Does Retailer Power Lead to Exclusion?

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Abstract

This paper examines whether retailer bargaining power and upfront slotting allowances prevent small manufacturers (who have no bargaining power) from obtaining adequate distribution. In contrast to the findings of Marx and Shaffer (2007), who showed that all equilibria involve limited distribution (i.e., exclusion of a retailer), we show that there is always an equilibrium in which full distribution is obtained, provided that full distribution is the industry profit-maximizing outcome. The key feature leading to this differing result is that we do not restrict each retailer to offering the manufacturer a single tariff.

1 Introduction

In a recent paper, Marx and Shaffer (2007) study a model of vertical contracting between a manufacturer and two retailers in which bargaining power resides with the retailers, who simultaneously make take-it-or-leave-it offers to the manufacturer. They reach the striking conclusion that when retailers have such bargaining power, all equilibria lead to exclusion of a retailer from carrying the manufacturer's product. This is so even though, following the reasoning of Segal (1999), exclusion would not occur in their model were it instead the manufacturer who made (public) take-it-or-leave it offers to the retailers. Marx and Shaffer's exclusion equilibria are sustained with "three-part tariffs" (described below in more detail) in which the manufacturer pays the retailer an upfront "slotting fee", and then the retailer can buy the manufacturer's product under two-part tariff pricing terms. Based on their findings, they conclude that upfront slotting payments can prevent small manufacturers (who have no bargaining power) from obtaining adequate distribution (i.e., get carried by all retailers).

Following the Marx and Shaffer article, Miklos-Thal, Rey, and Verge (forth.) observed that the result does not hold when retailers can make contingent offers, explicitly conditional on whether they have exclusivity. Miklos-Thal *et al.* show that in that case there is always an equilibrium in the Marx and Shaffer model that maximizes industry (or "vertical structure") profits and does not involve any exclusion. This finding, compared to the Marx and Shaffer result, seems to present a somewhat paradoxical conclusion: exclusion happens only if (explicit) exclusion is not allowed.

In this short paper we show that the key feature leading to the Marx and Shaffer result is rather Marx and Shaffer's restriction of retailers to

offering a single three-part tariff. Specifically, we show that when retailers can offer a menu of tariffs, there is always an equilibrium in which no exclusion occurs and industry profits are maximized, even when the tariffs cannot be made explicitly conditional on exclusivity. Our conclusion indicates that neither retailer market power nor slotting fees necessarily limit the distribution of manufacturers' products. The resulting outcome may be better for consumers than Marx and Shaffer's exclusionary outcome (retail coverage availability is greater, while prices may be either higher or lower), but is generally not socially optimal because of the industry's market power.

The rest of the paper is organized as follows: In Section 2, we describe the Marx and Shaffer model and result. In Section 3, we first present our analysis and result in the context of the Marx and Shaffer model, allowing for menus of three-part tariffs. Section 4 shows that a similar result holds when we allow for more general tariffs and alternative types of arrangements.

2 The Marx and Shaffer Model and Result

The basic framework of Marx and Shaffer is as follows. Two differentiated retailers R_1 and R_2 distribute the product of a manufacturer M. Retailers incur no costs other than what they pay the manufacturer, while the manufacturer's cost of producing quantities q_1 and q_2 (where q_i is the quantity sold to retailer i) is $c(q_1, q_2)$. Retailers have all the bargaining power in their bilateral relations with the manufacturer; their interaction is therefore modeled as follows:

1. R_1 and R_2 simultaneously make take-it-or-leave-it "three-part tariff" offers to M, stipulating wholesale prices w_1 and w_2 as well as lump-sum fees (more on this below).

2. M accepts or rejects each retailer's offer; accepted contracts are public.

3. The retailers with accepted tariffs compete on the downstream market and the relevant tariff conditions are implemented.

Marx and Shaffer assume that the stage 3 retail equilibrium when both retailers are making purchases at wholesale prices w_1 and w_2 results in profits for M and R_i of $\pi_M(w_1, w_2)$ and $\pi_i(w_i, w_{-i})$ respectively.[1] Marx and Shaffer moreover assume that $\pi_i(w_i, w_{-i})$ is nonincreasing in w_i and nondecreasing in w_{-i}, as would be expected when the retailers are (imperfect) substitutes, with these effects holding strictly at any (w_1, w_2) such that $\pi_i(w_i, w_{-i}) > 0$. The industry profit $\pi_M(w_1, w_2) + \sum_i \pi_i(w_i, w_{-i})$ is maximized at $(w_1, w_2) = (w_1^*, w_2^*)$, where it is equal to Π^*. If R_i instead monopolizes the retail market, the joint profit of M and R_i is $\pi_M(w_i, \infty) + \pi_i(w_i, \infty)$,[2] which achieves its maximum, Π_i^m, at wholesale price $w_i = w_i^m$. Marx and Shaffer focus on the case in which industry profits are greater when both retailers are active: $\Pi^* > \max\{\Pi_1^m, \Pi_2^m\}$.

Finally, Marx and Shaffer assume that each retailer's offer is a "three-part tariff," in which R_i's payments to M have the form:

$$t_i(q_i) = \begin{cases} -S_i & \text{if } q_i = 0, \\ -S_i + F_i + w_i q_i & \text{if } q_i > 0. \end{cases}$$

Such a tariff, which we denote by $T_i = (S_i, F_i, w_i)$, thus involves:

- an upfront "slotting" payment S_i paid *by M to R_i*;

[1] The notation "$-i$" refers to R_i's rival.

[2] There is a slight abuse of notation here, which simplifies the exposition; more formally, M's profit under exclusivity is either $\pi_M(w_1, \infty)$ or $\pi_M(\infty, w_2)$.

- a conditional fee F, paid *to M by R_i*, but only if R_i actually buys a positive quantity;
- a per unit wholesale price w_i.

Marx and Shaffer show that under these conditions all pure strategy subgame perfect Nash equilibria involve exclusion: only one retailer makes purchases from the manufacturer.

To proceed, observe first that the joint payoff of the manufacturer M and a retailer R_i cannot be less than what they could achieve in an exclusive relationship:

Lemma 1 *When the set of allowable contract offers includes three-part tariffs, in any subgame perfect Nash equilibrium the joint payoff of the manufacturer M and a retailer R_i $(i = 1, 2)$ cannot be less than Π_i^m.*

Proof. Let Π_M and Π_i be the equilibrium payoffs of M and R_i, respectively, and suppose that $\Pi_M + \Pi_i < \Pi_i^m$. Note that M must earn no more than Π_M by accepting only a contract from R_{-i} since otherwise M would have a profitable deviation.

Now consider a deviation by R_i in which he offers three-part tariff $\widetilde{T} = (\widetilde{S}, \widetilde{F}, \widetilde{w}) \equiv (\Pi_i^m - \delta - (\Pi_M + \varepsilon), \pi_i(w_i^m, \infty) - \delta, w_i^m)$ where $\varepsilon \in (0, (\Pi_i^m - \Pi_M - \Pi_i)/2)$ and $\delta \in (0, \varepsilon)$. This contract faces R_i with wholesale price w_i^m, together with a fixed fee for positive quantities that is lower than its monopoly revenues for that price. If M accepts only R_i's tariff $\widetilde{T}$, R_i will thus buy from M, and M's profit will be:

$$\begin{aligned}
\widetilde{\Pi}_M &= -\widetilde{S} + \widetilde{F} + \pi_M(w_i^m, \infty) \\
&= (\Pi_M + \varepsilon) + \delta - \Pi_i^m + \pi_i(w_i^m, \infty) - \delta + \pi_M(w_i^m, \infty) \\
&= \Pi_M + \varepsilon,
\end{aligned}$$

which exceeds his payoff from accepting no contract or only a contract offer from R_{-i}. Thus, M must accept R_i's contract $\widetilde{T}$ in any continuation equilibrium. R_i's profit in any continuation equilibrium is therefore bounded below by the upfront payment he receives in tariff $\widetilde{T}$: [I introduced an inequality sign in the equation below, reflecting the change in $\varepsilon \in (0, (\Pi_i^m - \Pi_M - \Pi_i)/2)$]

$$\widetilde{S} = (\Pi_i^m - \Pi_M) - \varepsilon - \delta > (\Pi_i + 2\varepsilon) - \varepsilon - \delta = \Pi_i + \varepsilon - \delta > \Pi_i.$$

Hence, R_i would have a profitable deviation. ■

Marx and Shaffer's exclusion result follows from Lemma 1. To see this, observe that, as noted by Marx and Shaffer (see their Lemma 1), in any equilibrium in which M deals with both retailers, each R_i must make M indifferent between accepting its offer and rejecting it, since R_i could otherwise demand a slightly larger upfront payment.[3] When each R_i can offer only a single three-part tariff T_i, this implies that if in equilibrium M were buying from both retailers, then M's payoff would be the same as in an exclusive relationship with R_i under the same tariff T_i. On the other hand, if both retailers are making purchases, retailer R_i's payoff would have to be strictly less than his payoff in an exclusive relationship under tariff T_i (since his profit is decreasing in the wholesale price w_{-i}). Since their joint payoff under tariff T_i can be no greater than Π_i^m, this would imply that their joint payoff in this equilibrium would be strictly less than Π_i^m, which is impossible by Lemma 1. So any pure

[3] The argument assumes here that, in case of multiple continuation equilibria, the selection among those equilibria does not depend on the upfront payment, which becomes a sunk cost at that stage.

Also, in their Lemma 1 Marx and Shaffer implicitly assume that M strictly prefers accepting either or both offers to accepting neither, i.e. that $\Pi_M > 0$. Our Assumption 1 below implies that this condition holds in any equilibrium.

strategy subgame perfect Nash equilibrium must have only one retailer making purchases from M.

3 Menus of Three-Part Tariffs

Marx and Shaffer's result assumes that retailers' offers consist of a single three-part tariff. We now examine what happens when each retailer can instead offer a menu of three-part tariffs. With such a menu, at stage 2 M can choose which tariff, if any, to accept from each retailer. We show that when such menus are possible a subgame perfect Nash equilibrium exists that implements the industry profit-maximizing outcome and gives each retailer R_i a profit equal to his "contribution" to *industry profit*, $\Delta_i \equiv \Pi^* - \Pi^m_{-i} \geq 0$. The manufacturer earns the residual $\Delta_M \equiv \Pi^* - \sum_i \Delta_i = \sum_i \Pi^m_i - \Pi^*$.

We first note that Lemma 1 implies that retailers cannot earn more than their contributions:

Corollary 2 *When the set of allowable contract offers includes three-part tariffs, in any subgame perfect Nash equilibrium a retailer R_i's payoff cannot exceed his contribution, $\Delta_i = \Pi^* - \Pi^m_i$.*

Proof. Since $\Pi_M + \Pi_{-i} \geq \Pi^m_{-i}$ by Lemma 1, and the total payoff is bounded above by Π^*, we have $\Pi_i \leq \Pi^* - (\Pi_M + \Pi_{-i}) \leq \Pi^* - \Pi^m_{-i} = \Delta_i$. ■

We also will make the following assumption:

Assumption 1: $\Pi^m_1 + \Pi^m_2 > \Pi^*$.

Assumption 1 captures the notion that sales through the two retailers are substitutes in either downstream demand or upstream manufacturing costs (or both). The assumption guarantees that in equilibrium M

always strictly prefers to accept one or both retailer offers rather than accept none (i.e., $\Pi_M > 0$), a feature that is implicitly assumed by Marx and Shaffer (see footnote 3).

To proceed, we construct an equilibrium supporting the (non-exclusionary) industry profit-maximizing outcome as follows: Suppose that each retailer $i = 1, 2$ offers M a menu $C_i = (T_i^C, T_i^E)$ which gives M a choice between two three-part tariffs, $T_i^C = (S_i^C, F_i^C, w_i^C)$ and $T_i^E = (S_i^E, F_i^E, w_i^E)$, designed respectively for "common agency" and "exclusive dealing." (Note that since these three-part tariffs do not have any explicit exclusivity requirements, M is free to accept contracts T_1^E and T_2^E.) The two three-part tariffs have the following structure:

- both options involve an upfront payment that gives R_i its full contribution to the industry profits: $S_i^C = S_i^E = \Delta_i$;
- the option designed for common agency, T_i^C, has $w_i^C = w_i^*$, to sustain the industry profit-maximizing outcome, and $F_i^C = \pi_i(w_i^*, w_{-i}^*)$, equal to R_i's equilibrium profit (gross of the payments S_i and F_i);
- the option designed for exclusive dealing, T_i^E, has $w_i^E = w_i^m$, to sustain the bilateral profit-maximizing outcome, and $F_i^E = \pi_i(w_i^m, \infty)$, equal to the profit that R_i can obtain under exclusivity.

In the equilibrium, M accepts the two tariffs $\left(T_1^C, T_2^C\right)$, and the retailers then implement the profit-maximizing outcome: wholesale prices $(w_1^C, w_2^C) = (w_1^*, w_2^*)$ generate the industry profit-maximizing prices and quantities if both retailers buy at these prices, and they are indeed willing to buy since the conditional fees (F_1^C, F_2^C) do not exceed their corresponding flow profits. In this continuation equilibrium, M recovers both retailers' flow profits through the conditional fees F_i^C; therefore, each

R_i just obtains his contribution to industry profits (Δ_i) through the up-front payment S_i, whereas M obtains the residual $\Delta_M = \Pi^* - \Delta_1 - \Delta_2$. Moreover, the joint profit of M and each retailer R_i, $\Delta_i + \Delta_M$, equals Π_i^m.

We now argue that both retailers offering these tariffs, and M accepting $\left(T_1^C, T_2^C\right)$ constitute a subgame perfect Nash equilibrium. Consider first M's acceptance decision. If M accepts a tariff from both retailers, in any continuation equilibrium each retailer R_i must earn at least S_i, which equals Δ_i. So M's profit cannot exceed $\Pi^* - \Delta_1 - \Delta_2 = \Delta_M$, which is what he gets by accepting $\left(T_1^C, T_2^C\right)$. If, instead, M accepts only a contract from one retailer, say R_i, then once again R_i's payoff is at least Δ_i. So M's profit is bounded above by $\Pi_i^m - \Delta_i = \Delta_M$. Hence, accepting $\left(T_1^C, T_2^C\right)$, which gives profit $\Delta_M > 0$, is an optimal choice for M.

Now consider deviations by a retailer, say R_i. Following any deviation, M must earn at least Δ_M, since this is what she receives by accepting only retailer R_{-i}'s tariff T_{-i}^E. So if M accepts only a contract from R_i, R_i's profit cannot increase since the joint profit of M and R_i is bounded above by their equilibrium joint profit, Π_i^m. If M instead accepts a contract from both retailers, then since R_{-i} must earn at least Δ_{-i} ($= S_{-i}^C = S_{-i}^E$) in any continuation equilibrium, R_i's profit is bounded above by $\Pi^* - \Delta_M - \Delta_{-i} = \Delta_i$. Thus, no profitable deviation exists for the retailers either.

The above offers and contination play thus constitute a subgame perfect Nash equilibrium in which both retailers are active and each retailer R_i earns its maximal achievable profit, Δ_i. Both retailers therefore prefer this equilibrium to any other equilibrium. In summary:

Proposition 3 *When retailers can offer menus of three-part tariffs,*

there exists a subgame perfect Nash equilibrium in which both retailers are active, industry profits are at the industry profit-maximizing level (Π^*)*, and the retailers earn their respective contributions to these profits* $(\Delta_1$ *and* $\Delta_2)$*.*

The menus of contracts offered by each retailer R_i here can be thought of as allowing M to respond in his contract with R_i to information M subsequently learns about the other retailer R_{-i}'s offer. That this can matter for equilibria can be seen in previous work on contracting with externalities/common agency [Segal and Whinston (2003), Martimort and Stole (2003)]. In the Marx and Shaffer setting, when menus are not allowed M has only an inefficient (i.e., not profit-maximizing) option for dealing exclusively with each retailer R_i. This leads retailer R_{-i} to be overly aggressive in his contract offer, leaving too little surplus for M and R_i, and causing R_i to deviate in a manner that leads M to deal exclusively with him. With a menu, each retailer can instead offer both a contract that works well if accepted together with a contract from the other retailer and a contract that works well if accepted on its own. Should either retailer demand too much of the surplus, the manufacturer can respond by accepting an attractive (i.e., profit-maximizing) option for dealing with only the other retailer.

The fact that a retailer can design a contract intended for an "exclusive" relationship in a way that ensures M will not also accept a contract from the retailer's rival follows from the same logic as in Marx and Shaffer's paper: in the "exclusive" contract each retailer R_i is indifferent about whether to purchase, so acceptance of a contract from the rival R_{-i} causes R_i to cease carrying M's goods, which makes accepting R_{-i}'s contract unprofitable. As noted by Miklos-Thal et al., however, slotting fees are not essential for accomplishing this goal. For example, we show

in the Appendix that when M faces a constant unit cost c, under mild regularity conditions the retailers can sustain the monopoly outcome by offering menus consisting of the following two options, which coincide with the previous tariffs T_i^C and T_i^E for large enough quantities but involve no slotting fees and cover the manufacturer's costs regardless of the quantity purchased:

- an option designed for common agency, satisfying $\hat{T}_i^C(q_i) = cq_i$ for $q \leq q_i^C$, and $\hat{T}_i^C(q_i) = F_i^C + w_i^* q_i$ for $q > q_i^C$, where q_i^C and F_i^C are chosen so that, given R_{-i}'s equilibrium behavior, R_i can obtain its contribution Δ_i either by selling q_i^C (and buying it at cost) or by selling the larger profit-maximizing quantity $q_i^* \equiv q_i(w_i^*, w_{-i}^*)$ [and paying $\hat{T}_i^C(q_i^*)$];
- an option designed for exclusive dealing, $\hat{T}_i^E$, satisfying $\hat{T}_i^E(q_i) = cq_i$ for $q \leq q_i^E$ and $\hat{T}_i^E(q_i) = F_i^E + w_i^m q_i$ for $q > q_i^E$, where q_i^E and F_i^E are chosen so that, absent R_{-i}, R_i can obtain its contribution Δ_i by buying q_i^E (at cost) as well as by buying the larger bilateral monopoly quantity $q_i^m \equiv q_i^m(w_i^m, \infty)$ [and paying $\hat{T}_i^E(q_i^m)$].

4 Extensions

Following Marx and Shaffer, we have focused so far on the set of outcomes achievable with contracts in which retailers face constant marginal wholesale prices. When retailer demand functions are not concave, this may limit the ability to support the industry profit-maximizing outcome. That is, letting $\rho_i(q_i, q_{-i})$ denote the revenue generated by R_i's sales, in the model studied above it may be that $\Pi^* < \max_{q_1,q_2} \sum_i \rho_i(q_i, q_{-i}) q_i - c(q_1, q_2)$. Here we show that similar insights apply to the unconstrained industry profits and, equally important, we extend the analysis to any number of retailers.

Suppose that there are n retailers, and let $N \equiv \{1, ..., n\}$. For any quantity profile $q \in Q = \left\{(q_i)_{i\in N} \mid q_i \in \mathbb{R}_+\right\}$, denote the industry profit by $\Pi(q) \equiv \sum_{i\in N} \rho_i(q) - c(q)$. Finally, for any subset of retailers $S \subset N$, define $Q^S = \{q \in Q \mid q_i = 0 \text{ if } i \notin S\}$ and suppose that the maximal profit that M and the retailers in S can obtain together, denoted $\Pi^S \equiv \max_{q\in Q^S} \Pi(q)$, is achieved at $q = q^S$. These retailers' joint contribution to industry profit is then defined as $\Delta_S \equiv \Pi^N - \Pi^{N\setminus S}$. For the sake of exposition, we will use the notation $\Delta_i \equiv \Delta_{\{i\}}$ for R_i's individual contribution. As before, $\Delta_M \equiv \Pi^N - \sum_{i\in N} \Delta_i$ is M's residual profit. To reflect retailers' imperfect substitutability, we assume:

Assumption 1': For any subset S such that $\#S \geq 2$, $\Delta_S > \sum_{i\in S} \Delta_i$.

Assumption 1' asserts that retailers are substitutes to each other in generating industry profit. For example, in the two retailer model studied above, $\Delta_{\{1,2\}} = \Pi^*$, so part (ii) of the assumption amounts to $\Pi^* > \sum_{i\in S}(\Pi^* - \Pi^m_{-i})$, i.e., to $\sum_{i\in S} \Pi^m_i > \Pi^*$.

The retailers can again use menus of contracts to sustain the industry profit Π^N. To see this, suppose that each R_i offers a contract consisting of the following options:

- a tariff T_i^C designed for common agency, giving R_i the choice between $C_i^0 \equiv (-\Delta_i, 0)$, which consists of buying nothing and receiving a payment from M equal to Δ_i, or $C_i^C \equiv \left(F_i^C, q_i^N\right)$, which consists of buying q_i^N in exchange for a payment $F_i^C \equiv \rho_i\left(q^N\right) - \Delta_i$;
- for each rival R_j, a tariff T_{ij}^E designed for the case where R_j is excluded, giving R_i the choice between C_i^0 or $C_{ij}^E \equiv (F_{ij}^E, q_i^{N\setminus\{j\}})$, which consists of buying $q_i^{N\setminus\{j\}}$ in exchange for a payment $F_{ij}^E \equiv \rho_i\left(q^{N\setminus\{j\}}\right) - \Delta_i$.

If all retailers offer these contracts and M accepts the options $\left(T_i^C\right)_{i\in N}$, there is a continuation equilibrium in which each R_i opts for C_i^C (each R_i is then indifferent between C_i^0 and C_i^C). This continuation equilibrium sustains the industry profit maximum Π^N, gives each R_i its contribution Δ_i, and thus gives M its residual contribution Δ_M. The joint profit of M and any subset S of retailers is moreover at least what they could obtain on their own since

$$\Delta_M + \sum_{i\in S} \Delta_i = \Pi^N - \sum_{j\in N\setminus S} \Delta_j \geq \Pi^N - \Delta_{N\setminus S} = \Pi^S,$$

where the inequality follows from part (ii) of Assumption 1'. This, in turn, implies that M cannot benefit from selecting any other set of options, since any R_i whose offer is accepted can secure its contribution Δ_i by opting for C_i^0, and dealing with a set S of retailers cannot generate more than Π^S.

Finally, no R_i can benefit from deviating. To see this, observe first that M can also secure its contribution Δ_M by accepting the tariffs $\left(T_{ji}^E\right)_{j\in N\setminus\{i\}}$: this induces every other retailer R_j, $j \neq i$, to opt for C_{ji}^E (this is indeed a continuation equilibrium since each R_j is then indifferent between C_j^0 and C_{ji}^E) and thus gives M a profit equal to

$$\Pi^{N\setminus\{i\}} - \sum_{j\in N\setminus\{i\}} \Delta_j = \Pi^N - \left(\Pi^N - \Pi^{N\setminus\{i\}}\right) - \sum_{j\in N\setminus\{i\}} \Delta_j = \Pi^N - \sum_{j\in N} \Delta_j = \Delta_M. \tag{1}$$

Moreover, any R_j whose offer is accepted can again secure its contribution Δ_j by opting for C_j^0. Thus, if a deviation by R_i leads M to accept contracts from the retailers in subset S, then R_i's profit is bounded above

by

$$\begin{aligned}\Pi^S - \Delta_M - \sum_{j \in S \setminus \{i\}} \Delta_j &= (\Pi^N - \Delta_{N \setminus S}) - (\Pi^N - \sum_{j \in N} \Delta_j) - \sum_{j \in S \setminus \{i\}} \Delta_j \\ &= \Delta_i + \sum_{j \in N \setminus S} \Delta_j - \Delta_{N \setminus S} \\ &\leq \Delta_i,\end{aligned}$$

where the inequality follows again from Assumption 1'.

Alternatively, one could build on Segal (1999)'s result mentioned in the Introduction. To sustain the industry profit maximum, suppose that each retailer R_i offers the manufacturer the following contract: "For a payment of Δ_i you can make a take-it-or-leave-it offer to me." If M accepts all offers, then by Segal's result the industry profit-maximizing outcome arises, and each party receives the same payoff as above. Moreover, since M and retailers in $S \subset N$ obtain Π^S in the candidate equilibrium, M is indeed willing to accept all the offers if they are made. Now consider whether any retailer has an incentive to deviate. The argument parallels that above: Any R_i whose offer is accepted obtains its contribution Δ_i and, from (1), M can also secure its own contribution Δ_M by accepting the offers of all of R_i's rivals. Therefore, by inducing M to accept the offers of a subset S of retailers, R_i cannot earn more than $\Pi^S - \Delta_M - \sum_{j \in S \setminus \{i\}} \Delta_j \leq \Delta_i$.

Appendix

We show in this Appendix that, when M faces a constant marginal cost c, it is possible to sustain the industry profit maximum Π^* by offering the tariffs $\hat{T}_i^C$ and $\hat{T}_i^E$ described in the text. The exact specification of the options depends on the nature of retail competition. For the sake of exposition, we will assume here that: (i) retailers compete in quantities (a similar analysis applies to price competition); (ii) the revenue generated by R_i's sales, $\rho_i(q_i, q_{-i})$, is continuous (with $\rho_i(0, q_{-i}) = 0$ for all q_{-i}), strictly concave in q_i, decreasing in q_{-i} (and strictly so if $\rho_i(q_i, q_{-i}) > 0$), and leads quantities to be strategic substitutes, i.e., $\partial^2 \rho_i / \partial q_i \partial q_{-i} < 0$. Let (q_1^*, q_2^*) denote the quantities purchased in the industry profit maximum supported by wholesale prices (w_1^*, w_2^*), and let q_i^m denote the quantity, supported by w_i^m, that maximizes profits in an exclusive relationship with R_i. Note that under these assumptions, $w_i^m = c$.[4]

The parameters of the tariff $\hat{T}_i^E$ are designed so that q_i^E is the smallest quantity satisfying $\rho_i(q_i, 0) - cq_i = \Delta_i$, and $F_i^E = \Pi_i^m - \Delta_i = \Delta_M$. Similarly, the parameters of the tariff $\hat{T}_i^C$ are designed so that q_i^C is the smallest quantity satisfying $\rho_i\left(q_i, q_{-i}^*\right) - cq_i = \Delta_i$, and $F_i^C = \rho_i\left(q_i^*, q_{-i}^*\right) - w_i^* q_i^* - \Delta_i$. It is straightforward to check that the quantity thresholds lie below the (industry or bilateral) monopoly levels (that is, $q_i^C < q_i^*$ and $q_i^E < q_i^m$),[5] and that the tariffs jump upwards at these thresholds (so

[4]In addition, given the concavity assumption made here, the linear wholesale prices

$$w_i^* = c + \left[\frac{\partial \rho_{-i}(q_{-i}^*, q_i^*)}{\partial q_i}\right] q_{-i}^* \text{ for } i = 1, 2$$

induce the *true* industry profit maximum $\max_{q_1, q_2} \sum_i \rho_i(q_i, q_{-i}) q_i - c(q_1 + q_2)$.

[5]This follows from our concavity assumption since the quantity q_i^C is the smallest

payments exceed the manufacturer's cost at all quantities).[6]

By construction, if M chooses $\hat{T}_1^C$ and $\hat{T}_2^C$, there exists a continuation equilibrium yielding the profit-maximizing outcome: each R_i, anticipating $q_{-i} = q_{-i}^*$, finds it optimal to choose q_i^* in the range $q_i > q_i^C$ where it faces the wholesale price w_i^*, is by construction indifferent between q_i^* and q_i^C, and prefers these quantities to any quantity $q_i < q_i^C$; it is thus willing to choose $q_i = q_i^*$. In this continuation equilibrium, each R_i obtains his contribution to industry profits (Δ_i), whereas M obtains Δ_M

solution to $\rho_i\left(q_i, q_{-i}^*\right) - cq_i = \Delta_i$, where

$$\begin{aligned}\Delta_i &= \Pi^* - \Pi_{-i}^m \\ &= \rho_i\left(q_i^*, q_{-i}^*\right) - cq_i^* + \rho_{-i}\left(q_{-i}^*, q_i^*\right) - cq_{-i}^* - \left[\rho_{-i}\left(q_{-i}^m, 0\right) - cq_{-i}^m\right] \\ &< \rho_i\left(q_i^*, q_{-i}^*\right) - cq_i^*,\end{aligned}$$

whereas q_i^E is the smallest solution to $\rho_i\left(q_i, 0\right) - cq_i = \Delta_i$, where

$$\Delta_i = \Pi^* - \Pi_{-i}^m < \Pi_i^m = \max_{q_i} \rho_i\left(q_i, 0\right) - cq_i.$$

[6]This fact derives from Assumption 1 for $\hat{T}_i^E$, which, since $w_i^m = c$, jumps by $\Delta_M > 0$ at q_i^E. For $\hat{T}_i^C$, the jump at q_i^C is equal to

$$J_i \equiv \left(w_i^* - c\right) q_i^C + F_i^C,$$

where F_i^C is chosen so that:

$$\rho_i\left(q_i^*, q_{-i}^*\right) - w_i^* q_i^* - F_i^C = \Delta_i = \rho_i\left(q_i^C, q_{-i}^*\right) - cq_i^C.$$

We thus have:

$$\begin{aligned}J_i &= \left(w_i^* - c\right) q_i^C + \rho_i\left(q_i^*, q_{-i}^*\right) - w_i^* q_i^* - \left[\rho_i\left(q_i^C, q_{-i}^*\right) - cq_i^C\right] \\ &= \rho_i\left(q_i^*, q_{-i}^*\right) - w_i^* q_i^* - \left[\rho_i\left(q_i^C, q_{-i}^*\right) - w_i^* q_i^C\right] \\ &= \max_{q_i}\left\{\rho_i\left(q_i, q_{-i}^*\right) - w_i^* q_i\right\} - \left[\rho_i\left(q_i^C, q_{-i}^*\right) - w_i^* q_i^C\right] > 0,\end{aligned}$$

where the last equality derives from the fact that (q_1^*, q_2^*) is a Nash equilibrium given wholesale prices (w_1^*, w_2^*) and the inequality stems from $q_i^C \neq q_i^*$ and strict concavity.

$(= \Pi^* - \Delta_1 - \Delta_2)$; the joint profit of M and each retailer R_i, $\Delta_i + \Delta_M$, thus equals Π_i^m.

If the retailers make the above-described offers, M cannot gain from accepting any other combination of options: M can obtain Δ_M by accepting only $\hat{T}_i^E$ since, anticipating being alone in the market, R_i is willing to buy q_i^m, which gives Δ_M to M and Δ_i to R_i. If instead M accepts only $\hat{T}_i^C$, then R_i can secure more than Δ_i (e.g., by choosing q_i^*), since it no longer faces competition, implying that M cannot obtain more than $\Pi_i^m - \Delta_i = \Delta_M$. If M instead accepts $\hat{T}_1^E$ and $\hat{T}_2^E$, then from strategic substitutability either each R_i chooses $q_i \leq q_i^E$ and M obtains zero profit, or one retailer chooses q_i^m while its rival chooses $q_{-i} = 0$, and M obtains again Δ_M. Finally, suppose that M accepts $\hat{T}_i^E$ and $\hat{T}_{-i}^C$. If R_{-i} is not active, then again R_i chooses q_i^m and M obtains Δ_M. If R_{-i} is active (i.e., $q_{-i} > 0$), then from strategic substitutability R_i chooses again $q_i \leq q_i^E$ and appropriates all the profit generated by its sales. Furthermore, if $q_i > q_i^*$ then R_{-i} chooses $q_{-i} \leq q_{-i}^C$ and M obtains zero profit; if instead $q_i \leq q_i^*$, then R_{-i} obtains at least Δ_i (e.g., by choosing q_{-i}^*) and thus, since its sales cannot generate more than Π_i^m, M cannot obtain more than $\Pi_i^m - \Delta_i = \Delta_M$.

Summing-up, if the retailers offer the above-mentioned options, there is a continuation equilibrium in which M chooses $\hat{T}_1^C$ and $\hat{T}_2^C$, and then the retailers implement the profit-maximizing outcome. We now check that no retailer has an incentive to deviate.

As before, a deviation by R_{-i}, say, can be profitable only if it increases the joint profit of M and R_{-i} above the equilibrium level, Π_{-i}^m, since M can always secure Δ_M by accepting $\hat{T}_i^E$ only. It follows that R_{-i} cannot benefit from deviating in a way that leads M to reject R_i's offers, since they cannot generate more than Π_{-i}^m in this way.

Consider now a deviation by R_{-i} that leads M to accept $\hat{T}_i^E$. Then, as above, either R_{-i} ends up selling nothing, in which case R_i can secure Δ_i (e.g., by choosing $q_i = q_i^m$) and thus the joint profit of M and R_{-i} cannot exceed $\Pi^* - \Delta_i = \Pi_{-i}^m$, or because R_{-i} sells a positive amount, R_i will buy less than q_i^E, in which case M supplies R_i at cost, and thus the joint profit of M and R_{-i} equals $\rho_{-i}(q_{-i}, q_i) - cq_{-i}$, which cannot exceed $\Pi_{-i}^m = \max_{q_{-i}}[\rho_{-i}(q_{-i}, 0) - cq_{-i}]$.

Finally, consider a deviation by R_{-i} that leads M to accept $\hat{T}_i^C$. If R_{-i} ends up selling more than q_{-i}^*, then R_i will buy – at cost – less than q_i^C; the joint profit of M and R_{-i} then again equals $[\rho_{-i}(q_{-i}, q_i) - cq_{-i}] \leq \Pi_{-i}^m$. If instead R_{-i} ends up selling less than q_{-i}^*, then R_i can secure Δ_i (e.g., by choosing $q_i = q_i^m$) and thus, again, the joint profit of M and R_{-i} cannot exceed $\Pi^* - \Delta_i = \Pi_{-i}^m$.

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