production,[2] in other cases production and delivery can be accelerated without raising per-unit costs. In the latter cases, avoiding costly production can be eliminated as the manufacturer's motive for offering Early Bird Discounts. For example, in 1988 Colgate-Palmolive, the producer of Ajax laundry detergent, offered its distributors the following promotion (Blattberg and Neslin 1990, pp. 319-321). Instead of charging dealers the standard wholesale price of $19.90 per case, Colgate-Palmolive offered the detergent for $14.30 per case provided that dealers preordered before a specified date. Since dealers could take delivery *immediately* after preordering, the manufacturer's motivation could not have been to smooth production. As a second example, consider the trade promotion by Kaspersky, the producer of an antivirus software. Since this manufacturer provides its software on CDs, it can expand production virtually instantaneously at constant per-unit cost. As a third example, consider the promotion by the Chinese firm Computec, a leading manufacturer of a computer accessory.[3] It is also delivered on CDs. Yet both of these manufacturers offered their dealers a substantial discount for preordering. Since these dealers operated in markets of different sizes, the dollar amounts of the discounts received differed widely. See Appendixes A, B, and C for the Colgate-Palmolive, Kaspersky, and Computec promotions, respectively. Unlike the typical practice with newspapers, where vendors receive credit for returning unsold units, dealers receiving Early Bird Discounts find that unsold merchandise is essentially nonreturnable.[4] To isolate the profit-shifting

[2] If accelerating production would raise per-unit costs, then it is less costly for the manufacturer to have at least some production occur prior to the realization of uncertain demand (e.g., Eichenbaum 1989). Stockouts are costly to dealers due to the loss of both immediate and long-term sales (Anderson et al. 2006). Preordering and inventory commitment may eliminate stockouts, avoiding situations where consumers would switch to competing products (McCardle et al. 2004). None of these self-insurance behaviors (Ehrlich and Becker 1972) involves strategic considerations on the manufacturer's part.

[3] At the owner's request, we have replaced the name of his firm with the pseudonym "Computec." Computec's executives said that they intentionally installed the two-stage sales process to alter the strategic interaction downstream and to increase dealer margins. Further evidence that production smoothing is not the company's motivation is that the company allows its dealers to take deliveries immediately after the last opportunity to preorder (see Appendix A).

[4] As is standard in their businesses, Computec, Kaspersky, Toshiba, Hitachi, and Carrier—at least in some of their international markets—prohibit dealer returns of preorders unless the products are defective. For higher-education book distributors/publishers such as NACSCORP and Kendall Hunt, returns policies for bookstores vary but can be restrictive, and some merchandise is simply nonreturnable. For fruit farms, according to those we interviewed, it is logistically difficult to return fresh fruits such as melons, and thus returns are rarely accepted by growers.

use of such discounts, we assume that there is no demand uncertainty and constant marginal cost of production in our analysis.[5]

We assume that the profit-maximizing manufacturer specifies a wholesale price and preorder discount. Given these ordering costs, dealers anticipating that their gross margins will be insufficient to cover their fixed costs exit; the remaining dealers then have the opportunity to preorder simultaneously, after which they set their retail prices simultaneously, and sell to consumers. If preorders are excessive, the dealer scraps the excess; if preorders are insufficient, the dealer satisfies the excess demand by augmenting his preorder at the undiscounted wholesale price. We assume that consumers regard goods purchased from different dealers to be perfect substitutes. We assume initially that the dealers are in a single market. If the manufacturer offers a positive discount smaller than some threshold, we show that retail prices would be the same as those charged by Bertrand competitors with identical marginal costs equal to the *undiscounted* wholesale price. However, the dealers earn positive gross margins since they acquired those goods at a discount.[6] If the manufacturer offers a sufficiently large discount, the downstream competition results in retail prices that are equivalent to a one-shot Cournot game with *marginal costs equal to the discounted wholesale price*, and dealers earn larger gross margins. We show that when dealer fixed costs are low, the manufacturer offers an Early Bird Discount to his multiple dealers and induces all but two dealers to exit; when fixed costs are high, the manufacturer offers no preorder discount (i.e. he switches to linear pricing) and induces all but one dealer to exit.

Later we investigate the scenario where the manufacturer serves both a big city and a small city. We identify circumstances in which Early Bird Discounts are more profitable for the manufacturer than two-part pricing with a uniform slotting allowance ("uniform slotting allowance" hereafter). The advantage of Early Bird Discounts is that the same discount offer rewards dealers who preorder more from the manufacturer larger gross margins. The advantage of a uniform slotting allowance is that the manufacturer can always redistribute the profits needed to cover dealer fixed costs without sacrificing the generation of maximum channel profits. As might be expected, Early Bird Discounts are more profitable when they would *also* induce dealers to set retail prices at the level which maximizes channel profits. However, Early Bird Discounts may be less profitable for the manufacturer under other circumstances.

[5] Of course, when accelerating production raises per-unit costs, *both* cost *and* strategic considerations may motivate the manufacturer to offer preorder discounts. Hence, in some of the examples we first cited, we cannot rule out the possibility that the manufacturers were motivated to some extent by the desire to avoid higher per-unit costs or dealer stockouts.

[6] We define gross margin as the difference between the sales revenue earned by a dealer and his total variable cost of acquiring the merchandise. Gross margin does not include the dealer's fixed costs.

In next section, we review related literature to highlight our contribution. Section 3 presents our results for one market. Section 4 identifies circumstances in two markets where Early Bird Discounts are strictly more profitable to the manufacturer than uniform slotting allowances. In Section 5, we show that Early Bird Discounts would be ineffective if dealers could costlessly return preordered merchandise or if they could not observe the mean preorders of their rivals. We then discuss how the manufacturer ensures in the real world that these two conditions are fulfilled. Section 6 concludes.

2. Relation to the Literature

Consider a profit-maximizing manufacturer who, if he wishes to distribute his product, must do so through one or more of his N (≥ 2) dealers. Since the dealers are selling a perfect substitute, it is well known that the manufacturer can maximize the sum of the profits in the vertical channel (his own plus those of his dealers) by choosing a wholesale price to each dealer that equals the monopoly price (e.g., Mathewson and Winter 1984; Katz 1989, pp. 678-679). Denote this as the optimal wholesale price θ^* and its associated maximized channel profit as Π_{max}. If the manufacturer simply sets θ^*, dealers in Bertrand competition will compete the retail price down to θ^*, and all the gross revenue will go to the manufacturer. His dealers would earn gross margins of zero. Given that dealers may have to incur fixed costs, such as decorations, lighting, advertising, business development, and office and rental charges, each of the N dealers would anticipate being unable to cover his fixed costs.

Suppose that the manufacturer cares only about his own profit but to market his product *has to* enable at least one of his N dealers to earn gross margins sufficient to stay in business. Lowering the wholesale price below θ^* would not increase the margins of the dealers because they are selling a homogeneous product (Bertrand 1883) and the undercutting of each other's retail price would drive dealer retail prices down to the manufacturer's reduced wholesale price.

A negative access fee such as slotting allowances can shift profits to the downstream dealers (e.g., Shaffer 1991; Desai 2000; FTC 2003; Kuksov and Pazgal 2007) that can be used to cover fixed costs of marketing and operations. Like slotting allowances, Early Bird Discounts help manufacturers shift profits to their dealers (e.g., Shaffer 1991; Desai 2000; FTC 2003; Kuksov and Pazgal 2007). However, Early Bird Discounts have a distinct advantage when the manufacturer has dealers of different sizes in different markets. This advantage comes from the observation that while slotting allowances are lump-sum transfers, Early Bird Discounts are similar to conventional, sales-based trade promotions that apply to each ordered unit (Blattberg and Neslin 1990, pp. 319-321).

If the manufacturer can offer slotting allowances, they are weakly more profitable than Early Bird Discounts when all dealers are in the same market. To identify circumstances where Early Bird Discounts are strictly more profitable, we assume the manufacturer also sells to a second market with a proportionately smaller demand at any price. If the same Early Bird Discount is offered to all dealers, those in the larger market will preorder larger amounts and will be rewarded *differentially*. To duplicate such payments, different slotting allowances would have to be offered to firms in different markets, a discriminatory practice that might be subject to legal scrutiny under the Robinson-Patman Act (Viscusi et al. 2005, pp. 343-352; Coughlan et al. 2006, pp. 390-393; see also Kuksov and Pazgal 2007, p. 263) and, in any case, would create unnecessary discord among dealers. The manufacturer *can* earn strictly higher profits by offering the same Early Bird Discount to all dealers instead of a uniform slotting allowance.

Our model is related to the literature of constrained-capacity pricing games pioneered by Kreps and Scheinkman (1983). In marketing, Padmanabhan and Png (1997) were the first to recognize that downstream dealers who preorder in the first stage would behave in the same way as firms with production capacity constraints. However, Padmanabhan and Png (1997, 2004) implicitly assume the market is cleared by an "auctioneer" but *not* by dealers' setting prices in the second stage of dealer pricing (see also Wang 2004, who makes the same assumption). In the literature, when subsequently ordering more and selling it (or, equivalently, expanding capacity and selling more) is impossible, the modeler must select one of several *ad hoc*, exogenous rationing rules to describe which customers are turned away if the prices set by firms in the second stage result in demands that cannot be satisfied (Kreps and Scheinkman 1983; Tirole 1988, pp. 212-214); otherwise, the payoffs associated with some strategy profiles are not well specified. But then the arbitrary choice of a "rationing rule" affects the equilibrium outcome and hence conclusions (e.g., Davidson and Deneckere 1986; Tirole 1988).[7]

To avoid this problem, Maggi (1996) abandons the need for rationing rules by assuming in the "rules of the game" that if production in the capacity-building stage proves insufficient to meet the demand in the pricing stage, then firms must satisfy the remaining demand by expanding their production capacity in the pricing stage at a higher marginal cost of production than that in the previous stage. Since demand is always satisfied, there is no need *either* to specify an arbitrary rationing rule *or* to abandon the assumption of price-setting firms. As documented in the earlier examples, dealers in many industries *can* augment their preorders, albeit at a higher cost.

[7] This may seem paradoxical since the profits of a firm who has more customers than he can serve will be the same no matter which customers he turns away. However, his rival's strategy may no longer be profit-maximizing depending on which customers the first firm turns away. In that case, what was an equilibrium under one rationing rule ceases to be an equilibrium under the other rationing rule.

Whenever this is the case, the real-world institution differs from the one modeled by Kreps and Scheinkman (1983) and Padmanabhan and Png (1997).

We contribute to the literature in the following manner. First, to emphasize the profit-generating effect of Early Bird Discounts, we extend existing models by having Bertrand dealers selling perfect substitutes (Bertrand 1883) but permitting augmentation to match real-world practice. Second, we endogenize the profit-maximizing manufacturer's choice of his wholesale price and preorder discount by taking into account dealers' fixed costs of running the business of distributing the manufacturer's product. Third, as a profit-transfer mechanism, we compare the effectiveness of Early Bird Discounts to linear pricing and uniform slotting allowances. Fourth, we clarify the roles of the observability of preordering (or capacity) and a no-returns policy, which are often not emphasized in the literature.[8] We show that *both* policies are necessary for Early Bird Discounts to be effective. Our result further contrasts with the findings in Padmanabhan and Png (1997, 2004) and Wang (2004), who — in the institutional setting where dealers cannot augment their preorders to manufacturers — find that the manufacturer's returns policy has no impact on downstream competition in the *absence* of demand uncertainty.

3. The Model

Suppose there are N identical dealers who can sell the manufacturer's product. At least one of these dealers must stay in business if the manufacturer's product is to be distributed.
The good costs the manufacturer m per unit to produce.[9] He commits to selling dealers whatever they order at a wholesale price of θ per unit. In addition, he offers them a lower price c ($\leq \theta$) if they preorder before a specified date.

Each dealer has a fixed cost (F) that must be paid for the dealer to remain in business. After observing the manufacturer's wholesale price and discount, dealers exit if and only if they anticipate that their gross margins will be strictly smaller than their fixed costs.[10] The R ($\leq$ N)

[8] The same issue of observability arises in, for instance, Kreps and Scheinkman (1983), Davidson and Deneckere (1986), Maggi (1996), Padmanabhan and Png (1997, 2004), and Wang (2004). Although the role of observability of firm capacities or preorders is not always explicitly discussed in these models, some mechanism through which each firm or dealer learns the capacities or preorders must be implicitly assumed. This is because, as Tirole emphasizes on two-stage capacity constrained games in his textbook (Tirole 1988, p. 217), to influence *subsequent* behavior, prior actions must be observable. Dixit (1982) and Shapiro (1989) make the same point.

[9] We are assuming that distribution is not the manufacturer's *forte*. That is, even if channel profits were maximized, the revenue net of production costs would be insufficient to cover the additional costs the manufacturer would incur if he tried to distribute the product himself. Thus, he is dependent on one or more dealers for distribution (Coughlan et al. 2006).

[10] In other words, we assume that dealers preorder and distribute the manufacturer's product if and only if they expect their profit (the difference between gross margins and fixed costs) to be weakly positive.

remaining dealers simultaneously preorder from the manufacturer at the Early Bird discount c. Each dealer observes the mean preorder of the other dealers and then simultaneously sets his retail price. Denote dealer i's retail price as p_i for i = 1,…, R.

Consumers demand at most one unit of the good. They observe the retail price of each dealer as well as the quantity each of them preordered. If the lowest price ($\min(p_1,\ldots p_R)$) is below their reservation level, they choose the lowest-price dealer to patronize. If one dealer has the lowest price, all the customers go to him. If more than one dealer has the lowest price, a dealer with x% of their preorders will get x% of the customers.[11] That is, if the lowest price is p, then the D(p) customers arrange themselves so that a dealer that preordered q_i would get $q_iD(p)/Z$ customers, where $Z = \sum_{j\in\{\text{lowest price firms}\}} q_j$.

We denote the inverse demand curve P(·) and assume it is strictly decreasing and weakly concave. No dealer can return unsold merchandise and it must be scrapped. We further assume that a dealer preordering less than he needs to satisfy demand of his customers *must* issue "rainchecks" by augmenting his preorder at the undiscounted wholesale price θ (Maggi, 1996).[12] Figure 1 provides a timeline of these events.

*** Figure 1 Goes Here ***

Symmetrically, we also assume the manufacturer remains in business if and only if he earns a weakly positive profit.

[11] If customers could instead not observe the quantity preordered by each dealer, demand would more plausibly be divided equally across the lowest-priced dealers, so that each would have demand, D(p)/R.

[12] The other known alternative in capacity-constrained oligopoly games such as ours is to assume one of several *ad hoc* rationing rules as in Kreps and Scheinkman (1983) and the subsequent literature (see Tirole 1988, p. 212-3). Our results would then depend on which arbitrary rationing rule we adopted (Davidson and Deneckere, 1986, p. 404). We instead follow Maggi (1996) in incorporating into the "rules of the game" the assumption that dealers must augment to satisfy unmet demand. As a shorthand, we refer to the Kreps-Schenkman assumption as the "no rainchecks" assumption and to Maggi's alternative as the "rainchecks" assumption. We make the latter assumption because (i) augmentation is a key feature in many of the real-world examples cited in the introduction, and (ii) requiring it also avoids equilibrium predictions that, as Davidson-Deneckere showed, depend on the arbitrary rationing rule that must be specified under the "no rainchecks" approach. The equilibrium may change because an equilibrium strategy profile under one rationing rule may not form an equilibrium under a new rationing rule since under the new rationing rule a rival firm inherits a different set of discarded customers and may have a profitable deviation where none existed under the old rule. The third option – allowing dealers to *choose* whether or not to issue rainchecks – requires a dealer to compare the payoff from each alternative and therefore again involves the adoption of an arbitrary rationing rule in the "no rainchecks" subgames.

Nevertheless, it is logically possible that some dealer would *strictly* prefer to turn away a customer unilaterally rather than offer him a raincheck if the rules of the game permitted such behavior. In our equilibrium, every dealer preorders enough to serve every customer (see Proposition 1). If a dealer nonetheless turned away a customer unilaterally under these circumstances, the dealer would be strictly worse off: he would forego the retail price the customer would pay but could not get any refund from the manufacturer on the preordered merchandise since the manufacturer has a "no returns" policy. We thank the associate editor and an anonymous referee for encouraging us to clarify these issues.

By his choice of wholesale price and preorder discount, the manufacturer can induce any number of dealers to exit. To induce a single firm to remain after the exit stage (R = 1), the manufacturer offers no Early Bird Discount ($\theta = c$); this is equivalent to linear pricing. As Spengler (1950) and others have shown, a single downstream dealer will set a retail price above his cost of ordering from the manufacturer and may earn more than enough to cover his fixed costs; no other dealer would be tempted not to exit since he would anticipate a gross margin of zero in the duopoly that would result. To induce more firms to remain (R = 2,…,N), the manufacturer offers a preorder discount calculated to give each of R dealers a gross margin that barely covers the fixed cost. No exiting dealer has a unilateral incentive to deviate since he would realize that each of R + 1 dealers would have a strictly smaller gross margin, which would be smaller than their fixed costs. This follows since, even if retail prices did not fall, each dealer's market share would decline; moreover, if retail prices were below the level that maximizes channel profits, they would decline further if the deviator became active.[13]

In the first subsection, we determine the manufacturer's maximum profit when R =2,…,N. In the second subsection, we consider the manufacturer's maximum profit when R = 1 and discuss when selling through two dealers is more profitable than selling through a single dealer. In the final subsection, we provide an example consolidating our findings and illustrating that for low fixed costs using an Early Bird Discount to sell through two dealers is profit-maximizing whereas for higher fixed costs using linear pricing (offering no preorder discount) to sell through a single dealer is superior.

3.1. The case of R = 2, …, N

We begin with the case where the manufacturer offers the N symmetric dealers the most profitable Early Bird Discount sufficient to keep R = 2,…, N of them in business.
Define $p^{Cournot}(c; R)$ and $q^{Cournot}(c; R)$, respectively, as the price and common production in a symmetric, static Cournot oligopoly game where R firms face demand D(p) and produce at marginal cost c. These two functions are useful in characterizing the dealer response to the Early Bird Discount offered by the manufacturer.

As is well known, R (= 2,…,N) Cournot oligopolists selling perfect substitutes price higher than R Bertrand oligopolists *provided* the two types of oligopolists have the same constant marginal cost and face the same consumer demand (Vives 1985, pp. 168-171). But if the marginal cost of the Bertrand firms is sufficiently higher ($\theta >> c$), then the Bertrand price (θ) and the

[13] As shown in Proposition 1, when retail prices are below the level that maximizes channel profits, those prices are Cournot prices. Therefore, they decrease in the number of dealers.

Cournot price ($p^{Cournot}(c;R)$) will coincide. We refer to the unique solution to $\theta = p^{Cournot}(c;R)$ as the "R-dealer CB boundary" (where CB stands for "Cournot-Bertrand") and denote it $\theta^{CB}(c;R)$. Since Cournot oligopolists charge consumers more if their marginal cost of production is higher $\theta^{CB}(c;R)$ is strictly increasing in its first argument; since the Cournot equilibrium price is strictly decreasing in the number of firms, $\theta^{CB}(c;R)$ is strictly decreasing in its second argument.

The response of dealers to any pair of prices charged by the manufacturer is summarized in the following proposition:

Proposition 1. When the discount is small ($p^{Cournot}(c;R) > \theta$), the dealers' retail price, sales, and preorders are equivalent to those in the Nash equilibrium of a symmetric Bertrand game where each of R firms has a marginal cost equal to the undiscounted wholesale cost (θ). In that case, each dealer's behavior is independent of c although the gross margin of each dealer, $(\theta - c)D(\theta)/R$, and the manufacturer, $(c - m)D(\theta)$ depend on both prices (c, θ) chosen by the manufacturer. When the discount is large ($p^{Cournot}(c;R) \leq \theta$), the dealers' retail price, sales, preorders, and gross margins of the $R > 1$ remaining dealers are equivalent to those in the Nash equilibrium of a symmetric Cournot game where each of R firms has a marginal cost equal to the preorder cost c. Hence, these dealer behaviors and dealer gross profits are independent of θ. The manufacturers profit, $(c - m)D(p^{Cournot}(c;R))$ is also independent of θ. In both regions, each dealer sells exactly what he preorders so no dealer augments or scraps.

Proof: See Appendix D.

The intuition for these results is as follows. If the observed mean preorder of rivals — inferred from the observed R and aggregate preorder Q — is small because the manufacturer has offered dealers a relatively puny discount, each dealer will conjecture that some rivals will augment their preorders in the pricing stage. In this circumstance, selling only the preordered quantity is not credible. Consequently, the equilibrium price and quantity of the two-stage game must coincide with that of a static Bertrand oligopoly game where prices are chosen simultaneously by firms with marginal cost θ.

In contrast, if the observed mean preorder of merchandise is large because the manufacturer has offered his dealers a relatively substantial discount, then each dealer realizes that no one has the incentive to supplement his preorder in the pricing stage. Hence, the "threat" of a rival dealer to sell no more than the preordered quantity is credible. Consequently, the price-quantity pair arising in the subgame-perfect equilibrium of the "two-stage" game must coincide with that of a static Cournot game where preordered quantities are chosen simultaneously by the dealers with marginal cost c.

In short, the manufacturer's choice of the per-unit preorder price and augmentation price of the dealers determines the gross margin earned by the dealers. Notice that the ability of Early Bird Discounts to generate margins for a perfect substitute is in stark *contrast* with discounts in linear pricing: the latter is completely dissipated because of dealers' price competition.

We now consider the most profitable strategy (c, θ) for the profit-maximizing manufacturer if he chooses R = 2,…,N dealers. The manufacturer will never price preorders below his own production cost, and dealers will never preorder unless it is cheaper to do so. Hence, $c \in [m, \theta]$. With θ on the vertical axis and c on the horizontal axis of Figure 2, this area lies above the 45-degree line and to the right of the vertical line c = m.

[Figure 2 Goes Here]

We have also inserted in this diagram the R-dealer CB boundary. Proposition 1 implies that the manufacturer can disregard any (c, θ) strictly above the R-dealer CB boundary since he can achieve the identical profit for that preorder price (c) but setting his wholesale price $p^{Cournot}(c;R)$ on the R-dealer CB boundary directly below. Therefore the most profitable choice for the manufacturer will have $p^{Cournot}(c;R) - \theta \geq 0$. It must also insure that the R dealers can cover their fixed costs. Thus, the manufacturer maximizes profits by solves the following problem:

$$\max_{c\geq 0,\theta\geq 0} (c - m)D(\theta)$$

$$\text{subject to} \quad D(\theta)(\theta - c) - RF \geq 0 \qquad (1)$$

$$p^{Cournot}(c;R) - \theta \geq 0 \qquad (2)$$

$$c - m \geq 0. \qquad (3)$$

We characterize the unique solution to the manufacturer's profit-maximization problem in Appendix E, and summarize its characteristics in the following proposition[14]:

Proposition 2. The best choice of the manufacturer always leaves the R dealers with zero profit (condition 1 holds with equality). Moreover, $\theta^* - \theta \geq 0$ and $p^{Cournot}(c;R) \geq \theta$ with complementary slackness. That is, if (i) the manufacturer's two charges (c, θ) are strictly below the R-dealer Cournot boundary (condition (2) holds as a strict inequality), then the wholesale price must maximize channel profits ($\theta^* = \text{argmax}(\theta - m)D(\theta)$); alternatively if (ii) the manufacturer wholesale price is strictly below θ^*, the manufacturer must set the two charges (c, θ) on the R-dealer CB boundary (condition (2) holds as an equality).

[14] Suppose the unique solution to the manufacturer's profit-maximization problem formalized above occurs on the R-dealer CB boundary. Note that there is then also a continuum of optima that can be achieved by taking the same c but raising θ, since changing θ has no effect when the dealers are behaving like "Cournot competitors."

Proof: To see that condition (1) must hold as an equality, notice that if the manufacturer increases c, he relaxes the constraints while at the same time increasing his payoff. For the remainder of the proof, see Appendix E.

We can describe this solution graphically using Figure 2. Channel profits are largest at $\theta = \theta^*$, i.e., point L. Channel profits do not change as one lowers the preorder cost (c) and moves horizontally to the R-dealer CB boundary since retail prices, preorders, and hence channel profits depend only on θ within the Bertrand region (see Proposition 1). As one moves horizontally to the left, the preordering cost falls and a larger share of the unchanged channel profit goes to the dealers. The gross margin of a dealer, $(\theta^* - c)D(\theta^*)/R$ where $R > 1$, decreases in c.

Once the R-dealer CB boundary in Figure 2 is reached (point M), the Cournot price ($p^{Cournot}(c;R)$) equals the Bertrand price (θ^*). If one then travels southwest along the R-dealer CB boundary, the equilibrium can be regarded as either Cournot with marginal cost c or Bertrand with marginal cost $\theta \leq \theta^*$. Since the retail price falls below the level that maximizes channel profits, channel profits decrease monotonically. Moreover, dealer gross margins increase monotonically.[15] Therefore, manufacturer profit must fall as one moves southwest along the R-dealer CB boundary.

If dealer gross margins are still strictly smaller than fixed costs when the R-dealer CB boundary is reached at (c^*, θ^*), the manufacturer sets the wholesale price and discount such that the price pair (c, θ) lies on the CB boundary southwest of point M in Figure 2. In particular, he sets the Early Bird Discount at the unique $c \in [m, c^*]$, solving $(p^{Cournot}(c;R) - c)D(p^{Cournot}(c;R)) - RF = 0$ and the wholesale price at $p^{Cournot}(c;R)$. Dealers in turn charge consumers the wholesale price and use the gross margins created by the Early Bird Discount to cover their fixed costs.

We conclude this subsection by stating the following proposition:

Proposition 3. The manufacturer's profit is always higher if he induces two dealers to remain rather than R = 3,…, N dealers.

Proof: Since the manufacturer squeezes the dealers so that they earn just enough gross margins to cover their fixed costs, the manufacturer's profit equals channel profit minus R fixed costs. If more dealers remain after the exit stage, more fixed costs must be covered. In addition, if more dealers compete, the retail price will weakly decrease and since $\theta \leq \theta^*$, this weak decrease in the retail price must in turn weakly decrease channel profit which is increasing in θ for $\theta \leq \theta^*$. It

[15] Dealer gross margins in the Cournot region equal the profits of Cournot competitors with marginal cost c. As discussed in Kotchen and Salant (2010), Cournot profits increase as c decreases given our assumption that inverse demand is weakly concave.

follows that the manufacturer earns higher profit if R = 2 than if more dealers remain after the exit stage.

Intuitively, the manufacturer takes the entire channel profit less what he gives dealers through the preorder discount that just covers their fixed costs. So if the addition of a third dealer left the equilibrium in the Bertrand region, the channel profit would not change but the manufacturer would have more fixed costs to cover. Hence, his profits would be smaller. If instead the equilibrium with the additional dealer was on the CB boundary with $\theta \leq \theta^*$, then not only would there be more fixed costs to cover but channel profits would be smaller since they decline with θ for $\theta \leq \theta^*$. Hence, again the manufacturer's profit would be smaller. It is therefore always in the interest of the manufacturer to induce the exit of at least N – 2 of the dealers.

3.2. The case of R = 1

Alternatively, the manufacturer can offer no preorder discount from the wholesale price ($\theta - c = 0$). In that case, all but one of the N dealers would exit since none would anticipate covering his fixed cost. None would regret exiting since if he unilaterally deviated by staying in, the resulting duopolistic competition would drive his gross margin to zero (Bertrand, 1883).

If the manufacturer offers no discount, then only one dealer will remain after the exit stage for any $F \in [0, \Pi_{max}]$, where Π_{max} is the maximum channel profit. If the fixed cost is sufficiently small, the single dealer can cover his fixed cost from the rents he earns. If the fixed cost is larger, he will be unable to cover his rent and the manufacturer will have to lower his wholesale price in order for the remaining dealer to break even.

Assume the manufacturer sets the wholesale price at θ and offers no preorder discount ($c = \theta$). The manufacturer solves the following problem:

$$\max_{\theta \geq m} (\theta - m)\, D(p)$$

$$\text{subject to} \quad p + D(p) / D'(p) = \theta \tag{4}$$

$$(p - \theta)D(p) \geq 1\, F. \tag{5}$$

The objective function is the manufacturer's profit if he sets the wholesale price of θ, and the single dealer sets his retail price (p). The first constraint implicitly defines the dealer's optimal retail price in response to the manufacturer's wholesale price. The final constraint insures that the dealer can cover his fixed cost.

Spengler (1950) analyzed this problem for F = 0. But his solution continues to hold provided F > 0 but is small enough that the second condition (inequality (5)) is slack. If the manufacturer were to set $\theta = m$, the single dealer would set the retail price at the level which maximizes channel profits ($\theta^* = \text{argmax}(\theta - m)D(\theta)$); but these maximized channel profits would all accrue to the dealer to cover his fixed costs since the manufacturer would be selling to him at cost. To maximize his profit, the manufacturer instead charges a larger wholesale price. In response the single dealer would charge a higher retail price, and consequently channel profits would be smaller than their maximum value – the "double marginalization" inefficiency first noted by Spengler (1950).

If the fixed cost is so large that the second constraint binds, then the two constraints alone determine the two endogenous variables (θ, p) as functions of the exogenous variable (F). In particular, if the fixed cost is larger, the manufacturer must reduce his wholesale price and the dealer will in turn reduce his retail price. The lowest wholesale price the manufacturer would set is $\theta = m$. In that case, all the maximized channel profit goes to cover the sole dealer's fixed cost so F must equal Π_{max}.

The tradeoff facing the manufacturer is, therefore, clear. With a single dealer (R = 1), only one fixed cost needs to be covered; on the other hand, in the absence of competition from another dealer, that single dealer will exercise his own market power and will price in a way that reduces channel profits; moreover, he may retain some of those profits as rents. With two dealers, two fixed costs must be covered but channel profits will be maximized in the Bertrand region and dealers earn no rents. For low fixed costs, it is always more profitable for the manufacturer to sell through two dealers; for higher fixed costs, the manufacturer makes more profit selling through a single dealer; of course, if each dealer's fixed cost exceeds maximized channel profit, the manufacturer can only operate at a loss and goes out of business.

3.3 An Example

To consolidate the findings in this section, we conclude with an example. Suppose the demand function is $D(p) = (a - p) / b$, $a > 0$ and $b > 0$. Then the maximum channel profit of $\Pi_{max} = (a - m)^2 / 4b$ is achieved at a retail price of $(a + m) / 2$.

The manufacturer must choose whether to distribute his product through one dealer (R = 1) or through two dealers (R = 2). To distribute through one dealer, he offers no Early Bird Discount. To distribute through two dealers in the most profitable way, he offers them an Early Bird discount just sufficient for the duopolists to cover their fixed costs. In Figure 3, we depict his profit as a function of the dealer fixed cost F, $\pi_m^1(F)$ and $\pi_m^2(F)$, for the R = 1 and R = 2 cases respectively. The upper envelope of the nonnegative portions of the two functions, $U(F) = \max(\pi_m^1(F), \pi_m^2(F), 0)$, is the maximum profit the manufacturer can achieve. If F is low, it is most profitable to offer an Early Bird Discount since, although two fixed costs must be covered instead of one, competition among the dealers results in a lower retail price and higher profit for the manufacturer. If F is sufficiently high, however, distribution through a single dealer is more profitable even though, in the absence of competition, his exercise of market power results in double marginalization. If the fixed cost strictly exceeds maximum channel profit (Π_{max}), the manufacturer goes out of business.

Spengler (1950) analyzed the case of a single dealer with no fixed costs. In that case, the manufacturer earns $\pi_m^1 = \Pi_{max} / 2$ and the dealer earns $\pi_d = \Pi_{max} / 4$. If the dealer's fixed cost is smaller than his gross margin, the manufacturer continues to achieve his unconstrained profit of $\pi_m^1 = \Pi_{max} / 2$ and lets the dealer pay the fixed cost out of his gross margin. However, for fixed costs larger than $\Pi_{max} / 4$, the manufacturer must lower his wholesale price (θ) so the dealer can cover his fixed cost. As show in Appendix F, the manufacturer's profit is strictly decreasing and strictly concave for $F \in (\Pi_{max} / 4, \Pi_{max})$. When $\theta = m, \pi_m^1 = 0.$ In that case, the dealer earns maximum channel profits which are just sufficient to cover his fixed cost. We depict in Figure 3 π_m^1 and the transition point ($\Pi_{max} / 4, \Pi_{max} / 2$).[16, 17]

If the manufacturer sells through two dealers and the fixed cost is sufficiently small, then he charges his dealers a wholesale price of $\theta^* = (a + m) / 2$ which they in turn charge consumers. The two dealers preorder and sell a total of $(a – m) / 2b$ units. Consequently channel profit is maximized and the manufacturer sets the preorder discount so dealers can just cover their fixed costs. Since the manufacturer earns $\pi_m^2 = \Pi_{max} – 2F$, the manufacturer's profit as a function of F decreases linearly from Π_{max} at rate 2. In this range, an increase in the fixed cost of \$1 causes the manufacturer to lower his preorder charge enough that the gross margin of each of the two dealers rises by \$1. Once the preorder price is so low that $p^{Cournot}(c; 2) = \theta^*$, however, further increases in the fixed cost require the manufacturer to reduce his wholesale price as well as his preorder charge. Since channel profits now decline as F increases, the manufacturer's profit decreases at a rate faster than 2. In Appendix F, we show that the manufacturer's profit is strictly decreasing and strictly concave in this range.

16 In Appendix F, we review Spengler's solution and extend it to the case where the dealer cannot cover his fixed cost out of the gross margin in Spengler's solution. Readers interested in more detailed calculations for this example should consult Appendix F.

17 Early Bird Discounts degenerate into linear pricing when $\theta = c$. If a single dealer can preorder at c per unit and augment at the per-unit cost $\theta = c$, we envision him as preordering what is profit-maximizing for a monopolist dealer to sell if product can be acquired at marginal cost c. The dealer would make a strict loss by preordering more. If he preordered less, he would earn an unchanged profit since it would then be profit-maximizing to acquire the remainder by augmenting at $\theta = c$. If F = 0 the equilibrium payoff of the manufacturer and his single dealer is the same as in Spengler (1950).

To determine the fixed cost and manufacturer's profit when the manufacturer begins to reduce his wholesale price, note that at that point the following three equations must hold:

$$p^{Cournot}(c;\,2) = \theta^* \tag{6}$$

$$p^{Cournot}(c;2) + \frac{D(p^{Cournot}(c;2))}{2D'(p^{Cournot}(c;2))} = c \tag{7}$$

$$(p^{Cournot}(c;2) - c)D(p^{Cournot}(c;2)) = 2\,F \tag{8}$$

Equation (7) is the retail price that occurs when two dealers, acting like Cournot competitors, preorder at cost c; equation (8) insures that the manufacturer leaves dealers only enough gross margin that the two dealers pay their fixed costs.

Replacing $p^{Cournot}(c;2)$ by θ^* in (7) and (8) and then, using (7) to replace the first factor in (8) by $-D(\theta^*)/2D'(\theta^*)$, we conclude that the transition occurs at $F = \frac{1}{4}\left(\frac{(D(\theta^*))^2}{-D'(\theta^*)}\right) = \frac{\Pi_{max}}{4}$.[18] At that fixed cost, the manufacturer's profit is $\pi_m^2 = \Pi_{max} / 2$. Hence, when R = 2, the transition point on the manufacturer's profit function coincides the corresponding transition point when R = 1. We depict in Figure 3 the upper envelope, which consists of 3 segments: (1) if the fixed cost is sufficiently low, the manufacturer uses an Early Bird Discount and sets his wholesale price at θ^*; (2) once F is larger than $\Pi_{max} / 2$, the manufacturer distributes his product through a single dealer by lowering his wholesale price from Spengler's solution and consequently earns a lower profit than Spengler calculated; (3) finally, if the fixed cost exceeds maximum channel profits (Π_{max}), the manufacturer goes out of business.

4. Are Early Bird Discounts Ever More Profitable than Slotting Allowances?

Suppose in the previous section that the fixed cost is small enough that the more profitable choice is to set $\theta = \theta^*$ and to offer a preorder discount sufficient that two dealers remain. Denote this fixed cost as $\overline{F}$ and the induced profit-maximizing choices as $\overline{c}$, $\overline{\theta}$ where $\overline{\theta} = \theta^*$. In this solution, channel profits are maximized and the gross margin of the two dealers just covers their fixed costs, leaving the manufacturer with $\Pi_{max} - 2F$ in profits.

Exactly this profit could have been obtained by the manufacturer if he used a *slotting allowance* instead of an Early Bird Discount. For then he could set the wholesale price of each dealer at θ^*. If offered no discount, they would set their retail prices at θ^* and would earn zero gross margin. The manufacturer would then pay each dealer a slotting allowance S large enough

[18] The last equality follows since $\theta^* = (a + m) / 2 \Rightarrow b(a - \theta^*) / b = (\theta^* - m) \Rightarrow D(\theta^*) / -D'(\theta^*) = (\theta^* - m) \Rightarrow (D(\theta^*))^2 / -D'(\theta^*) = (\theta^* - m)D(\theta^*) = \Pi_{max}$.

to cover each fixed cost (S = F). Consequently the manufacturer would earn $\Pi_{max} - 2F$. Since the Early Bird Discount provides no advantage in this case, it is reasonable to ask whether it is *ever* strictly advantageous. We show below conditions sufficient for it to strictly dominate slotting allowances.

Assume that, in addition to the city where fixed costs are $\overline{F}$, there exists a second, smaller city with $\chi < 1$ times the demand at any price. We denote variables in this city by "hats" and call the city "Hatville." Thus, $\hat{D}(p) = \chi D(p)$.

We require that the manufacturer *not* discriminate among dealers to avoid legal scrutiny (Viscusi et al. 2005, pp. 343-352; Coughlan et al. 2006, pp. 390-393) or the possibility of discord among dealers. Every dealer, regardless of city, must be offered the same contract, be it an Early Bird Discount or a wholesale price coupled with a slotting allowance.

We consider the Early Bird Discount first. The manufacturer's profit-maximization problem in this two-city case is as follows:

$$\max_{c\geq 0,\theta\geq 0} (c - m)(1+ \chi)\, D(\theta)$$

$$\text{subject to} \quad p^{Cournot}(c;2) \geq \theta \tag{9}$$

$$\hat{p}^{Cournot}(c;2) \geq \theta \tag{10}$$

$$(\theta - c)D(\theta) - 2F \geq 0 \tag{11}$$

$$(\theta - c)\, \chi D(\theta) - 2\hat{F} \geq 0. \tag{12}$$

Since at any price, demand in Hatville is $\chi < 1$ times as large and, after the exit stage, each city will have two active dealers (even if different numbers of dealers exit in the two cities), $\hat{p}^{Cournot}(c;2) = p^{Cournot}(c;2)$ and condition (10) will always be satisfied when condition (9) holds.[19] Since condition (10) is redundant, we delete it. Assume that each fixed cost in the smaller city is no bigger than $\chi < 1$ times the fixed cost in the bigger city. That is, in Hatville, the fixed cost is $\hat{F} = \delta F$, where $\delta \leq \chi < 1$. Since condition (12) must hold if condition (11) does, we delete the redundant condition (12).

Observe that the manufacturer's profit-maximization problem in the two-city case has the same constraint set as in the one-city case of section 3.1 and an objective function $(1+ \chi)$ times as

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[19] In the smaller city, the Cournot price solves the equation $p + \frac{\hat{D}(p)}{2\hat{D}'(p)} = c$. Since $\hat{D}(p) = \chi D(p)$, this equation can be rewritten as $p + \frac{\chi\hat{D}(p)}{2\chi\hat{D}'(p)} = c$. This simplifies to precisely the equation determining the Cournot price in the larger city. Hence the two Cournot prices are the same.

large. Therefore, if the fixed cost in the large city is $\overline{F}$, then the optimum will once again occur at $\overline{c}$, θ^*, and the manufacturer's profit will be $(\overline{c} - m)(1 + \chi)D(\theta^*)$.

Suppose now the manufacturer could use a *uniform* slotting allowance instead of a uniform Early Bird Discount. Then he could choose the wholesale price and slotting allowance to maximize his total profits in the two cities:

$$\max_{S\geq 0,\theta\geq 0} (\theta - m)(1 + \chi)D(\theta) - 4S \tag{13}$$

$$\text{subject to} \qquad S \geq F \tag{14}$$

$$S \geq \delta F. \tag{15}$$

Since $\delta < 1$, condition (15) must hold if condition (14) does. So we can delete condition (15) as redundant. Since the maximand is strictly decreasing in S, condition (14) will hold with equality. Using it to substitute out of S in the objective function, we conclude that the profit-maximizing manufacturer will set $\theta = \theta^*$, $S = F$ and will earn a profit of $(\theta^* - m)(1 + \chi)D(\theta^*) - 4F$.

We now verify that use of the Early Bird Discount is strictly more profitable for any $\delta \leq \chi < 1$. The profit of the manufacturer from an Early Bird Discount is $(\overline{c} - m)(1 + \chi)D(\theta^*)$ and his profit from the uniform slotting allowance is $(\theta^* - m)(1+\chi)D(\theta^*)- 4F = (1 + \chi)\Pi_{max} - 4F$. To establish that the Early Bird Discount is strictly more profitable, note that:

$$\begin{aligned}(\overline{c} - m)(1 + \chi)D(\theta^*) &= ((\theta^* - m) - (\theta^* - \overline{c}))(1 + \chi)D(\theta^*)\\ &= (1 + \chi)\,\Pi_{max} - (1 + \chi)\,(\theta^* - \overline{c})\,D(\theta^*)\\ &= (1 + \chi)\,\Pi_{max} - (1 + \chi)2F\\ &> (1 + \chi)\,\Pi_{max} - 4F. \end{aligned} \tag{16}$$

The strict inequality in the last line follows since $\chi < 1$.[20] Both strategies maximize channel profits. The advantage of Early Bird Discounts is that dealers in the smaller city, although offered the same contract as dealers in the larger city, choose to preorder less in aggregate. The disadvantage of uniform slotting allowances is that the manufacturer is compelled to pay dealers in the smaller city as much as dealers in the larger city.

5. Profit-Shifting Early Bird Discounts: Real-World Considerations

When rival dealers' preorders are not disclosed before the Pricing stage or merchandise returns are permitted at no cost, Early Bird Discounts lose their effect. To implement Early Bird Discounts, the manufacturer needs to do *more* than merely choose the optimal cost pair (c, θ) to

[20] Notice that if demand were the same in the two cities, contrary to our assumption, then $\chi = 1$ and the derivation shows that Early Bird Discounts and slotting allowances are equally profitable. This confirms our conclusion in the one-city case.

charge his dealers. He needs to ensure that the preorders of his dealers constitute "credible threats" (e.g., Dixit 1982, p. 17; Tirole 1988, p. 217; Shapiro 1989, p. 382). To achieve this, the manufacturer must arrange matters so that (1) each dealer *observes* the mean preorder of his rivals before setting his own price; and (2) each dealer recognizes that returning unsold merchandise that was preordered at a discount is prohibitively expensive. *Both* conditions must be satisfied for the manufacturer to be able to shift positive profits to the dealers; otherwise, no matter what parameters the manufacturer sets for the Early Bird Discount, dealers price at the preorder cost and earn zero margins.

To see this, suppose returns are impossible, as we have been assuming, but suppose now that the mean preorder of rival dealers is unobservable. Assume that $N \geq 2$ dealers are offered an Early Bird Discount. Then the equilibrium retail pricing strategy in our game (shown in Appendix D to depend on the observed aggregate preorder, Q) cannot be implemented. In this new game, each dealer can unilaterally change his preorder and retail price without being observed. It is as if the preordering and pricing stages are a single stage. In this circumstance, the lowest retail price in equilibrium can never strictly exceed c, for in that case, every dealer has an incentive to unilaterally price slightly below the lowest price and to preorder enough to satisfy the entire market demand. In doing so, he would steal all the customers of his rivals and earn a margin on every sale. In the Nash equilibrium of this new game, therefore, every dealer would price at the per-unit cost of preordering (c), none would anticipate covering his fixed cost and all dealers – or all but one – would exit.

Suppose instead that each dealer observed the mean preorder of rival dealers, as we have been assuming, *but* the manufacturer permitted free returns of unsold merchandise. Then every dealer could preorder D(0) and return costlessly what he did not sell. In this case, the magnitude of preorders, although observable, conveys no useful information, and the retail price of every dealer would again collapse to the preorder cost (c). Once again, if two or more dealers remained after the exit stage, each would anticipate earning a zero gross margin and being unable to cover his fixed cost. Hence, if unsold preorders could be costlessly returned, at most one dealer would remain after the exit stage.

Therefore, the two requirements are necessary. But how do real-world manufacturers satisfy these two necessary requirements?

As mentioned in the introduction, many manufacturers simply *prohibit* dealer returns of merchandise preordered at a discount (unless the goods are defective at the time of delivery or have been returned to the dealer by a customer). Other upstream firms do allow returns but only for a limited time and only if dealers pay both shipping costs and restocking fees; these restrictions can make dealer returns unprofitable even though they are permitted.[21]

As for mechanisms for discovering the mean preorder of rivals, the same salesperson often takes preorders from competing dealers and is therefore certainly in a position to disclose rivals' mean preorder information before dealers set prices; moreover, as shown, the manufacturer and dealers benefit from such disclosures. In other contexts, manufacturers organize sales contests among their sales reps or dealers that implicitly reveal the size of rivals' preorders. Finally, company intranets are also used to post such information.

6. Conclusions

In our analysis, we have compared Early Bird Discounts with linear pricing and slotting allowances. A full-fledged formal comparison of Early Bird Discounts with other methods of profit-shifting, such as nonlinear pricing schemes, resale price maintenance, and exclusive territories, is beyond the scope of this paper.

One does not need formalism, however, to note that other profit-shifting restraints (e.g., uniform slotting allowances) may be perceived as unfair. Territorial restrictions involve significant administrative and monitoring costs (Dutta et al. 1994) and are difficult to adapt to new circumstances. Other policies, such as minimum resale price maintenance and account-specific pricing, a form of price discrimination, can and have invited antitrust scrutiny in the United States and elsewhere (Carlton and Perloff 2005, pp. 670-675; Coughlan et al. 2006, pp. 378-399).

In contrast, preordering at a discount is both legal and practical. The mechanism provides the manufacturer in the proposal stage with a flexible way to adjust the amount of profit he transfers to downstream dealers. The appearance of uniform offering to multiple dealers across heterogeneous markets further increases its practical value. Whenever Early Bird Discounts are adopted by the manufacturer, either channel profits are maximized but dealers receive a larger portion of them than they would under linear pricing or some channel profits are forgone. In the latter case, the resulting retail prices and preorders are Cournot-equivalent with marginal cost equal to preorder cost even though dealers are price setters.

Although general in some respects (any number of players, any weakly concave inverse demand), our analysis is limited in another respect. The question arises whether our analysis generalizes if we relax our assumption that dealers sell perfect substitutes. In some cases,

[21] See Coughlan et al. (2006, pp. 83-89) for a detailed discussion on the process and the high cost of handling and restocking returned merchandise in marketing channels.

differences in location and service would make an assumption of imperfect substitutes in demand more plausible. Suppose that, in the absence of Early Bird Discounts, dealers selling imperfect substitutes did not earn sufficient gross margin to cover their fixed costs. Could an Early Bird Discount still be used to shift profits from the manufacturer to the dealers? Our analysis is complementary to that of imperfect substitutes—as long as the analysis is restricted to two dealers with symmetric linear demand. Lo and Salant (2015) show how to reinterpret the strategic trade model of Maggi (1996) to establish our Proposition 1.[22] The restrictions there on the number of players and the demand system are based on Maggi's analysis. Once it is established that the dealer response to any Early Bird Discount remains the same when the goods are imperfect substitutes, it follows that the manufacturer will use Early Bird Discounts exactly as we describe here.

Our analysis emphasizes the importance of understanding institutional arrangements in distribution channels. Without knowing details about channel arrangements (e.g., Early Bird Discounts and returns policies), researchers would naturally presume that dealers setting retail price simultaneously after preordering at the discounted wholesale price would set the same retail prices as Bertrand competitors with identical marginal costs equal to the *preorder cost*. Hence, the dealers cannot earn margins to cover fixed costs of operating the business. However, this presumption—and result—is erroneous. One can instead describe dealers as Bertrand competitors acting as if their marginal cost is the *undiscounted wholesale price*; they would set retail price equal to that wholesale price in the perfect substitutes case and to something higher in the imperfect substitutes cases. Alternatively, one can describe dealers as Cournot competitors with marginal cost equal to preorder cost when the discount is sufficiently large. Dealers earn gross margins that can be used to cover their fixed costs.

[22] To make this as clear as possible, we have adopted Maggi's notation with two minor exceptions. First, we denote the preorder cost as c, which is equivalent to his original cost of building capability, denoted as c_0 in his paper. Second, Maggi has another variable c as firms' selling cost, which we set as zero. Of course, the proof of our proposition is entirely different, because we are dealing with an arbitrary number of players, a wider class of inverse demand curves, and perfect substitutes.

FIGURE 1. TIMELINE OF EVENTS

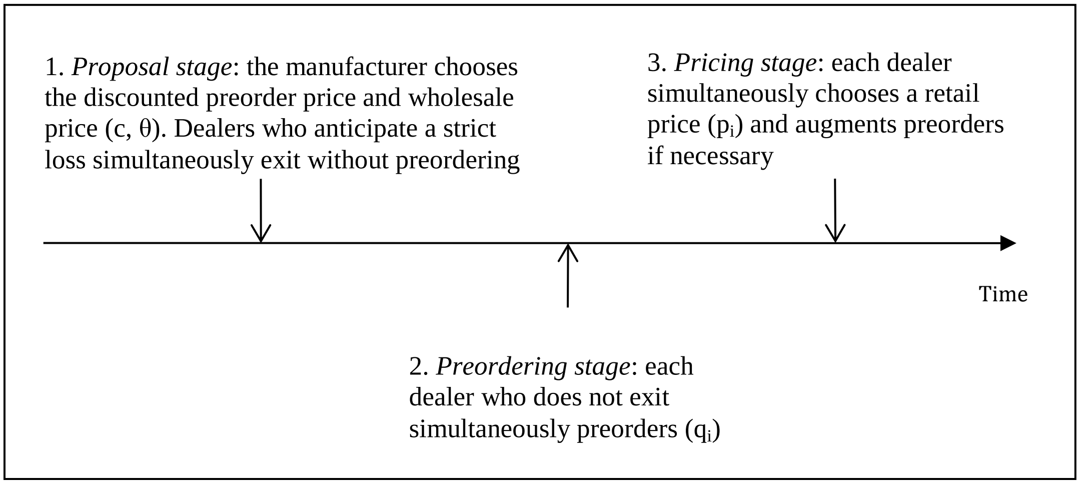


FIGURE 2. DEALERS' RESPONSE TO THE UNDISCOUNTED WHOLESALE PRICE AND PREORDER PRICE (R-DEALER CASE)

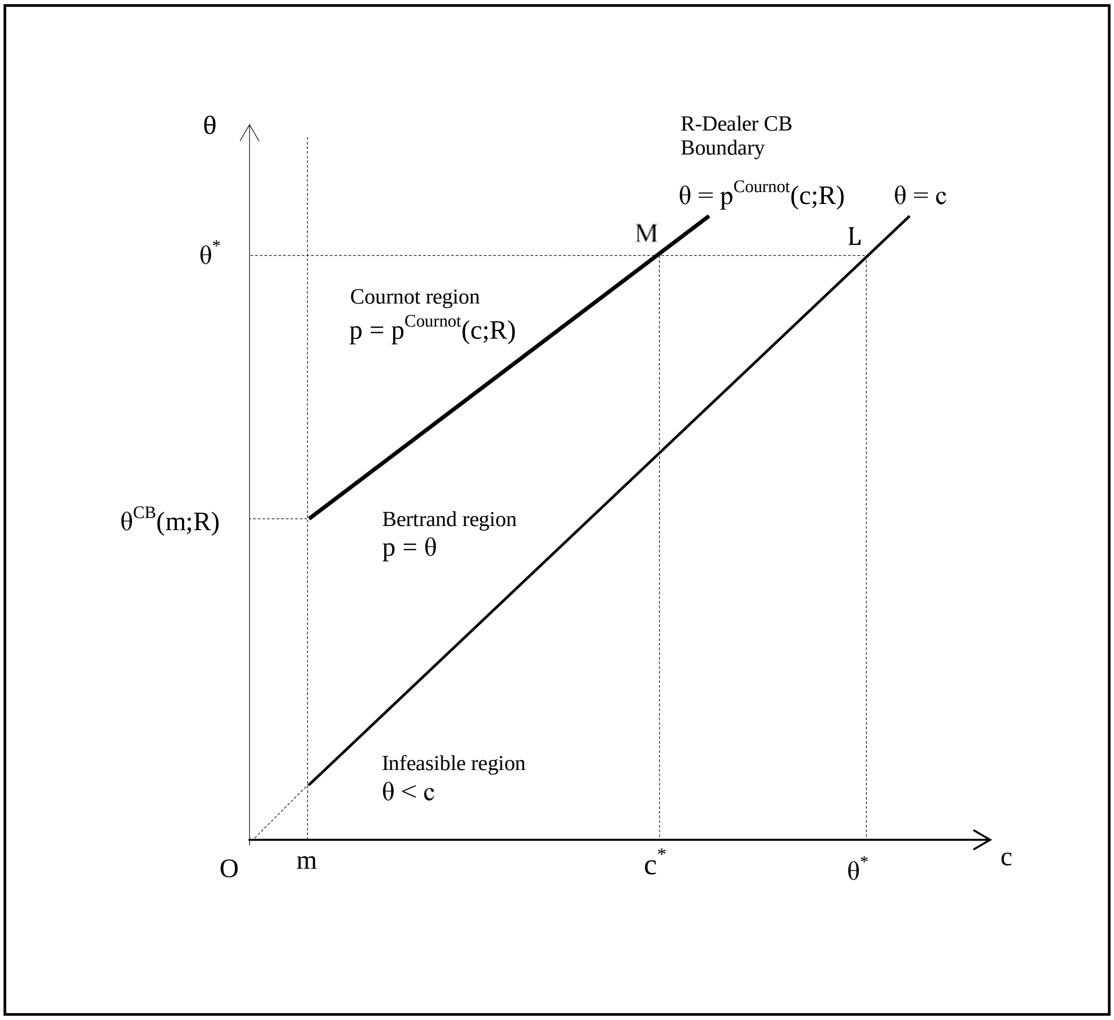
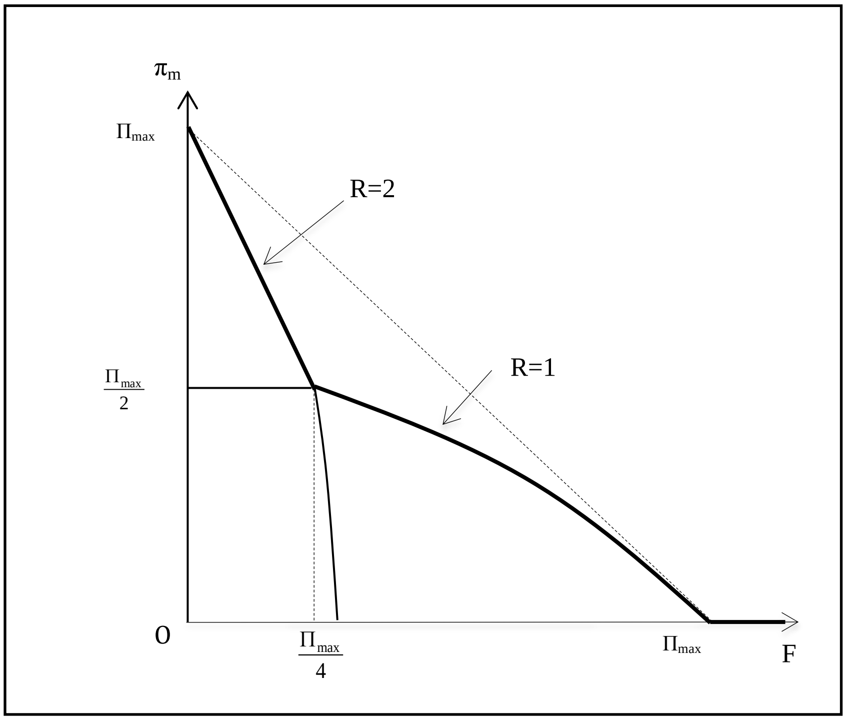


FIGURE 3. MANUFACTURER'S PROFIT AS A FUNCTION OF A DEALER'S FIXED COST



APPENDIX A: Colgate-Palmolive's Promotion on Ajax Laundry Detergent

Colgate-Palmolive Company

November 5, 1988

To Our Valued Customers:

We are pleased to offer an allowance of $5.60 off our standard invoice price $19.90 on Ajax Laundry Detergent Giant size for the ordering period beginning January 23 to March 10. On a truckload basis, your net cost is thus lowered to $14.30 per unit. The ship dates are from February 6 to March 17.

Product Information

Item	UPC	Case Packout	Case Weight
Ajax Giant	05281	14/36oz	37.5 lbs

Your orders from this promotion may further qualify for marketing support such as funding for television or radio advertising from the Ajax Line Special Event Merchandise Contract.

Sincerely

Vice President – Sales

Source: Adapted from Blattberg and Neslin (1990), pp. 319-321.
Note: The terms in this promotion correspond to the notation in our model as follows: $\theta = 19.90$; $c = 14.30$.

APPENDIX B: Kaspersky's 2009 Midyear Promotion

Following is the 2009 midyear promotion offered by Kaspersky for its sales promotion within the Beijing area of an antivirus consumer software product.

Beijing Region Kaspersky "2010 Version" Product Preorder Policy

Respected Dealer Friends,

Kaspersky's 2010 new full-function security software is soon to be launched. Our preorder policies are as follows:

Pre-order price:
- Kaspersky Full-Function Security Software 2010 Version: 130 yuan/unit

Payment: between July 17-22, 2009[a]

Promotional details for Kaspersky Full-Function Security Software 2010 Version
- Each 100-unit order gets 4 additional free units[b]

Kaspersky products strictly follow our regional sales policy. Orders from this promotion are restricted to sales within the Beijing region. We will not honor our incentives if your products are found to have been sold in other regions. Please contact our Beijing branch for details of this promotion.

Note: The terms in this promotion correspond to the notation in our model as follows: $\theta = 130$; $c = (100/104)$ (4 free *additional* units per 100 units as preorder discounts; excluding other discounts from which we abstract).

[a] Delivery of the packaged software CDs, based on dealers' requests, can start as soon as the preordering period ends.

[b] In addition, Kaspersky offers other incentives on preorders. These additional terms are described in Kaspersky's "Dealership-Development" document and may include sales quotas, monetary rewards, prizes, and dealer-specific support in advertising, consumer promotions, and promotional materials.

APPENDIX C: Computec's 2005 Second Quarterly Promotions

C1. Computec's second quarterly promotion in 2005 for its consumer product.

Computec "New Version" Product Sales Policy

Respected Computec Dealers and Distributors:

After several years of hard work and cooperation between Computec and our dealers, Computec's product has shown growing market shares. Our sales trend is strong and every region is exhibiting hot sales. This makes our product the unassailable leading brand in the market.

To enhance consumer demand in the summer, Computec is launching our "New Version" product, together with millions of dollars of marketing expenses, to organize this promotion campaign. At the same time, to reward our core channel partners and retail outlets during summer holidays, we will start the "1000-store Cool Gift" campaign. We hope our dealers will seize this opportunity to set another sales record.

In this summer promotion campaign, we will stabilize channel prices to protect the profitability of our dealers by penalizing those who viciously lower channel prices.

Our sales policies for the promotion are:

A. Product and Price

- Product name: "Computec Consumer Product 2005 Version"
- List wholesale price: 95 yuan/unit
- Discounted wholesale price: 90 yuan/unit

B. Duration

- July 7–8, 2005 (based on the time shown on your bank telex deposits)
- From July 9 onward, Computec 2005 Version reverts to its regular list wholesale price of 95 yuan/unit

C. Ordering Policy

- Product delivery starts on July 10, 2005 in the order in which we have received payments during the promotion period.[a]
- Computec's sales managers may assign sales quotas.[b] We will offer additional marketing and advertising support for those whose orders exceed these quotas.

Computec Technology Co. Ltd.

Notes: The terms in this dealer promotion correspond to the notation in our model as follows: $\theta = 95$; $c = 90$ (excluding quantity discounts from which we abstracted).

[a] Although a dealer has to take all deliveries before a specified date, the dealer can divide his total preorder into smaller portions and decide when to take delivery of each portion.

[b] The sales quota includes a minimum order of 1,000 units in this sales cycle.

C2. Computec's second quarterly promotion in 2005 for its small and medium enterprise (SME) product line

"Computec Product Small & Medium Enterprise (SME) Version" Product Promotion Policies

Respected Computec Dealers and Distributors:

Thank you for your support and cooperation for the past many years.

Computec is becoming an integrated manufacturer in the computer accessory market. Our market share and sales are both increasing rapidly for our hardware and software.

The peak selling season has arrived. Again, Computec is organizing our "SME version" promotion. In this promotion, Computec is offering the following incentives for our long-term dealers and distributors:

1. Promotion Period
From 13:30 08/17/2005 to 17:00 08/19/2005 (based on the time shown on your bank telex deposits)
2. Ordering price during the promotion period:
For our assigned dealers, your ordering price is 2% off the standard list wholesale prices.
3. Special incentives
Orders of more than 80000 yuan get 1 unit of Product X[a] free.

- Orders of more than 200000 yuan get 3 units of Product X free.
- Orders of more than 500000 yuan get 8 units of Product X free.
- All orders during the promotion period are also eligible for routine annual discounts.[b]

4. Other regulations

- Those who ordered from us during this promotion period are eligible to sign an SME agreement with Computec. We will register those company names in "Computec SME dealership list."[c]
- We may offer advertising and other marketing support for those who participate in this promotion.

6. After the promotion period, the ordering prices of "SME version" will revert to the list wholesale prices terms specified in the dealership agreement.
7. After we receive your payment, we will start product delivery. Dealers must take possession of all ordered units on or before 17:30 09/02/2005.[d]
8. Computec reserves all rights to interpret the policies and regulations of this promotion.

Computec works with you for prosperity.

Computec Technology Co. Ltd.

Notes: The terms in this promotion correspond to the notation in our model as follows: θ varies depending on the product; $c = 0.98\theta$ (2% preorder discounts; excluding quantity discounts from which we abstracted).

[a] Computec also makes and sells an enterprise computer product, referred to here by the pseudonym Product X, which is complementary to the SME product line.

[b] Annual discounts are on average 10% and based on *preorders* taken during the four quarterly promotion periods in one year. Together with the 2% discount mentioned above, the total discounts for preorders amount to 12%. At the same time, there are minimum orders (sales quotas) for the dealers for each promotion period.

[c] Computec distributes this list to existing and potential customers so that the latter will solicit business from those that are listed.

[d] Although a dealer has to take all deliveries before a specified date, the dealer can divide his total preorder into smaller portions and decide when to take delivery of each portion.

APPENDIX D: Proof of Proposition 1

Suppose $R \geq 2$ dealers remain after the exit stage. Denote the preorder of dealer i as q_i and the retail price it subsequently chooses as p_i. Denote the aggregate preorder as $Q = \sum_{i=1}^{R} q_i$. In this appendix, we prove Proposition 1: If $p^{Cournot}(c;R) > \theta$, then $p = \theta$ and $Q = D(\theta)$, whereas if $p^{Cournot}(c;R) \leq \theta$, then $p = p^{Cournot}(c;R)$ and $Q = Rq^{Cournot}(c;R)$.

Recall that under the "rules of the game," if the lowest retail price is p, then the D(p) customers arrange themselves so that a lowest-price firm that preordered q_i would get $q_i D(p)/Z$ customers, where $Z = \sum_{j\in\{\text{lowest price firms}\}} q_j$.

It follows that if $D(p)/Z \leq 1$, every dealer has preordered weakly more than its customers demand, and if $D(p)/Z > 1$, each dealer has preordered less than its customers demand. In the latter case, each dealer is required to satisfy the remaining demand ($([D(p)/Z] - 1)q_i > 0$) by augmenting the preorder at the undiscounted wholesale price (θ). We denote the inverse demand curve $P(\cdot)$ and assume it is strictly decreasing and weakly concave.

Pricing Subgames

Denote the number of firms remaining after the exit stage as R. Assume $R > 1$ and that the manufacturer has chosen wholesale price θ and discounted price c. Then, in the symmetric Nash equilibrium of each subgame indexed by $\{q_i, Q_{-i}, R\}$ for $i = 1,\ldots,R$, each dealer will set its retail price equal to $p_i = \max(0, \min(\theta, P(Q))$. To prove that this profile of retail prices forms a Nash equilibrium in the subgame, we consider three cases:

Case 1: When observed total preorders are small; that is, $P(Q) > \theta$. In the conjectured equilibrium, $p_i = p_{-i} = \theta$, $Q = D(\theta)$, dealer i would get in revenue $\theta q_i + (\theta - \theta)\{[D(\theta)/Z] - 1\}q_i$. The first term is the revenue from selling the preorder. The second term reflects the net margin per unit (its first factor) multiplied by the amount of augmenting required under the rules of the game (the product of the second and third factors). Since consumers would pay the dealer what it cost him to augment (θ per unit), augmenting earns zero margins and the firm's revenue would be $\theta q_i > 0$. Dealer i cannot strictly increase his revenue by unilaterally deviating from $p_i = \theta$. If he strictly raised his retail price, he would lose all his customers and earn zero revenue. Suppose instead he unilaterally reduced the retail price to $\theta - \varepsilon > 0$. Then he would earn less on his preorders but would have to augment more to cover all the remaining demand. As a result, he would earn the negative amount $(\theta - \varepsilon) - \theta < 0$ on every additional unit.

Case 2: When observed total preorders are large; that is, $\theta \geq P(Q) > 0$. In the conjectured equilibrium, $p_i = p_{-i} = P(Q)$, $Q = Z$. Since $D(P(Q))/Z = 1$, each dealer's preorder exactly satisfies the demand of his customers, and there is no need to augment. Dealer i would get in revenue

$P(Q)q_i \geq 0$. Unilaterally raising his price would result in no customers and no revenue. Unilaterally reducing his price by $\varepsilon > 0$ would result in smaller revenue from his preorders. Moreover, as the firm charging the lowest price, he would be required to augment and would lose money doing so, since he would earn the negative amount $(P(Q) - \varepsilon) - \theta < 0$ on each additional unit. Hence, neither deviation would strictly improve dealer i's revenue.

Case 3: When observed total preorders are very large; that is, $Q \geq D(0) \Leftrightarrow P(Q) = 0$. In the conjectured equilibrium, $p_i = p_{-i} = 0$. In this case, dealer i would earn zero revenue, but he would also earn nothing if he unilaterally increased his price. Reducing his price unilaterally is infeasible, but if it were not, it would be unprofitable.

We conclude therefore that if $R > 1$, every firm will charge the retail price $p_i = \max(0, \min(\theta, P(Q))$ for $i = 1, \ldots, R$.

Preordering Subgames

Assume that the number of firms that did not exit is $R > 1$ and that the manufacturer has chosen wholesale price θ and discounted price c.

Case 1: Suppose $p^{Cournot}(c;R) > \theta$. Then in the proposed subgame-perfect equilibrium, $q_i = q_{-i} = D(\theta)/R$. If this strategy profile is played, every dealer will subsequently set the retail price $P(R\cdot D(\theta)/R) = \theta$, since this is the equilibrium price in the pricing subgame that follows. Dealer i would earn $q_i D(\theta)/R > 0$ in the proposed equilibrium. If dealer i unilaterally reduced his preorder, he would incur a strict loss, since the common retail price would remain θ. So he would lose the margin $\theta - c > 0$ on each unit he failed to preorder and would break even on the amount he was required to augment. If dealer i unilaterally increased his preorder instead, his gross margin would also unilaterally decline. To see this, note that his gross margin would equal $q_i[P(q_i + (R - 1)D(\theta))/R) - c]$. Since the first and second derivatives of the inverse demand function are negative by assumption, this function is strictly concave. Moreover, the first derivative of the gross-margin function is strictly negative for $q_i > D(\theta)/R > q^{Cournot}(c;R)$.[23] Finally, if he unilaterally preordered a very large amount, the common retail price in the pricing stage would fall to zero. He would scrap and get zero gross margin from his preorders. Hence, no dealer has a strict incentive to deviate unilaterally in either direction from his proposed equilibrium strategy.

[23] At Cournot equilibrium, no oligopolist would strictly benefit from increasing or decreasing his production. So $p^{Cournot}(c;R) + q^{Cournot}(c;R)\cdot P'(R\cdot q^{Cournot}(c;R)) - c = 0$. Since $\theta < p^{Cournot}(c;R)$, $D(\theta)/R > q^{Cournot}(c;R)$, and $P'(\cdot) < 0$ is strictly decreasing, it follows that $\theta + (D(\theta)/R)\cdot P'(D(\theta)) - c < 0$. This last expression is the marginal change in dealer i's gross margin if he unilaterally increased his preorder in the neighborhood of his proposed equilibrium strategy. Given strict concavity of his gross-margin function, non-local increases in his preorder are also unprofitable.

Case 2: Suppose dealers observe that $p^{Cournot}(c;R) \leq \theta$. Then in the proposed equilibrium, $q_i = q_{-i} = q^{Cournot}(c;R)$. Since $Q = R \cdot q^{Cournot}(c;R) < D(0)$ and $p^{Cournot}(c;R) = P(R \cdot q^{Cournot}(c;R))$, the common retail price in the last stage would be $0 < p_i = p_{-i} = p^{Cournot}(c;R) \leq \theta$. If dealer i deviated locally by preordering a larger amount, the common retail price in the final stage P(Q) would fall to clear the market. Since dealer i would no longer be choosing the Cournot best reply to the unchanged preorders of the other (R – 1) dealers, his net profit would strictly decline. If dealer i unilaterally preordered a very large amount, the common retail price in the pricing stage would fall to zero. Those dealers who had placed a preorder, including him, would scrap; he would get zero gross margin. On the other hand, if he unilaterally preordered an amount smaller than $q^{Cournot}(c;R)$, the common retail price in the final stage would rise. Suppose it remained below θ. Then dealer i would no longer be choosing the best reply to the preorders of the other (R – 1) dealers, and his net profit would decline. Finally, any unilateral reduction in i's preorder after the common retail price reached θ would also be harmful. Dealer i would lose the margin $\theta - c > 0$ on each unit reduction in his preorders beyond that point; he would break even on each unit that he was required to augment, since the price customers pay would just cover the undiscounted wholesale price the manufacturer would charge dealer i.

To summarize our findings, in a symmetric subgame-perfect equilibrium, if $p^{Cournot}(c;R) > \theta$, then $p = \theta$ and $Q = D(\theta)$, whereas if $p^{Cournot}(c;R) \leq \theta$, then $p = p^{Cournot}(c;R)$ and $Q = Rq^{Cournot}(c;R)$. QED.

APPENDIX E: Proof of Proposition 2

To analyze the constrained profit-maximization problem of the manufacturer for the $R > 1$ case, we append the multiplier λ to constraint (1), γ to constraint (2), and δ to constraint (3). The Lagrangean of the problem is

$$L = (c - m)D(\theta) + \lambda[D(\theta)(\theta - c) - RF] + \gamma[p^{Cournot}(c;R) - \theta] + \delta[c - m].$$

At an optimum, the following conditions must hold:

$$\theta \geq 0,\ (c - m)D'(\theta) + \lambda[D'(\theta)(\theta - c) + D(\theta)] - \gamma \leq 0,\ \text{c.s.} \tag{E1}$$

$$c \geq 0,\ D(\theta) - \lambda D(\theta) + \gamma p'^{Cournot}(c;R) + \delta \leq 0,\ \text{c.s.} \tag{E2}$$

$$\lambda \geq 0,\ D(\theta)(\theta - c) - RF \geq 0,\ \text{c.s.} \tag{E3}$$

$$\gamma \geq 0,\ p^{Cournot}(c;R) - \theta \geq 0,\ \text{c.s.} \tag{E4}$$

$$\delta \geq 0,\ c - m \geq 0,\ \text{c.s.} \tag{E5}$$

The notation "c.s." is an abbreviation for "complementary slackness." The condition $a \geq 0$, $b \geq 0$, c.s. means that both a and b are nonnegative and, in addition, that at least one of these variables is zero; thus, the condition eliminates the possibility that both variables are strictly positive.

We begin with three preliminary observations:

1. (E2) requires $\lambda > 0$, and therefore (E3) requires $D(\theta)(\theta - c) - RF = 0$.
2. (E3) requires that $\theta > c > 0$. Since $\theta > 0$, (E1) implies $(c - m)D'(\theta) + \lambda[D'(\theta)(\theta - c) + D(\theta)] - \gamma = 0$.
3. (E5) requires $c > 0$. Since $c > 0$, (E2) requires $D(\theta) - \lambda D(\theta) + \gamma p'^{Cournot}(c;R) + \delta = 0$.

Optimum in the Interior of the Bertrand Region

If the optimum occurs in the interior of the Bertrand region, (E4) requires $\gamma = 0$, and since $\lambda > 0$, (E3) requires that $D(\theta)(\theta - c) - RF = 0$. Moreover, $c - m > 0$, implying that $\delta = 0$.[24] We deduce from (E2) that $\lambda = 1$ and from (E1) that $\theta = \theta^*$, the implicit solution to $(\theta - m)D'(\theta) + D(\theta)$.

Optimum on the R-dealer CB Boundary of the Bertrand Region

On the CB boundary, $p^{Cournot}(c;R) - \theta = 0$, so (E4) implies that $\gamma \geq 0$. Recall that c^* is the solution to $p^{Cournot}(c;R) - \theta^* = 0$. That is, (c^*, θ^*) is on the CB boundary at the channel-profit maximizing wholesale price. If this is not a solution, it is because $D(p^{Cournot}(c^*;R))(p^{Cournot}(c^*;R) - c^*) - RF < 0$. The left-hand side is the sum of dealer profits in Cournot equilibrium where each firm has constant marginal cost $c = c^*$. It has been shown (Kotchen and Salant 2010, p. 247) that, given our assumption that the inverse demand curve is weakly concave, Cournot industry profits are strictly

[24] Suppose the contrary: $c - m = 0$ in the interior of the Bertrand region. (E1) yields $(\theta - m)D'(\theta)+D(\theta) = 0$, which by definition implies $\theta = \theta^*$. However, it is well known that the price charged in a Cournot oligopoly (with two or more dealers) is strictly smaller than the price a monopolist would charge, $p^{Cournot}(m;R) < \theta^*$, so (E4) would be violated. Therefore, we must have $c > m$ in the interior of the Bertrand region.

decreasing in the common constant marginal cost. It follows that if $D(p^{Cournot}(c^*;R))(p^{Cournot}(c^*;R) - c^*) - RF < 0$, the constrained optimum occurs at $\theta < \theta^*$.

Existence and Uniqueness

If RF is sufficiently large, the constraint set will be empty and the manufacturer goes out of business, earning a payoff of zero. If the constraint set is nonempty, the solution to the constrained maximization problem must be unique. Recall that this solution occurs either in the interior of the Bertrand region with $\theta = \theta^*$ or on the R-dealer CB boundary. We first prove that if there exists one solution in the interior of the Bertrand region (respectively, on the R-dealer CB boundary), there cannot be any other solution in the interior of the Bertrand region (respectively, on the R-dealer CB boundary). We conclude by proving that if a solution occurs in one of these two regions, there cannot be an additional solution in the other region.

There can be at most one solution in the interior of the Bertrand region. The assumption that the inverse demand curve is weakly concave ensures that channel profits are a strictly concave function of θ, and hence there is a unique channel-profit maximizing wholesale price. Given that price, if one discounted price (c) generates dealer gross margins exactly equal to their fixed costs, no other discounted price will achieve exactly those margins, since dealer gross margins monotonically fall as the preorder cost rises.

There can also be at most one solution *on* the R-dealer CB boundary, for along that boundary, dealer gross margins increase monotonically as c decreases.

The optimum can occur in only one of these two regions, because as one reduces c and moves horizontally across the Bertrand region at θ^* and then continues down the R-dealer CB boundary ($\theta < \theta^*$), dealer gross margins monotonically increase. Hence, if they exactly covered fixed costs in the interior of the Bertrand region, they must exceed the fixed costs anywhere on the R-dealer CB boundary. Similarly, if they exactly covered the fixed costs at $\theta < \theta^*$ somewhere on the R-dealer CB boundary, they must be strictly smaller at any point in the interior of the Bertrand region with the wholesale price set at the channel-profit maximizing price (θ^*). QED.

APPENDIX F: Mathematical Proof of Example

The case of R = 1

We begin by deriving the profit function of the manufacturer when demand is linear and the one remaining dealer has fixed cost F.

Given D(p) = (a – p) / b, in the Spengler's (1950) case, the single dealer's optimal retail price for a given manufacturer's wholesale price θ is

$$p(\theta) = \arg\max_{p\geq 0}(p-\theta)\frac{(a-p)}{b} - F = \frac{a+\theta}{2}.$$

And the single dealer's optimal quantity is $D(p(\theta)) = \frac{a-\theta}{2b}$. The manufacturer maximizes his profit, $(\theta - m)\frac{(a-\theta)}{2b}$, and obtains his optimal wholesale price $\theta^* = (a + m) / 2$. Maximized manufacturer profit is therefore

$$\pi_m^1 = (\frac{a+m}{2} - m)(\frac{a-m}{4b}) = \frac{(a-m)^2}{8b} = \frac{1}{2}\Pi_{max}. \qquad \text{(F1)}$$

The Spengler solution holds provided the gross margin of the dealer weakly exceeds his fixed cost. Substituting the optimal wholesale price $\theta^* = (a + m) / 2$ into the exclusive dealer's profit function, we get

$\pi_d = (p(\theta) - \theta)D(p(\theta)) - F = \left(\frac{a+\theta}{2} - \theta\right)\left(\frac{a-\theta}{2b}\right) - F = \frac{(a-m)^2}{16b} - F$. Thus, Spengler's solution holds for any $F \leq \frac{(a-m)^2}{16b} = \frac{1}{4}\Pi_{max}$.

If the fixed cost is larger, however, the manufacturer must reduce his wholesale price or his single dealer will exit. In this case the endogenous variables (p, θ, π's) are determined by the two constraints (4) and (5) in the main text and by the following equation defining manufacturer profit:

$$\pi_m^1 = (\theta - m)D(p(\theta)) = (\theta - m)\frac{(a-\theta)}{2b} = 0.$$

Hence, $\frac{d\pi_m^1}{d\theta} = \frac{a+m-2\theta}{2b}$. On the other hand, substituting $p(\theta) = \frac{a+\theta}{2}$ and $D(p(\theta)) = \frac{a-\theta}{2b}$ into (5) and differentiating, we obtain $\frac{dF}{d\theta} = \frac{-(a-\theta)}{2b} < 0$. Therefore,

$$\frac{d\pi_m^1}{dF} = \frac{\theta - m}{a-\theta} - 1. \qquad \text{(F2)}$$

Equation (F2) implies that the second portion of π_m^1 starts to descend at F = $\frac{\Pi_{max}}{4}$ and since θ^* = (a + m) / 2 , $\frac{d\pi_m^1}{dF} = 0$, implying that there is no kink in π_m^1 at the transition point. Moreover, $\frac{d\pi_m^1}{dF}$ is larger than –1 because the first term in (F2) is positive; but since $\frac{dF}{d\theta} < 0$, this term is decreasing in F. Hence, the second portion of π_m^1 starts out flat and is decreasing and strictly concave in F until it reaches the horizontal axis (π_m^1 = 0). Since at that point θ = m, equation (F3) implies $\frac{d\pi_m^1}{dF}$ = –1.

The case of R = 2

In the text, we show that in the Bertrand region the manufacturer's profit function $\pi_m^2 = \Pi_{max} - 2F$ declines linearly until the transition point derived in the text. Here, we describe the profit function, π_m^2, if F is larger, and hence the manufacturer operates in the Cournot region.

In the Cournot region, the common retail price is $p^{Cournot}(c; 2) = \frac{a+2c}{3}$, and each dealer preorders and sells $D(p^{Cournot}(c; 2)) / 2 = \frac{a-c}{3b}$. Since dealers' total gross margins just their fixed costs, $(p^{Cournot}(c; 2) - c)D(p^{Cournot}(c; 2)) = 2(a - c)^2/(9b) = 2F$. Solving for F, we conclude that F = $(a - c)^2/(9b)$. Thus a one dollar increase in fixed costs requires the manufacturer to cut the preorder cost at a rate of $\frac{dc}{dF} = -\frac{9b}{2(a-c)} < 0$. Since the manufacturer's profit is

$$\pi_m^2 = (c-m)D(p^{Cournot}(c)) = \frac{2(a-c)(c-m)}{3b},$$

we have $\frac{d\pi_m^2}{dc} = \frac{2(a+m-2c)}{3b}$. This is negative because c < θ^* = (a + m) / 2. Using these results, we have

$$\frac{d\pi_m^2}{dF} = \frac{d\pi_m^2}{dc} \cdot \frac{dc}{dF} = -\frac{3(a-2c+m)}{a-c} = \frac{a-m}{(bF)^{1/2}} - 6. \qquad \text{(F3)}$$

The last equality uses the fact that $c = a - 3(bF)^{1/2}$ since $F = \frac{(a-c)^2}{9b}$. Since $\frac{d\pi_m^2}{dF}$ in (F3) is the product of a positive derivative and a negative derivative, it is negative. Since the first term on the right-hand side of (F3) is positive and decreasing in F, the manufacturer's profit function in this region is not only strictly decreasing but also strictly concave.

References

Anderson, E., G. J. Fitzsimons, D. Simester. 2006. Measuring and mitigating the costs of stockouts. *Management Science*. **52**(11) 1751-1763.

Bertrand, J. 1883. Revue de la théorie de la recherche sociale and recherches sur les principes mathématiques de la théorie des richesses. *Journal des Savants.* 499-508.

Blattberg, R., S. Neslin. 1990. *Sales Promotion: Concepts, Methods, and Strategies*. Prentice Hall, Englewood Cliffs, NJ.

Carlton, D., J. Perloff. 2005. *Modern Industrial Organization*. Addison-Wesley, New York, NY.

Coughlan, A. T., E. Anderson, L. W. Stern, A. I. El-Ansary. 2006. *Marketing Channels.* Prentice Hall, Upper Saddle River, NJ.

Davidson, C., R. Deneckere. 1986. Long-term competition in capacity, short-run competition in price, and the Cournot model. *RAND Journal of Economics*. **17** 404-415.

Desai, P. S. 2000. Multiple messages to retain retailers: signaling new product demand. *Marketing Science*. **19**(4) 381-389.

Dixit, A. 1982. Imperfect competition and public policy: recent developments in oligopoly competition. *American Economic Review*. **72** 12-17.

Dutta, S., M. Bergen, G. John. 1994. The governance of exclusive territories when dealers can bootleg. *Marketing Science.* **13** 83-89.

Ehrlich, I., G. Becker. 1972. Market insurance, self-insurance, and self-protection. *Journal of Political Economy*. **80** 623-648.

Eichenbaum, M. 1989. Some empirical evidence on the production level and production cost smoothing models of inventory investments. *American Economic Review*. **79** 853-864.

FTC (Federal Trade Commission). 2003. Slotting allowances in the retail grocery industry: selected case studies in five product categories.

Ingene, C., M. Parry. 1995. Channel coordination when dealers compete. *Marketing Science.* **14**(4) 360-377.

Iyer, G., J. M. Villas-Boas. 2003. A bargaining theory of distribution channels. *Journal of Marketing Research*. **40**(1) 81-99.

Katz, M. 1989. Vertical contractual relations. In R. Schmalensee, R. Willig, eds. *Handbook of Industrial Organization*. Vol. 1, Chapter 11. Elsevier Science, New York, NY.

Kotchen, M., S. Salant. 2010. A free lunch in the commons. *Journal of Environmental Economics and Management*. **61** 245-253.

Kreps, D. M., J. A. Scheinkman. 1983. Quantity precommitment and Bertrand competition yield Cournot outcomes. *Bell Journal of Economics*. **14**(2) 326-337.

Kuksov, D., A. Pazgal. 2007. The effect of costs and competition on slotting allowances. *Marketing Science.* **26**(2) 259-267.

Lilien, G. L., P., Kotler, K. S. Moorthy. 1991. *Marketing Models*. Prentice Hall, Englewood Cliffs, NJ.

Lo, D., S. Salant. 2015. Early Bird Discounts for Dealers. Santa Clara University discussion paper.

Maggi, G. 1996. Strategic trade policies with endogenous mode of competition. *American Economic Review.* **86** 237-258.

Mathewson, R., F. Winter. 1984. An economic theory of vertical restraints. *RAND Journal of Economics.* **15** 27-38.

McCardle, K., K. Rajaram, C. Tang. 2004. Advance booking discount programs under retail competition. *Management Science.* **50**(5) 701-708.

Padmanabhan V., I. P. L. Png. 1997. Manufacturer's returns policies and retail competition. *Marketing Science*. **16**(1) 81-94.

Padmanabhan V., I. P. L. Png. 2004. Reply to "Do returns policies intensify retail competition?" *Marketing Science*. **23**(4) 614-618.

Shaffer, G. 1991. Slotting allowances and resale price maintenance: a comparison of facilitating practices. *RAND Journal of Economics.* **22** 120-135.

Shapiro, C. 1989. Theories of oligopoly behavior. In R. Schmalensee, R. Willig, eds. *Handbook of Industrial Organization*. Vol. 1, Chapter 6. Elsevier Science, New York, NY.

Spengler, J. 1950. Vertical integration and anti-trust policy. *Journal of Political Economy*. **58** 347-352.

Tirole, J. 1988. *The Theory of Industrial Organization*. MIT Press, Cambridge, MA.

Viscusi, W., J. Vernon, J. Harrington. 2005. *Economics and Regulation of Antitrust*. MIT Press, Cambridge, MA.

Vives, X. 1985. On the efficiency of Bertrand and Cournot equilibria with product differentiation. *Journal of Economic Theory.* **36** 166-175.

Vives, X. 1999. *Oligopoly Pricing*. MIT Press, Cambridge, MA.

Wang, H. 2004. Do returns policies intensify retail competition? *Marketing Science*. **23**(4) 611-613.