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One-Stop Shopping as a Cause of Slotting Fees: A Rent-Shifting Mechanism*

Stéphane Caprice † Vanessa von Schlippenbach ‡

May 2012

Abstract

Consumers increasingly prefer to bundle their purchases into a single shopping trip, inducing complementaries between initially independent or substitutable goods. Taking this one-stop shopping behavior into account, we show that slotting fees may emerge as a result of a rent-shifting mechanism in a three-party negotiation framework, where a monopolistic retailer negotiates sequentially with two suppliers about two-part tariff contracts. If the goods are initially independent or sufficiently differentiated, the wholesale price negotiated with the first supplier is upward distorted. This allows the retailer and the first supplier to extract rent from the second supplier. To compensate the retailer for the higher wholesale price, the first supplier pays a slotting fee as long as its bargaining power vis-à-vis the retailer is not too large.

JEL-Classification: L22, L42

Keywords: One-stop shopping, rent-shifting, slotting fees

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1 Introduction

Since the late 1980s, it has become a widespread practice that retailers charge slotting fees to place manufacturers' products on the shelves. The amount of slotting allowances differs widely across product categories and manufacturers within the same product category (FTC 2003: 15).[1] The emergence of slotting allowances is often associated with the increasing buyer power of retailers (e.g., Bloom et al. 2000), even though large retailers with tremendous bargaining power vis-à-vis their suppliers, e.g. Wal-Mart and Costco, never charge slotting fees (FTC 2001: 18).[2] Thus, retailer buyer power does not provide a comprehensive explanation for the use of slotting allowances as well as the difference in their amount. Moreover, it is controversial whether powerful manufacturers are more or less likely to pay slotting fees.[3]

In this paper, we provide a new rationale for the use of slotting allowances that is based on consumer shopping behavior. Consumers increasingly prefer to concentrate a substantial part of their weekly grocery purchases with a single trip to one retailer.[4] Accordingly, their shopping baskets include items from various product categories as well as multiple items from the same product category.[5] This implies that the purchase decision of a so-called one-stop shopper depends on the price for the whole shopping basket rather than individual product prices. One-stop shopping behavior, therefore, induces complementarity between products offered at a retail outlet that are initially independent or substitutable.

Taking the consumer preference for one-stop shopping explicitly into account, we show that slotting fees may emerge as a result of a rent-shifting mechanism in a three-party negotiation framework.[6] Precisely, we consider a monopolistic retailer that negotiates sequentially with two suppliers about two-part

[1] In the U.S., the amount of slotting fees per item, per retailer and per metropolitan area ranges between $2,313 and $21,768 (FTC 2003: vii).

[2] "Wal-Mart reportedly makes a point of avoiding schedules of allowances and discounts and insists instead on receiving the single best price that a supplier can offer. A representative of Costco gave a similar description of his firm's policy once it has selected an item that it wants to buy: '[W]e really don't require any fees. We just want the best price that they can give us'" (FTC 2001: 18).

[3] Focusing on new products, Rao and Mahi (2003) find that powerful suppliers are less likely to pay slotting fees. In turn, both White et al. (2000) and Bone et al. (2006) find that smaller manufacturers are less likely to pay slotting fees. Furthermore, the FTC (2003: vii) reports that retailers even waive or reduce slotting fees for "suppliers that do not pay slotting allowances to any retailer".

[4] In the UK, about 70% of the consumers practice this so-called one-stop shopping behavior, covering about 80% of their weekly expenditures for fast-moving consumer goods on a weekly main trip (Competition Commission 2000: 24-26).

[5] For categories such as carbonated soft drinks, ready-to-eat cereals, canned soups, and cookies, consumers regularly purchase multiple products from the same category (Dubé 2004: 66).

[6] Slotting allowances are represented by negative fixed fees (see Shaffer 1991, Chu 1992, Kuksov and Pazgal 2007, and Foros and Kind 2008).

tariff delivery contracts.[7] The suppliers' products are either independent, i.e. belonging to different product categories, or substitutes, i.e. belonging to the same product category. We show that the wholesale price negotiated with the first supplier is always upwards distorted if the goods are initially independent or—in the case of initial substitutes—sufficiently differentiated. In other words, the first wholesale price is upwards distorted as long as the complementary effect resulting from consumer one-stop shopping behavior outweighs the original substitution effect. In this case, a higher wholesale price of the first good reduces the demand for both goods offered by the retailer. As a consequence, the second supplier contributes less to the joint profit with the retailer, enabling the retailer and the first supplier to extract rent from the second supplier. This mechanism applies within a category for sufficiently differentiated goods as well as across categories. To compensate the retailer for the upwards distorted wholesale price, the first supplier has to pay a slotting fee as long as its bargaining power vis-à-vis the retailer is sufficiently low. Thus, slotting fees are not used to exploit those suppliers that pay them. They are rather the result of a rent-shifting mechanism, which is to the detriment of those suppliers that do not pay slotting fees.[8]

Our findings account for some of the stylized facts of slotting allowances. First, we show that slotting allowances are less likely to emerge if the retailer has strong bargaining power—at least vis-à-vis the second supplier—as this results in a less distorted wholesale price in the first negotiation. Moreover, our results reveal that a first supplier with strong bargaining power vis-à-vis the retailer does not pay slotting fees. Second, we show that the retailer prefers to negotiate first with a less powerful supplier in order to extract rent from the more powerful second supplier. Accordingly, powerful suppliers are less likely to pay slotting fees if the retailer can choose the order of negotiations. Overall, our findings account for the fact that some manufacturers pay slotting fees, while others do not pay them. We may, thus, explain the difference of slotting allowances across and within product categories (see FTC 2003: 15).

This paper contributes to the literature on slotting fees based on the strategic use of contracts in vertically related industries.[9] Shaffer (1991) shows that slotting fees can constitute a facilitating mechanism for softening competition in downstream markets.[10] In addition, Kuksov and Pazgal (2007) find

[7] In the grocery sector, delivery is often based on two-part tariff contracts. For empirical evidence, see Bonnet and Dubois (2010) and Villas-Boas (2007).

[8] Neglecting consumer one-stop shopping behavior, Marx and Shaffer (1999) show in a similar framework with two suppliers of imperfect substitutes that below-cost pricing in intermediate good markets occurs as it allows the retailer and the first supplier to extract rent from the second supplier. Moreover, our approach differs from Marx and Shaffer (2007a) and (2008) who also consider a rent-shifting mechanism in sequential negotiations. While our analysis is restricted to two-part tariffs, they allow for more general contracting terms which lead to full rent extraction without any distortion.

[9] This literature traces back to the seminal papers of Bonnano and Vickers (1988) as well as Rey and Stiglitz (1988). For more details, see Caillaud and Rey (1995).

[10] In a similar vein, Foros and Kind (2008) find that slotting allowances serve to reduce downstream competition even

that more intense retail competition, higher retail fixed costs and stronger retailer buyer power have a positive impact on slotting allowances.[11] While these articles relate the emergence of slotting allowances to downstream competition, we explain slotting allowances as a result from a rent-shifting mechanism in a framework with a downstream monopoly. Furthermore, our findings reveal that powerful retailers do not charge slotting fees to their suppliers.[12] This outcome is similar to the findings of Marx and Shaffer (2010), who analyze a multistage contracting game with a downstream retailer and two upstream manufacturers of two independent goods. Before sequential negotiations about efficient delivery contracts take place, each supplier bids to obtain a slot in the retailer's assortment. If the retailer offers only one slot, the manufacturers compete for access to the retailer's shelves, resulting in the payment of slotting allowances by one supplier. Within this framework, Marx and Shaffer (2010) find that the stronger the bargaining position of the retailer the less likely is the retailer to limit shelf space in order to extract rent from the suppliers. Our rent-shifting mechanism, however, does not rely on the scarcity of shelf space but rather on consumer one-stop shopping behavior.[13]

The remainder of the paper is organized as follows. In Section 2, we specify our model. In Section 3, we solve the game for subgame perfect equilibria. In Section 4, we analyze the drivers of slotting allowances. Thereby, we also address the implications of a ban of slotting allowances and the order of negotiations for slotting allowances. Finally, we summarize our results, discuss the limitations of our model and conclude.

2 The Model

Consider a vertical structure with two upstream firms U_i, $i = 1, 2$, and a downstream firm D. Each upstream firm U_i produces a single good i. The upstream firms sell their goods to the downstream firm for subsequent distribution to final consumers. Goods 1 and 2 are either independent or imperfect substitutes. While the upstream firms bear positive constant marginal costs of production $c > 0$, the

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if contracts are not observable. In the context of multi-product markets, Innes and Hamilton (2006) demonstrate how a monopolistic supplier and competitive retailers can use slotting fees to obtain vertically integrated monopoly profits.

[11] Exclusion at both the upstream (Shaffer 2005) and the downstream level (Marx and Shaffer 2007b) as well as signaling or screening purposes (see, e.g., Kelly 1991, Chu 1992, DeVuyst 2005 and Sullivan 1997) are further reasons for the use of slotting allowances.

[12] In contrast, Foros et al. (2009) show that slotting fees emerge if the retailer's bargaining power is sufficiently large. They analyze a bilateral monopoly where the upstream firm and the downstream firm agree on a two-part tariff and where the upstream firm has to invest in noncontractible sales offers.

[13] In contrast to Marx and Shaffer (2010), the contracts in our framework are not efficient. Accordingly, we show that slotting allowances increase consumer prices as the quantity of the first supplier's product is downwards distorted in order to extract surplus from the second supplier.

downstream firm's marginal costs of distribution are normalized to zero. All firms incur zero fixed costs.

The downstream retailer negotiates bilaterally and sequentially with the two upstream suppliers about the terms of delivery in the form of two-part tariff contracts (w_i, F_i), entailing a linear wholesale price w_i and a fixed fee F_i. Without loss of generality, we assume that the retailer negotiates first with supplier U_1 and then enters into negotiations with supplier U_2.[14] The game consists of three stages. In stage one, the retailer and the supplier U_1 negotiate a contract (w_1, F_1) for the purchase of good 1. In stage two, the negotiations between the retailer and supplier U_2 about a contract (w_2, F_2) take place. In stage three, the retailer sets prices and the consumers make their purchase decision.

Negotiation outcomes are observable and both the suppliers and the retailer are fully committed to these contracts. Furthermore, the contract with the first supplier cannot be contingent on the quantity the retailer purchases from the second supplier.[15] Each retailer-supplier pair aims at maximizing its respective joint profit when determining the wholesale price.[16] The surplus is divided such that each party gets its disagreement payoff plus a share of the incremental gains from trade, with the proportion $\delta_i \in [0, 1]$ going to the supplier and the proportion $1 - \delta_i$ going to the retailer. In the case of $\delta_i = 0$ the retailer makes a take-it-or-leave-it offer to the supplier U_i, while the opposite holds for $\delta_i = 1$. The asymmetries in the trading parties' bargaining strength rely on several exogenously given factors, such as differences in their impatience to reach an agreement or their beliefs concerning the probability of negotiation breakdown (Binmore et al. 1986).

Consumer utility is given by

$$U(x_0, x_1, x_2) = x_0 + u(x_1, x_2) = x_0 + \sum_{i=1}^{2} x_i \left(1 - \frac{x_i}{2}\right) - \sigma x_1 x_2 \tag{1}$$

with x_0 denoting the consumption of a numeraire and with x_1 and x_2 referring to the consumed quantities of goods 1 and 2. The parameter $\sigma \in [0, 1)$ indicates the degree of substitutability between goods 1 and 2. For $\sigma = 0$, the goods are independent and, thus, belong to two different product categories, while they are substitutes and, thus, belong to the same product category for $\sigma > 0$. As σ approaches 1, the more products 1 and 2 are substitutable. Note that the degree of substitutability between the products offered is not related to the bargaining power of each supplier δ_i.[17]

[14] The sequentiality of negotiations can be justified as the retailer and the first supplier benefit from shifting rents from the second supplier (see Möller 2007; Marshall and Merlo 2004). Moreover, this timing "is often what one observes in reality given that not all manufacturer-retailer contracts are in effect for the same length of time" (Marx and Shaffer 2010: 582).

[15] This crucial assumption can be justified if the purchases of the retailer cannot be easily observed by the rival manufacturer or verified in court. Moreover, contingent contracts may violate antitrust laws.

[16] For a non-cooperative foundation of the generalized Nash bargaining solution, see Binmore et al. (1986).

[17] See Kuksov and Pazgal (2007) for a similar distinction. The potential interdependence between bargaining power and substitutability is analyzed at the end of Section 3.

The consumers are uniformly distributed with density one along a line of infinite length. Their individual location is denoted by $\theta \in (-\infty, \infty)$. The numeraire is available everywhere along the line, while consumer goods 1 and 2 have to be purchased at the retail store located at θ^D. Without loss of generality, we assume $\theta^D = 0$. Consumers incur transportation cost t per unit distance. Thus, a consumer located at θ bears shopping costs of $|\theta| t$. This implies that consumers purchase the two goods in one single shopping trip if they are available at the retailer.[18]

Given that the price for the numeraire is normalized to one and that consumers are identical in income I, the utility-maximizing quantities of a consumer located at θ are given by[19]

$$\left(x_0^*\left(p_1, p_2, \theta\right),\ x_1^*(p_1, p_2),\ x_2^*(p_1, p_2)\right) := \arg\max_{x_0, x_1, x_2} U(x_0, x_1, x_2) \tag{2}$$
$$\text{s.t. } x_0 + p_1 x_1 + p_2 x_2 + |\theta| t \leq I,$$

where p_1 and p_2 denote the prices of good 1 and 2, respectively. Consumers refrain from shopping at the retailer if their utility from local consumption and, thus, from purchasing only the numeraire exceeds their maximal utility from buying at the retailer, i.e.

$$U(I, 0, 0) = I \geq U(x_0^*(p_1, p_2, \theta), x_1^*(p_1, p_2), x_2^*(p_1, p_2)). \tag{3}$$

The set of consumers being indifferent between buying at the retailer or not is denoted by $\theta^*\left(p_1, p_2\right)$, which is given by the unique positive solution of

$$U(x_0^*(p_1, p_2, \theta), x_1^*(p_1, p_2), x_2^*(p_1, p_2)) = I. \tag{4}$$

Note that the market size, i.e. $2\theta^*\left(p_1, p_2\right)$, is increasing in the consumer gross utility from purchasing at the retailer. Since consumer gross utility is decreasing in the substitutability of products, i.e. $\partial U(x_0, x_1, x_2)/\partial\sigma < 0$, the market size is decreasing in σ. Likewise, an increase in transportation costs negatively affects the market size, without having an impact on the utility-maximizing demand of any individual consumer.

Combining (2) and (4), the overall demand for good i is given by

$$X_i^*(p_1, p_2) = 2\theta^*\left(p_1, p_2\right) x_i^*(p_1, p_2), \tag{5}$$

$$\begin{aligned} \text{with} \quad &: \quad x_i^*\left(p_1, p_2\right) = \frac{1}{1+\sigma} - \frac{1}{1-\sigma^2} p_i + \frac{\sigma}{1-\sigma^2} p_j \\ \text{and} \quad &: \quad \theta^*\left(p_1, p_2\right) = \frac{2\left(1-\sigma\right)\left(1-p_i-p_j\right) + p_i^2 + p_j^2 - 2\sigma p_i p_j}{2t\left(1-\sigma^2\right)}. \end{aligned}$$

[18] This specification allows us to get simple computable results. We would obtain similar outcomes if consumers were heterogeneous in their consumption but identical in their locations, i.e. incurring the same transportation cost to reach the retailer. In Appendix B, we extend the model to the case where only a share of consumers purchase both goods, while the other share buy one good only.

[19] To simplify notations, some arguments are omitted in the demand functions.

The demand functions are continuous in all variables. Moreover, an increase in p_j has two countervailing effects on the overall demand for good i,[20] i.e.

$$\frac{\partial X_i^*(p_1,p_2)}{\partial p_j} = 2\theta^*(p_1,p_2)\underbrace{\frac{\partial x_i^*(p_1,p_2)}{\partial p_j}}_{\geq 0} + 2x_i^*(p_1,p_2)\underbrace{\frac{\partial \theta^*(p_1,p_2)}{\partial p_j}}_{<0} \tag{6}$$

$$\text{if } x_i^*(p_1,p_2) > 0 \text{ with } i = 1,2, i \neq j.$$

Due to the complementary effect induced by consumer one-stop shopping behavior, a higher p_j induces a higher price for the whole shopping basket such that fewer consumers are willing to buy at the retailer. This implies that an increase in p_j negatively affects the market size, i.e. $\partial\theta^*(p_1,p_2)/\partial p_j < 0$. In the case of independent goods, we, thus, have $\partial X_i^*(p_1,p_2)/\partial p_j < 0$ due to $\partial x_i^*(p_1,p_2)/\partial p_j = 0$. If, instead, the goods are imperfect substitutes, i.e. $\partial x_i^*(p_1,p_2)/\partial p_j > 0$, the overall demand for good i reacts ambiguously to an increase in p_j. As long as the products are strongly differentiated, i.e. σ relatively low, the complementarity effect outweighs the substitution effect. The substitution effect, however, dominates if the products are highly substitutable, i.e. σ sufficiently high. Precisely, we have $\partial X_i^*(p_1,p_2)/\partial p_j|_{p_1=p_2=p} \gtreqless 0$ if $\sigma \gtreqless 1/2$.

Consider now the case where the retailer only offers good 1. Consumer gross utility from consumption, then, refers to

$$U(x_0,x_1,0) = x_0 + x_1 - \frac{1}{2}x_1^2, \tag{7}$$

yielding the utility-maximizing demand functions

$$(x_0^*(p_1,\infty,\theta),\ x_1^*(p_1,\infty)) := \arg\max_{x_0,x_1} U(x_0,x_1,0) \tag{8}$$

$$\text{s.t. } x_0 + p_1x_1 + |\theta|\, t \leq I.$$

Accordingly, we denote the set of consumers who are indifferent between purchasing at the retail store or staying with local consumption of the numeraire by $\theta^*(p_1,\infty)$, which is given by the unique positive solution of

$$U(x_0^*(p_1,\infty,\theta), x_1^*(p_1,\infty), 0) = I. \tag{9}$$

The overall market demand for good 1, then, refers to

$$\begin{aligned} X_1^*(p_1,\infty) &= 2\theta^*(p_1,\infty)x_1^*(p_1,\infty) \\ \text{with} &: \quad x_1^*(p_1,\infty) = 1 - p_1 \\ \text{and} &: \quad \theta^*(p_1,\infty) = \frac{(1-p_1)^2}{2t}. \end{aligned} \tag{10}$$

[20]See Stahl (1987) for more details on these effects. More generally, for an early account of consumer shopping behavior and the related positive demand externalities see Stahl (1982) and Beggs (1994).

Analogously, the overall market demand for good 2 if the retailer does not sell good 1 is given by

$$\begin{aligned} X_2^*(\infty, p_2) &= 2\theta^*(\infty, p_2) x_2^*(\infty, p_2) \\ \text{with} &: \quad x_2^*(\infty, p_2) = 1 - p_2 \\ \text{and} &: \quad \theta^*(\infty, p_2) = \frac{(1-p_2)^2}{2t}. \end{aligned} \tag{11}$$

Using our assumptions, we obtain the gross revenue the retailer earns when selling both products, i.e.

$$R(p_1, p_2) = \sum_{i=1}^{2} (p_i - w_i) X_i^*(p_1, p_2). \tag{12}$$

Analogously, the retailer's gross revenue when selling only good 1 is given by

$$R(p_1, \infty) = (p_1 - w_1) X_1^*(p_1, \infty), \tag{13}$$

while it refers to

$$R(\infty, p_2) = (p_2 - w_2) X_2^*(\infty, p_2) \tag{14}$$

if the retailer only sells good 2.

3 Equilibrium Analysis

To solve for the equilibrium strategies of the retailer and the two suppliers, we proceed by backward induction since our solution concept is subgame perfection.

Downstream Prices. In the last stage of the game, the retailer sets the prices for good 1 and 2, taking the contracts with each supplier as given. Maximizing the retailer's profit when selling both products, i.e. $R(p_1, p_2) - \sum_{i=1}^{2} F_i$, with respect to p_1 and p_2, we obtain the equilibrium downstream prices $p_1^*(w_1, w_2)$ and $p_2^*(w_1, w_2)$.[21] Denoting $X_i^*(p_1^*, p_2^*) := X_i(w_1, w_2)$ and $R(p_1^*, p_2^*) := R(w_1, w_2)$, the reduced profit functions of the downstream and the upstream firms are given by

$$\pi_{1,2}^{D} = R(w_1, w_2) - \sum_{i=1}^{2} F_i, \tag{15}$$

$$\pi_{1,2}^{U_i} = (w_i - c) X_i(w_1, w_2) + F_i \tag{16}$$

[21] Due to our simple representation of consumer behavior (linearity of the individual demand functions and separability of the utility function) the price of one product is independent of the other product's wholesale price. Accordingly, the equilibrium prices are given by

$$p_i^*(w_1, w_2) = p_1^*(w_1, \infty) = p_2^*(\infty, w_2) = \frac{1}{4}(1 + 3w_i), i = 1, 2.$$

if the retailer sells both goods. If the retailer sells only good 1, the respective reduced profit functions are given by

$$\pi_{1,0}^{D} = R(w_1, \infty) - F_1, \tag{17}$$

$$\pi_{1,0}^{U_1} = (w_1 - c)\, X_1 (w_1, \infty) + F_1, \tag{18}$$

while the upstream firm U_2 makes zero profit, i.e. $\pi_{1,0}^{U_2} = 0$. Analogously, if the retailer sells only good 2, the respective reduced profit functions are given by

$$\pi_{0,2}^{D} = R(\infty, w_2) - F_2, \tag{19}$$

$$\pi_{0,2}^{U_1} = 0, \tag{20}$$

$$\pi_{0,2}^{U_2} = (w_2 - c)\, X_2(\infty, w_2) + F_2. \tag{21}$$

Negotiation with the Second Supplier. Anticipating the equilibrium strategies of the retailer in stage three and taking the contract (w_1, F_1) as given, the second supplier U_2 negotiates with the retailer about a two-part tariff (w_2, F_2). If the negotiations with the retailer fail, the second supplier has no alternative to get its good distributed. Accordingly, its disagreement payoff is zero. In contrast, the retailer may still sell good 1 in the case of negotiation breakdown with supplier U_2. Correspondingly, the equilibrium bargaining outcome of the negotiations between the retailer and the second supplier can be characterized by the solution of

$$\max_{w_2, F_2} \left(\pi_{1,2}^{U_2}\right)^{\delta_2} \left(\pi_{1,2}^{D} - \pi_{1,0}^{D}\right)^{1-\delta_2}. \tag{22}$$

Solving (22) for the equilibrium wholesale price w_2^* and the equilibrium fixed fee F_2^*, we obtain:

Lemma 1 *If the gains from trade between the retailer and the second supplier U_2 are positive, there exists a unique equilibrium with*

$$w_2^* = c \textit{ and } F_2^* (w_1) = \delta_2 \left(R(w_1, c) - R(w_1, \infty)\right).$$

Proof. See Appendix A. ■

As the outcome of the second negotiation does not affect the contract chosen in the first stage, the retailer and the second supplier have no incentive to distort the respective wholesale price. Accordingly, they choose a wholesale price that maximizes their joint profit, i.e. $w_2^* = c$. The fixed fee is then used to share the joint profit. Precisely, the retailer pays a lump-sum fee $F_2^* (w_1)$ to the supplier U_2 which corresponds to the supplier's incremental contribution to the joint profit, weighted according to the supplier's respective bargaining power.

Negotiation with the First Supplier. Anticipating the equilibrium strategies in stages two and three, the retailer and the first supplier U_1 negotiate about a two-part delivery tariff (w_1, F_1). While the disagreement profit of the first supplier is zero, the retailer can still bargain with the second supplier in the case of negotiation breakdown with the first supplier. The respective wholesale price equals marginal cost of production and the respective fixed fee refers to $F_2^* = \delta_2 R(\infty, c)$. Accordingly, the retailer's disagreement payoff in the negotiation with the first supplier is given by $\pi_{0,2}^D = (1-\delta_2) R(\infty, c)$. The equilibrium bargaining outcome of the retailer and the first supplier is, therefore, characterized by the solution of

$$\max_{w_1, F_1} \left(\pi_{1,2}^{U_1}\right)^{\delta_1} \left(\pi_{1,2}^D - \pi_{0,2}^D\right)^{1-\delta_1}, \tag{23}$$

where the profits of the upstream supplier U_1 and the downstream retailer are given by

$$\begin{aligned} \pi_{1,2}^D &= R(w_1, c) - F_1 - F_2^*(w_1) \\ &= R(w_1, c) - F_1 - \delta_2 (R(w_1, c) - R(w_1, \infty)) \end{aligned} \tag{24}$$

and

$$\pi_{1,2}^{U_1} = (w_1 - c) X_1 (w_1, c) + F_1. \tag{25}$$

Maximizing (23) with respect to w_1 and F_1 and rearranging terms, the equilibrium fixed fee is obtained as[22]

$$\begin{aligned} F_1^* = {} & \delta_1 [(1-\delta_2)(R(w_1^*, c) - R(\infty, c)) + \delta_2 R(w_1^*, \infty)] \\ & - (1-\delta_1)(w_1^* - c) X_1(w_1^*, c). \end{aligned} \tag{26}$$

Using (26), the equilibrium wholesale price w_1^* is implicitly given by

$$\left. \frac{\partial [(w_1 - c) X_1 (w_1, c) + R(w_1, c) - \delta_2 (R(w_1, c) - R(w_1, \infty))]}{\partial w_1} \right|_{w_1 = w_1^*} = 0. \tag{27}$$

The term $\partial [(w_1 - c) X_1 (w_1, c) + R(w_1, c)] / \partial w_1$ determines the marginal impact of an increasing w_1 on the overall industry profit. It becomes zero if the wholesale price equals marginal cost, i.e. $w_1 = c$. The term $\partial [\delta_2 (R(w_1, c) - R(w_1, \infty))] / \partial w_1$ characterizes the marginal impact of an increasing w_1 on the incremental contribution of the second supplier, weighted according to its bargaining power δ_2 (see Lemma 1).

Proposition 1 *If trade takes place between the retailer and the first supplier U_1, there exists a unique equilibrium wholesale price*

$$w_1^* = c - \frac{\delta_2 (X_1(w_1^*, c) - X_1(w_1^*, \infty))}{\partial X_1(w_1^*, c) / \partial w_1}. \tag{28}$$

Proof. See Appendix A. ■

If the retailer has take-it-or-leave-it power vis-à-vis the second supplier, i.e. $\delta_2 = 0$, the retailer implements a wholesale price as to maximize the overall industry profit, i.e. $w_1^* = c$. For $\delta_2 > 0$, however, the

[22] The derivation of F_1^* can be found in the Appendix A (see Proof of Proposition 1).

wholesale price negotiated with the first supplier is either upwards or downwards distorted. The direction of the distortion depends on the sign of $\Delta X = X_1(w_1^*, c) - X_1(w_1^*, \infty)$ because of $\partial X_1(w_1^*, c)/\partial w_1 < 0$.

If the goods are initially independent and, thus, belong to different product categories (i.e. $\sigma = 0$), we have $x_1(w_1^*, c) = x_1(w_1^*, \infty)$.[23] Since $\theta(w_1^*, c) - \theta(w_1^*, \infty) > 0$ due to the complementarity effect induced by consumer one-stop shopping behavior, we obtain $\Delta X > 0$. The wholesale price is, therefore, upwards distorted, resulting in a lower demand for both goods. Accordingly, the second supplier contributes less to the joint profit with the retailer, enabling the retailer and the first supplier to extract rent from the second supplier.

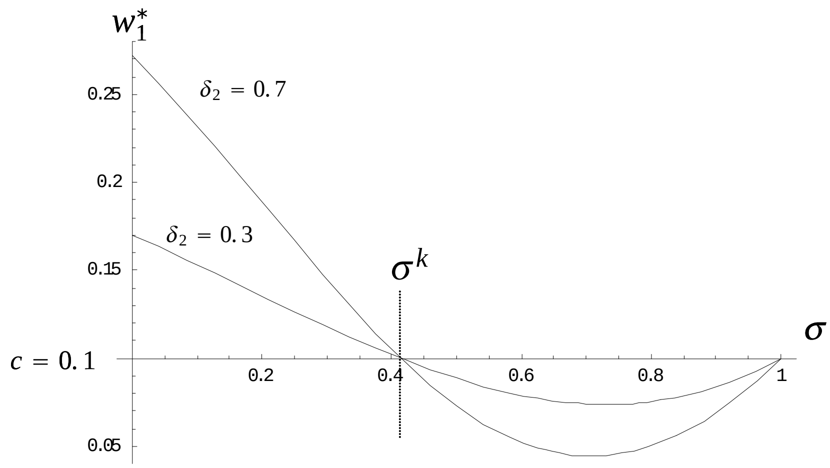

Figure 1: Wholesale price w_1^* in $\sigma \in [0, 1)$ for $c = 0.1$.

Considering the case where the consumers combine the purchase of substitutes (i.e. $\sigma > 0$), we have $x_1(w_1^*, c) - x_1(w_1^*, \infty) < 0$. This implies a trade-off between the complementary effect resulting from consumer one-stop shopping behavior, i.e. $\theta(w_1^*, c) - \theta(w_1^*, \infty) > 0$, and the initial substitutability of the goods, i.e. $x_1(w_1^*, c) - x_1(w_1^*, \infty) < 0$. If the goods are close substitutes, the substitutability effect outweighs the complementary effect, leading to a downwards distortion of the wholesale price negotiated in the first negotiation. This improves the retailer's disagreement payoff in the negotiation with the second supplier, allowing the retailer and the first supplier to extract rent from the second supplier. If, instead, the goods are sufficiently differentiated, the complementary effect dominates the substitution effect, implying an upwards distorted wholesale price (Figure 1). In either case, a higher degree of distortion in the first negotiation reduces the incremental gains from trade of the retailer and the second supplier, which enables the retailer and the first supplier to extract rent from the second supplier.[24]

[23] Note that we denote $x_i^*(p_1^*, p_2^*) := x_i(w_1, w_2)$ and $\theta^*\left(p_1^*, p_2^*\right) := \theta(w_1, w_2)$.

[24] This result also holds if only some consumers purchase both goods and, thus, act as one-stop shoppers. However, the

For close substitutes, our results are in line with previous work on sequential contracting and rent-shifting mechanisms in intermediate goods markets, showing that the quantity of the first supplier's product is upwards distorted when delivery contracts are not contingent on one another (Marx and Shaffer 1999). In contrast, we identify a rent-shifting mechanism for independent and sufficiently differentiated goods, which is based on an upwards distorted wholesale price in the first negotiation.

Proposition 2 *There exists a threshold σ^k that is implicitly given by $X_1(w_1^*, c) \equiv X_1(w_1^*, \infty)$, where for all $\sigma < \sigma^k$ ($\sigma \geq \sigma^k$) the wholesale price negotiated with the first supplier is upwards (downwards) distorted. The extent of distortion is increasing in the bargaining power of the second supplier, i.e. $\partial |w_1^* - c| / \partial \delta_2 > 0$.*

Proof. See Appendix A. ■

Our results further reveal that the distribution of bargaining power between the retailer and the two suppliers has no impact on the direction of the distortion, i.e. either upwards or downwards. However, the bargaining power of the second supplier, i.e. δ_2, affects the extent of distortion (see (28)). As a distorted wholesale price induces inefficiencies, the retailer and the first supplier have little incentive to distort the wholesale price if the retailer has already strong bargaining power vis-à-vis the second supplier. Thus, the lower the retailer's bargaining power in the negotiations with the second supplier the more the wholesale price in the first negotiation is distorted.[25]

4 Slotting Allowances

Given the distortion of the wholesale price w_1^* and the distribution of bargaining power between the retailer and the first supplier, the fixed fee can be either positive, indicating a payment by the retailer, or negative, indicating a slotting fee to be paid by the first supplier. The retailer never charges slotting fees if it has take-it-or-leave-it power vis-à-vis the second supplier, i.e. $\delta_2 = 0$. The reason is that the retailer and the first supplier are able to fully extract rent from the second supplier. Accordingly, there is no need to distort the wholesale price in the first negotiation. Furthermore, slotting allowances never

smaller the share of one-stop shoppers the lower the distortion of the wholesale price negotiated with the first supplier (see Appendix B).

[25] Considering a framework with two independent categories A and B, where category A consists of one good and category B consists of two imperfect substitutes, and assuming that the retailer negotiates first with the supplier in category A and then enters into negotiations with the suppliers of category B, we obtain similar results when linking the bargaining power of the retailer and the degree of product substitutability in category B. The extent of distortion is decreasing in the degree of product substitutability in category B and, thus, in the retailer's bargaining power vis-à-vis the suppliers in category B. A numerical analysis is available on request. However, the wholesale price for the good in category A is always upwards distorted as the categories are initially independent.

emerge if the wholesale price in the first negotiation is downwards distorted, i.e. for $\delta_2 > 0$ and $\sigma \geq \sigma^k$. Otherwise, the first supplier's participation constraint would be violated.

If, instead, the wholesale price is upwards distorted, i.e. $\delta_2 > 0$ and $\sigma < \sigma^k$, the first supplier benefits from a positive price-cost margin, which makes the emergence of slotting fees possible. Precisely, the first supplier pays a slotting fee as long as its bargaining power vis-à-vis the retailer is sufficiently low. Rearranging (26), the equilibrium fixed fee is given by

$$\begin{aligned} F_1^* \quad &= \quad -\underbrace{(w_1^* - c)X_1(w_1^*, c)}_{A} \\ &\quad +\underbrace{\delta_1 \left[(1-\delta_2)\left[R(w_1^*, c) - R(\infty, c)\right] + \delta_2 R(w_1^*, \infty) + (w_1^* - c)X_1(w_1^*, c)\right]}_{B}. \end{aligned} \tag{29}$$

That is, the fixed fee F_1^* corresponds to the joint profit of the first supplier and the retailer weighted according to the bargaining power of the first supplier, i.e. term B, which is reduced by the price-cost margin earned by the first supplier, i.e. term A. Considering $\delta_1 = 0$, we obtain $F_1^* = -(w_1^* - c)X_1(w_1^*, c) < 0$ as the wholesale price negotiated with the first supplier is upwards distorted, i.e. $w_1^* > c$. For $\delta_1 > 0$, term B is strictly increasing in δ_1. If δ_1 is sufficiently large, term B outweighs the negative term A. This implies that the retailer does not charge slotting fees from powerful suppliers (see FTC 2003: vii).

Proposition 3 *For any $\sigma < \sigma^k$ and $\delta_2 > 0$, there exists a unique threshold*

$$\delta_1^k(\sigma, \delta_2) = \frac{(w_1^* - c)X_1(w_1^*, c)}{(w_1^* - c)X_1(w_1^*, c) + (1-\delta_2)\left(R(w_1^*, c) - R(\infty, c)\right) + \delta_2 R(w_1^*, \infty)}$$

such that $F_1^* < 0$ if $\delta_1 < \delta_1^k(\sigma, \delta_2)$. Moreover, comparative statics reveal that $\partial \delta_1^k(\sigma, \delta_2)/\partial \delta_2 > 0$ and $\partial \delta_1^k(\sigma, \delta_2)/\partial \sigma < 0$.

Proof. See Appendix A. ■

Slotting allowances are more likely to emerge the more differentiated the products are, i.e. $\partial \delta_1^k(\sigma, \delta_2)/\partial \sigma < 0$, as the upwards distortion of the wholesale price negotiated with the first supplier is the stronger the more the products are differentiated. This implies that slotting allowances are rather the result of rent-shifting across categories than within categories. Our results further reveal that the distortion of the first wholesale price is increasing in the bargaining power of the second supplier (see Proposition 1). Slotting allowances are, therefore, more likely to be charged from the first supplier the stronger the bargaining position of the second supplier, i.e. $\partial \delta_1^k(\sigma, \delta_2)/\partial \delta_2 > 0$.[26] For $\delta_1 = \delta_2 = 0$, slotting fees never emerge. This may explain why large and powerful retailers like Wal-Mart or Costco never ask for slotting fees (FTC 2001: 18).

[26] Considering again the two-category framework as described in Footnote 25, the emergence of slotting fees is more likely if the goods in category B are sufficiently differentiated.

Ban of Slotting Allowances. To assess the impact of slotting allowances on consumer surplus and the individual firms' profits, we now assume that slotting allowances are not feasible. For $\sigma < \sigma^k, \delta_2 > 0$ and $\delta_1 < \delta_1^k(\sigma, \delta_2)$, the ban of slotting allowances imposes a binding constraint. The outcome of the negotiations between the retailer and the first supplier under a ban of slotting allowances is characterized by

$$\widetilde{w}_1, \widetilde{F}_1 := \arg\max_{w_1, F_1} \left(\pi_{1,2}^{U_1}\right)^{\delta_1} \left(\pi_{1,2}^D - \pi_{0,2}^D\right)^{1-\delta_1} \text{ s.t. } F_1 \geq 0. \tag{30}$$

Proposition 4 *If slotting fees are not feasible, the equilibrium wholesale price in the first negotiation is given by $\widetilde{w}_1 < w_1^*$ for $\sigma < \sigma^k, \delta_2 > 0$ and $\delta_1 < \delta_1^k(\sigma, \delta_2)$. Otherwise, we have $\widetilde{w}_1 = w_1^*$. For $\widetilde{w}_1 < w_1^*$, comparative statics reveal $d\widetilde{w}_1/d\delta_1 > 0$.*

Proof. See Appendix A. ■

If the ban of slotting fees is binding, the wholesale price is the only instrument the retailer and the first supplier can use to divide their joint profit and to extract rent from the second supplier. Accordingly, $\widetilde{w}_1$ is less distorted than if slotting allowances were feasible, i.e. $\widetilde{w}_1 < w_1^*$. Furthermore, the wholesale price is increasing in δ_1 to account for the bargaining power of the first supplier. The less distorted $\widetilde{w}_1$ results in a rise of both consumer surplus and industry profit. In particular, the second supplier benefits from a less distorted wholesale price in the first negotiation. That is, a lower wholesale price in the first negotiation improves the marginal contribution of the second supplier to the joint profit with the retailer. Correspondingly, the retailer loses if a ban of slotting allowances is enforced and binding. The profit of the first supplier is, however, ambiguously affected by a ban of slotting allowances. The first supplier is better off when paying a slotting fee as long as its bargaining power is sufficiently low, while it is better off under a ban of slotting allowances if its bargaining power is close to $\delta_1^k(\sigma, \delta_2)$.[27]

Retailer's Preferred Order of Negotiations. So far, we have taken the order of negotiations as given. Assuming that the suppliers differ in their exogenously given bargaining power and that supplier U_1 is less powerful than supplier U_2, i.e. $\delta_1 < \delta_2$, we allow the retailer to decide about the order of negotiations.

Proposition 5 *The retailer prefers to negotiate first with the less powerful supplier in order to improve its bargaining position vis-à-vis the stronger supplier.*

Proof. See Appendix A. ■

[27] Intuitively, the first supplier cannot negotiate a high wholesale price $\widetilde{w}_1$ if its bargaining power is relatively low, i.e. δ_1 close to zero. That is, a first supplier with relatively low bargaining power vis-à-vis the retailer benefits from paying a slotting fee as this comes along with a higher margin, i.e. $w_1^* > \widetilde{w}_1$. The opposite occurs for large values of δ_1, i.e. δ_1 close to $\delta_1^k(\sigma, \delta_2)$.

If the retailer negotiates first with the more powerful supplier U_2, the distortion of the wholesale price enables the retailer and supplier U_2 to extract part of the rent from the less powerful supplier U_1. Inverting the order of negotiations, i.e. letting the retailer negotiate first with the less powerful supplier U_1, and assuming that the wholesale price determined in the first negotiation remains the same as in the case where the retailer negotiates first with U_2, the retailer and the first supplier extract the same amount of rent from the supplier U_2. However, compared to the case where the retailer negotiates first with U_2, the retailer is better off negotiating first with U_1 as it shares the extracted rent with the less powerful supplier. Moreover, as the retailer and the less powerful supplier U_1 agree on a more distorted wholesale price (see Proposition 2), which allows to shift more rent from the second supplier, the retailer's preference to negotiate first with the less powerful supplier becomes even more pronounced. The retailer, thus, prefers to negotiate first with the less powerful supplier. These findings are in line with Marx and Shaffer (2007a), who analyze the retailer's preferred order of negotiations in a three-party framework. In contrast to our model, they allow for contracts that are efficient and lead to full rent extraction from the second supplier, while in our framework only partial rent extraction is possible.[28]

Our results further reveal that slotting fees are more likely to occur if the retailer negotiates first with the less powerful supplier, i.e. supplier U_1. That is, slotting fees arise for $\delta_1 < \delta_1^k(\sigma, \delta_2)$ if the retailer negotiates first with supplier U_1, while they arise for $\delta_2 < \delta_2^k(\sigma, \delta_1)$ if the retailer negotiates first with supplier U_2. As the threshold $\delta_i^k(\sigma, \delta_j)$, $i = 1, 2$, $i \neq j$, is increasing in the bargaining power of the second supplier δ_j (see Proposition 1), we have $\delta_1^k(\sigma, \delta_2) > \delta_2^k(\sigma, \delta_1)$ for $\delta_1 < \delta_2$.

Corollary 1 *If the retailer decides about the order of negotiations, slotting fees are more likely to occur.*

5 Conclusion

Taking into account consumer preferences for one-stop shopping, we show that slotting allowances may result from a rent-shifting mechanism in a three-party framework. Thereby, slotting fees are not used to exploit those suppliers that pay them. They are rather the result of a rent-shifting mechanism at the expense of those suppliers that do not pay slotting fees. Overall, slotting fees can be used to shift rent across categories as well as across manufacturers of sufficiently differentiated products in the same product category. Furthermore, we show that slotting allowances come along with a welfare loss as they are induced by an upwards distorted wholesale price in the first negotiation.

Our results critically depend on the observability of contracts and the players' commitment to the contracts. In the case of simultaneous negotiations or secret contracts, the retailer would purchase the

[28] Marx and Shaffer (2007a) further show that the buyer is indifferent as to which supplier to negotiate with first if rent extraction is infeasible.

efficient quantity of any product (Bernheim and Whinston 1985). Moreover, our results are restricted to the assumption of two-part tariffs. This assumption implies that there are only two instruments available to control three objectives, i.e. the maximization of the overall joint profit, the division of surplus between the first supplier and the retailer, as well as the extraction of surplus from the second supplier. Accordingly, distortion arises both on and off the equilibrium path. Considering more general contracts which allow for different payments on and off equilibrium, the retailer and the first supplier are able to fully disentangle their three objectives. Accordingly, the wholesale price negotiated with the first supplier is never distorted in such a framework. The same holds if the contract with the first supplier is contingent on the quantity purchased from the second supplier. This is due to the fact that the equilibrium contract induces the efficient quantity along the equilibrium path, while the distortion is only arising "out of equilibrium" to extract second manufacturer's surplus.[29] However, such contracts require that the first supplier verifies the quantity negotiated with the second supplier, which is rather difficult and costly in reality.

Finally, our analysis is restricted to the case of a monopolistic retailer. Showing that one-stop shopping may cause slotting allowances in the case of a retail monopoly, we expect that retail competition reinforces the complementarity effect making slotting fees more likely. This would be an interesting task for future research.

Appendix A

Proof of Lemma 1. Maximizing (22) with respect to w_2 and F_2, we obtain the following first-order conditions

$$\frac{\partial NP_2}{\partial w_2} = \delta_2\left(\pi_{1,2}^D - \pi_{1,0}^D\right)\frac{\partial \pi_{1,2}^{U_2}}{\partial w_2} + (1-\delta_2)\pi_{1,2}^{U_2}\frac{\partial\left[\pi_{1,2}^D - \pi_{1,0}^D\right]}{\partial w_2} = 0, \tag{31}$$

$$\frac{\partial NP_2}{\partial F_2} = \delta_2\left(\pi_{1,2}^D - \pi_{1,0}^D\right) - (1-\delta_2)\pi_{1,2}^{U_2} = 0. \tag{32}$$

Using (31) and (32), we easily obtain

$$\frac{\delta_2\left(\pi_{1,2}^D - \pi_{1,0}^D\right)}{(1-\delta_2)\pi_{1,2}^{S_2}} = -\frac{\partial\left(\pi_{1,2}^D - \pi_{1,0}^D\right)/\partial w_2}{\partial \pi_{1,2}^{S_2}/\partial w_2} = 1, \tag{33}$$

implying

$$-\partial\left(\pi_{1,2}^D - \pi_{1,0}^D\right)/\partial w_2 = \partial \pi_{1,2}^{U_2}/\partial w_2. \tag{34}$$

Using (34) and applying the envelope theorem, we get

$$(w_2 - c)\partial X_2(w_1, w_2)/\partial w_2 = 0. \tag{35}$$

[29] For more details, see Marx and Shaffer (2008) or Marx and Shaffer (2007a).

The equality is fulfilled for

$$w_2^* = c. \tag{36}$$

Combining (36) together with (32), we obtain

$$F_2^*(w_1) = \delta_2 \left(R(w_1, c) - R(w_1, \infty) \right). \tag{37}$$

Proof of Proposition 1. Maximizing (23) with respect to w_1 and F_1, we obtain the following first-order conditions

$$\begin{aligned}
\frac{\partial NP_1}{\partial w_1} &= \delta_1 \left(\pi_{1,2}^D - \pi_{0,2}^D \right) \frac{\partial \pi_{1,2}^{U_1}}{\partial w_1} + (1-\delta_1) \pi_{1,2}^{U_1} \frac{\partial \left(\pi_{1,2}^D - \pi_{0,2}^D \right)}{\partial w_1} = 0, && (38) \\
\frac{\partial NP_1}{\partial F_1} &= \delta_1 \left(\pi_{1,2}^D - \pi_{0,2}^D \right) - (1-\delta_1) \pi_{1,2}^{U_1} = 0 && (39) \\
\text{with} &: \quad \frac{\partial \pi_{1,2}^{U_1}}{\partial w_1} = X_1(w_1, c) + (w_1 - c) \frac{\partial X_1(w_1, c)}{\partial w_1} \\
\text{and} &: \quad \frac{\partial \left(\pi_{1,2}^D - \pi_{0,2}^D \right)}{\partial w_1} = -X_1(w_1, c) + \delta_2 \left(X_1(w_1, c) - X_1(w_1, \infty) \right).
\end{aligned}$$

Using (38) and (39) and applying the envelope theorem, the equilibrium wholesale price w_1^* is given by

$$w_1^* = c - \frac{\delta_2 \left(X_1(w_1^*, c) - X_1(w_1^*, \infty) \right)}{\partial X_1(w_1^*, c) / \partial w_1}. \tag{40}$$

Using (39), the equilibrium fixed fee is given by

$$\begin{aligned}
F_1^* &= -\left(1 - \delta_1\right) (w_1^* - c) X_1(w_1^*, c) && (41) \\
&\quad + \delta_1 \left[(1 - \delta_2) \left[R(w_1^*, c) - R(\infty, c) \right] + \delta_2 R(w_1^*, \infty) \right].
\end{aligned}$$

Proof of Proposition 2. To prove the existence of σ^k, we reformulate (28) and obtain

$$\begin{aligned}
\Phi(w_1, \cdot) &= (w_1 - c) \frac{\partial X_1(w_1, c)}{\partial w_1} + \delta_2 \left(X_1(w_1, c) - X_1(w_1, \infty) \right) && (42) \\
\text{with} &: \quad \Phi(w_1^*) = 0.
\end{aligned}$$

Substituting $w_1 = c$, we get

$$\Phi(c, \cdot) = \delta_2 \left(X_1(c, c) - X_1(c, \infty) \right) = \delta_2 \left[\frac{27(1-c)^3}{64t} \left(\frac{1}{(1+\sigma)^2} - \frac{1}{2} \right) \right], \tag{43}$$

implying $\Phi(c, \cdot) \lesseqqgtr 0$ for all $\sigma \gtreqqless \sigma^k := -1 + \sqrt{2}$. Assuming concavity of the objective function, i.e. the Nash product formalized in (23),[30] the equilibrium wholesale price satisfies $w_1^* \gtreqqless c$ for $\sigma \lesseqqgtr \sigma^k$.

To analyze comparative statics, i.e. $\partial \left| w_1^* - c \right| / \partial \delta_2 > 0$, we apply the implicit function theorem to (42). Due to the concavity of (42), we have $sign \left[\partial w_1^* / \partial \delta_2 \right] = sign \left[\partial \Phi(w_1^*, \delta_2) / \partial \delta_2 \right] = sign \left[X_1(w_1^*, c) - X_1(w_1^*, \infty) \right].$ The analysis of $X_1(w_1^*, c) - X_1(w_1^*, \infty)$ reveals that $\partial \Phi(w_1^*, \delta_2) / \partial \delta_2 < 0$ if $X_1(w_1^*, c) - X_1(w_1^*, \infty) < 0$ and

[30] The concavity has been checked by simulations.

$w_1^* < c$ implying $\partial w_1^*/\partial\delta_2 < 0$. Otherwise it holds that $\partial\Phi(w_1^*,\delta_2)/\partial\delta_2 > 0$ if $X_1(w_1^*,c) - X_1(w_1^*,\infty) > 0$ and $w_1^* > c$, implying $\partial w_1^*/\partial\delta_2 > 0$. Hence, we have $\partial\left|w_1^* - c\right|/\partial\delta_2 > 0$.

Proof of Proposition 3. The fixed fee F_1^* is monotonically increasing in the first supplier's bargaining power, as $dF_1^*/d\delta_1 = (w_1^* - c)X_1(w_1^*,c) + (1-\delta_2)\left[R(w_1^*,c) - R(\infty,c)\right] + \delta_2 R(w_1^*,\infty) > 0$. Because of $F_1^*|_{\delta_1=0} < 0$ and $F_1^*|_{\delta_1=1} > 0$, there exists a unique threshold $\delta_1^k(\sigma,\delta_2)$ that is implicitly given by $F_1^*\left(\delta_1^k,\cdot\right) \equiv 0$.

To prove $\partial\delta_1^k(\sigma,\delta_2)/\partial\delta_2 > 0$, we use $F_1^*\left(\delta_1^k(\sigma,\delta_2),\delta_2\right) = 0$ and apply the implicit function theorem, i.e.

$$\frac{\partial\delta_1^k(\sigma,\delta_2)}{\partial\delta_2} = -\frac{\partial F_1^*/\partial\delta_2}{\partial F_1^*/\partial\delta_1}. \tag{44}$$

Since $\partial F_1^*/\partial\delta_1 > 0$, we have $sign\left(\partial\delta_1^k(\sigma,\delta_2)/\partial\delta_2\right) = sign\left(-\partial F_1^*/\partial\delta_2\right)$ with

$$-\frac{\partial F_1^*}{\partial\delta_2} = -\frac{\partial F_1^*}{\partial w_1}\frac{\partial w_1^*}{\partial\delta_2} - \frac{\partial F_1^*}{\partial\delta_2}. \tag{45}$$

For any $\sigma < \sigma^k$, we have $\partial F_1^*/\partial\delta_2 = -\delta_1\left[R(w_1^*,c) - R(w_1^*,\infty) - R(\infty,c)\right] < 0$ and, $\partial w_1^*(\delta_2)/\partial\delta_2 > 0$ (see Proposition 1). To show that $-\partial F_1^*/\partial w_1 > 0$, we rewrite F_1^* as the sum of two terms, $-(w_1^* - c)X_1(w_1^*,c)$ and $\delta_1\left[(w_1^* - c)X_1(w_1^*,c) + R(w_1^*,c) - \delta_2\left[R(w_1^*,c) - R(w_1^*,\infty)\right] - (1-\delta_2)R(\infty,c)\right]$. The second term corresponds to the joint profit of the first supplier and the retailer weighted by δ_1. The derivative of this term with respect to w_1 is zero, i.e. $\Phi(w_1^*) = 0$. This enables us to write $-\partial F_1^*/\partial w_1 = \partial\left[(w_1 - c)X_1(w_1,c)\right]/\partial w_1|_{w_1=w_1^*}$. Using $\Phi(w_1^*) = 0$, we can write

$$\left.\left[\frac{\partial(w_1 - c)X_1(w_1,c)}{\partial w_1} + (1-\delta_2)\frac{\partial R(w_1,c)}{\partial w_1} + \delta_2\frac{\partial R(w_1,\infty)}{\partial w_1}\right]\right|_{w_1=w_1^*} = 0. \tag{46}$$

Since $\partial\left[R(w_1,c)\right]/\partial w_1 < 0$ and $\partial\left[R(w_1,\infty)\right]/\partial w_1 < 0$, it follows that $\partial\left[(w_1 - c)X_1(w_1,c)\right]/\partial w_1|_{w_1=w_1^*} > 0$. This implies that $-dF_1^*/dw_1 > 0$. Hence, we have $\partial\delta_1^k(\sigma,\delta_2)/\partial\delta_2 > 0$.

Turning to the comparative statics of $\delta_1^k(\sigma,\delta_2)$ in σ, we have $sign\left(\partial\delta_1^k(\sigma,\delta_2)/\partial\sigma\right) = sign\left(-\partial F_1^*/\partial\sigma\right)$, i.e.

$$-\frac{\partial F_1^*}{\partial\sigma} = -\frac{\partial F_1^*}{\partial w_1}\frac{\partial w_1^*}{\partial\sigma} < 0.$$

This holds since $-\partial F_1^*/\partial w_1 > 0$ and $\partial w_1^*/\partial\sigma < 0$ for σ sufficiently low.

Proof of Proposition 4. To prove the first part of Proposition 4, i.e. $\widetilde{w}_1 < w_1^*$, we differentiate (30) with respect to w_1, getting

$$\begin{aligned}
\Psi(w_1) &= (1-\delta_1)(w_1 - c)X_1(w_1,c)\left[(1-\delta_2)\frac{\partial R(w_1,c)}{\partial w_1} + \delta_2\frac{\partial R(w_1,\infty)}{\partial w_1}\right] \\
&\quad +\delta_1\frac{\partial\left[(w_1 - c)X_1(w_1,c)\right]}{\partial w_1}\left[(1-\delta_2)\left(R(w_1,c) - R(\infty,c)\right) + \delta_2 R(w_1,\infty)\right] \\
\text{with:} &\quad \Psi(w_1)|_{w_1=\widetilde{w}_1} = 0.
\end{aligned} \tag{47}$$

Using $\Phi\left(w_1\right)|_{w_1=w_1^*}=0$ (see 46), we can write

$$\begin{aligned}\Psi\left(w_1\right)|_{w_1=w_1^*} &= \left.\frac{\partial\left(w_1-c\right)X_1\left(w_1,c\right)}{\partial w_1}\right|_{w_1=w_1^*} \\ &\times\underbrace{\left[\begin{array}{c}-\left(1-\delta_1\right)\left(w_1^*-c\right)X_1\left(w_1^*,c\right)+\\ \delta_1\left[\left(1-\delta_2\right)\left(R(w_1^*,c)-R(\infty,c)\right)+\delta_2R(w_1^*,\infty)\right]\end{array}\right]}_{T_1}.\end{aligned} \tag{48}$$

Note that the term T_1 in (48) refers to F_1^*. Since $\partial\left(w_1-c\right)X_1\left(w_1,c\right)/\partial w_1>0$ and $F_1^*<0$ for any $\delta_1<\delta_1^k(\cdot)$, it follows that $\Psi\left(w_1\right)|_{w_1=w_1^*}<0$. Assuming concavity of the objective function, we get $\widetilde{w}_1<w_1^*$ for $\delta_1<\delta_1^k(\cdot)$.

Applying the implicit function theorem, we analyze the comparative statics, i.e. $d\widetilde{w}_1/d\delta_1>0$. We know that $sign\left[d\widetilde{w}_1/d\delta_1\right]=sign\left[\partial\Psi/\partial\delta_1\right]$ with

$$\begin{aligned}\frac{\partial\Psi}{\partial\delta_1} &= -\left[\left(w_1-c\right)X_1\left(w_1,c\right)\right]\left[\left(1-\delta_2\right)\frac{\partial R(w_1,c)}{\partial w_1}+\delta_2\frac{\partial R(w_1,\infty)}{\partial w_1}\right] \\ &\quad+\frac{\partial\left[\left(w_1-c\right)X_1\left(w_1,c\right)\right]}{\partial w_1}\left[\left(1-\delta_2\right)\left(R(w_1,c)-R(\infty,c)\right)+\delta_2R(w_1,\infty)\right].\end{aligned} \tag{49}$$

Using previous results, we get

$$\Psi\left(\widetilde{w}_1\right)=\left.\begin{array}{c}\delta_1\left[\partial\Psi\left(\cdot\right)/\partial\delta_1\right]\\ +\left[\left(w_1-c\right)X_1\left(w_1,c\right)\right]\left[\left(1-\delta_2\right)\frac{\partial R(w_1,c)}{\partial w_1}+\delta_2\frac{\partial R(w_1,\infty)}{\partial w_1}\right]\end{array}\right|_{w_1=\widetilde{w}_1}=0. \tag{50}$$

Since $\partial R(w_1,c)/\partial w_1<0$ and $\partial R(w_1,\infty)/\partial w_1<0$, we get from $\Psi\left(\widetilde{w}_1\right)=0$ that $\partial\Psi\left(\cdot\right)/\partial\delta_1>0$, implying $d\widetilde{w}_1/d\delta_1>0$. Moreover, because of $dw_1^*/d\delta_1=0$ and $\widetilde{w}_1\leq w_1^*$, we get $d\left(w_1^*-\widetilde{w}_1\right)/d\delta_1<0$.

Proof of Proposition 5. Denoting the first supplier by index i and the second supplier by index j, the downstream firm's profit is given by

$$\begin{aligned}\pi_{i,j}^D\left(w_i\right) &= \delta_i\left(1-\delta_j\right)R(\infty,c)+\left(1-\delta_i\right)\left[(w_i-c)X_i(w_i,c)+R(w_i,c)\right] \\ &\quad-\left(1-\delta_i\right)\delta_j\left[R(w_i,c)-R(w_i,\infty)\right],i=1,2,\ i\neq j.\end{aligned} \tag{51}$$

We denote the wholesale prices negotiated with the first supplier by $\widehat{w}_i$. Assuming $\delta_1<\delta_2$, we have $0<|\widehat{w}_2-c|<|\widehat{w}_1-c|$ (see Proposition 1) since the distortion of the wholesale price in the first stage is increasing in the bargaining power of the second supplier. Thus, to prove $\pi_{1,2}^D\left(\widehat{w}_1\right)>\pi_{2,1}^D\left(\widehat{w}_2\right)$, we have to show that $\pi_{1,2}^D\left(\widehat{w}_2\right)>\pi_{2,1}^D\left(\widehat{w}_2\right)$. Denoting $\Delta\pi^D(\widehat{w}_2)=\pi_{1,2}^D\left(\widehat{w}_2\right)-\pi_{2,1}^D\left(\widehat{w}_2\right)$, we get

$$\Delta\pi^D(\widehat{w}_2)=\left(\delta_2-\delta_1\right)\left[(\widehat{w}_2-c)X_2(\widehat{w}_2,c)+R(\widehat{w}_2,\infty)-R(\infty,c)\right]. \tag{52}$$

Since $(\delta_2-\delta_1)>0$, we have to show that $(\widehat{w}_2-c)X_2(\widehat{w}_2,c)+R(\widehat{w}_2,\infty)-R(\infty,c)>0$. Denoting $\underline{w}_1$ the wholesale price negotiated in the first stage for $\delta_2=1$, we get

$$\left.\left\{\frac{\partial\left[\left(w_1-c\right)X_1\left(w_1,c\right)+R\left(w_1,c\right)\right]}{\partial w_1}-\frac{\partial\left[R\left(w_1,c\right)-R\left(w_1,\infty\right)\right]}{\partial w_1}\right\}\right|_{w_1=\underline{w}_1}=0. \tag{53}$$

We rewrite (53) by $\partial A(w_1)/\partial w_1 - \partial B(w_1)/\partial w_1 = 0$, where $A(w_1)$ denotes the industry surplus and $B(w_1)$ the incremental contribution of the second supplier. Using $\partial A(w_1)/\partial w_1 < 0$, $\partial B(w_1)/\partial w_1 < 0$ and $\partial A(w_1)/\partial w_1 - \partial B(w_1)/\partial w_1 > 0$ for any $w_1 < \underline{w}_1$, the concavity of the objective function reveals

$$A(c) - A(w_1) < B(c) - B(w_1) \;\; \forall \; w_1 < \underline{w}_1. \tag{54}$$

Since $|\widehat{w}_2 - c| < |\underline{w}_1 - c|$ (see Proposition 1), we obtain

$$A(c) - A(\widehat{w}_2) < B(c) - B(\widehat{w}_2) \;\text{ for } w_1 = \widehat{w}_2. \tag{55}$$

Rewriting (55), we get

$$(\widehat{w}_2 - c)X_2(\widehat{w}_2, c) + R(\widehat{w}_2, \infty) - R(\infty, c) > 0. \tag{56}$$

Hence, we have $\pi^D_{1,2}(\widehat{w}_2) - \pi^D_{2,1}(\widehat{w}_2) > 0$ for $\delta_1 < \delta_2$ (see 52). From $\pi^D_{1,2}(\widehat{w}_2) > \pi^D_{2,1}(\widehat{w}_2)$ and $\pi^D_{1,2}(\widehat{w}_1) > \pi^D_{1,2}(\widehat{w}_2)$, we get $\pi^D_{1,2}(\widehat{w}_1) > \pi^D_{2,1}(\widehat{w}_2)$.

Appendix B

Consider the case where only a share λ of consumers buys both products in a single shopping trip, while a share $1-\lambda$ of consumers purchases only one product per trip. Thereby, we assume that a share α of the single-product shoppers buys good 1 and a share $1-\alpha$ of the single-product shoppers buys good 2. Accordingly, the overall demand functions for good 1 and good 2 are given by

$$\overline{X}_1(p_1,p_2) = \lambda X_1^*(p_1,p_2) + (1-\lambda)\alpha X_1^*(p_1,\infty), \tag{57}$$

$$\overline{X}_2(p_1,p_2) = \lambda X_1^*(p_1,p_2) + (1-\lambda)(1-\alpha) X_2^*(\infty,p_2). \tag{58}$$

Thus, the complementary effect induced by one-stop shopping behavior is increasing in the share of consumers that purchase both goods at the retailer, i.e. λ. If the retailer does not sell good 2, the overall demand for good 1 is

$$\overline{X}_1(p_1,\infty) = \lambda X_1^*(p_1,\infty) + (1-\lambda)\alpha X_1^*(p_1,\infty) = [\lambda + \alpha(1-\lambda)]\, X_1^*(p_1,\infty). \tag{59}$$

Analogously, the overall demand for good 2 if the retailer only offers good 2 is

$$\overline{X}_2(\infty,p_2) = \lambda X_2^*(\infty,p_2) + (1-\lambda)(1-\alpha) X_2^*(\infty,p_2) = [1 - \alpha(1-\lambda)]\, X_2^*(\infty,p_2). \tag{60}$$

Referring to Lemma 1 and Proposition 1, the equilibrium wholesale prices are then given by

$$\overline{w}_1 = c - \lambda\delta_2 \frac{\overline{X}_1(\overline{w}_1, c) - \overline{X}_1(\overline{w}_1, \infty)}{\partial \overline{X}_1(\overline{w}_1, c)/\partial w_1}$$

and

$$\overline{w}_2 = c.$$

Since $\partial\overline{X}_1(\overline{w}_1, c)/\partial w_1 < 0$, the direction of the distortion of $\overline{w}_1$ still depends on the sign of $\Delta X = \overline{X}_1(\overline{w}_1, c) - \overline{X}_1(\overline{w}_1, \infty)$. This implies that Proposition 2 still holds if not all consumers purchase both products within the category. In other words, the threshold σ^k remains the same as in our basic framework, i.e. $\sigma^k = -1 + \sqrt{2}$. However, the share of one-stop shoppers affects the extent of the distortion. For $\sigma < \sigma^k$, the wholesale price $\overline{w}_1$ is increasing in λ, while it is decreasing in λ for $\sigma \geq \sigma^k$ (see Figure 2).

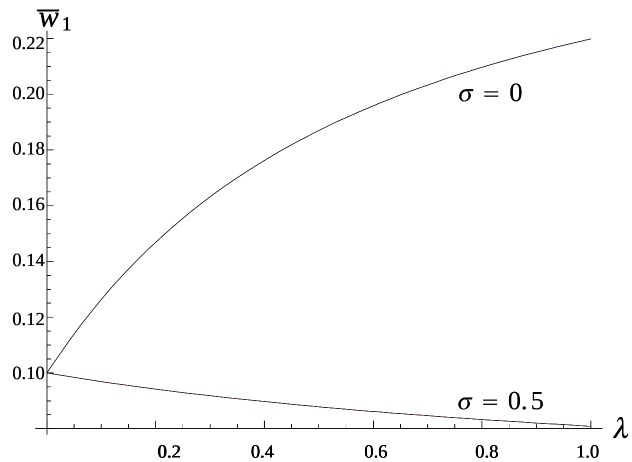

Figure 2: Wholesale price $\overline{w}_1$ in $\lambda \in [0, 1]$ for $c = 0.1$.

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