Exclusive quality

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March 13, 2007

Abstract

It is shown in this study that in the case of vertically differentiated products, Bertrand competition at the retail level does not prevent an incumbent upstream firm from using exclusivity contracts to deter the entry of a more efficient rival, contrary to what happens in the homogenous product case. Indeed, because of differentiation, the incumbent's inferior product is not eliminated upon entry. As a result, a retailer who considers rejecting the exclusivity clause expects to earn much less than the incumbent's monopoly rents. Thus, in equilibrium, the incumbent can always offer high enough an upfront payment to induce all retailers to sign on the contract.

KEYWORDS: vertical differentiation, contracts, exclusion, monopolization.
JEL CODES: L12, L42.

1 Introduction

Exclusivity clauses often govern commercial relationships between firms. Those clauses can take various forms. They can be one-sided, in the sense that only one party to a

*I am grateful to the Stockholm-based Knut and Alice Wallenberg Foundation for financial support. This paper is an amended version of Chapter 4 in my doctoral dissertation defended at the Stockholm School of Economics. It has benefited from helpful comments from Tore Ellingsen, Tim Howington, Chloé Le Coq, Stefan Napel, Per B. Overgaard, Lars Persson, Marcus Salomonsson, Jörgen Weibull, as well as conference participants at the XXII Jornadas de Economia Industrial (Barcelona, 2006) and seminar audiences at Maastricht University, Tilburg University, HEC Montréal. Any remaining error or shortcoming is mine only.

transaction commits not to deal with any other counterparty, or they can be reciprocal. For instance, organizers of popular sporting events often grant one television channel exclusive broadcasting rights, an instance in which a seller commits to sell to a single buyer. Conversely, many distribution systems are organized around exclusive franchising, an arrangement by which a given retailer commits to distribute the product(s) of a single manufacturer. Examples of reciprocal arrangements can be found in the advertising industry, where agencies often win a particular firm's *total* advertising budget under the agreement that they will not take the account of one of its rivals.

In this paper, the focus is on one-sided clauses that commit a retailer to buy from a single producer, arguably the ones that place the most restrictions on commerce. As for other kinds of vertical restraints, there is a lively debate about the likely consequences of such clauses on competition and the attention they should receive from antitrust authorities. Building on the existing literature, I construct a stylized model in which products are vertically differentiated and an incumbent monopolist has the possibility of offering exclusivity contracts to retailers before a potential entrant makes its decision about developing a superior product. I show that, contrary to what happens in the homogenous product case (see Fumagalli and Motta, 2006), intense competition at the retail level (in the form of Bertrand competition) helps the incumbent deter the entry of his rival. Indeed, whereas efficiency dictates that the incumbent firm be shut down, the exclusion of the potential entrant is the only equilibrium outcome when retailers can easily steal business from each other.

An important implication of this result is that competition authorities should not take pretext of intense retail competition to dismiss the claims that exclusivity contracts can threaten the competitive structure of an industry. In other words, no legal safe harbor based on the intensity of retail rivalry should be devised, for the nature of competition at the upstream level, in particular the existence of product differentiation, ought to be taken into account as well.

To be true, US courts and antitrust practitioners gave early credence to the possibility of foreclosing rivals through vertical integration or other vertical arrangements.[1] Yet, in the 1970s, some leading scholars mounted a critique of what constituted, in their eyes, the use of a logically-flawed theory. Posner (1976) and Bork (1978) gave particularly eloquent expositions of the argument which came to be associated with the "Chicago critique" of antitrust government activity. According to these authors, in order to induce a buyer to sign on an exclusivity contract, an incumbent firm should

[1] Two cases are often quoted in that respect. In the 1922 *United Shoe Machinery Corporation* case, the Supreme Court argued that certain features of the leases used by that manufacturer prevented shoe makers from leasing rival machines. In the 1951 *Lorain Journal* case, the only newspaper in Lorain, Ohio decided to refuse advertisements from firms that were simultaneously advertising on a radio station in nearby Elyria. The Court found those conducts illegal, being exclusionary and non-beneficial to consumers.

compensate this buyer for the full loss he suffers from not buying from a more efficient entrant.[2] If buyers are final consumers, this loss amounts to the difference between consumer surplus under entry and under monopoly. It comprises the monopoly rent and the usual deadweight loss. Hence, even by offering to give up the whole of its rent, a monopolist is not able to compensate consumers to the full extent. Therefore, deterring entry is not a feasible policy and exclusivity contracts, if observed, must be based on some other motivations, typically some efficiency considerations. As a consequence, competition authorities should not worry about their use.

The Chicago critique forced industrial economists into reconsidering their theories. In the past twenty years, a flurry of contributions addressed the possibility of vertical foreclosure or entry deterrence through the use of vertical arrangements. There is now a vast literature available on this topic.[3] Early on, researchers explored two different routes, one concerned with the possible anti-competitive effect of vertical *mergers* on *existing* rivals, the other one concerned with the deterrence of a *potential* rival's entry by an incumbent through the use of vertical arrangements, especially exclusivity *contracts*.

This paper takes the second route, the one leading to entry deterrence via exclusivity contracts.[4] The work on such contracts is associated with Rasmusen, Ramseyer and Wiley (1991) and Segal and Whinston (2000).[5] In their common set-up, a potential entrant needs to generate enough revenues in order to cover its entry cost, which requires to serve a minimum number of consumers. The existence of this minimum viable scale creates scope for entry deterrence, as one consumer's agreement to buy only from the incumbent exerts an externality on all the other consumers by making the entry of the more efficient rival more difficult. By exploiting this externality, the incumbent, who moves first by offering exclusivity contracts to consumers, is able to prevent entry. Indeed, if all consumers sign up, a unilateral deviation by one consumer will not prove sufficient to induce entry, so that this consumer has no incentive not to sign up as well.

Recently, Fumagalli and Motta (2006) have cast doubt on the validity of this line of reasoning by studying the case where the purchasers of the incumbent's product are retailers rather than final consumers, as previously assumed. They show that, in this case, even a small degree of competition between retailers is sufficient to disturb the incumbent's deterrence scheme. In effect, competition between retailers introduces an additional externality across them. A retailer's signing on an exclusivity contract

[2] There is no welfare loss if the potential entrant is less efficient than the incumbent (e.g. produces at a higher cost).

[3] An excellent discussion is found in Rey and Tirole (2006).

[4] The first route, vertical foreclosure by way of merging, now comprises numerous bifurcations but two popular destinations are associated with the pioneering contributions of Ordover, Saloner and Salop (1990) and Hart and Tirole (1990).

[5] See also the early contribution of Aghion and Bolton (1987). In their model, contracts may be breached provided compensation is paid. Exclusivity contracts constitute a barrier to entry but entry may occur in equilibrium.

indeed gives the other retailers an additional incentive to market the entrant's product, as they will face less competition in selling it. As a result, first, every retailer becomes pivotal because the demand from only one of them proves sufficient to make entry profitable. Second, a retailer anticipates big profits when unilaterally deviating from the incumbent's exclusivity scheme, which obliges the latter to pay high compensations. The combination of both facts makes the deterrence scheme prohibitively costly to the incumbent.

So far, the discussion has been conducted under the hypothesis that the upstream firms produce a homogenous product.[6] I show in the present study that, when the two upstream firms sell vertically differentiated products, the main result in Fumagalli and Motta (2006) is reversed: intense retail competition helps the incumbent preempt the entry of its rival (in that it does not have to rely on a coordination failure on the part of buyers, as in the absence of retail competition).[7] Indeed, upon entry, because of differentiation, the incumbent's inferior product is *not* eliminated from the market. This has two consequences that sharply contrast with the homogenous-product case. First, the potential entrant cannot capture all the efficiency gains associated with the introduction of its superior product. Second, in the situation where one retailer has signed on the exclusivity clause, the incumbent's survival is not at stake. Both facts decrease the cost of the deterrence scheme to the incumbent, to the point where it becomes implementable with simultaneous, identical exclusivity offers.

Crucially, my result extends to the case where upstream firms are allowed to use two-part tariffs, a feature I think any theory of entry deterrence should possess, as contractual relationships between firms typically specify non-linear price schedules. It is also in that case that the exclusion mechanism can be the most clearly observed. All that matters for exclusion is that the reservation payment demanded by a retailer for signing on the contract be low. That reservation payment is given by the profit made by a retailer in the subgame where all retailers but he have signed up. In turn, that is determined by the decrease in the incumbent's profit in this subgame. If there is harsh retail competition, the incumbent continues reaching a good fraction of final consumers through contract-bound retailers and so does not need to make the "free" retailer an

[6] To our knowledge, the only prominent article discussing vertical foreclosure in the case of differentiated upstream goods is Ma (1997). Yet, the author assumes a particular downstream structure since the retailers sell so-called option contracts to the final consumers, who, for a fixed fee, purchase the possibility to buy one of the two goods (of their choice) at pre-specified prices at some time in the future. Stenneck (2006) looks at the role of quality in exclusive distribution agreements but his focus is not on foreclosure. Indeed, there is a single upstream firm in his bargaining model. Fumagalli and Motta (2002) use a (horizontal) differentiation parameter as a proxy for the intensity of competition at the *downstream* level.

[7] Fumagalli and Motta (2006) noted the possibility for intense downstream competition to facilitate exclusion if it had the feature of squeezing a retailer' profit when deviating from a candidate exclusion equilibrium. They stated however that "in most circumstances strong enough downstream competition makes it profitable to reject the exclusive contract."

attractive offer. As a result, the entrant cannot help with using a pricing scheme that leaves the latter with little profit. Thus, in equilibrium, the incumbent is always able to convince all retailers to sign up by making a suitable upfront payment. In contrast, if there is little competition, the incumbent is at risk of having its product discontinued by the free retailer and so of being shut out of a good part of the market. He is then compelled to offer the "free" retailer attractive financial terms. On that ground, though, the entrant, whose superior product generates more revenues, can match any offer, allowing for entry equilibria. Therefore, in the case of differentiated products, retail competition, by creating the expectation of low post-entry profits for a retailer tempted not to sign on the exclusivity contract, is responsible for exclusion.

The rest of this paper is organized as follows. Section 2 describes the game. Section 3 is devoted to the linear-pricing case. In turn, I study the situation when the two products are sold by independent retail monopolists and when there is Bertrand competition at the retail level. Section 4 is concerned with the case where producers are allowed to use two-part tariffs. Section 5 offers a discussion of the results. Technicalities are relegated to two appendices at the end of the paper.

2 Model

In this paper, I consider four variations of a basic game, depending on whether upstream firms use linear or two-part tariffs and whether downstream firms compete with each other in prices or do not compete at all.

I look at an industry in which products are vertically differentiated. The industry is characterized by the presence of two downstream firms (retailers), labelled 1 and 2, and two upstream firms (producers), I (for incumbent) and E (for entrant). The incumbent upstream firm, I, produces a good of quality q_I at constant unit cost c_I and sells it to retailer j at unit price w_I^j (along with a fixed fee ϕ_I^j in the two-part tariff variation) for $j = 1, 2$. The rival in the upstream segment, E, has the option of entering the market and selling its product of quality $q_E \geq q_I$ to retailers for a price w_E (along with a fixed fee ϕ_E in the two-part tariff variation). Doing so would entail the expense of a fixed and unrecoverable amount $F > 0$, as well as per-unit production costs equal to c_E. Choosing not to enter the market would bring E zero profit.

The two upstream firms cannot sell their products directly to final consumers. For simplicity, the retailers are assumed to buy and resell the goods at no cost. In turn, I examine two polar structures for the downstream segment. In the first variation, the retailers are local monopolists, each serving (a random) half of the population of consumers. In the second variation, the retailers compete *à la Bertrand* for the entire population of consumers. The level of F is assumed to be such that E needs to sell to both local monopolists in order to find it profitable to enter. This assumption will be made precise for the linear-pricing and two-part-tariff variations in equations (A1) and

(A2) below, respectively.[8]

There is a unit mass of consumers indexed by θ and uniformly distributed over $[0,1]$. Consumers value the first unit consumed only. A consumer θ who buys one unit of quality q_i at price p_i derives utility

$$U(q_i, p_i; \theta) = \theta q_i - p_i. \tag{1}$$

The utility from not consuming the good is set to zero. Observe that the type θ of a consumer stands for his willingness to pay for quality at the margin.

Players are engaged in an extensive-form game of complete information that allows the incumbent to offer retailers exclusivity contracts before the potential entrant can make its decision. An exclusivity contract commits the retailer to purchase only from the incumbent but does not constrain the latter's behavior.[9]

The timing of the game is as follows. At time t_0, I offers retailers identical exclusivity contracts in exchange for his payment of a sum $y \geq 0$, and retailers simultaneously decide to accept or not.[10]

At time t_1, the actions previously taken are observed by all players. The distinctive feature of the history of play at this stage is the number S of retailers who have signed on an exclusivity contract, where S can take the values 0, 1, or 2. E then decides on entry.

At time t_2, the action taken by E is observed by all players. In addition to S, a distinctive feature of the history of play at that stage is the number N of upstream firms that are active on the market, where N can take the values 1 or 2. Active firms simultaneously name their price (or, in the two-part tariff variation, their price schedule). I is allowed to discriminate between the two retailers only in the case when one has signed an exclusivity contract and the other has not. Thus, only in subgames where $S = 1$ can we have $w_I^1 \neq w_I^2$ (or $\phi_I^1 \neq \phi_I^2$ in the two-part tariff variation). E can only sell her product to those retailers who have not signed an exclusivity contract with I (that is, exclusivity contracts are perfectly enforced) and is constrained to charge the same price w_E to them.

At time t_3, the retailers simultaneously choose the product(s) they offer for sale and name their prices. In the local-monopolist variation, the retailers do so independently on each other. In the Bertrand variation, the retailers compete in prices for final

[8] The problem is interesting only if the fixed cost lies in some intermediate range. If the barriers to entry are too low, then exclusion is never achievable; if they are too high, then entry is never profitable.

[9] That is, exclusivity goes one-way only and I is free to continue selling its product to the other retailer.

[10] Rasmusen, Ramseyer and Wiley (1991), Segal and Whinston (2000), and Fumagalli and Motta (2006) study variations of the game where the incumbent is allowed to make retailers simultaneous yet different offers, or sequential offers. In those papers, the case of simultaneous, identical offers is the less favorable to exclusion. I focus on it so as to set as hard a task as possible for the incumbent. Results extend to the cases of discriminatory or sequential offers.

consumers. They are committed to serve the demand adressed to them at the posted prices, and to order the corresponding inputs. In case both retailers charge the same price for the same product, I assume that all consumers patronize the firm with the strictly lower marginal cost. If the retailers face the same marginal input cost, then a fair coin toss determines which one all consumers buy from.[11]

For each variant of the model, I look for the subgame-perfect Nash equilibria.

Observe that the model is as close as possible to the one studied by Fumagalli and Motta (2006). Indeed, with our notation, their model obtains when $q_I = q_E = 1$ and $c_I > c_E = 0$.[12] Because products are homogenous in their specification, efficiency dictates that firm I, which is cost-inefficient, be shut down (provided E's fixed cost is not too large). In order to replicate that necessary feature in the simplest differentiated-product setting, I further restrict attention to the case where $c_I = c_E = 0$ and $q_E > q_I > 0$. In this configuration, E's product is unambiguously superior to I's product: if both products were offered at their true resource cost, all consumers would choose to buy q_E and firm I would shut down.[13]

Notice that if there were no retailers and the two producers were allowed to compete in prices for the *direct* patronage of final consumers, the game would correspond to what I will refer to as the "standard model of vertical differentiation."[14] As it will be used repeatedly in what follows, I describe it in Appendix A for reference.

[11] These assumptions are made to avoid the non-existence of a pure-strategy Bertrand equilibrium in the retailing subgame. It is well-known that if prices were chosen on a finite grid, as is realistic, the outcome in the case when the two firms have different marginal costs would be similar to the one assumed here.

[12] There is one modification: in their model, retailers incur a fixed cost for being active and have to make a separate decision about entry. This has the advantage of eliminating equilibrium multiplicity in some instances but is not innocuous in their model, as they discuss in Section III of their article. In particular, it gives a retailer buying from the efficient producer the possibility to charge the monopoly price by ruling out the presence of a firm making no sales but driving prices down. This assumption would not play a role in our model where such a situation never arises.

[13] When price is set at marginal cost (here, zero), the rise in consumer surplus from the introduction of E's product is given by $(q_E - q_I)/2$. As long as F is below that level, E's product should be introduced by a social planner seeking to maximize total surplus. This will always be true under the different assumptions (A1 and A2) which we later make about the size of the sunk cost.

[14] This model was introduced by Gabzsewicz and Thisse (1979) and Shaked and Sutton (1982). It was popularized by Tirole (1988) who specified simple preferences à la Mussa and Rosen (1978). It was used in the specific form under which it appears in the present study by Ronnen (1991) and solved in a slightly more general form by Wauthy (1996). Most of those articles study the choice of qualities by producers. Keep in mind that in our model qualities are exogenously given.

3 Linear pricing

Suppose that the upstream firms choose a unit price for their product. I first look at the benchmark case when the market is divided in two separate submarkets, each served by one retailer, so that there is no strategic interaction between 1 and 2. I then consider the game where both retailers compete in the entire market. As indicated in Section 2, I make the assumption that in the first case, serving only one local market is not sufficient for E to cover its entry cost, F, while serving both markets is. In the present context, that assumption amounts to

$$\frac{1}{4}\left(\frac{2q_E}{4q_E - q_I}\right)^2 (q_E - q_I) < F < \frac{1}{2}\left(\frac{2q_E}{4q_E - q_I}\right)^2 (q_E - q_I). \tag{A1}$$

I show that whereas coordination problems lead to the co-existence of both exclusion and non-exclusion equilibria in the case of independent monopolists, exclusion is always achieved (at no cost) when retailers compete.

3.1 No competition in the downstream market

Suppose first that 1 and 2 are local retail monopolists in two separate submarkets, each serving (a randomly drawn) half of the population of consumers. I solve the game by backward induction. Proposition 2 establishes the co-existence of both exclusion and non-exclusion equilibria.

3.1.1 Retailer's choice

At time t_3, a retailer's problem depends on its contractual obligations. Given the input prices, w_I and w_E, a retailer who has signed on the exclusivity clause (a "bound" retailer) will charge the monopoly price $(q_I + w_I)/2$ for the only good it is allowed to market. A retailer who has not signed on the exclusivity clause (a "free" retailer) can choose to sell either product or both (or none) of them. In the following proposition, we characterize its product selection choice. It happens to be efficient, given the input costs. That is, a "free" monopolist will make the same product selection choice as the one a central planner would make if w_I and w_E were the true resource costs. This is intuitive: the monopolist wants to extract as much surplus as possible from consumers and so has an incentive to introduce the efficient product mix in order to raise their willingness to pay. However, unlike a benevolent social planner, the monopolist will charge the monopoly prices $(q_i + w_i)/2$ in all configurations.[15]

[15] For the sake of expositional convenience, we abstract in the following proposition from the possibility that w_I or w_E is so high that the retailer cannot make a profit by selling the corresponding product. In addition, every time an inequality is weak, the retailer is indifferent between different courses of action; we always resolve the uncertainty in favor of the entrant's product.

Proposition 1 *If* $\frac{w_E}{q_E} \leq \frac{w_I}{q_I}$*, then a "free" retail monopolist sells only E's product. If* $\frac{w_E}{q_E} > \frac{w_I}{q_I}$*, then as long as* $q_E - w_E \geq q_I - w_I$ *it markets both products. When the inequality is reversed, it sells only I's product. In all configurations, it charges the monopoly price* $(q_i + w_i)/2$ *for the good(s) it markets.*

Proof. See Appendix B. ■

3.1.2 Upstream competition

At time t_2, if E has decided not to enter (or has decided to enter in spite of both retailers signing on the exclusivity clause), then I is *de facto* a monopolist in the upstream segment. He will charge the monopoly price and each retailer will mark this price up in a classical instance of double marginalization.

Suppose now that E has decided to enter and that a least one retailer has not signed on the exclusivity contract. Given the "free" retail monopolist's optimal policy, what prices will the upstream firms charge him? Clearly, under linear pricing, it is not possible for E to exclude I by means of limit-pricing in equilibrium. According to the previous proposition, that would require $\frac{w_E}{q_E} \leq \frac{w_I}{q_I}$, and since I's marginal cost is zero, either $w_E > 0$ and I could cut its price sufficiently to reverse the inequality, or $w_E = w_I = 0$ and E could increase profit by marginally raising its price. Therefore, in equilibrium, both products must be sold by the "free" retailer.

The upstream firms thus anticipate that they play a game analogous to the standard model of vertical differentiation, with the difference that, because of double marginalization (and the linearity of demand), they end up selling only half the quantities that would have been demanded by final consumers, had those been directly charged the input prices. Because the payoff functions are only rescaled, the game has the same equilibrium as the standard model: firm E, whose product is of superior quality, charges a higher price than firm I and captures most of the market.

3.1.3 Contracting

At time t_0, given our assumption about the size of F, the crucial issue is the possibility for I to induce *one* retailer to sign on an exclusivity contract. Yet, the incumbent is here constrained to make identical offers to *both* retailers. By symmetry, the question hence becomes whether on a given submarket the increase in I's profit brought about by the suppression of the competition from E can compensate for the decrease in the retailer' profits. Under the maintained hypothesis that E enters the market, the answer is no, as argued by the proponents of the Chicago critique. Indeed, because I is unable to extract all the surplus from consumers, his monopoly rents are smaller than the decrease in the retailer's profits following the disappearance of E's product. (In a sense, the argument is even compounded by product differentiation because, in addition to the usual price increase, top consumers now get the "wrong" product under I's monopoly, which considerably decreases their willingness to pay.)

Thus, if retailer j is convinced that E will enter, there is no compensation y that I can rationally offer to induce him to accept the exclusivity contract. As a consequence, a strategy profile in which no retailer signs on and E enters can be an equilibrium.

On the other hand, we have assumed with (A1) that serving only one local market was not sufficient for E to cover its fixed cost, F, unlike serving both. Therefore, if retailer j anticipates the other retailer to sign on, he has no reason not to accept the contract as well, as not doing so would not induce E to enter anyway.

So, two types of equilibria co-exist: equilibria in which neither retailer signs up, and equilibria in which both retailers sign up. I is able to exclude E only by taking advantage of a coordination failure between the two retailers. The logic is identical to the one in Proposition 1 in Segal and Whinston (2000).

Proposition 2 *In the case where the retailers are local monopolists, each serving half of the population of consumers, and upstream firms are constrained to use linear price schedules, there exist both "exclusion equilibria" and "non-exclusion equilibria".*

Proof. See Appendix B. ■

3.2 Bertrand competition in the downstream market

Suppose now that 1 and 2 compete in prices *à la Bertrand* in the entire market. Absent any exclusivity arrangement, the competition between retailers will force them to charge the price they pay for their inputs. Each will serve half of the demand for each product and make zero profit. At the upstream level, the game played by the producers is thus identical to standard model of vertical differentiation, since double marginalization does no longer occur.

In order to assess the possibility of exclusion, we have to determine the outcome of the pricing subgame where, say, 1 alone has signed the exclusivity contract and 2 is the only potential seller of E's product (since this outcome determines the reservation compensation demanded by a given retailer, here, 2, to sign on the contract). The situation is now asymmetric, for I, who has access to both retailers, can set the price that will be charged to final consumers (any mark-up being eliminated through the price rivalry between 1 and 2), whereas E's input price will be marked up by his single retailer. As a consequence, E's sales are diminished. It is the case that they are diminished to such an extent that E cannot cover its entry cost under assumption (A1). Hence, E will not enter unless neither retailer signs up. However, this cannot happen, as I is always able to bribe retailers into signing up, given that they anticipate to make zero profit following entry.

We are now in the position to assert our central result: I is able to exclude *at no cost.*

Proposition 3 *In the case when retailers compete à la Bertrand, and upstream firms are constrained to use linear price schedules, there are only equilibria in which I excludes E at no cost.*

Proof. See Appendix B. ■

The equilibrium path can be described as follows: I offers both retailers to sign up for zero compensation; at least one of them does (out of indifference); E decides against entry; I then charges the monopoly price that is passed onto final consumers. This result is particularly striking because exclusion is the only outcome in the setting that is the less favorable to the incumbent's deterrence scheme according to the previous literature: the case of simultaneous and non-discriminatory offers. Moreover, exclusion is achieved at no cost to the incumbent.

This outcome is a consequence of the differentiated nature of the industry. In Fumagalli and Motta (2006), a retailer deviating from an exclusion candidate equilibrium chooses to market only the entrant's product while the other, "bound" retailer is contractually obliged to market only the incumbent's. The situation is symmetric in the sense that each upstream firm competes in the final market through one of the two retailers. The deviator then captures the entire market (because it buys from a cheaper source), which is sufficient for the entrant to cover its fixed cost. In our model, it is not in a unilateral deviator's interests to refrain from selling I's product. Indeed, the "bound" retailer will market it anyway. In a classical instance of Bertrand undercutting, the "free" retailer can always increase profit by selling I' s product himself at the same price as its rival's or slightly below, without cannibalizing its sales of E's superior product. Therefore, the incumbent continues reaching final consumers through both retailers. This introduces an asymmetry in the game that has negative consequences on E's sales.

4 Two-part tariffs

Suppose now that producers are allowed to use tariffs specifying a proportional part (with coefficient w_i) along with a fixed fee, $\phi_i \geq 0$.[16] Throughout this section we continue to make the assumption that in the local monopolists case, E would have to sell to both retailers in order to recoup its development costs. In the present context, where double marginalization is no longer an issue, that amounts to assuming that

$$\frac{q_E - q_I}{8} < F < \frac{q_E - q_I}{4}. \tag{A2}$$

[16] The fee is incurred only in case a strictly positive quantity is ordered.

I show that in the case where the market is divided between two local monopolists, there are some equilibrium outcomes where only E's product is distributed, and some other where only I's product is. By contrast, the exclusion of E is the only outcome in the case of Bertrand competition between retailers.

4.1 Local monopolists

I first consider the benchmark case where consumers are served by two local retail monopolists. Producers have an incentive to set their price at marginal cost so as to avoid the double-marginalization problem, and use the fixed fee to extract as much as they can of the retailer's profit. In this situation, abstracting from the level of the fixed fees, a retailer would never choose to sell I's product, in accordance with Proposition 1: if both products cost the same, it is better to go for the superior one, which raises consumers' willingness to pay.

I is willing to pay as much as the whole of its monopoly rents on the local market in order to maintain its monopoly and induce the retailer to reject E's offer. Yet, E, whose product generates more revenue than the incumbent's, can profitably match this offer by decreasing its fixed fee. As a result, under the expectation that E will enter the market, I cannot promise retailers enough money to induce them to sign on the exclusivity contract. So there are equilibria in which neither retailer signs on the contract and E's product is the only one sold. This outcome makes clear that as soon as the efficient entrant is allowed to take part in the "bidding for the right to exclude" (something made possible here by the existence of the fixed fee), it can only win.

Yet, our assumption regarding the size of the fixed cost (A2) allows for a coordination failure among retailers, leading to exclusion. Indeed, neither retailer feels pivotal if he expects the other one to sign up, in which case there is no point in refusing to sign up as well So, there is another equilibrium outcome in which E's entry is deterred.

Proposition 4 *In the case where the retailers are local monopolists, each serving half of the population of consumers, and upstream firms offer two-part tariffs, there exist both "exclusion equilibria" and "entry equilibria".*

Proof. See Appendix B. ■

As in the linear-pricing case, exclusion occurs only because of a coordination failure between retailers. Observe that in the "entry equilibria" the active (but ultimately unsuccessful) presence of the incumbent after entry is needed in order for E not to engage into some opportunistic behavior that would leave the retailers with little or even zero profit. As a matter of fact, retailers are left with the equivalent of I's monopoly rents. As has been noted by previous authors, if the incumbent could instead commit to withdraw upon entry (or more generally could commit to policies that are contingent on E's presence or absence), exclusion would be the unique outcome.

4.2 Bertrand competition

When the retailers compete for the entire population of consumers, they cannot play one producer against the other to the same extent as in the previous "entry equilibria". Indeed, consider the subgame following the acceptance of the contract by retailer 1 only and E's entry. The situation is inherently unstable; as a matter of fact, there does not exist any Nash equilibrium in pure strategies. The reason is that I can always choose to distribute its product through the "bound" retailer (disregarding the other one), so that he is always guaranteed the profit he would make in the standard model. As a consequence, the outcome where both producers "bid" for the right to sell through retailer 2 (by decreasing their fixed fee), a race that can only be lost by I, whose product generates less revenues, cannot be an equilibrium here. Yet, the configuration in which each producer sells its product through one retailer and cashes the standard model profits cannot be an equilibrium either. Indeed, the temptation for I to bribe 2 into distributing its product instead of E's is always present: if I chose to distribute its product through the "bound" retailer" only, then E would choose to extract all the profit from the "free" retailer, and I could then profitably deviate by offering the latter any strictly positive share of its monopoly rents.

There exists a mixed-strategy equilibrium, which can be informally described as follows. With respective probabilities α and β, I and E play in a way that reproduces the outcome of the standard model of vertical differentiation. That is, I sells its product to 1 at zero marginal cost (and makes a prohibitive offer to 2), while E sells its product to 2 at zero marginal cost. Both charge a fixed fee equal to their respective standard duopoly profit and repatriate all the producer surplus at their level. With probability $1 - \alpha$, I decides to make a random bid to establish 2 as a retail monopolist marketing only q_I. With probability $1 - \beta$, E makes a random counter-offer to have 2 sell only q_E. In equilibrium, I is held down to his minimal payoff (the standard duopoly profit). Importantly, 2 is left with less than I's monopoly rents in expectation.[17]

This is strikingly different from the case of homogenous products. In that case, in the subgame following the acceptance of the contract by 1 and E's entry, I has no choice but to enter into a bidding war for the access to the "free" retailer's services. Indeed, if the latter chooses to sell E's product, then E captures the entire market. It is therefore a matter of survival for I to try to induce 2 not to carry q_E by leaving him as much profit as possible. In equilibrium, I promises 2 the whole of its monopoly rents (by

[17] We fully charaterize the cumulative distribution functions used by the producers in the proof of Proposition 5. This mixed-strategy equilibrium is not unique. Indeed, there is a whole continuum of mixed-strategy profiles leading to the same outcome. We do believe, although we do not prove, that this outcome is unique. In any case, it is the most favorable to the entrant because it is the one in which I is held down to its minmax payoff, which means that its "willingness to bribe 2" and induce him to reject the offer by E is maximal. That, in turn, ensures that a retailer's reservation payment for signing on the contract (and so the cost of the deterrence scheme) is maximal.

charging no fixed fee) but this offer is matched by E. Thus, a retailer deviating from an exclusion equilibrium candidate by refusing the exclusivity clause can always secure that amount. In these circumstances, there is no compensation that I can rationally promise so as to have 2 sign on the contract, as the former's willingness to pay is precisely equal to its monopoly rents. Therefore, exclusion is not feasible.

In contrast, in the case of differentiated products, 2 receives much less than the monopoly rents, if only because some of the time producers manage to reproduce the outcome of the standard duopoly model and extract all the retailers' profits. It is thus clear that I could exclude E if it were allowed to make discriminatory or sequential offers to the retailers (for such offers constrain the incumbent to pay a positive compensation to at most one of the two retailers). I show that, even when I is constrained to make simultaneous, identical offers, he can compensate both retailers sufficiently to have them sign on the contract.

We therefore have the following proposition.

Proposition 5 *In the case where the retailers compete à la Bertrand, and upstream firms offer two-part tariffs, I excludes E in equilibrium.*

Proof. See Appendix B. ■

So, exclusion is not driven by the double marginalization problem that arises when a product is sold through two successive price-setters. That problem was responsible for the fact that I could exclude at not cost in the linear-tariff case, not for exclusion *per se*. Observe that if the potential entrant could compete with the incumbent at time t_0, or promise to extract less surplus upon entry, it could profitably enter the market. In truth, inefficient exclusion is generated by the entrant's inability to commit to share part of its profit, not by the nature of pricing. The incumbent's only advantage is that, through the exclusivity contracts, it can commit to rebate some profit to the downstream firms.

5 Discussion

I have shown in this paper that, when products are vertically differentiated, intense (i.e. Bertrand) downstream competition makes it easier for an incumbent producer to use long-term exclusivity contracts so as to prevent a clearly superior product from being introduced, as he does not have to rely on a coordination failure on the part of retailers (as in the absence of retail competition). Indeed, under linear pricing, if one retailer signs on the contract but the other doesn't, the demand addressed to the incumbent upon entry is reduced but continues to be positive, as products are differentiated. Yet, the situation is not symmetric as the incumbent, whose product continues to be marketed by both retailers, does not suffer from double marginalization. The incumbent thus captures a higher share of the market than otherwise. The entrant's diminished sales then prove insufficient to allow it to recover its development costs so that exclusion is achieved at no cost to the incumbent. Under non-linear pricing, the potential entrant finds it profitable to enter even if only one retailer has signed on. However, the "free" retailer cannot hope for the entrant to leave him with the equivalent of the incumbent's monopoly rents, because product differentiation dampens the "bidding war" between producers. As a result, the incumbent is able to bribe that retailer into signing on the exclusivity clause as well.

In the linear-pricing case, the phenomenon I describe is comparable to the vertical foreclosure argument in Ordover, Saloner and Salop (1990). However, the structure of the industry is reversed: in my model the retailing services constitute the essential input, whereas in their model the bottleneck is located upstream. An exclusivity contract in my model is akin to downstream integration coupled with a refusal to deal on the part of the bottleneck owner in their model. A subtle issue in Ordover, Saloner and Salop (1990) is that the foreclosing upstream firm often continues to serve the non-integrated retailer so as to weaken the market power exerted on the latter by the rival upstream firm, and prevent their merger. In my model, a contract-bound retailer is not allowed to continue marketing the entrant's product so that exclusion occurs without subtlety, so to speak. This does not affect the feasibility of exclusion, for the potential entrant does not take part in the initial contracting phase so that there is no counter-merger to prevent.

I now comment on the robustness and implications of my results, examining in turn (i) market structure, (ii) the nature of product differentiation and (iii) the nature of contractual arrangements, before drawing some (tentative) policy lessons.

(i) In my model, the general argument obviously relies on the fact that the downstream segment structure is fixed. If entry was easy at this level, either by upstream firms or independent retailers, exclusion would not be possible. Thus, it must be the case that there exist barriers to entry both at the production and the retail level.

The argument also relies on the fact that the incumbent's product continues to be sold after entry. This feature might not extend to those cases where vertical differentiation is very large and marginal costs are different from zero, as the seller of the high-quality product might engage in limit-pricing and price the incumbent out of the market in equilibrium. In those circumstances, the incumbent would have to fight for survival following entry and a deviating retailer would be able to extract the equivalent of the incumbent's rents from the entrant. As a result, Fumagalli and Motta (2006)'s argument woud be restored. Yet, limit-pricing is not sustainable when the products are sufficiently similar and the spirit of our results should be preserved as long as the quality differential is moderate in comparison to the cost differential. I stress that, within the frame of my model, exclusion obtains under Bertrand competition at the retail level for any level of product differentiation, however small.

Although I have only reported results about the polar cases of inexistent or Bertrand retail competition, it is intuitive that there is a level of downstream competition above which exclusion ceases to be dependent on miscoordination among retailers and becomes the unique equilibrium outcome. Indeed, retail market power allows a retailer to elicit a bidding war from the two producers for the right to reach his "captive" consumers, whereas retail competition facilitates the incumbent's survival. As a result, a deviating retailer's post-entry profit, its reservation payment for signing on the exclusivity clause, decreases with competition.

One could wonder what would happen in the plausible case where the potential entrant were allowed to offer the same product as the incumbent's (without incurring any development cost) alongside the superior product. It can be shown that exclusion of that latter product continues to be the only equilibrium outcome under Bertrand competition at the retail level whenever the entrant has the option of making a separate decision about product selection. In that case, it never wants to jeopardize its sales of the superior product by carrying the inferior one. As a result, when one retailer deviates from the exclusion scheme, the incumbent continues to be guaranteed the standard duopoly profit and the remainder of argument is unchanged. Exclusion disappears only if the entrant can commit in advance to the joint production of both qualities or if he cannot help with introducing the lower one upon entry.

(ii) My result concerns vertically differentiated products, but a version of it should carry over to the case of horizontal product differentiation. Indeed, the crux of the argument, that the expected profit of a retailer considering no to sign on the contract is smaller than the incumbent's monopoly rent, depends only on the incumbent's survival not being at stake following entry, a feature of any differentiated product oligopoly.

One reason for focusing on vertical differentiation is that the introduction of a higher quality by the entrant can be interpreted as the result of technical innovation. In that respect, my model have implications for technological change (and its repression). Indeed, in my setting, once a product that might be improved upon has been brought to the market, the first order of business for its producer is to engage into long-term exclusivity relationships with retailers. Indeed, this might prove sufficient to deter any rival innovator from investing into the development of a superior product (over the length of the contracts).

(iii) The model is concerned with explicit exclusivity clauses. Yet, in practice, exclusivity can be achieved not only by means of signing a contract explicitely written for that purpose but also by including clauses (e.g. high termination fees, quantity forcing, quantity rebates or loyalty rebates) that induce a signer to make decisions that give rise to the same outcome. This was recognized as early as in 1922 with the US Supreme Court case *United Shoe Machinery Corp*[18]. In the European Union, some prominent antitrust cases recently featured the exclusionary use of such clauses (see.

[18] United Shoe Machinery Corp. vs. U.S., 258 U.S. 451, 458 (1922).

especially, *Michelin II*[19], *British Airways*[20]).

Thus, the fact that downstream markets are highly competitive should not lead antitrust practitioners to dismiss claims that vertical restraints threaten the competitive structure of an industry; no safe harbor test can be based on the level of retail competition as it would lead to a worrying amount of false negatives in cases in which products are differentiated. In the end, my analysis can be viewed as dual to Fumagalli and Motta's (2006). In the case of homogenous products, they conclude that "controlling for other factors [...] it would be more likely to observe exclusive contracts in industries with highly differentiated products [at the downstream level] than in highly competitive downstream markets." I show that even in these instances where the downstream markets are highly competitive (because retailers are homogenous Bertand competitors), differentiation at the upstream level may restore the possibility to use long-term contracts to deter entry. Therefore, everything else being equal, the current theory suggests that scarce antitrust enforcement resources should be devoted to the monitoring of exclusivity contracts in industries where products are differentiated at the upstream *or* downstream level, because those are the instances in which retailers considering not to enter into the exclusivity arrangement can expect the smallest profit.

Yet, it is worth emphasizing that my model does not provide any reason for the existence of such contracts but the exclusion motive. Hence, this study should not be interpreted as indicating that long-term vertical arrangements are likely to arise from anti-competitive behavior in a vertically-differentiated environment. They might or they might not. Even if they do, the detrimental consequences might well be counterbalanced by some other (efficiency) considerations. In the end, a careful examination of the exact nature of competition in the industry is the only path to a proper assessment of these practices.

[19] European Commission decision COMP/E-2/36.041/PO — Michelin of 20 June 2001 (*OJEC*, L, 31/05/2002, 143/1-53).

[20] European Commission decision IV/D-2/34.780 — Virgin/British Airways of 14 July 1999 (*OJEC*, L, 4/02/2000, 30/1-24).

A The standard model of vertical product differentiation

I consider an industry in which two firms produce vertically differentiated products. For the sake of concreteness, the firms are labelled I and E but bear in mind that in the proofs given in Appendix B this model applies to the subgame where retailers compete with each other and are supplied at (zero) marginal cost. Firm i produces a good of quality q_i at zero cost, $i \in \{I, E\}$. We have that $q_E > q_I > 0$. (E is the high-quality producer.) The two firms compete *à la Bertrand* for the patronage of consumers. Without loss of generality, the strategy space of firm i is taken to be $[0, q_i]$.

There is a unit mass of consumers indexed by θ and uniformly distributed over $[0, 1]$. Consumers value the first unit consumed only. A consumer θ who buys one unit of quality q_i at price p_i derives utility

$$U(q_i, p_i; \theta) = \theta q_i - p_i. \tag{2}$$

The utility from not consuming the good is set to zero. Consumers make their purchase decision after observing the prices posted by the firms.

Given two prices p_E and p_I, we denote by the $\hat{\theta}$ the consumer who derives the same utility from purchasing quality q_E as from purchasing quality q_I:

$$\hat{\theta} = \frac{p_E - p_I}{q_E - q_I}. \tag{3}$$

We denote by $\tilde{\theta}_i$ the consumer who is indifferent between purchasing firm i's product and not consuming the good:

$$\tilde{\theta}_i = \frac{p_i}{q_i}. \tag{4}$$

It is easily shown that the model has a ranking property summarized by the equivalences below:

$$\begin{cases} \frac{p_E}{q_E} > \frac{p_I}{q_I} \Longleftrightarrow \hat{\theta} > \tilde{\theta}_E > \tilde{\theta}_I \\ \frac{p_E}{q_E} = \frac{p_I}{q_I} \Longleftrightarrow \hat{\theta} = \tilde{\theta}_E = \tilde{\theta}_I \\ \frac{p_E}{q_E} < \frac{p_I}{q_I} \Longleftrightarrow \hat{\theta} < \tilde{\theta}_E < \tilde{\theta}_I \end{cases}. \tag{5}$$

Thus, there is demand for product q_I if and only if its hedonic price is smaller than the hedonic price for q_E.

A.1 E's best-response

Consider firm E's situation first, given p_I. We introduce the price a for which $\hat{\theta} = \tilde{\theta}_E = \tilde{\theta}_I$:

$$a = p_I \frac{q_E}{q_I}. \tag{6}$$

If firm E prices below a, then it becomes a monopolist. The monopoly price is given by $q_E/2$. Thus, E's candidate best response on $[0,a]$, denoted BR_E^-, is $\min\left\{\frac{q_E}{2}, a\right\}$. Observe that

$$\frac{q_E}{2} \leq a \Longleftrightarrow p_I \geq \frac{q_I}{2}. \tag{7}$$

If firm E prices above a, then it faces competition from firm I. On the real line its program is strictly concave. The sufficient first-order condition gives

$$p_E = \frac{p_I + q_E - q_I}{2}. \tag{8}$$

Thus, E's candidate best response on $[a, q_E]$, denoted BR_E^+, is $\max\left\{\frac{p_I+q_E-q_I}{2}, a\right\}$. Observe that

$$\frac{p_I + q_E - q_I}{2} \geq a \Longleftrightarrow p_I \leq \frac{q_I\left(q_E - q_I\right)}{2q_E - q_I}. \tag{9}$$

This treshold is always smaller than the one above applying to BR_E^-.

Therefore, disregarding the bounds of the domain for p_I, firm E's best-response correspondence is given by

$$BR_E(p_I) = \begin{cases} \frac{p_I+q_E-q_I}{2} & \text{if } p_I < \frac{q_I(q_E-q_I)}{2q_E-q_I} \\ p_I\frac{q_E}{q_I} & \text{if } \frac{q_I(q_E-q_I)}{2q_E-q_I} \leq p_I < \frac{q_I}{2} \\ \frac{q_E}{2} & \text{if } p_I \geq \frac{q_I}{2} \end{cases}. \tag{10}$$

A.2 I's best-response

Consider now firm I's situation, given p_E. We introduce the price b for which $\hat{\theta} = 1$. That is,

$$b = p_E - \left(q_E - q_I\right). \tag{11}$$

If firm I prices below b, it becomes a monopolist. The monopoly price is given by $q_I/2$. Thus, I's candidate best response on $[0,b]$, denoted $BR_I^- = \min\left\{\frac{q_I}{2}, b\right\}$. (If p_E is sufficiently low, then b can turn negative. So, in all rigor, we should write $b = \max\left\{0, p_E - \left(q_E - q_I\right)\right\}$.) Observe that

$$\frac{q_I}{2} \leq b \Longleftrightarrow p_E \geq \frac{q_I}{2} + \left(q_E - q_I\right). \tag{12}$$

If firm I prices above b, then it faces competition from firm E. The necessary and sufficient first-order condition (for the unrestricted program) gives

$$p_I = \frac{q_I}{q_E}\frac{p_E}{2}. \tag{13}$$

Thus, I's candidate best response on $[b, q_I]$, denoted $BR_I^+ = \max\left\{\frac{q_I}{q_E}\frac{p_E}{2}, b\right\}$. Observe that

$$\frac{q_I}{q_E}\frac{p_E}{2} \geq b \Longleftrightarrow p_I \leq \frac{2q_E\left(q_E - q_I\right)}{2q_E - q_I}. \tag{14}$$

This treshold is always smaller than the one above applying to BR_2^-, for

$$\frac{q_I}{2} + \left(q_E - q_I\right) - \frac{2q_E\left(q_E - q_I\right)}{2q_E - q_I} = \frac{\left(q_I\right)^2}{2\left(2q_E - q_I\right)}. \tag{15}$$

Therefore, disregarding the bounds of the domain for p_E, firm I's best-response correspondence is given by

$$BR_I(p_E) = \begin{cases} \frac{q_I}{q_E}\frac{p_E}{2} & \text{if } p_E < \frac{2q_E(q_E - q_I)}{2q_E - q_I} \\ p_E - \left(q_E - q_I\right) & \text{if } \frac{2q_E(q_E-q_I)}{2q_E-q_I} \leq p_E < \frac{q_I}{2} + \left(q_E - q_I\right) \\ \frac{q_I}{2} & \text{if } p_E \geq \frac{q_I}{2} + \left(q_E - q_I\right) \end{cases}. \tag{16}$$

A.3 Nash equilibrium

It is now a matter of cheking that the two best-response graphes intersect only once, on their first segment. Therefore, there is a unique equilibrium. Solving for the intersection:

$$p_E^* = \frac{2q_E\left(q_E - q_I\right)}{4q_E - q_I}, \tag{17}$$

$$p_I^* = \frac{q_I\left(q_E - q_I\right)}{4q_E - q_I}. \tag{18}$$

The corresponding demands are given by

$$D_E^* = \frac{2q_E}{4q_E - q_I}, \tag{19}$$

$$D_I^* = \frac{q_E}{4q_E - q_I}. \tag{20}$$

B Proofs

To facilitate the exposition, in the following proofs, starred variables refer to equilibrium prices, quantities or profits of the standard model of vertical differentiation described in Appendix A.

B.1 Proof of Proposition 1

If $\frac{w_E}{q_E} \leq \frac{w_I}{q_I}$, then a "free" retail monopolist sells only E's product. If $\frac{w_E}{q_E} \geq \frac{w_I}{q_I}$, then as long as $q_E - w_E > q_I - w_I$ it markets both products. When the inequality is reversed, it sells only I's product. In all configurations, it charges the monopoly prices $(q_i + w_i)/2$ for the good(s) it markets.

Assume that the prices charged by I and E are smaller than the willingness to pay of the consumer with the highest valuation. That is, $w_i < q_i$ for $i = 1, 2$. We now consider the profitability of the different product mix options. Suppose firstly that local monopolist j markets only one of the two goods. We denote the last consumer willing to buy product q_i by $\tilde{\theta}_i$. Given the consumers' preferences, $\tilde{\theta}_i = p_i/q_i$. So,

$$\pi_j = \frac{1}{2}(p_i - w_i)(1 - \frac{p_i}{q_i}). \tag{21}$$

Maximizing π_j is a concave problem and the first-order condition gives

$$p_i = \frac{q_i + w_i}{2}. \tag{22}$$

At the optimum, the unit margin is $(q_i - w_i)/2$ and the profit is

$$\begin{aligned} \pi_j &= \frac{1}{2}\left(\frac{q_i - w_i}{2}\right)\left(\frac{q_i - w_i}{2q_i}\right) \\ &= \frac{1}{8}\frac{(q_i - w_i)^2}{q_i}. \end{aligned} \tag{23}$$

So marketing E's product only to I's product only is preferable if and only if

$$q_E - w_E \geq \sqrt{\frac{q_E}{q_I}}\left(q_I - w_I\right). \tag{24}$$

Suppose secondly that j sells positive quantities of both products. There is a consumer $\hat{\theta}$ who is indifferent between buying either product. The retailer seeks to maximize

$$\begin{aligned} \pi_j &= \frac{1}{2}\left[(p_E - w_E)\left(1 - \hat{\theta}\right) + (p_I - w_I)\left(\hat{\theta} - \tilde{\theta}_I\right)\right] \\ &= \frac{1}{2}\left[(p_E - w_E)\left(1 - \frac{p_E - p_I}{q_E - q_I}\right) + (p_I - w_I)\left(\frac{p_E - \frac{q_E}{q_I}p_I}{q_E - q_I}\right)\right]. \end{aligned} \tag{25}$$

The program is concave in both prices. Solving the system of first-order conditions gives:

$$p_E = \frac{q_E + w_E}{2}, \tag{26}$$

$$p_I = \frac{q_I + w_I}{2}, \tag{27}$$

the consumer who is indifferent between buying from either firm being located at

$$\hat{\theta} = \frac{1}{2} + \frac{1}{2}\frac{w_E - w_I}{q_E - q_I}. \tag{28}$$

This set of prices maximizes profit (under the constraint that both products are marketed) only if the so-called hedonic price for the high-quality product (i.e. the price per unit of quality) is higher than the hedonic price for the low-quality product. Otherwise, there is no demand for the latter. This condition is satisfied if and only if:

$$\frac{q_E + w_E}{2q_E} > \frac{q_I + w_I}{2q_I}, \tag{29}$$

which reduces to

$$\frac{w_E}{q_E} > \frac{w_I}{q_I}. \tag{30}$$

Suppose now that condition (30) is violated. There are two cases.

(i) $w_E \leq w_I$, in which case, $q_E - w_E > q_I - w_I$ (since $q_E > q_I$ by assumption) and $\frac{w_E}{q_E} < \frac{w_I}{q_I}$. In that case, both the unit margin and the volumes are higher when selling q_E.

(ii) $w_I < w_E \leq w_I \frac{q_E}{q_I}$, in which case we have that

$$\begin{aligned} q_E - w_E &\geq q_E \left(\frac{q_I - w_I}{q_I} \right) & (31) \\ &\geq \sqrt{\frac{q_E}{q_I}} \left(q_I - w_I \right), & (32) \end{aligned}$$

since $q_E/q_I > 1$ by assumption. Thus, selling q_E is preferable. We conclude that when inequality (30) is reversed, selling E's product only is then an optimal policy.

Suppose now that condition (30) holds. If j markets both products, then the prices are the same as when it sells only one of them. As a result, the mass of consumers served by the firm is the same as when it sells only I's product. Yet, it charges higher prices to the top consumers. "Cannibalization" does occur: a fraction $\hat{\theta} - \tilde{\theta}_E$ of consumers who would have bought the high-quality product at a high price if it were the only good available switch when presented with the low-quality alternative. If $q_E - w_E < q_I - w_I$, this is good news for the monopolist as these customers will generate higher profit margins but then, it would be preferable to have all consumers switch, and to drop E's product altogether. If $q_E - w_E \geq q_I - w_I$, then selling both products is at least as profitable as selling good q_I only. In order to know whether good q_I should be marketed at all, one has to compare the losses due to cannibalization to the gains arising from the additional mass of consumers $\tilde{\theta}_E - \tilde{\theta}_I$ purchasing the low-quality good. The gains generated by these extra consumers are given by

$$\left(\tilde{\theta}_E - \tilde{\theta}_I \right) (p_I - w_I) = \frac{1}{8} \left(\frac{w_E}{q_E} - \frac{w_I}{q_I} \right) (q_I - w_I). \tag{33}$$

The loss on those consumers who switch to the low-quality variant are given by

$$\begin{aligned}\left(\hat{\theta}-\tilde{\theta}_E\right)\left[(p_E-w_E)-(p_I-w_I)\right] &= \frac{1}{8}\left(\frac{w_E-w_I}{q_E-q_I}-\frac{w_E}{q_E}\right) \\ &\quad\cdot\left[(q_E-w_E)-(q_I-w_I)\right]. \qquad (34)\end{aligned}$$

The gains are greater than the losses if and only if

$$\left(\frac{w_E}{q_E}-\frac{w_I}{q_I}\right)(q_I-w_I) \geq \left(\frac{w_E-w_I}{q_E-q_I}-\frac{w_E}{q_E}\right)\left[(q_E-w_E)-(q_I-w_I)\right], \qquad (35)$$

or, equivalently, since by assumption (30) $w_I q_E - w_E q_I < 0$:

$$\frac{w_I}{q_I} \leq \frac{w_E}{q_E}, \qquad (36)$$

which is then always satisfied. So, when $q_E - w_E \geq q_I - w_I$, the gains from selling product q_I to some additional consumers always compensate for the losses incurred on those consumers who give up on product q_E. QED

B.2 Proof of Proposition 2

In the case where the retailers are local monopolists, each serving half of the population of consumers, and upstream firms are constrained to use linear price schedules, there exist both "exclusion equilibria" and "non-exclusion equilibria".

At time t_2, on a given submarket, either retailer j is "bound", or it is "free". Suppose it is "free". According to Proposition 1, in order for E to price I out, prices should be such that $\frac{w_E}{q_E} \leq \frac{w_I}{q_I}$. Either $w_E > 0$ and I could cut its price strictly below $\frac{q_I}{q_E}w_E$ and capture some of the demand, or $w_E = 0$ and E can profit from raising his price strictly above $\frac{q_E}{q_I}w_I$. Similarly, I cannot price E out. Therefore, in equilibrium, both products must be sold by j, who charges $(q_i + w_i)/2$ at time t_3. As a consequence,

$$\hat{\theta} = \frac{1}{2} + \frac{1}{2}\frac{w_E - w_I}{q_E - q_I} \qquad (37)$$

and

$$\tilde{\theta}_I = \frac{1}{2} + \frac{1}{2}\frac{w_I}{q_I}. \qquad (38)$$

Firm E hence seeks to maximize:

$$\begin{aligned}\pi_E &= \frac{1}{2}w_E\left(1-\frac{1}{2}-\frac{1}{2}\frac{w_E-w_I}{q_E-q_I}\right) \\ &= \frac{1}{4}w_E\left(1-\frac{w_E-w_I}{q_E-q_I}\right). \qquad (39)\end{aligned}$$

Meanwhile, firm I seeks to maximize:

$$\begin{aligned} \pi_I &= \frac{1}{2}w_I\left[\frac{1}{2}+\frac{1}{2}\frac{w_E-w_I}{q_E-q_I}-\left(\frac{1}{2}+\frac{1}{2}\frac{w_I}{q_I}\right)\right] \\ &= \frac{1}{4}w_E\left(\frac{w_E-w_I}{q_E-q_I}-\frac{w_I}{q_I}\right). \end{aligned} \tag{40}$$

That is, the game is analogous to the standard model of vertical differentiation, with the difference that, because of double marginalization, demand on this submarket is halved. From Appendix A, we know that there is a unique equilibrium with prices

$$w_E^* = \frac{2q_E\left(q_E-q_I\right)}{4q_E-q_I}, \tag{41}$$

$$w_I^* = \frac{q_I\left(q_E-q_I\right)}{4q_E-q_I}. \tag{42}$$

and with corresponding quantities:

$$D_E = \frac{1}{4}D_E^* = \frac{1}{2}\frac{q_E}{4q_E-q_I}, \tag{43}$$

$$D_I = \frac{1}{4}D_I^* = \frac{1}{4}\frac{q_E}{4q_E-q_I}, \tag{44}$$

where D_i stands for the demand addressed to producer $i \in \{E, I\}$.

Downstream equilibrium prices are given by $p_i = (w_i + q_i)/2$, i.e.

$$p_E = \frac{1}{2}\frac{q_E\left(6q_E-3q_I\right)}{4q_E-q_I} \tag{45}$$

$$p_I = \frac{1}{2}\frac{q_I\left(5q_E-2q_I\right)}{4q_E-q_I}. \tag{46}$$

The upstream firms' equilibrium profits are

$$\pi_E = \frac{1}{4}\left(\frac{2q_E}{4q_E-q_I}\right)^2\left(q_E-q_I\right) \tag{47}$$

$$\pi_I = \frac{1}{4}\frac{q_Eq_I}{\left(4q_E-q_I\right)^2}\left(q_E-q_I\right). \tag{48}$$

Retailer j's equilibrium profits are given by

$$\pi_j = \left[\left(\frac{q_E-w_E^*}{2}\right)D_E+\left(\frac{q_I-w_I^*}{2}\right)D_I\right], \tag{49}$$

or,

$$\pi_j = \frac{1}{8}\frac{(q_E)^2(4q_E+5q_I)}{(4q_E-q_I)^2}. \tag{50}$$

If retailer j is "bound", then I is a monopolist. It charges the monopoly price $q_I/2$, and 1/8 unit is sold. Hence, in this local market,

$$\pi_I = \frac{q_I}{8}, \tag{51}$$

and

$$\pi_j = \frac{q_I}{32}. \tag{52}$$

We now proceed to show that I cannot offer retailer j high enough a compensation to induce him to sign on the contract if E is anticipated to enter. (Since I is constrained to make identical offers, it is sufficient to focus on only one of the two local markets.)

On a given local market, the surge in I's profits occasioned by the disappearance of E is given by:

$$\begin{aligned}\Delta\pi_I &= \frac{q_I}{16} - \frac{4}{16}\frac{q_E q_I}{(4q_E-q_I)^2}(q_E-q_I) \\ &= \frac{q_I}{16}\frac{q_I^2-4q_Iq_E+12q_E^2}{(4q_E-q_I)^2}.\end{aligned} \tag{53}$$

The corresponding decrease in j's profits is given by:

$$\begin{aligned}\Delta\pi_j &= \frac{1}{8}\frac{(q_E)^2(4q_E+5q_I)}{(4q_E-q_I)^2} - \frac{q_I}{32} \\ &= \frac{1}{32}\frac{4(q_E)^2(4q_E+5q_I)-q_I(4q_E-q_I)^2}{(4q_E-q_I)^2}.\end{aligned} \tag{54}$$

A direct computation gives

$$\Delta\pi_I - \Delta\pi_j = \frac{4q_Iq_E-4(q_E)^2-3(q_I)^2}{32(4q_E-q_I)^2}, \tag{55}$$

which is negative, as $q_I < q_E$ by assumption.

Given assumption (A1) and the value for π_E^*, any equilibrium strategy profile must entail the following behavioral strategy for E at time t_1: enter if $S=0$; do not enter if $S=1$ or $S=2$.

We next show that there cannot be any equilibrium outcome involving $S=1$. Indeed, in that case, the "bound" retailer is pivotal, in the sense that his refusal to sign up would lead to E's entry. The maximum compensation that I can rationally offer is $y = \Delta\pi_I$. Since $\Delta\pi_I - \Delta\pi_j < 0$, it is not rational for the "bound" retailer to accept.

We now describe some strategy profiles constituting "entry equilibria": I offers any given compensation y in $[0, \Delta\pi_I]$; retailer j rejects the contract for any $y < \Delta\pi_j$, accepts if $y \geq \Delta\pi_j$, $j = 1, 2$; E enters if $S = 0$ and does not enter otherwise; from time t_2 on, all firms behave as in sections 3.1.1 and 3.1.2. I has no interest in deviating since no compensation y accepted by the retailers leads to an increase in profit. Each retailer's strategy is optimal given that the other retailer behaves symmetrically. In particular, E would not enter in case j alone accepted the contract.

We finally describe strategy profiles constituting "exclusion equilibria": I offers a compensation y_0 such that $0 \leq y_0 \leq \Delta\pi_I$; retailer j rejects the contract for any $y < y_0$, accepts if $y \geq y_0$, $j = 1, 2$; E enters if $S = 0$ and does not enter otherwise; from time t_2 on, all firms behave as in sections 3.1.1 and 3.1.2. Again, I has no interest in deviating since no lower y continues to trigger acceptance and a higher y would be wasted for no cause. Each retailer's strategy is optimal. When $y \geq y_0$, given that the other retailer accepts the offer, E would not enter in case j rejected the contract. So there is no reason to reject y_0. Moreover, it should not accept any $y < \Delta\pi_j$ when $y < y_0$ and he is pivotal. QED

B.3 Proof of Proposition 3

In the case when retailers compete à la Bertrand, and firms are constrained to use linear price schedules, there are only equilibria in which I excludes E at no cost.

In order to assess the possibility of exclusion, we have to determine the outcome of the pricing game when 1 alone has signed the exclusivity contract ($S = 1$) and 2 is the only potential seller of E's product. In principle, 2 then seeks to maximize

$$\pi_2 = (p_E - w_E)\left(1 - \frac{p_E - p_I}{q_E - q_I}\right) + (p_I^2 - w_I^2)\left(\frac{p_E - \frac{q_E}{q_I}p_I}{q_E - q_I}\right) \tag{56}$$

with respect to p_E and p_I^2 (as long as $p_I^2 < p_I^1$, else demand for product q_I vanishes).

Yet, p_I^2 is constrained by Bertrand competition between retailers, whose outcome is

$$p_I^1 = p_I^2 = \max\left\{w_I^1, w_I^2\right\} \equiv p_I. \tag{57}$$

It is then clear that at time t_2 I will decide to charge the same price to both retailers:

$$w_I^1 = w_I^2 \equiv w_I. \tag{58}$$

Doing otherwise would amount to leaving a fraction of the revenues generated by its product to the retailer being charged the lowest price. In turn, observe that it is not possible that 2 does not carry I's product at time t_3. If it were so, then 1 would sell it at a profit. Whatever the price it charges for E' s product, 2 could keep it at that level and sell I's product at 1's price, thereby leaving the sales of E's product unchanged and capturing half the sales of I's product.

Hence, retailers do not make any profit on I's product and the first-order condition for 2's program gives:

$$p_E = \frac{w_I + q_E - q_I + w_E}{2}. \tag{59}$$

Thus,

$$\hat{\theta} = \frac{1}{2} + \frac{1}{2}\frac{w_E - w_I}{q_E - q_I}. \tag{60}$$

By backwards induction, firm E seeks to maximize

$$\pi_E = \frac{1}{2} w_E \left(1 - \frac{w_E - w_I}{q_E - q_I}\right), \tag{61}$$

giving

$$w_E = \frac{w_I + q_E - q_I}{2}. \tag{62}$$

Observe that this is exactly the same response as in the local-monopolists case. By linearity of the demand curves, although the quantities are halved, the price decisions remain unchanged.

Hence, the equilibrium upstream prices are unchanged:

$$w_E^* = \frac{2q_E (q_E - q_I)}{4q_E - q_I}, \tag{63}$$

$$w_I^* = \frac{q_I (q_E - q_I)}{4q_E - q_I}. \tag{64}$$

At the downstream level, though, the outcome is different because I, who sells to both retailers, can in practice determine the final price while E suffers from double marginalization. Hence:

$$p_E = \frac{3q_E (q_E - q_I)}{4q_E - q_I}, \tag{65}$$

$$p_I = w_I^*. \tag{66}$$

As a result, firm I captures most of the market and we have:

$$D_E = \frac{1}{2}\frac{q_E}{4q_E - q_I} \tag{67}$$

$$D_I = \frac{q_E}{4q_E - q_I}. \tag{68}$$

So, E's equilibrium quantity is halved, as compared to the local-monopolists case, and so are its profits. Therefore, we have

$$\pi_E = \left(\frac{q_E}{4q_E - q_I}\right)^2 (q_E - q_I) < F, \tag{69}$$

the last inequality resulting from assumption (A1). Therefore, E will not enter unless neither retailer signs up.

Let us now show that the following profile of strategies is a subgame-perfect equilibrium:

a) I offers both firms exclusivity contracts in exchange of compensation $y = 0$; both firms accept;

b) E enters if and only if $S = 0$;

c) upstream firms price according to the following table, summarizing their behavior as a function of the number of active upstream firms, $N \in \{1, 2\}$ (where $N = 1$ stands for the case when E does not enter) and S:

N	S	w_I	w_E
1	0	$\frac{q_I}{2}$	n/a
1	1	$\frac{q_I}{2}$	n/a
1	2	$\frac{q_I}{2}$	n/a
2	0	$\frac{q_I(q_E-q_I)}{4q_E-q_I}$	$\frac{2q_E(q_E-q_I)}{4q_E-q_I}$
2	1	$\frac{q_I(q_E-q_I)}{4q_E-q_I}$	$\frac{2q_E(q_E-q_I)}{4q_E-q_I}$
2	2	$\frac{q_I}{2}$	n/a

;

d) in all cases but $S = 1$, and $N = 2$, both retailers charge their input prices; if $S = 1$ and $N = 2$, then $p_I^1 = p_I^2 = w_I^*$ and $p_E^2 = \frac{3}{2}\frac{q_E(2q_E-q_I)}{4q_E-q_I}$.

The computations above showed that the strategies in c) and d) are the equilibria in each of the corresponding subgames. We have shown that $\pi_E > F$ only when $S = 0$, so it is optimal for E to enter if and only if $S = 0$.

In a), neither retailer has an incentive to refuse to sign on for any $y \geq 0$, as a unilateral deviation would not trigger E's entry, anyway. For his part, I cannot get the retailers to sign on for cheaper.

Consider now the strategy profile where everything is as above, except that one retailer does not sign on. We show that it is also an equlbirium. The "free" retailer is indifferent between signing up or not. The retailer that has signed on is also indifferent as its deviation would trigger entry but would not affect its profit (zero in all cases).

We claim that no other strategy profile is a subgame-perfect equilibrium.

Consider first any strategy profile in which at least one of the retailers signs on and $y > 0$. Then I can decrease this amount and still induce acceptance, since the "bound" retailer expects to make zero profit in case he deviates and E enters.

Suppose now that there is an equilibrium in which both retailers decline to sign on for a compensation y. In the continuation equilibrium, E must enter since in the ensuing subgame it collects enough revenue to cover its sunk cost but retailers will make zero profit. If $y = 0$, then at time t_0, I can deviate and raise y, triggering acceptance of the contracts. If $y > 0$, then the original strategy profile was not an equilibrum, as retailers should have taken on the offer, given that they make zero profit following entry. QED

B.4 Proof of Proposition 4

In the case where the retailers are local monopolists, each serving half of the population of consumers, and upstream firms offer two-part tariffs, there exist both "exclusion equilibria" and "entry equilibria".

At time t_2, in any continuation equilibrium, active firms set w_i to zero in order to avoid double marginalization. On a local market that is open to competition, the sole comparison of sales on this basis would lead retailer j to market E's product only by Proposition 1(because w_I/q_I would then be equal to w_E/q_E). To avoid being priced out of the market, I is willing to bribe retailer j into carrying its product instead of E's. The best offer that I can make is to transfer the entire monopoly profit to the retailer: $q_I/8$. This is achieved by promising not to charge any fee. Yet, this offer can always be matched by firm E, whose product commands higher revenues on j's market: $q_E/8$. Thus, in a continuation equilibrium with $S \neq 2$, $w_I = 0$, $\phi_I = 0$, $w_E = 0$ and $\phi_E = (q_E - q_I)/8$. Only q_E is sold. (Should I make another, less favorable offer, then E would best-respond by increasing ϕ_E. In turn, the resulting strategy profile would not be an equilibrium as I could profitably deviate by decreasing its fixed and exclude E.) We have that on one open local market, $\pi_E = \phi_E$, so that by assumption (A2) E should enter the market at time t_1 if and only if $S = 0$.

There exist "exclusion equilibria", in which $S = 2$. If $S = 2$ and E does not enter, then in the continuation equilibria at time t_2, I extracts all the surplus by charging $\phi_I = q_I/8$ and $w_I = 0$ on both markets. Thus, the retailers make zero (operational) profit at that stage. They should be willing to accept any offer bringing more profit than y_0 (whatever that is). The maximum amount that I can rebate them is its monopoly rents: $q_I/8$. Retailer j anticipates that in case he refuses to sign on, E will not enter as the other local market is not open to competition, anyway. As a result, any strategy profile where I offers y_0 such that $0 \leq y_0 \leq q_I/8$, retailers accept the contract as long as $y \geq y_0$ but reject it otherwise, and E does not enter, is an equilibrium.

There also exist "entry equilibria" involving $S = 0$. Take any strategy profile where I offers y_0 such that $0 \leq y_0 \leq q_I/8$, retailers refuse the contract as long as $y_0 < q_I/8$ but reject it otherwise, and E enters. I sees no point in raising its offer because either it does not change the set of signers or it triggers acceptance but leads to a loss. Retailers choose not to sign because they are guaranteed $q_I/8$ following entry, which is at least as good as what I can offer. QED

B.5 Proof of Proposition 5

I*n the case where the retailers compete à la Bertrand, and upstream firms offer two-part tariffs, I excludes E in equilibrium.*

In the subgames following either $S = 2$ or E's decision not to enter, I charges $\phi_I = \frac{q_I}{8}$, $w_I = 0$. That is, I repatriates the monopoly profit at his level.

In the subgame where neither retailer signs on the incumbent's offer ($S = 0$) and E enters ($N = 2$), the outcome is the same as in the standard model of vertical differentiation. Indeed, at time t_3, retailers cannot refrain from carrying a given product (as long as the unit price, or the fixed fee, is not prohibitive). If an upstream firm's tariff does not comprise a fixed fee, both retailers charge the input price and make zero profit on that product. If the upstream firm charges a fixed fee, then the retailers face the same decreasing average-cost curve. If the fixed fee is strictly smaller than the maximum level of gross profits, then given our tie-breaking rule, there is a unique equilibrium in pure strategies in which both firms charge the lowest price compatible with zero profit and are randomly selected to serve the market. Unless the fixed fee equals the maximum level of gross profits, this outcome is dominated, from the producer's point of view, by the policy consisting in setting the fixed fee to zero and charging its optimal downstream price to both retailers. An upstream firm still faces the temptation of bribing retailers into stopping to carry their rival's product but in this symmetric Bertrand retail configuration, there is no way retailers can be left with some positive profit in equilibrium. As a result, it is not rational for E to price I out in equilibrium. (That would require setting $w_E = 0$.) So, the outcome of the standard vertical product differentiation model makes for the only equilibrium. The equilibrium involves

$$w_E^* = \frac{2q_E (q_E - q_I)}{4q_E - q_I}, \tag{70}$$

$$w_I^* = \frac{q_I (q_E - q_I)}{4q_E - q_I}, \tag{71}$$

and no fixed fees, leading to

$$D_E = D_E^* = \frac{2q_E}{4q_E - q_I}, \tag{72}$$

$$D_I = D_I^* = \frac{q_E}{4q_E - q_I}. \tag{73}$$

Upstream firms make the corresponding profits while downtream firms make zero profit.

E always finds its entry decision vindicated. Indeed, one has

$$\pi_E = \pi_E^* = \left(\frac{2q_E}{4q_E - q_I}\right)^2 (q_E - q_I) > \frac{q_E - q_I}{4}. \tag{74}$$

Consider now the subgame in which only 1 has signed on the exclusivity clause ($S = 1$) and E has entered ($N = 2$). There is no Nash equilibrium in pure strategies. The reason is that I can always choose to distribute its product through the "bound" retailer. As a consequence, I is always guaranteed the standard duopoly profit π_I^*. The equilibrium outcome of the standard duopoly model of vertical differentiation then makes for an obvious candidate. A corresponding strategy profile would be the one in which I chooses $\phi_I^1 = \pi_I^*$, $w_I^1 = 0$, any ϕ_I^2, $w_I^2 = q_I$, and E sets $\phi_E = \pi_E^*$, $w_E = 0$. Yet, this cannot be an equilibrium, for I can always succesfully bribe 2 into rejecting E's offer and sharing the monopoly rents. Indeed, a deviation is profitable for I if 2 prefers it to E's tariff and leaves I with more than the duopoly profit. The first condition translates into

$$\frac{q_I}{4} - \phi_I^2 > \frac{q_E}{4} - \pi_E^*, \tag{75}$$

while the second requires

$$\phi_I^2 > \pi_I^*. \tag{76}$$

Those two conditions can be simultaneously satisfied. Indeed,

$$\frac{q_I}{4} - \pi_I^* > \frac{q_E}{4} - \pi_E^* \Longleftrightarrow \frac{q_E}{4q_E - q_I} > \frac{1}{4}, \tag{77}$$

which is always true. The only way to sustain a duopolistic equilibrium in pure strategies would thus consist in guaranteeing that 2 is left with enough profit to be immune from such deviating offers from I. Yet, E is not willing to decrease ϕ_E if I does not make such an offer. In other words, it is not possible to construct an equilibrium in which I is guaranteed the duopoly profit and 2 is guaranteed at least $\frac{q_I}{4} - \pi_I^*$.

We now construct the mixed-strategy equilibrium we focus on, and derive the equilibrium payoffs used for backwards induction.

With probability α, I chooses $\phi_I^1 = \pi_I^*$, $w_I^1 = 0$, $\phi_I^2 = 0$, $w_I^2 = q_I$. We call this pure (behavioral) strategy A. With probability $1 - \alpha$, I sets $\phi_I^1 = 0$ $w_I^1 = q_I$, $w_I^2 = 0$, and chooses ϕ_I^2 according to a continuous cumulative distribution function Q with support $\left[\pi_I^*, \pi_E^* - \frac{q_E - q_I}{4}\right]$. Slightly abusing notation we call this mixed (behavioral) strategy Q.

With probability β, E chooses $\phi_E = \pi_E^*$, $w_E = 0$. We call this pure (behavioral) strategy B. With probability $1 - \beta$, E sets $w_E = 0$ and chooses ϕ_E according to a continuous cumulative distribution function R with support $\left[\pi_I^* + \frac{q_E - q_I}{4}, \pi_E^*\right]$. Slightly abusing notation we call this mixed (behavioral) strategy R.

The outcome of the competition between retailers at time t_3 is as follows:

- when A is played against B, 1 accepts I's offer; 2 accepts E's offer; the outcome is the same as in the standard model of vertical differentiation, in which retailers make zero profit;
- when A is played against R, 1 accepts I's offer; 2 accepts E's offer; the prices are the same in the standard duopoly equilibrium but retailer 2, who is charged a lower fee than previously, makes strictly positive profits;
- when Q is played against B, 1 prices itself out of the market (i.e. posts price $p_I^1 = q_I$ and does not make any sale); 2 accepts I's offer; it charges the monopoly price on q_I and enjoys profits greater than $\frac{q_E}{4} - \phi_I^2 \geq \frac{q_E}{4} - \pi_E^*$;
- when Q is played against R, 1 prices itself out of the market ; 2 compares the offers and selects the one leaving him with the highest profit; it then charges the monopoly price on whatever good it has chosen to sell and enjoys strictly positive profits.

Obviously, playing strategy A brings I the duopoly profit π_I^*. Every strategy in the support of Q must bring the same profit. Given ϕ_I^2, the profit is equal to that fee times the probability that it is accepted by 2. That translates into the following equation:

$$\phi_I^2 \left\{ \beta + (1-\beta) \left[1 - R\left(\phi_I^2 + \frac{q_E - q_I}{4} \right) \right] \right\} = \pi_I^*. \tag{78}$$

Solving for R, we obtain:

$$R\left(\phi_I^2 + \frac{q_E - q_I}{4} \right) = 1 - \frac{\frac{\pi_I^*}{\phi_I^2} - \beta}{1-\beta}, \tag{79}$$

or, using the following change of variable: $\phi_E \equiv \phi_I^2 + \frac{q_E - q_I}{4}$,

$$R(\phi_E) = 1 - \frac{\frac{\pi_I^*}{\phi_E - \frac{q_E - q_I}{4}} - \beta}{1-\beta}. \tag{80}$$

Observe that

$$R\left(\pi_I^* + \frac{q_E - q_I}{4} \right) = 0, \tag{81}$$

and we must have

$$R(\pi_E^*) = 1, \tag{82}$$

giving

$$\beta = \frac{\pi_I^*}{\pi_E^* - \frac{q_E - q_I}{4}}. \tag{83}$$

Similarly, playing strategy B earns E a payoff of $\alpha\pi_E^*$. Every strategy ϕ_E in the support of R must bring the same profit. That translates into the following equation:

$$\phi_E \left\{ \alpha + (1-\alpha) \left[1 - Q \left(\phi_E - \frac{q_E - q_I}{4} \right) \right] \right\} = \alpha\pi_E^*. \tag{84}$$

Solving for Q, we obtain:

$$Q \left(\phi_E - \frac{q_E - q_I}{4} \right) = 1 - \frac{\alpha}{1-\alpha} \left(\frac{\pi_E^*}{\phi_E} - 1 \right), \tag{85}$$

or, using the following change of variable: $\phi_E \equiv \phi_I^2 + \frac{q_E - q_I}{4}$,

$$Q\left(\phi_I^2\right) = 1 - \frac{\alpha}{1-\alpha} \left(\frac{\pi_E^*}{\phi_I^2 + \frac{q_E - q_I}{4}} - 1 \right). \tag{86}$$

Observe that

$$Q \left(\pi_E^* - \frac{q_E - q_I}{4} \right) = 1, \tag{87}$$

and that we must have

$$Q\left(\pi_I^*\right) = 0, \tag{88}$$

giving

$$\alpha = \frac{\pi_I^* + \frac{q_E - q_I}{4}}{\pi_E^*}. \tag{89}$$

It is easily verified that all probabilities lie between 0 and 1 and that the cumulative distribution functions are strictly and continuously increasing. Thus, we have a well-defined mixed-strategy equilibrium in the subgame where $S = 1$ and $N = 2$.

It is easy to derive the producers' equilibrium profits. I receives π_I^* on average, whereas E receives $\pi_I^* + \frac{q_E - q_I}{4}$, which is less than its standard duopoly profit. Given assumption (A2), this is always greater than F, so that E should decide in favor of entry if $S = 1$.

The question then becomes: can I induce 2 to sign on the exclusivity contract by compensating him for the profit he would then forego? I's total willingness to pay is $\frac{q_I}{4} - \pi_I^*$. The determination of 2's exact equilibrium payoff, π_2^m, requires the computation of integrals; a logarithmic term appears and makes comparisons difficult. Yet, it suffices to bound π_2^m from above. Given the structure of the mixed-strategy equilibrium, when I plays Q, the best that 2 can get is I's monopoly rents. When I plays A, 2 earns nothing when E plays B and gets at most E's standard duopoly profit minus the smallest fee charged by E when it plays R. That is

$$\begin{aligned} \pi_2^m &< (1-\alpha) \left(\frac{q_I}{4} - \pi_I^* \right) + \alpha (1-\beta) \left[\pi_E^* - \left(\pi_I^* + \frac{q_E - q_I}{4} \right) \right] \\ &< (1-\alpha\beta) \left(\frac{q_I}{4} - \pi_I^* \right) - \alpha (1-\beta) \left(\frac{q_E}{4} - \pi_E^* \right). \end{aligned} \tag{90}$$

If we can show that

$$(1-\alpha\beta)\left(\frac{q_I}{4}-\pi_I^*\right)-\alpha(1-\beta)\left(\frac{q_E}{4}-\pi_E^*\right)<\frac{1}{2}\left(\frac{q_I}{4}-\pi_I^*\right), \tag{91}$$

then we will have proven that I can profitably compensate potential deviators with the use of simultaneous, identical offers at time t_0. The inequality can be rewritten as

$$\frac{\alpha-\alpha\beta}{\frac{1}{2}-\alpha\beta}>\frac{\frac{q_I}{4}-\pi_I^*}{\frac{q_E}{4}-\pi_E^*}. \tag{92}$$

The left-hand side is increasing in α. Assume for the time being that it is possible to show that $\alpha>3/4$. If we can show that

$$\frac{\frac{3}{4}(1-\beta)}{\frac{1}{2}-\frac{3}{4}\beta}>\frac{\frac{q_I}{4}-\pi_I^*}{\frac{q_E}{4}-\pi_E^*}, \tag{93}$$

then we are done.

The last inequality can be rewritten as

$$\frac{1}{4}\left(\frac{q_E}{4}-\pi_E^*\right)>\left(\frac{1}{2}-\frac{3}{4}\beta\right)\left[\left(\frac{q_I}{4}-\pi_I^*\right)-\left(\frac{q_E}{4}-\pi_E^*\right)\right]. \tag{94}$$

We now show that

$$\text{(i) } \frac{1}{4}>\left(\frac{1}{2}-\frac{3}{4}\beta\right), \tag{95}$$
$$\text{(ii) } \left(\frac{q_E}{4}-\pi_E^*\right)>\left(\frac{q_I}{4}-\pi_I^*\right)-\left(\frac{q_E}{4}-\pi_E^*\right),$$

thereby showing that the previous inequality is true.

(i) A direct computation gives

$$\beta=\frac{4q_E}{8q_E-q_I}, \tag{96}$$

which is greater than $1/3$ since $q_E>q_I>0$.

(ii) We have that

$$\frac{\frac{q_I}{4}-\pi_I^*}{\frac{q_E}{4}-\pi_E^*} = \frac{12(q_E)^2-4q_Eq_I+(q_I)^2}{8(q_E)^2+q_Eq_I} \tag{97}$$
$$< 2. \tag{98}$$

It remains to show that α is indeed larger than $3/4$. A direct computation gives

$$\alpha=\frac{16(q_E)^2-4q_Eq_I+(q_I)^2}{16(q_E)^2}, \tag{99}$$

which is greater than $3/4$ since $q_E > q_I > 0$.

Therefore, if the mixed-strategy equilibrium we have described is played in the subgame where $S = 1$ and $N = 2$, then there is a unique equilibrium in the entire game. I offers $y = \pi_2^m$ to both retailers. Retailer j signs on the exclusivity contract as long as $y \geq \pi_2^m$ if he expects the other retailer to sign on, and as soon as $y > 0$, otherwise. I enters if and only if $S \neq 2$. The prices in the respective subgames are as indicated above. I has no profitable deviation as it earns $2\pi_I^*$ if it decreases y, while it makes $q_I/4 - 2\pi_2^m > 2\pi_I^*$ upon acceptance of its contract. Retailer j has no incentive to deviate as that would bring him π_2^m, given that the other retailer plays his part of the equilibrium strategy.

There is no other exclusion equilibrium, for there is no point for a retailer in refusing an offer $y \geq \pi_2^m$. (If the other retailer accepts this offer, it makes π_2^m in expectation; if the other retailer accepts, it makes zero profit.) Thus, if there was an exclusion equilibrium candidate involving $y > \pi_2^m$, I could decrease his upfront payment and still induces acceptance.

There is no "entry equilibrium". In any profile involving $S = 0$, retailers make zero profit at time t_3. It is sufficient for I to set $y > \pi_2^m$ to induce acceptance by both retailers and increase its profit. QED

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