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# Shelf Space Fees and Inter-Brand Competition

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## ABSTRACT

When in-store display influences consumer choices, shelf space allocation can be strategically used by retailers to extract payments from manufacturers. The paper finds that manufacturers with more popular brands have higher willingness-to-pay for the premium shelf spaces of supermarkets. Shelf space fees soften inter-brand competition and result in higher sale-weighted average retail price as well as inter-brand price differences. The fees increase the industry profit but lower the upstream profit. Both the aggregate consumer surplus and social welfare are negatively affected. This paper suggests that even when the fees do not drive small manufacturers out of retail stores, they might still be anticompetitive.

## Keywords:

Antitrust; In-store display; Shelf space fee; Retail market; Slotting allowance

**JEL Classification:** L1, L4, M2, M3

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## 1. Introduction

Shelf space fees are the payments by manufacturers to obtain access to retailers' shelf spaces. In the modern retail industry, the fees have become one of the major sources of revenue for retailers (Desiraju 2001). Assuming that in-store display can influence consumers' choices among competing brands, this paper studies how shelf space fees affect inter-brand competition and welfare. Considers a spatial model where two competing manufacturers sell through two competing supermarkets. The stores have two types of shelf spaces, which are called premium spaces and regular spaces. The premium shelf spaces are more sale-facilitating. The stores first auction off the right of using their premium shelf spaces to manufacturers. The manufacturers, who produce substitute products, then choose their wholesale prices. The stores engage in price competition with spatial differentiation. The consumers, who have unit demands and different tastes, first choose a store to visit and then choose a brand to purchase.

It is shown that manufacturer with more popular brand has higher willing-to-pay for the premium shelf spaces. And once a manufacturer wins the first auction of shelf space, its willingness-to-pay becomes higher in the second auction. Hence we always have one manufacturer winning the premium shelf spaces of both stores in equilibrium. Both manufacturers are worse off when the shelf space auctions are introduced, but the supermarkets are better off with them. After the shelf space reallocation, the inter-brand competition is softened and the sale-weighted average retail price is higher. On the other hand, the inter-brand price difference is larger and thus more consumers are induced to buy their less preferred brands. Eventually both the aggregate consumer surplus and social

welfare are decreased. This paper therefore suggests that the practices of demanding shelf space fees may be anticompetitive.

Shelf space fee is an important category of slotting allowances.<sup>1</sup> The welfare implication of those allowances is controversial. One line of studies suggests that the fees are the result of scarce shelf spaces facing escalating number of new products. Since the products with highest potential are most likely to pay high shelf space fees and manufacturers typically know their products better than retailers, the fees help to efficiently allocation the limited shelf spaces, or help the retailers to screen quality new products (Kelly, 1991; Chu, 1992; Sullivan, 1997; Lariviere and Padmanabhan, 1997; and others). These models, which are based on asymmetric information regarding newly introduced products, are definitely sensible. Nevertheless, the fees for new products only amount to a fraction of the slotting allowances observed in the real world. Those theories might not explain why producers of established products also have to pay for retail shelf spaces.

Another line of studies focuses on the exclusionary effect of slotting fees. The findings are based on the buyer power of large retailers. Shaffer (2001) finds that slotting fees can serve as a facilitating device, which depresses retail competition and lead to higher retail prices. The mechanism has some similarity to the “strategic vertical separation” (Bonanno and Vickers, 1988; Rey and Stiglitz, 1988; and others). Marx and Shaffer (2007) suggests that powerful manufacturers may intentionally bid up the shelf space fees in order to drive less powerful competitors out of the marketplace. The total exclusion effect is apparently

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<sup>1</sup> There is no consensus on the definition of slotting allowances, which are also called slotting fees, listing fees, pay-to-stay fees, street money, etc. Narrowly defined slotting fees refer to the “one-time payments a supplier makes to a retailer as a condition for the initial placement of the supplier’s product on the retailer’s store shelves or for initial access to the retailer’s warehouse space (FTC, 2003).” More broadly defined slotting fees apply to not only new products but also matured products (Shaffer, 2001 and others).

anticompetitive. Marx and Shaffer (2004) use a duopoly-monopoly model to show that a monopoly retailer may strategically limit the supply of shelf space in order to extract more shelf fees from manufacturers. The findings in this line of studies are consistent with the commonly observed fact that slotting fees hinder small manufacturers from obtain adequate shelf spaces. They also answer the question why retailers may use their buyer power to negotiate upfront payments rather than lower wholesale prices. The current paper also considers the lump sum fees charged on established products. But instead of considering the total exclusion effects, it studies how shelf space fees influence inter-brand competition. Moreover, the findings do not critically depend on retailer buyer power.

The current paper also relates to the literature about in-store stimuli and consumer's in-store decision-making. There are considerable evidences suggesting that in-store stimuli, such as sale promotion and point-of-purchase display, significantly influence consumers' brand choices. For instances, Cavallo and Temares (1969) find that there are about 19 percent of shoppers switching brands in the store with respect to three product categories (beverages, frozen & canned vegetables, and soaps & detergents). Dreze, Hoch and Purk, (1994)'s field experiment on shelf management finds that shelf location has a large impact on sales. Those studies imply that supermarkets have considerable capability in influencing consumers' choices. They can do that by changing consumers' in-store search costs for different brands, or even altering consumers' preferences among the brands. Therefore, shelf management and other merchandising services might be strategically used by supermarkets to extract more revenue from suppliers.

This paper supports the empirical findings of Rennhoff (2008). Rennhoff considers a

model where competing manufacturers bid for premium shelf space at retail outlets through “merchandising allowances”. A monopoly retailer chooses display configurations and retail prices. He estimates the parameters of the model with data of sales of four top selling brands of ketchup (Heinz, Hunts, Del Monte, and retailers’ private label) from the Food Marketing Policy Center’s IRI Infoscan Data Base (USA), and then uses the estimated parameters to conduct a counterfactual experiment to observe what if the firms are not allowed to offer merchandising allowances to obtain premium shelf spaces. It is found that merchandising allowances increase retail price and profits, which means the retailer is better off while the consumers are worse off. The allowances also lower the social welfare, which means they might be anticompetitive.

The rest of the paper will proceed as follows. Section 2 describes a bilateral oligopoly with price competition. Section 3 presents the subgame perfect Nash equilibrium of the game. Section 4 discusses the welfare implication of supermarkets’ shelf space fees. Section 5 concludes the paper. The proofs of the major results are put in the Appendix.

## **2. A Model**

Consider a retail market in a linear city with length of  $L$ . There are two symmetric supermarkets, denoted as  $a$  and  $b$  respectively, locating at the two ends of the city. They have zero marginal operating costs. There is a continuum of consumers evenly distributed along the linear city. A consumer’s unitary transportation cost in the city is denoted as  $s > 0$ . Since it is  $sL$  that is essential in measuring the degree of spatial differentiation between the two stores, we can assume  $L=1$  without loss of generality.

The product market in consideration has two competing brands, manufactured by firm 1 and 2 respectively. We also denote the two brands as 1 and 2 respectively for convenience. The marginal production costs of the manufacturers are assumed to be zero.<sup>2</sup> Consumers have unit demand toward the products with high enough reservation prices. Assume that the measure of the consumers is  $e + f$ , where  $e \geq f > 0$ . If the two brands of products were equally priced and symmetrically (or “naturally”) displayed in the stores, there are  $e$  consumers preferring brand 1 and  $f$  consumers preferring brand 2. In other words, the manufacturer takes  $\frac{e}{e+f}$  and  $\frac{f}{e+f}$  of the market respectively in that case. We say manufacturer 1 has a better brand name than 2 when  $e > f$ . However, for a given  $\Delta \in R$ , if brand 1 were sold at a price that is  $\Delta$  higher (or  $-\Delta$  lower) than brand 2, there would be  $t\Delta$  consumers switching from brand 1 to brand 2 (or  $-t\Delta$  consumers switching from brand 2 to brand 1), where  $t > 0$ .<sup>3</sup> Note that the product differentiation between the two brands is depicted by parameter  $t$ . A larger  $t$  indicates smaller product differentiation.<sup>4</sup> Assume that the tastes of the consumers cannot be directly observed by the retailers, which means direct price discrimination is impossible. We also assume that the consumers’ preferences between the two brands are unrelated to their geographical locations.

Given the consumer tastes prescribed above, the social welfare is maximized when the

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<sup>2</sup> It appears that the model implicitly assumes that the upstream and downstream firms have the same marginal costs. But it is easy to show that this simplification does not affect the major results.

<sup>3</sup> One might suggest that the number of switchers should positively depend on the original customer base of the high price store. In that case, the manufacturer with a better brand name would have even stronger incentive to bid for the premium shelf spaces of the supermarkets. Therefore the major results of the paper would not be notably affected.

<sup>4</sup> The product market is not represented by a Hotelling model because the analysis is painful when the consumer tastes are not uniformly distributed along the “linear city”. Nevertheless, the main results are unlikely to be affected as long as the consumer tastes are continuously distributed between the two brands. The key point is that if the distribution is biased toward brand 1, then the profit margin of manufacturer 1 is larger.

two brands are symmetrically displayed and equally priced. As assumed, the symmetry in-store display minimizes the consumers' total search cost. On the other hand, inter-brand price difference induces some consumers to purchase their less preferred brand, which leads to welfare losses. Since the number of switchers is linear to the price difference, the welfare loss from price difference  $\Delta$  is

$$(1) \quad \int_0^{\Delta} tv dv = \frac{1}{2} t \Delta^2.$$

Assume that consumers observe the sale-weighted average retail prices of the stores but not the exact retail prices of the individual products. Therefore a supermarket does not mind putting the same profit margins on the two brands in equilibrium. In order to simplify the modeling, we indeed assume that the profit margins of the two brands are the same within each store. We will see that this assumption leads to two consequences. First, the profit margins of the stores only depend on the inter-store spatial differentiation. Second, the wholesale prices of the manufacturers only depend on the inter-brand product differentiation. Denote the profit margins of the two supermarkets as  $\alpha$  and  $\beta$  respectively.

Each supermarket has two types of shelf spaces, premium shelf spaces and regular shelf spaces. The supermarkets can decide which brand of product to be displayed on which type of shelf spaces. Conditional on both brands are equally priced, if a brand were displayed on the premium shelf space, then compared to the case where the two brands are symmetrically displayed, the advantageously displayed brand would attract extra  $\frac{\delta}{e+f}$  of the consumers that visit the store, where  $0 < \delta < f$ . For instance, if brand 1 were displayed on the premium shelf space, then  $\frac{e+\delta}{e+f}$  of the store's shoppers would choose brand 1, conditional

on both brands are offered at the same price. In-store display may affect consumers' choices by altering their preferences between the two brands or their in-store search costs for the products. This paper does not explicitly model each consumer's in-store search cost, but assumes that the total search cost of the consumers is minimized when the two brands are symmetrically (or naturally) displayed. In other words, the total in-store search cost increases when a retailer strategically manipulates the in-store display.

**Lemma 1:** *If a supermarket has equal and fixed profit margins on the two brands, then its premium shelf space is more valuable to the manufacturer that has a better brand name.*

Intuitively, a manufacturer that has a better brand name enjoy a larger margin between its wholesale price and marginal cost.<sup>5</sup> The premium shelf spaces, which direct more customers to the brands that take the spaces, generate more profit for the manufacturer that has a larger profit margin. Therefore a manufacturer with a better brand name is willing to pay more for the spaces. Lemma 1 is helpful in understanding the mechanism behind the main results of this paper.

The game played in this markets is as following: *First, supermarket a sells the right of using its premium shelf space to a manufacturer through a standard English auction (with private values); Second, observing the result of the first stage, supermarket b auctions off its premium shelf space through a English auction; Third, the manufacturers simultaneously*

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<sup>5</sup> This outcome would be more significant if the manufacturer with a better brand name has lower marginal production cost. Therefore the results of this paper would remain valid. On the other hand, the manufacturer with a better brand name may not have larger profit margin if its marginal cost is much higher than its rivals. In that case, the results of the current paper do not apply.

announce their wholesale prices  $w_1$  and  $w_2$ ; Fourth, the supermarkets purchase the products from the manufacturers and determine their retail profit margins;<sup>6</sup> Finally, the consumers enter the market and decide which store to go and which brand to purchase.

The stores auction off their premium shelf spaces sequentially in the game. This assumption is invoked because a manufacturer's willingness-to-pay for the premium shelf space of a store depends on whether it has already won the counterpart in the other store. The game would be more complicated if the two auctions must be conducted simultaneously, since each bidder would have to form a "rational" belief about the outcome of the other auction. But the results of this paper do not appear to be sensitive to this treatment. On the other hand, sequential auctioning might also be more realistic than simultaneous auctioning.

The retail prices are the sums of the wholesale prices and the retail profit margins. The modeling implies that the inter-brand price differences are the same in both stores, and the inter-store price differences are the same for both brands. The retail prices of the two brands and the price differences in the market are illustrated in following table.

**Table 1:** The retail price configuration in the market

	<i>Manufacturer 1:</i> Wholesale price $w_1$	<i>Manufacturer 2:</i> Wholesale price $w_2$	<i>Inter-brand</i> <i>difference</i>
<i>Store a: margin <math>\alpha</math></i>	$r_{a1} = w_1 + \alpha$	$r_{a2} = w_2 + \alpha$	$w_1 - w_2$
<i>Store b: margin <math>\beta</math></i>	$r_{b1} = w_1 + \beta$	$r_{b2} = w_2 + \beta$	$w_1 - w_2$
<i>Inter-store difference</i>	$\alpha - \beta$	$\alpha - \beta$	

<sup>6</sup> Assume that the retail inventories can be instantly refilled. Hence the supermarkets engage in an unconstrained price competition.

### 3. The Equilibrium

We consider the subgame perfect equilibrium of the game. At the *final* stage, the number of consumers that visit each store only depends on the difference between the stores' profit margins, which is  $\alpha - \beta$ . Based on this observation, we can solve the *fourth* stage of the game and obtain following result.

**Lemma 2:** *In the retail market, the supermarkets' equilibrium profit margins are*

$$(2) \quad \alpha^* = \beta^* = s$$

Hence the markups of the supermarkets only depend on the degree of spatial differentiation between the stores. In particular, they do not depend on the shelf space allocation. An immediate implication of Lemma 2 is that each supermarket's ex post profit constantly equals to  $\frac{(e+f)s}{2}$ , which does not depend on the inter-brand competition or the shelf space allocation.

At the *third* stage of the game, the manufacturers determine their wholesale prices. The subgame equilibrium wholesale prices depend on the outcomes of the two auctions in the first two stages, which have three possible cases.

Case 1: Manufacturer 1, which has a better brand name, obtains both stores' premium shelf spaces. Denote the consequent wholesale prices as  $(w_1^{++}, w_2^{00})$ .

Case 2: Manufacturer 2, which has a less popular brand name, obtains both stores' premium shelf spaces. Denote the consequent wholesale prices as  $(w_1^{00}, w_2^{++})$ .

Case 3: Each manufacturer obtains the premium shelf space of one store. Denote the consequent wholesale prices as  $(w_1^{+0}, w_2^{0+})$ .

Consider case 1 first. Recall that the inter-brand price differences are  $w_1 - w_2$  in both supermarkets, which induces  $t(w_1 - w_2)$  consumers to switch from brand 1 to 2 (or induces  $t(w_2 - w_1)$  consumers to switch from brand 2 to 1). Hence the profit functions of the manufacturers are

$$(3) \quad \pi_1 = w_1[e + \delta - t(w_1 - w_2)] \quad \text{and}$$

$$(4) \quad \pi_2 = w_2[f - \delta + t(w_1 - w_2)]$$

respectively. The first order conditions of the profit maximization problems are

$$(5) \quad w_1 = \frac{1}{2}\left(\frac{e + \delta}{t} + w_2\right) \quad \text{and} \quad w_2 = \frac{1}{2}\left(\frac{f - \delta}{t} + w_1\right).$$

Therefore the equilibrium wholesale prices are

$$(6) \quad w_1^{++} = \frac{2e + f + \delta}{3t} \quad \text{and} \quad w_2^{00} = \frac{e + 2f - \delta}{3t}.$$

The manufacturers' equilibrium quantities of sales are

$$(7) \quad q_1^{++} = \frac{2e + f + \delta}{3} \quad \text{and} \quad q_2^{00} = \frac{e + 2f - \delta}{3}.$$

Note that the arithmetic average wholesale price,  $\frac{e + f}{2t}$ , is unaffected by the allocation of shelf spaces in this case. The sale-weighted average wholesale price must get higher since manufacturer 1 sells more than manufacturer 2. The manufacturers' profits at the second stage of the game are:

$$(8) \quad \pi_1^{++} = \frac{(2e + f + \delta)^2}{9t} \quad \text{and} \quad \pi_2^{00} = \frac{(e + 2f - \delta)^2}{9t}.$$

In case 2, where manufacturer 2' product is displayed on the premium shelf spaces of both stores, parallel analyses leads to following subgame equilibrium outcome.

$$(9) \quad w_1^{00} = \frac{2e + f - \delta}{3t} \quad \text{and} \quad w_2^{++} = \frac{e + 2f + \delta}{3t}.$$

$$(10) \quad q_1^{00} = \frac{2e + f - \delta}{3} \quad \text{and} \quad q_2^{++} = \frac{e + 2f + \delta}{3}.$$

$$(11) \quad \pi_1^{00} = \frac{(2e + f - \delta)^2}{9t} \quad \text{and} \quad \pi_2^{++} = \frac{(e + 2f + \delta)^2}{9t}.$$

In case 3, suppose that manufacturer 1 wins the premium shelf space of supermarket  $a$ , while manufacturer 2 wins that of supermarket  $b$ . By the symmetry of the supermarkets, we have each store attracting half of the consumers. The profit of each manufacturer is the sum of its profits from the two stores. We have

$$(12) \quad \begin{aligned} \pi_1 &= w_1 \left[ \frac{e + \delta}{e + f} \cdot \frac{e + f}{2} - \frac{t(w_1 - w_2)}{2} \right] + w_1 \left[ \frac{e - \delta}{e + f} \cdot \frac{e + f}{2} - \frac{t(w_1 - w_2)}{2} \right] \\ &= w_1 [e - t(w_1 - w_2)]. \end{aligned}$$

Similarly, manufacturer 2's profit function is

$$(13) \quad \pi_2 = w_2 [f + t(w_1 - w_2)].$$

Notice that the manufacturers' profits shown in (12) and (13) do not depend on parameter  $\delta$ . Hence a manufacturer's advantageous position in one store is exactly canceled out by its disadvantageous position in the other store.

The first order conditions of the manufacturers' profit maximization problems are

$$(14) \quad w_1 = \frac{1}{2} \left( \frac{e}{t} + w_2 \right) \quad \text{and} \quad w_2 = \frac{1}{2} \left( \frac{f}{t} + w_1 \right),$$

We have following subgame equilibrium outcome.

$$(15) \quad w_1^{+0} = \frac{2e + f}{3t} \quad \text{and} \quad w_2^{0+} = \frac{e + 2f}{3t},$$

$$(16) \quad q_1^{+0} = \frac{2e + f}{3} \quad \text{and} \quad q_2^{0+} = \frac{e + 2f}{3},$$

$$(17) \quad \pi_1^{+0} = \frac{(2e + f)^2}{9t} \quad \text{and} \quad \pi_2^{0+} = \frac{(e + 2f)^2}{9t}.$$

Although shelf space fees transfer profits from manufacturers to supermarkets, the

subgame equilibrium in case 3 is almost identical to the case when the two brands are symmetrically displayed in all stores. The ex post profits of the manufacturers in the three cases are summarized in Table 2.

**Table 2:** Shelf space allocation and manufacturers' profits

	Manufacturer 1	Manufacturer 2
<b>Case 1</b>	$\pi_1^{++} = \frac{(2e + f + \delta)^2}{9t}$	$\pi_2^{00} = \frac{(e + 2f - \delta)^2}{9t}$
<b>Case 2</b>	$\pi_1^{00} = \frac{(2e + f - \delta)^2}{9t}$	$\pi_2^{++} = \frac{(e + 2f + \delta)^2}{9t}$
<b>Case 3</b>	$\pi_1^{+0} = \frac{(2e + f)^2}{9t}$	$\pi_2^{0+} = \frac{(e + 2f)^2}{9t}$

At the *second* stage of the game, where the manufacturers bid for the premium shelf space of store *b*, the auction is conducted under two possible outcomes of stage 1, where manufacture 1 or 2 wins the first auction.

**Lemma 3:** *A manufacturer's willingness-to-pay for the premium shelf space of store *b* is higher if it has already won the auction of store *a*.*

At the *first* stage of the game, the manufacturers anticipate the subsequent plays of the game and bid for the premium shelf space of store *a*. It turns out that the larger manufacturer would win both auctions.

**Lemma 4:** *If  $e > f$ , then manufacturer 1 wins the premium shelf spaces of both stores in the subgame perfect equilibrium of the game.*

From Lemma 4 and analyses of Case 1 of the third stage, we can characterize the equilibrium of the market as follows. The proof is straightforward. I omit the details.

**Proposition 1:** *If  $e > f$ , manufacturer 1 wins both stores' premium shelf spaces and the equilibrium prices and sales of the upstream market are*

$$(18) \quad w_1^* = \frac{2e + f + \delta}{3t} \quad \text{and} \quad w_2^* = \frac{e + 2f - \delta}{3t},$$

$$(19) \quad q_1^* = \frac{2e + f + \delta}{3} \quad \text{and} \quad q_2^* = \frac{e + 2f - \delta}{3},$$

We see from Proposition 1 that the asymmetric shelf space display raises the price and quantity of sale of the product with better brand name, while lowers those with less popular brand name. In other words, the shelf space fees help the larger manufacturer to become even larger.

If the manufacturers are symmetric, *i.e.*,  $e = f$ , and tie is impossible in the auctions, then there are two possible equilibria where one of the manufacturers wins both stores' premium shelf spaces. Indeed, whoever wins the first auction would win the second auction. The winner sells  $\frac{3e + \delta}{3}$  units of product at wholesale price of  $\frac{3e + \delta}{3t}$ , while the other manufacturer sells  $\frac{3e - \delta}{3}$  units at price  $\frac{3e - \delta}{3t}$ . Therefore an asymmetric equilibrium would arise from a symmetric setup.

#### 4. Welfare

If the supermarkets are prohibited from charging shelf space fees, they would display all brands symmetrically in order to minimize consumer search cost.<sup>7</sup> When the fees are allowed, one can easily calculate the sale-weighted average wholesale price from Proposition 1, which is

$$(20) \quad \bar{w}^* = \frac{q_1^*}{e+f} w_1^* + \frac{q_2^*}{e+f} w_2^* = \frac{5e^2 + 5f^2 + 8ef + 2\delta^2 + 2(e-f)\delta}{9t(e+f)}.$$

It increases with  $\delta$ . From this perspective, the ex post inter-brand competition may be weakened by the shelf space auctions. Intuitively, when manufacturer 1 obtains the premium shelf spaces of the supermarkets, it is able to sell more at higher price, which leads to higher average prices. Since the retail profit margins are constant no matter the fees are allowed or not, the weighted average retail price is also higher with the fees. I write this result as a corollary of Proposition 1.

**Corollary 1:** *The sale-weighted average wholesale price and retail price are higher with the shelf space fees. Consequently, the total revenue of the industry and the total payment of the consumers are higher with the fees.*

The shelf space reallocation leads to asymmetric in-store display of the two brands. It enlarges the degree of asymmetry between the brands. The price difference between the two

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<sup>7</sup> In contrast, Rennhoff (2004) assumes that when merchandising allowances are banned, the monopoly retailer still faces an optimality problem in choosing a brand of product for its premium shelf space. This treatment is appropriate since the retailer can set different profit margins for different brands. But in the current paper the stores have no incentive to promote a brand unless they can collect fees for it.

brands would then be enlarged. Shelf space auctions tend to reinforce the market position of the manufacturers that have more popular brands. This effect might be undesirable from the perspective of competition authorities. Nevertheless, even the large manufacturer cannot gain from the shelf space fees in this static model.

**Corollary 2:** *The manufacturers are worse off while the supermarkets are better off with the shelf space fees.*

Now we consider the consumer surplus and social welfare. Denote  $V_i$  as consumer  $i$ 's reservation value toward his/her preferred brand. Then  $V = \sum_i V_i$  is the consumers' aggregate reservation value when resources are social-optimally allocated. Denote  $P$  as the consumers' total payment,  $B$  as the consumers' total loss from using their less preferred products, and  $S$  as the consumers' total in-store search cost. Then the aggregate consumer surplus is

$$(21) \quad \text{Consumer surplus} = V - P - B - S .$$

And the social welfare is

$$(22) \quad \text{Social welfare} = V - B - S .$$

Note that though in-store display may affect the consumers' preferences between the two brands, but it may not affect the aggregate reservation value  $V$ . The total payment  $P$  is raised by the shelf space fees (Corollary 1). The loss  $B$  is increased when shelf space fees push up inter-brand price differences and thus more consumers end up with their less

preferred brands. Indeed, a key point of this paper is that shelf space fees make the upstream market less balanced and thus lead to welfare loss. Finally, we have assumed that manipulating in-store display never reduces the consumers' total search cost. Therefore from (21) and (22) we immediately have following result.

**Proposition 2:** *If in-store display cannot affect consumers' aggregate reservation value  $V$ , then the shelf space fees reduce the aggregate consumer surplus and the social welfare.*

Note that the results of this paper actually rely on the fact that the manufacturer with a better brand name attains a larger profit margin (in the absence of shelf space fees), and thus has larger incentive to bid for the premium shelf spaces. The distortion in the market is enlarged when the leading manufacturer's market position is reinforced by the favorable shelf space allocation. The idea might be extended to a model where consumers have more general demand functions, as long as the manufacturer with a better brand name tends to have a larger profit margin. Details are left for future studies. Is it possible for the manufacturer with a better brand name to have smaller profit margin than its rivals? The answer is yes. But that usually happens when the better-known manufacturer has substantially higher marginal production cost than its rivals. Theoretically, an exceedingly efficient entrant manufacturer, who does not have a well-known brand name, may bid aggressively for the premium shelf spaces of retail stores. In that case, the welfare implications of shelf space fees could be more positive compared to those found in the current paper.

## 5. Concluding remarks

Previous literature on the anticompetitive effects of shelf space fees emphasizes the total exclusion outcome where some manufacturers are driven out of retail stores. This paper instead models how the fees influence inter-brand competition. The model suggests that manufacturers with better brand names usually have higher willingness-to-pay for the shelf spaces of retail stores. Therefore shelf space fees tend to strengthen the market position of those large manufacturers. The finding is consistent with the empirical observation that small manufacturers are often unable to obtain adequate shelf spaces when retailers demand shelf space fees or slotting allowances. The model also finds that when the degree of asymmetry in the upstream market increases, the inter-brand competition would be softened and the average selling price would be higher. Hence shelf space fees eventually decrease aggregate consumer surplus. The fees decrease the social welfare since they enlarge inter-brand price differences, which induce more consumers to choose their less preferred brands. The findings support the view that shelf space fees, or slotting allowances, might be anticompetitive.

The model of this paper does not critically rely on retailer market power. Even when the retailers are monopolistic competitive, they might still demand shelf space fees as long as in-store display influences consumer choices. On the other hand, since shelf space fees increase the profitability of supermarkets for given market structure, there might be excess entry to the retail market when the fees are allowed. That situation may result in more welfare losses.

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## Appendix

**Proof of Lemma 1:** Denote the manufacturers' wholesale prices as  $w_1$  and  $w_2$ . If manufacturer 1 obtains the premium shelf space, the two manufacturers' profit functions are

$$(A1) \quad \pi_1 = kw_1[e + \delta - t(w_1 - w_2)] \quad \text{and} \quad \pi_2 = kw_2[f - \delta + t(w_1 - w_2)]$$

respectively, where  $k$  represents the market share of the supermarket. Solving the game between the manufacturers in this store, we have equilibrium wholesale prices and profits of

$$(A2) \quad w_1^* = \frac{2e + f + \delta}{3t} \quad \text{and} \quad w_2^* = \frac{e + 2f - \delta}{3t}.$$

$$(A3) \quad \pi_1^* = k \frac{(2e + f + \delta)^2}{9t} \quad \text{and} \quad \pi_2^* = k \frac{(e + 2f - \delta)^2}{9t}.$$

Similarly, if manufacturer 2 obtains the premium shelf space, the two manufacturers' profit functions are

$$(A4) \quad \pi_1 = kw_1[e - \delta - t(w_1 - w_2)] \quad \text{and} \quad \pi_2 = kw_2[f + \delta + t(w_1 - w_2)]$$

respectively. Solving the game, we have equilibrium wholesale prices and profits of

$$(A5) \quad w_1^* = \frac{2e + f - \delta}{3t} \quad \text{and} \quad w_2^* = \frac{e + 2f + \delta}{3t}.$$

$$(A6) \quad \pi_1^*{}' = k \frac{(2e + f - \delta)^2}{9t} \quad \text{and} \quad \pi_2^*{}' = k \frac{(e + 2f + \delta)^2}{9t}.$$

Hence manufacturer 1 is willing to pay up to  $\pi_1^* - \pi_1^*{}'$  while manufacturer 2 is willing to pay up to  $\pi_2^*{}' - \pi_2^*$  for the premium shelf space. It is easy to check that

$$(A7) \quad \pi_1^* - \pi_1^*{}' > \pi_2^*{}' - \pi_2^*, \quad \text{when } e > f.$$

Hence the premium shelf space is more valuable to manufacturer 1 that has a better brand name. *Q.E.D.*

**Proof of Lemma 2:** Denote the location of the consumer that is indifferent to purchasing from either store as  $x \in [0,1]$ . Conditional on  $|\alpha - \beta| < s$ , it satisfies

$$(A8) \quad \alpha + sx = \beta + s(1-x), \quad i.e., \quad x = \frac{1}{2} - \frac{\alpha - \beta}{2s}.$$

Since the implied density of consumers in the city is  $e+f$ , the profit functions of the two supermarkets are

$$(A9) \quad \pi_a = \alpha(e+f)\left(\frac{1}{2} - \frac{\alpha - \beta}{2s}\right) \quad \text{and}$$

$$(A10) \quad \pi_b = \beta(e+f)\left(\frac{1}{2} + \frac{\alpha - \beta}{2s}\right)$$

respectively. The first order conditions are

$$(A11) \quad \alpha = \frac{1}{2}(s + \beta) \quad \text{and} \quad \beta = \frac{1}{2}(s + \alpha)$$

respectively. From (A11) we immediately have the stores' equilibrium profit margins prescribed in (2). *Q.E.D.*

**Proof of Lemma 3:** If manufacturer 1 does not win the first auction, it is willing to pay up to

$$(A12) \quad \pi_1^{+0} - \pi_1^{00} = \frac{2\delta(2e+f) - \delta^2}{9t}$$

for the premium shelf space of store  $b$ . However, if manufacturer 1 has already won the auction of store  $a$ , it is willing to pay up to

$$(A13) \quad \pi_1^{++} - \pi_1^{+0} = \frac{2\delta(2e+f) + \delta^2}{9t},$$

for the premium shelf space of store  $b$ . It is easy to check that  $\pi_1^{+0} - \pi_1^{00} < \pi_1^{++} - \pi_1^{+0}$  as long as  $\delta > 0$ . Hence manufacturer 1's willingness-to-pay is higher in later case.

Similarly, we can show that manufacturer 2 is willing to pay strictly more in the second auction if it has already won the first one. *Q.E.D.*

**Proof of Lemma 4:** In the second stage of the game, if manufacturer 1 has won the first auction, it would surely win the second auction according to Lemma 1. In the English auction with private values, store  $b$ 's revenue from the auction should be the loser's valuation of the premium shelf space at that stage, which is

$$(A14) \quad \pi_2^{0+} - \pi_2^{00} = \frac{2\delta(e+2f) - \delta^2}{9t}.$$

If manufacturer 2 has won the first auction, it would win the second auction if and only if

$$(A15) \quad \pi_2^{++} - \pi_2^{0+} \geq \pi_1^{+0} - \pi_1^{00},$$

which happens when  $\delta \geq e - f$ , and the winning price would be

$$(A16) \quad \pi_1^{+0} - \pi_1^{00} = \frac{2\delta(2e+f) - \delta^2}{9t}.$$

If  $\delta < e - f$ , manufacturer 1 would win the second auction at price

$$(A17) \quad \pi_2^{++} - \pi_2^{0+} = \frac{2\delta(e+2f) + \delta^2}{9t}.$$

First consider the case  $\delta \geq e - f$ . At the first stage of the game, manufacturer 1 understands that if it wins the first auction, it would win the second one too. On the contrary, if it loses the first auction, it would lose the second one as well. Manufacturer 1's willingness-to-pay in the first auction is

$$(A18) \quad [\pi_1^{++} - (\pi_2^{0+} - \pi_2^{00})] - \pi_1^{00}.$$

Similarly, manufacturer 2 understands that it would win the second auction if and only if it could win the first one. Hence to win the first auction it is willing to pay up to

$$(A19) \quad [\pi_2^{++} - (\pi_1^{+0} - \pi_1^{00})] - \pi_2^{00}.$$

One can check that (A19) is less than (A18). Hence manufacturer 1 wins the first auction at

price of (A19), which is  $\frac{6\delta f + \delta^2}{9t}$ , and then also wins the second auction.

Now consider the case  $\delta < e - f$ . Then no matter who wins the first auction, manufacturer 1 would win the second auction. Manufacturer 1's willingness-to-pay in the first auction is

$$\begin{aligned}
 & [\pi_1^{++} - (\pi_2^{0+} - \pi_2^{00})] - [\pi_1^{+0} - (\pi_2^{++} - \pi_2^{0+})] \\
 &= \frac{2\delta(2e + f) + \delta^2}{9t} - \frac{2\delta(e + 2f) - \delta^2}{9t} + \frac{2\delta(e + 2f) + \delta^2}{9t} \\
 \text{(A20)} \quad &= \frac{2\delta(2e + f) + 3\delta^2}{9t}.
 \end{aligned}$$

In contrast, manufacturer 2's willingness-to-pay in the first auction is

$$\text{(A21)} \quad \pi_2^{0+} - \pi_2^{00} = \frac{2\delta(e + 2f) - \delta^2}{9t} < \frac{2\delta(2e + f) + 3\delta^2}{9t}.$$

Hence manufacturer 1 wins the first auction at price of  $\frac{2\delta(e + 2f) - \delta^2}{9t}$ , and then also wins the second auction.

Summing up, manufacturer 1 must win both auctions. *Q.E.D.*

**Proof of Corollary 2:** Suppose manufacturer 1 always wins the auctions of shelf spaces.

The manufacturers' ex post gross profits at the third stage of the game are

$$\text{(A22)} \quad \pi_1^* = \frac{(2e + f + \delta)^2}{9t} \quad \text{and} \quad \pi_2^* = \frac{(2e + f - \delta)^2}{9t}$$

respectively. One can see that the aggregate ex post profit is higher with the fees, but manufacturer 2's ex post profit is lower with the fees. On the other hand, manufacturer 1 pays shelf space fees of

$$(A23) \quad p_1(\delta) = \begin{cases} \frac{6\delta f + \delta^2}{9t} & \text{if } \delta \geq e - f \\ \frac{2\delta(e + 2f) - \delta^2}{9t} & \text{if } \delta < e - f \end{cases}$$

in the first auction and

$$(A24) \quad p_2(\delta) = \frac{2\delta(e + 2f) - \delta^2}{9t}$$

in the second auction. So the total payment is

$$(A25) \quad p_1(\delta) + p_2(\delta) = \begin{cases} \frac{2\delta(e + 5f)}{9t} & \text{if } \delta \geq e - f \\ \frac{4\delta(e + 2f) - 2\delta^2}{9t} & \text{if } \delta < e - f \end{cases}.$$

But manufacturer 1's profit gain from the premium shelf spaces is

$$(A26) \quad \pi_1^*(\delta) - \pi_1^*(0) = \frac{2\delta(2e + f) + \delta^2}{9t}$$

which is always smaller than  $p_1(\delta) + p_2(\delta)$  for any  $0 < \delta < f$ . Hence manufacturer 1 is also worse off with the shelf space fees.

Since the industry revenue is higher (Corollary 1) while the upstream profit is lower with the shelf space fees, the supermarkets must gain from the fees. Indeed, since the ex post profits are constant (lemma 2), the shelf space fees are the stores' net gain. *Q.E.D.*