Buyer Power through Producers' Differentiation. *

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Abstract

This paper shows that a retailer may choose to differentiate his supplying producer from his rival's, at the expense of a downgrading in the quality of the product he offers to consumers, not to relax downstream competition, but to improve his buyer power in the negotiation with his producer. We consider a simple vertical industry where two producers sell products differentiated in quality to two retailers who operate in separated markets. In the game, retailers first choose which product to stock, then each retailer and her chosen producer bargain, where this pairwise bargaining happens sequentially, over the terms of a two-part tariff contract. Finally, retailers choose the quantities. We show that when upstream production costs are convex, the share of the total profits going to the retailer is higher if the latter choose to differentiate. We also are able to isolate the wish to differentiate as "only" due to increasing buyer power: namely that, via producers' differentiation, the retailer gets a larger share of smaller total profits. We show that this result also holds when retailers do not commit

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ex-ante on which product they stock and, in fact, we show that product differentiation to increase buyer power is even more likely in this case. We also derive the consequences of a differentiation induced by buyer power motives for consumer surplus and welfare, and extend our results for the case of downstream competition.

JEL Classifications: $L13$, $L42$. Keywords: Buyer Power, Vertical Relationships, Product Differentiation, Sequential Bargaining.

1   Introduction

The retail sector underwent major changes in Europe and in the United States in the last thirty years. In particular, successive merger waves have led to the constitution of large international retail groups: in 2002 nearly 30% of the 200 top world retailers' sales turnover was realized by the top first ten retailers, among which were the American Wal-Mart and the French Carrefour.[1]

The issue of the potential and current increase in the buyer power of large retailers was raised simultaneously by industry participants, the media,[2], and by the Competition authorities in general.[3] Competition authorities took into account the retailers' buyer power in their analysis, either as an element of countervailing power in the cases of mergers between producers, or as a potential threat to competition. For instance, some merger proposals between the retailers Rewe/Meinl and Carrefour/Promodes, were authorized by the European Commission, only after the merging parties had committed themselves to maintain their relationships with a group of particularly exposed suppliers. Recent reports of the OECD[4], the OFT[5] or consulting

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[1]Deloitte, 2004 Global Powers of Retailing.

[2]Lynn, B. C., 2006. "Breaking the Chain: The Antitrust Case Against Wal-mart", www.Harpers.org, July 31, 2006.

[3]Schelings, R. and Wright J., "'Sui Generis'?: An Antitrust Analysis of Buyer Power in the Unites States and European Union", Law and Economics Working Paper series, Georges Mason University School of Law; EC, 1999; "Buyer power and its impact on competition in the food retail distribution sector of the European Union". DG IV. Brussels.

[4]OECD, (1999), "Buying Power and Multiproduct Retailers", series of round tables on Competition Policy DAFFE/CLP, 21.

[5]"The Welfare Consequences of the Exercise of Buyer Power", Dobson and al. OFT Report, 1998.

groups[6] document the degree of and state of buyer power in the retail sector across countries and the issues that arise.

Buyer power has been the subject of a recent Industrial Organization literature, both empirical and theoretical, which raises in particular the question of its measurement, its origins and its consequences for social welfare (Inderst and Mazzarotto (2006)). Among the origins of buyer power, a large literature has been devoted to determining the framework under which larger firms could indeed obtain greater discount from their supplier (Inderst and Shaffer (2006)). Other determinants such as the ability of a retailer to switch to an alternative supplier are often put forward. This paper shows that producers' differentiation may also be a source of buyer power for a retailer.

Moreover, among the consequences of buyer power, most articles have focused on the price effects of buyer power. As retailers exert their buyer power to lower their costs, these gains are partly passed through to consumers through lower retail prices. Another important issue is that of the "non-price" effects of buyer power, in particular, the effect of the exercise of market power on the manufacturers' innovation incentives or on the variety of products they offer. Our paper fits directly in these recent developments by raising the question of the implications of the retailers' buyer power on the assortment of products which they offer in their shelves to the consumers.

The main argument of this paper is first developed in a simple framework where two symmetric non-competing retailers, being each a monopolist on downstream separated markets, have to choose in a first stage, which product to stock in their shelves. There are two products differentiated in quality and offered by different producers and the retailers are capacity (shelf) constrained, and do indeed offer only one product. In a second stage, each retailer and her chosen producer sequentially bargain by pair over a two-part tariff contract and in a third stage retailers choose the quantity of products to sell on the final market. In this context, we show that the retailers may choose to offer products differentiated in quality to the consumers. The differentiation does not aim at relaxing downstream competition - since we have assumed that retailers were not competing - but at improving retailers'

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[6]"Buyer Power in Post-Merger Markets, The Efficiency Defense and Merger Simulation", PWC Economics Competition, Spring 2005.

buyer power in their negotiation with their supplying producer.[7] Indeed, when production cost are convex the greater the number of retailers he deals with the greater the share of joint profits the producer is able to capture. A direct consequence is that retailers' buyer power may be raised thanks to the producers' differentiation. Moreover, we show that there are cases that, by choosing the low quality product, the total joint profits to be shared are lower than if the retailer stuck to the high quality product the other retailer lists, but he is still able to extract a bigger share of those smaller profits. In doing so, we are able to isolate a wish to differentiate as "only" due to increasing buyer power (increasing the share of the "pie"). When differentiation occurs it harms not only the surplus of consumers who buy the product of lower quality, but can also prove to be harmful for social welfare overall. We then develop a more complex game where retailers do not commit first on which product to stock in their shelves, but only choose, as they bargain sequentially, the order of their negotiation with the two producers. Indeed, as producers are asymmetric, the bargaining outcomes appear to be sensitive to the order of negotiations (cf.Raskovich (2007)). We show that all our results hold in this framework.

Several articles are devoted to the consequences of the balance of power between producers and retailers on retailers' listing strategy and thus are directly related to our work. Avenel and Caprice (2006) show how a high quality producer may have an incentive to offer different contracts to symmetric competing retailers in order that the latter specialize their offer: one of the retailers offers the high quality product while her competitor offers a low quality good supplied by a competitive fringe. This listing choice specialization is imposed by the producer, when his market power is high enough, to improve his profits thanks to the downstream competition relaxation effect. Shaffer (2005) highlights the adverse effect of slotting allowances competition between producers on retailer's listing choice. A producer may offer slotting

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[7]The IO literature devoted to the analysis of producer and retailer relationships traditionally refers to the principal-agent paradigm. The producer (principal) offers a take-it or leave-it contract to the retailer (agent). In this framework, the buyer power is limited to the retailer's ability to refuse the contract. Recent works on buyer power rather use the bargaining theory and assume that producer and retailer bargain over their contract (see for example Iyer and Villas-Boas (2003)). The balance of power between producer and retailer depends on the respective status-quo profits of the parties, i.e their outside option profits.

allowances to secure his patronage in retailers' shelves when the latter are capacity constrained (each retailer can only stock one product while two products are available in the market) to the detriment of another product offered by a competitive fringe. This strategy may thus harm consumer surplus. The paper by Inderst and Shaffer (2005) is also closely related to our work. They identify a new mechanism through which a horizontal merger between retailers can increase retailer's buyer power. Before the merger, retailers are on separated markets and buy from two different producers. After the merger, the new consolidated retailer may commit to a single sourcing strategy in order to increase her buyer power. Finally, Chen (2006) shows that when a retailer chooses the number of products' variety she puts in her shelves (without capacity constraints) and bears a constant retail cost, her countervailing power lowers consumer prices but reduces product diversity. On the one hand, the monopoly distortion in price is reduced but on the other hand, the distortion in terms of variety of products is increased and consumers are always worse off.

This paper also sheds light into the theory of product differentiation (Anderson, De Palma and Thisse (1992)) showing that buyer power can be a source of differentiation. This idea has to our knowledge not been previously explored and researched in the literature. Differentiation itself is not unambiguously welfare improving or welfare reducing. Consumers may benefit from the availability of a wide variety of product offerings to serve their differing preferences. Yet differentiation can also facilitate the exercise of market power. The producer (or retailer) who offers a differentiated product often enjoys a localized monopoly and may be able to charge a higher price than it otherwise could. Since our theoretical argument is developed in a context where the retailers are not competing in the downstream markets, differentiation here only affect the production cost and the balance of power between producers and retailers.

The paper proceeds as follows. The next section presents the model, section 3 derives equilibria of the game where retailers can commit in a first stage on their listing strategy. This first game enables us to present the main insight of our results in a simple way. The section 4 then relaxes this commitment assumption deriving an ordered bargaining game, and shows that our results still hold. Section 5 derives an extension with downstream competition. Section 6 concludes.

2   The model

Two producers offer vertically differentiated products $K = \{H, L\}$ of a respective quality $k = \{h, l\}$. The quality index l is strictly lower than h. For simplicity, let both producers have exactly the same cost function $C(q)$[8]. Thus, if producer H is able to produce a higher quality good it may be explained for example by a higher reputation collected in the past (thanks to a sunk cost). One can consider here, for instance, that H is the first national brand producer while L would be the second national brand producer. Let the cost increase with the quantity produced ($C'(q) > 0$) and let the results be derived according to different shapes of this cost function.

Producers cannot sell their product directly to consumers but can do it through retailers. There are two retailers who operate on separated markets, each retailer being a monopolist on her market. Although, there are two differentiated products, retailers' shelf space is assumed to be limited: each retailer has a single slot for a product.[9] Let the subscript $i = \{1, 2\}$ denote the retailer and the superscript $K = \{H, L\}$ denote the product sold.

Consumer's demand for good K at retailer i increases with the level of quality k and decreases in its price denoted p_i^K. As in the original vertical differentiation model of Mussa and Rosen (1978), consumers have a marginal willingness to pay for quality θ, and we assume that this parameter is distributed according to a density $f(\theta)$ on an interval $[0, \overline{\theta}]$. Without loss of generality, the size of the market is normalized to 1. We also assume that each consumer buys at most one unit of the good. The surplus a θ-type consumer withdraws from its consumption at the price p_i^K is $S(\theta) = \theta k - p_i^K$. Consumers buy the good as long as $S(\theta) \geq 0$.

In this setting, let us first consider the following simple game (I):

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[8]We could assume that the production cost of the low quality good is smaller without changing qualitatively our results.

[9]For example, consider the case of a product with a certain facing width, and the shelf space only allows one facing of a product to be visible in the shelf, while additional units of the same product can be stored behind the facing. The restriction that retailers only stock one product is a simplifying assumption. The results would also hold for the case when retailers can carry a fixed number M of products in the shelf, where there are $N > M$ products available at the producer level.

Stage 1: Each retailer chooses which product K to stock in his shelf;

Stage 2 : Each pair of retailer and his chosen producer bargains sequentially on a two-part tariff contract (w_i^K, T_i^K) where w_i^K is the price paid per unit of good and T_i^K is a fixed tariff independent of the quantity of the good.

Stage 3: Retailers choose their final quantity q_i^K [10].

The main assumption of this simple game is the ability of retailers to commit in the first stage on their listing choice. This hypothesis is close to Scott-Morton and Zettelmeyer (2004) as we allow only a certain set of retailers to be relevant for certain producers, because retailers already commit to carry certain products ex-ante. This simplifying assumption allows us to present the main insights of the paper in a simple way. It boils down to assuming that there is a sunk cost per negotiation for retailers sufficiently high to deter retailers to enter in a bargaining process with all producers whereas they finally have to select only one product.

We use the sequential bargaining game as defined by Stole and Zwiebel (1996). A sequence of bargaining by pair is set, and we solve sequentially the bargaining in the order of the sequence. If there is a breakdown in the negotiation between a given pair of firms, this change in the sequence becomes common knowledge and the sequence of bargaining starts again without the pair who has reached a disagreement. This bargaining game is efficient since joint profits are maximized and since the order of negotiations is irrelevant for the bargaining outcomes. When firms have equal exogenous bargaining power, the payoff functions coincide with the Shapley value.

Then, section 4 presents a bilateral sequential bargaining game where retailers do not commit ex-ante on which product they stock but simply choose the order of their negotiation with producers. This ordered bargaining game (II) is as follows:

Stage 1 : Pairs bargain sequentially on a two-part tariff contract (w_i^K, T_i^K) where w_i^K is the price paid per unit of good and T_i^K is a fixed tariff independent of the quantity of the good. Each retailer chooses the order of his

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[10]The alternative assumption where retailers set their price p_i^K in the last stage wouldn't change the results when retailers are in separated markets.

negotiations with producers.

Stage 2: Retailers choose their final quantity q_i^K.

Producers and retailers have full information and common knowledge of the structure of the game. In this bargaining game, we assume arbitrarily, without any incidence on the bargaining equilibrium, that retailer 1 begins in the sequence of negotiation. Each retailer then chooses freely with whom to bargain first. Because of the capacity constraint, each retailer may reach an agreement with only one of the two producers. If retailer 1 succeeds in his bargaining with the first producer he bargains with, he does not bargain with the next producer, and the latter has only played the role of an outside option profit in the first bargaining. On the contrary, if retailer 1 bargains with the next producer, everyone knows that the previous bargaining has ended by a breach. In case a bargaining has breached, any further bargaining between these parties is foreclosed.

Producers are asymmetric and thus the equilibrium payoffs will depend on the order of the negotiation chosen by retailers.

Section 3 derives equilibria of game (I), where each retailer has committed in a first stage on which products he wants to stock in his shelves. It is shown that retailers may commit to stock differentiated products only in order to raise their buyer power towards their supplying producer. Section 4 derives equilibria of game (II) which allows us to relax the assumption of commitment in the first stage, and thus extends our result to a more general framework.

3   Each retailer commits on her listing choice

This section solves the Game (I). Retailer i's inverse demand function is $P_i^K(q_i^K)$ if he stocks the good K of quality k where q_i^K is the quantity offered. We denote the vertical bilateral joint profits for the sales by retailer i of a quantity q_i^K of good K as $\Upsilon_i^K\left(q_i^K\right) = P_i^K(q_i^K)q_i^K - C(q_i^K)$. We assume that $\Upsilon_i^L\left(q_i^L\right)$ strictly increases in l.[11] Game (I) is solved by backward induction.

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[11]This assumption is verified by a wide class of distribution functions $F(\theta)$.

3.1 The quantity choice

As each retailer is a monopolist in her market, her demand is as follows. Consumers buy the good as long as $S(\theta) \geq 0$ and thus the total demand for good K is $q_i^K = \int_{\frac{P_i^K}{k}}^{\overline{\theta}} f(\theta) d\theta$. Let $P_i^K\left(q_i^K\right)$ denote the corresponding inverse demand function for good K at retailer i.

In the last stage of the game, retailer i, who carries the good K, chooses the quantity q_i^K that maximizes her profit taking as given her own two-part tariff (w_i^K, T_i^K) negotiated in stage 2. Retailer i's profit is:

$$\pi_i^K = (P_i^K\left(q_i^K\right) - w_i^K)q_i^K - T_i^K \tag{1}$$

We assume that π_i^K is concave in q_i^K. Retailer i's optimal quantity choice is denoted $q_i^{Km}(.)$ where the superscript "m" stands for monopoly. The optimal quantity $q_i^{Km}(.)$ solves the following first order condition:

$$\frac{\partial P_i^K(q_i^K)}{\partial q_i^K}q_i^K + P_i^K(q_i^K) - w_i^K = 0 \tag{2}$$

As both retailers are in separated markets, the optimal quantity choice of a retailer in the last stage is independent of the quantity chosen by the other retailer.

In the second stage, the bargaining takes place and there are two cases to consider according to retailers' listing choices in the first stage. The two listing structures are denoted $\{K, K\}$ and $\{K, -K\}$.

3.2 The bargaining game

3.2.1 Case $\{K, -K\}$

In this case, retailers supply from different producers, and since they are in separated markets, the two negotiations are completely independent from one another.

K and i bargain over a two-part tariff contract (w_i^K, T_i^K). We denote Π_i^K the profit realized by the producer K who supplies the retailer i through a contract (w_i^K, T_i^K):

$$\Pi_i^K = w_i^K q_i^K + T_i^K - C(q_i^K). \tag{3}$$

The equilibrium two-part tariff $(\widehat{w}_i^K, \widehat{T}_i^K)$ is the solution of the following Nash

program:

$$\underset{w_i^K, T_i^K}{Max} (\Pi_i^K)^{1-\alpha}(\pi_i^K)^\alpha \tag{4}$$

where $\alpha \in (0,1)$ is a parameter describing the exogenous buyer power of retailers. Solving the FOCs, we find that the optimal wholesale price is equal to the marginal cost of production and thus maximize bilateral joint profits. Thus the equilibrium wholesale price is defined by the following implicit function: $\widehat{w}_i^K = \left.\frac{\partial C(q_i^K)}{\partial q_i^K}\right|_{q_i^K = q_i^{Km}(\widehat{w}_i^K)}$.

Let $q_i^{Km}(\widehat{w}_i^K) = \widehat{q}_i^K$. The equilibrium transfer is such that the retailer (resp. the producer) captures exactly a share α (resp. $1 - \alpha$) of the joint profits:

$$\widehat{T}_i^K = (1-\alpha)P(\widehat{q}_i^K)\widehat{q}_i^K - \widehat{w}_i^K\widehat{q}_i^K + \alpha C(\widehat{q}_i^K) \tag{5}$$

Lemma 1 *Whatever the cost function, when retailers stock differentiated products, each retailer i (resp. the producer K) captures a share α (resp. $1 - \alpha$) of the optimal bilateral joint profits $\widehat{\Upsilon}_i^K$.*

Proof. A detailed proof is available in Appendix 7.1.1. ■

The Nash program insures that first, the size of the pie is maximum, it is here equal to the monopoly profit, and second, that the pie is shared according to the exogenous bargaining power α.

3.2.2 Case $\{K, K\}$

The two retailers bargain with the same producer. Negotiations are no longer independent from one another since the producer K has a status-quo in his bargaining towards each retailer: in case of a breach in the bargaining between K and i, K realizes a positive profit with the other retailer j. We here assume that contracts are negotiated sequentially. A sequence of bargaining is first set: first (K, i) and second (K, j), and in case of a breakdown in the negotiation between a pair (K, i), the other pair (K, j) learns it and renegotiate her contract.

We solve the bargaining backward. If K and i have failed to find an agreement, the Nash program of the negotiation between K and j would be:

$$\underset{w_j^K, T_j^K}{Max} (\Pi_j^K)^{1-\alpha}(\pi_j^K)^\alpha \tag{6}$$

which gives the following status-quo profit for the producer K:

$$\overline{\Pi_j^K} = (1 - \alpha)\widehat{\Upsilon}_j^K \tag{7}$$

Thus the bargaining between K and i in the first stage anticipating the status-quo profit of the producer K with j leads to the following Nash program:

$$\underset{w_i^K, T_i^K}{Max} (\Pi_{i+j}^K - \overline{\Pi_j^K})^{1-\alpha}(\pi_i^K)^\alpha \tag{8}$$

where $\Pi_{i+j}^K = w_i^K q_i^K + T_i^K + w_j^K q_j^K + T_j^K - C(q_i^K + q_j^K)$.

Note here that retailers' buyer power is exerted through two different channels: first, and as in case $\{K, -K\}$, through the exogenous bargaining power parameter α, and second, through the level of the producer's status-quo in the bargaining. In game (I), retailers have no status-quo in their bargaining since they do not have the freedom to change of producer in the bargaining stage. Game (II) allows us to take into account also retailer's status-quo in the bargaining.[12]

From the FOCs and from the symmetry between markets, the optimal input prices w_i^{K*} are equal to the marginal costs of production which maximize bilateral joint profits. Thus, w_i^{K*} is defined in equilibrium by $w_i^{K*} = w_j^{K*}$ and the following implicit function:

$$w_i^{K*} = \left.\frac{\partial C(q_i^K + q_j^K)}{\partial q_i^K}\right|_{(q_i^{Km}(w_i^{K*}), q_j^{Km}(w_j^{K*}))} \tag{9}$$

Let $q_i^{Km}(w_i^{K*}) = q_i^{K*}$. By symmetry, we define $\Upsilon_i^{K*} = \Upsilon_j^{K*} = P_i^K(q_i^{K*})q_i^{K*} - \frac{1}{2}C(2q_i^{K*})$ the joint profits by a retailer with the producer K. Let also $\widehat{\Upsilon}_{ij}^{K*} = \Upsilon_i^{K*} + \Upsilon_j^{K*}$ denote the total joint profits between producer K and both retailers.

Here, the optimal tariff now shares the joint profits depending on the producer's status-quo. The lower the incremental profit the producer obtains thanks to his relationships with i, the higher the tariff paid by the retailer to the producer. Of course, the issue of the bargaining is here independent

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[12]Note that if we have assumed a sequential bargaining, our results would be unchanged considering a simultaneous bargaining game framework with observability of contracts and authorizing renegotiation in case of a failure in the bargaining of a given pair.

of the order of negotiations.

Replacing the equilibrium tariff in retailers' profits, we obtain:

$$\pi_1^{K*} = \pi_2^{K*} = \alpha \Upsilon_i^{K*} + \frac{\alpha(1-\alpha)}{1+\alpha}(\Upsilon_i^{K*} - \widehat{\Upsilon}_i^K) \tag{10}$$

We thus analyze (10) in three sub-cases:

(1) When the cost function is linear $(C''(q) = 0)$, since $\Upsilon_i^{K*} = \widehat{\Upsilon}_i^K$, the second term in equation (10) is zero and $\pi_1^{K*} = \pi_2^{K*} = \alpha \Upsilon_i^{K*}$. Here, each retailer and the producer capture respectively a share α and $1 - \alpha$ of their joint profits.
(2) When the cost function is concave $(C''(q) < 0)$, $\Upsilon_i^{K*} > \widehat{\Upsilon}_i^K$ and the second term is strictly positive. Here, the retailer captures a share $\delta > \alpha$ of her joint profits with the producer Υ_i^{K*}.

(3) When the cost function is convex $(C''(q) > 0)$, on the contrary $\Upsilon_i^{K*} < \widehat{\Upsilon}_i^K$ and the second term is strictly negative. In that case, the retailer captures a share $\gamma < \alpha$ of her joint profit with the producer Υ_i^{K*}.

We thus obtain our first proposition:

Proposition 2 *If the upstream cost functions are convex, and if retailers can commit on which product they stock before the negotiation takes place, a retailer increases her buyer power in carrying a differentiated product.*

Proof. Straightforward from (10). Detailed proof is derived in appendix 7.1.2. ∎

The insight for this result is as follows. If the producer has a convex cost function, the marginal cost of production of the producer is reduced in case he deals only with one retailer. This effect tends to reinforce his status-quo profit in comparison of the marginal joint profits he may realize with each of the two retailers. The convexity of costs here insures that the greater the number of retailers he bargains with, the greater the producer's bargaining power. Conversely, when cost are convex, retailers have a greater buyer

power when they buy from differentiated producers. Inderst and Wey (2003) have previously shown that, in another context, the convexity of cost may also explain why a larger buyer has a greater bargaining power towards a producer than a smaller buyer. A larger buyer who buys a greater quantity of good, induces on average a smaller incremental production cost than the smaller quantity bought by a smaller size buyer. As also shown by Chipty and Snyder (1999), this is because each buyer regards himself as marginal in his negotiation with the producer.[13] Chemla (2003) has also shown that an upstream monopoly, who can choose and commit on the number of retailers he supplies, could have a greater seller power in dealing with multiple retailers. His result relies on the same mechanism as the producer incurs a fix cost per retailer that is strictly increasing with the number of retailers. The cost convexity is due to agency costs in an incomplete contract environment rather than to the production function, but the basic insight is the same.

3.3   Optimal listing choice

Here we solve the first stage of game (I). First of all, note that since both producers have the same cost function and since retailers can, in our simple demand framework, always extract a higher surplus from consumers by selling the high quality product, it is straightforward that there is no equilibrium where the two retailers would choose to stock L. It is always optimal, at least for one of the two retailers, say 1, to sell H. Then, the remaining question is : what is the best response for the retailer 2, either to stock H or L?[14]

We analyze this choice in turn for the case where the cost function is linear, concave and convex.

1−Linear cost function
In this case we know, retailer 2 captures a share α of her joint profits with the producer whatever her listing choice. Her choice thus only depends on the

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[13]Note here that a recent paper by Smith and Thanassoulis (2006) shows that when there is uncertainty on the final volumes bargained for each seller, on the contrary, retailer's buyer power increases when the seller's cost function is concave (and diminishes when the seller's cost function is convex).

[14]Alternatively, we could consider that the producer L can enter the market without cost and does not enter the market unless he is listed by a retailer (unless he has an order).

comparison of joint profits the retailer can realize with each of the producer. Since the cost functions are identical and linear, we always have $\Upsilon_2^{H*} > \widehat{\Upsilon}_2^L$ since $l \in [0, h[$. Thus, retailer 2 chooses to stock H.

2−Concave cost function

In this case, retailer 2 obtains a share $\delta > \alpha$ of her joint profits with the producer when she carries also the product H and a share α when she stocks the differentiated product L. Moreover, since the cost function is concave the marginal cost of production of the producer H is lowered when the two retailers stock his product rather than when 2 carries $L : \widehat{\Upsilon}_2^L < \Upsilon_2^{H*}$. Thus, the retailer 2 realizes also strictly higher joint profits carrying H than L and thus chooses to stock H.

3−Convex cost function

If the cost function is convex, the retailer captures a share $\gamma < \alpha$ of her joint profits when she also carries H, $\pi_2^{H*} = \gamma \Upsilon_2^{H*}$ and a share α if she carries L, $\widehat{\pi}_2^L = \alpha \widehat{\Upsilon}_2^L$.

Comparing joint profits, we know that, since the cost function is convex, the joint profits realized with L can now be higher than the joint profits realized with H. More precisely, in two extreme cases, when $l = 0$ then $\widehat{\Upsilon}_2^L = 0$ and when $l = h$ then $\widehat{\Upsilon}_2^L > \Upsilon_2^{H*}$.[15] By definition $\widehat{\Upsilon}_2^L$ strictly increases with the quality of the product l, thus, there exists a unique threshold $\bar{l} \in (0, h)$ such that if $l \in (\bar{l}, h]$, the joint profits when the retailer stocks L is strictly higher than joint profits if the retailer stocks H also. Let us now focus on the interval of qualities where $l \in [0, \bar{l}]$ and $\widehat{\Upsilon}_2^L \leq \Upsilon_2^{H*}$. In $l = \bar{l}$, by definition $\widehat{\Upsilon}_2^L(\bar{l}) = \Upsilon_2^{H*}$ and since the retailer has a lower share of the joint profits when she stocks H, we have: $\pi_2^{H*} < \widehat{\pi}_2^L(\bar{l})$. Since $\widehat{\Upsilon}_2^L(0) = 0$ and $\widehat{\Upsilon}_2^L(l)$ strictly increases in l, there exists a unique threshold $\widetilde{l} \in (0, \bar{l})$ such that retailer 2 realizes a better profit in stocking L when $l > \widetilde{l}$ and stocking H when $l \leq \widetilde{l}$. The above discussion leads us to the following lemma:

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[15]See detailed proof in appendix 7.1.3.

Lemma 3 *When $C''(q) \leq 0$, the only Nash equilibrium of the game is $\{H, H\}$. When $C''(q) > 0$, there is a unique threshold $\widetilde{l}$ implicitly defined by the following identity (A): $\alpha \widehat{\Upsilon}_2^L = \alpha \Upsilon_2^{H*} + \alpha \frac{(1-\alpha)}{(1+\alpha)}(\Upsilon_2^{H*} - \widehat{\Upsilon}_2^H)$. When $l \epsilon [\widetilde{l}, 1]$, the unique Nash equilibrium of the game is $\{H, L\}$.*

Proof. See appendix 7.1.3. ■

A retailer renounces to stock the high quality product only if the differential of quality with the second brand is not too high. This result translates well that, when a first national brand has a very strong brand, it is less likely that the retailer renounces to stock it in her shelves.
In the interval of qualities $[\bar{l}, h]$, the retailer 2 stocks L rather than H and two reasons explain her choice: (1) to raise her buyer power and (2) to increase her joint profits with the producer thanks to the reduction of her marginal cost. Both effects are derived from the convexity of costs. Thus $\{H, L\}$ is the unique Nash equilibrium of the game when $l > \bar{l}$.
In the interval of qualities $[\widetilde{l}, \bar{l}]$, joint profits are lower and the only motivation for 2 to stock L rather than H is that, in supplying from a producer who has no alternative outlet on equilibrium, she has a greater buyer power. This result is novel and interesting and allows us to highlight another source of differentiation that relies on buyer power: the producers' differentiation. Here, retailers do not stock differentiated products in their shelves to relax retail competition since each retailer is a monopolist in her downstream market. We thus obtain the following proposition:

Proposition 4 *Non competing retailers may choose producers' differentiation only with the purpose to increase their buyer power.*

Proof. Straightforward since $\widehat{\Upsilon}_2^L \leq \Upsilon_2^{H*}$ when $l \epsilon [\widetilde{l}, \bar{l}]$. ■

The threshold $\widetilde{l}$ varies with the retailers' exogenous bargaining power α. From the identity (A) given in lemma 3, when $\alpha \in (0, 1]$, dividing the two sides of the equality by α, it is immediate that $\widetilde{l}$ strictly increases in α. The intuition is clear: as retailers have a greater bargaining power, they have less incentive to use producers' differentiation as a leverage to increase their buyer power. If $\alpha = 1$, retailers capture the entire surplus of their relationships with the producer, and the listing choice is realized only through the comparison of the retailer 2 joint profits selling either H or L. Indeed, only the threshold $\bar{l}$

is relevant and $\widetilde{l} = \overline{l}$.

If $\alpha = 0$, retailers are indifferent between H or L. However, when $\alpha \to 0$, $\widetilde{l} \to l^*$ where l^* is such that $\widehat{\Upsilon}_2^L + \widehat{\Upsilon}_2^H = \Upsilon_{12}^{H*}$. This equality gives a direct comparison between the profit a fully merged firm (full merger between retailers and producers) would realize selling differentiated products in his two stores rather than the same product of high quality. The insight is as follows. As retailers have no power, and as retailers are committed towards their supplying producer, producers are able to capture the whole industry profit when $\alpha \to 0$. However, clearly producer H has an advantage towards his rival L who offers a lower quality product. Thus L will be able to impose his product on one retailer's shelves only if he can at least offer a compensation to H amounting to $\Upsilon_{12}^{H*} - \widehat{\Upsilon}_2^H + \varepsilon$, for renouncing to be present on both retailers' shelves. As long as $\widehat{\Upsilon}_2^L \geq \Upsilon_{12}^{H*} - \widehat{\Upsilon}_2^H$, the producer L earns a higher profit than the latter compensation and both producers are strictly better off if L imposes his product on one of the retailers' shelves.

This threshold l^* is lower than $\overline{l}$ since in the fully merged case, the economies of cost realized by the first retailer through producer's differentiation are internalized and thus increases the profitability of this strategy. In the case of separated retailers, both retailers would prefer to be the one who selects the high quality product and this effect lowers the profitability of the differentiation strategy.

If we now look at the consumer surplus, the choice by 2 to stock the product L has different consequences according to the market considered. For consumers located in retailer 1's market, the effect is strictly beneficial: because of cost convexity, H's marginal cost of production is lowered when 2 renounces to stock also the product H, which allows 1 to sell a greater quantity of good H at a lower price. For the retailer 2's consumers, the effects are more complex. On the one hand, the decrease in marginal cost also has a positive effect for consumers since it tends to lower prices, but on the other hand, the downgrading in quality is clearly harmful. Concerning industry profits, we know it is optimal for a fully merged industry to have one of the retailers selling the product L if $l \geq l^*$. As we have just shown that $\widetilde{l} \geq l^*$, whenever the retailer 2 chooses producers' differentiation for buyer power power motive it is clearly beneficial for total industry profits.

The total effect on consumer surplus and welfare depends on the definition of both $f(\theta)$ and $C(q)$. Therefore, we briefly derive in the next subsection an illustrative example with a quadratic cost function and a uniform distribution

function of consumers' tastes, and analyze more closely the consequences of our results in terms of consumer surplus and welfare.

3.4   Illustrative example

Let the high quality parameter h be normalized to 1 while the low quality l varies in the interval $[0, 1]$. The parameter θ is assumed to be uniformly distributed on the interval $[0, 1]$. Therefore, the inverse demand for the good K of quality k is: $P_i^K = k \left(1 - q_i^K\right)$

To focus on the most interesting case, let the cost function be convex and defined by the following equation: $C(q) = \frac{cq^2}{2}$, where $c > 0$. In this example, we always have π_i^K concave and Υ_i^K strictly increases in k. Solving the game, we obtain the following results.[16]

We represent in Figure 1 the different thresholds $\bar{l}$ and $\widetilde{l}$ defined in the general case and for $\alpha = \frac{1}{2}$. In this example the corresponding thresholds are functions of the parameter c. We also represent a threshold l^s (resp. l^{s2}) such that if $l > l^s$ (resp. $l > l^{s2}$), the producers' differentiation increases the sum of consumers' surplus in both markets (resp. retailer 2's market consumer surplus).

Note first that all the thresholds strictly decrease with c since the benefit of producers' differentiation increases with the cost convexity for retailers, for the vertical industry, or for the consumers. In the shaded area, the retailer chooses to supply from the low quality producer only in order to improve her buyer power since $l \in [\widetilde{l}, \bar{l}]$. Moreover, in the same area, this strategy is always damaging for consumer surplus since $l < l^s$. When c is low enough, i.e, at the left of the vertical dotted line, a differentiation induced by a "raising buyer power" motive can only have negative effects on consumer surplus regardless of l. We thus obtain the following remark.

Corollary 5 *Producers' differentiation may damage consumer surplus and welfare for low degree of convexity in the cost function.*

Proof. See in appendix 7.1.4. ■

For sufficiently low values of the parameter c, the damages for consumers on market 2 surpass the benefits for consumers on market 1. It is clear that, at

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[16]All details on deriving the example and obtaining the equilibrium values are available in Appendix 7.1.4.
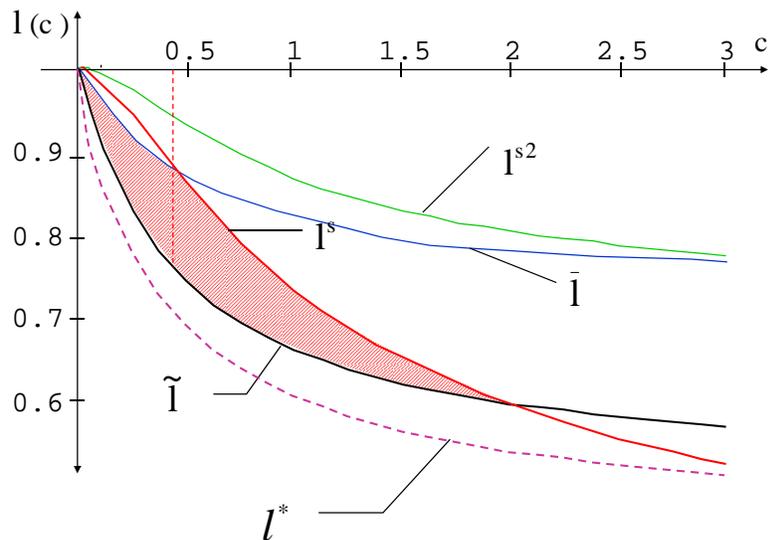
Figure 1: Thresholds in Game (I) given $\alpha = \frac{1}{2}$

a given level of quality l, the negative effect of 2 carrying L for the market 2 consumers is reduced as the level of cost is raised. On the other hand, the benefits of 2 carrying L for the consumers in market 1 strictly increases with the parameter "c" which also is a degree of cost convexity. The total effect on surplus will thus be negative if "c" is not too large. About welfare, as producers' differentiation is always beneficial for total industry profit whenever it arises, there is one more positive effect that balances the potential negative effect on consumer surplus. The negative effect on consumer surplus are always stronger than the negative effect on total welfare. However, in our illustrative example for low values of c the effect of producers' differentiation due to buyer power motive is also negative for total welfare.

18

4 Retailers do no commit on which product they stock in their shelves

This section relaxes the previous assumption where retailers had to commit in a first stage on which product to stock in their shelves. We solve in this section the ordered bargaining game, *i.e.* the game (II) defined in section 2. Here, a retailer can use one of the producers as a status-quo in her bargaining with the other producer.

The last stage of the game of quantity choice is unchanged. Let us then consider the bargaining between the four players $\{H, L, 1, 2\}$. The sequence of bargaining is determined as follows.

As producers are asymmetric, we first assume that each retailer chooses the order in which she bargains with the producers. This choice is the only one that may affect the bargaining equilibrium. However, notice that the retailers do not have to commit on the order of their negotiations with the producers. A retailer's choice is publicly revealed to all players as the retailer starts his first bargaining. Indeed, as in the previous game, information is perfect and thus all the bargaining process is observable. All pairs know perfectly the issue of earlier negotiations in the sequence and perfectly anticipate the issue of posterior negotiations.[17]

Second, because of the capacity constraint, each retailer stops bargaining at his first success with a producer. In case there is a breach in one given pair's negotiation, the whole sequence of bargaining starts again excluding any further negotiation for this pair.

The game is solved and we focus on the interesting case where the production costs are convex. We arbitrarily set that retailer 1 starts in the bargaining sequence and first bargains with H.[18] We thus solve the game backward by first characterizing the optimal choice of retailer 2 either to first bargain with H or with L. Second, anticipating this choice by retailer 2, we check that indeed the retailer 1 chooses to bargain first with H.

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[17]Notice that passive beliefs are not a required assumptions (as in de Fontenay and Gans (2005)) as no multilateral deviation is possible due to the capacity constraint that insures a retailer only bargains successfully with one producer.

[18]Indeed, since retailers are symmetric, equilibria are unchanged whether retailer 1 or retailer 2 bargains first.

4.1 Case 1: If the retailer 2 chooses to bargain first with H

The corresponding sequence of bargaining is $(H-1, L-1, H-2, L-2)$, that corresponds to retailer 1 starting with H and retailer 2 also starting with H. Note that if the bargaining between H and 1 is successful, then the $L-1$ bargaining is skipped and the bargaining goes on following the sequence $(H-2, L-2)$. In this case, both retailers are symmetric. To determine the status-quo profits of the pair of firms H and i when they bargain, we first determine the profits H and i would get in case of a breakdown in their negotiation. We thus solve the corresponding bargaining subgame $(H-j, L-j, L-i)$ (or indifferently $(L-i, H-j, L-j)$). The detailed analysis of this subgame is available in appendix 7.2.1 and we denote the corresponding status-quo profits of firms H and i respectively $\pi_i^{L,(Hj,Lj,Li)}$ and $\Pi_j^{H,(Hj,Lj,Li)}$.

The bargaining programme of firms H and i is:

$$\underset{w_i^K, T_i^K}{Max}\, (\pi_i^{H,(Hj,Lj,Hi,Li)} - \pi_i^{L,(Hj,Lj,Li)})^\alpha (\Pi_i^{H,(Hj,Lj,Hi,Li)} - \Pi_j^{H,(Hj,Lj,Li)})^{(1-\alpha)} \quad (11)$$

where profits are:

$$\pi_i^{H,(Hj,Lj,Hi,Li)} = (P_i^H(q_i^{Hm}) - w_i^H)q_i^{Hm} - T_i^H$$

and

$$\Pi_i^{H,(Hj,Lj,Hi,Li)} = \sum_{i=1,2}(w_i^H q_i^{Hm} + T_i^H) - C(q_i^{Hm} + q_j^{Hm})$$

Solving the programme (11) for $i = \{1, 2\}$ leads to the following lemma:

Lemma 6 *On equilibrium* $(H1, H2)$*, the wholesale tariffs are always equal to the marginal cost of production and contracts are always efficient. Retailers' equilibrium payoffs are:*

$$\pi_i^{H,(H1,L1,H2,L2)} = \frac{\alpha((1+\alpha)\Upsilon_{12}^{H*} + \Upsilon_{12}^{L*}(1-\alpha^2) + (1-\alpha+\alpha^2)\widehat{\Upsilon}_{i1}^L - (1-\alpha)\widehat{\Upsilon}_i^H))}{(1+\alpha)^2}.$$
$$(12)$$

Proof. See Appendix 7.2.1. ∎

We then check that the retailer's profit $\pi_i^{H,(H1,L1,H2,L2)}$ is larger than the profit he would get precipitating a breakdown with H, i.e his status-quo profit in his bargaining.

Let l_1 denote the quality threshold defined by $\widehat{\Upsilon}_i^L = C1$, where $C1$ is defined in appendix 7.2.1.

Lemma 7 *If $l \leq l_1$, there exist an equilibrium $(H1, H2)$ where both retailers succeed in their bargaining with H. If $l > l_1$, there is an equilibrium $(H1, L2)$, where the retailer 2 precipitates a breakdown in his negotiation with H and then succeeds in his bargaining with L.*

Proof. See Appendix 7.2.1. ∎

If the differentiation in quality is sufficiently low, it may not be possible to find a mutually profitable agreement for H and 2, and thus the equilibrium is $(H - 1, L - 2)$.

4.2 Case 2: If the retailer 2 chooses to bargain first with L

The corresponding sequence of bargaining is $(H - 1, L - 1, L - 2, H - 2)$. We first determine status-quo profits of firms for the negotiations $H - 1$ and $L - 2$ in this sequence.

- In case of a breakdown between L and 2, we determine the subgame equilibria for the sequence $\{H - 1, L - 1, H - 2\}$.[19]

Here, two potential subgame equilibria arise depending on a threshold l_2 defined by $\widehat{\Upsilon}_i^L = C2$[20]:

If $l > l_2$, the subgame equilibrium is $(L - 1, H - 2)$ and both 2 and L have a positive status-quo profit in their bargaining. If $l \leq l_2$, the subgame equilibrium is $(H - 1, H - 2)$ and thus only 2 has a positive status-quo profit in his bargaining with L. Let $\pi_2^{H,(H1,L1,H2)}$ and $\Pi_1^{L,(H1,L1,H2)}$ denote the respective

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[19]Note here that when the breakdown between L and 2 happens, 1 has already chosen to bargain first with H. We assume that 1 can not change the order of his negotiations when the sequence of bargaining starts again after a breakdown between L and 2. This assumption is made for simplicity but does not change qualitatively the result. The direct consequence is that we do not consider the subgame $(L - 1, H - 1, L - 2)$.

[20]C2 is given in appendix 7.2.2.

status-quo profit of firm 2 and L.[21]

The bargaining programme of firms L and 2 thus is:

$$\underset{w_2^L, T_2^L}{Max}(\pi_2^{L,(H1,L1,L2,H2)} - \pi_2^{H,(H1,L1,H2)})^\alpha(\Pi_2^{L,(H1,L1,L2,H2)} - \Pi_1^{L,(H1,L1,H2)})^{(1-\alpha)}$$

(13)

where
$$\pi_2^{L,(H1,L1,L2,H2)} = (P_2^L(q_2^{Lm}) - w_2^L)q_2^{Lm} - T_2^L$$

and
$$\Pi_2^{L,(H1,L1,L2,H2)} = w_2^L q_2^{Lm} + T_2^L - C(q_2^{Lm})$$

- In case of a breakdown between H and 1, parties realize the profits associated to the subgame $(L-1, H-2, L-2)$.[22]

There exist only one equilibrium of this subgame $(L-1, H-2)$ and the status-quo profits of firms 1 and H are respectively denoted $\pi_1^{L,(L1,H2,L2)}$ and $\Pi_2^{H,(L1,H2,L2)}$.[23]

The bargaining between H and 1 then solves the following programme:

$$\underset{w_1^H, T_1^H}{Max}(\pi_1^{H,(H1,L1,L2,H2)} - \pi_1^{L,(L1,H2,L2)})^\alpha(\Pi_1^{H,(H1,L1,L2,H2)} - \Pi_2^{H,(L1,H2,L2)})^{(1-\alpha)}$$

(14)

where
$$\pi_1^{H,(H1,L1,L2,H2)} = (P_1^H(q_1^{Hm}) - w_1^H)q_1^{Hm} - T_1^H$$

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[21] These expressions are given in appendix 7.2.2.

[22] In case of a breakdown between H and 1, 2 hasn't chosen yet the order of her bargaining with producers. At the second round of bargaining (absent H-1), the retailer 2 is still free to choose either the sequence $(L-1, H-2, L-2)$ or $(L-1, L-2, H-2)$. It is clear that the subgame $(L-1, H-2, L-2)$ is strictly preferred by retailer 2.

[23] These expressions are given in appendix 7.2.2.

and

$$\Pi_1^{H,(H1,L1,L2,H2)} = w_1^H q_1^{Hm} + T_1^H - C(q_1^{Hm})$$

Solving the two programmes (13) and (14), we obtain the following lemma:

Lemma 8 *On equilibrium* $(H1, L2)$*, the wholesale tariff is always equal to the marginal cost of production and contracts are always efficient.*
Retailers' equilibrium payoffs are:

$$\pi_1^{H,(H1,L1,L2,H2)} = \frac{\alpha(\alpha(1+\alpha)\widehat{\Upsilon}_i^H + (1 - \alpha + \alpha^2 - \alpha^3)\widehat{\Upsilon}_i^L + \alpha(1-\alpha)\Upsilon_{12}^{L*})}{1+\alpha}$$

(15)

and

$$\pi_2^{L,(H1,L1,L2,H2)} = \begin{array}{ll} \frac{\alpha((1+\alpha)\widehat{\Upsilon}_i^L - (1-\alpha)^2\widehat{\Upsilon}_i^H + (1-\alpha)\Upsilon_{12}^{H*})}{1+\alpha} & if\, l \leq l_2 \\ = \alpha(\widehat{\Upsilon}_i^H(1-\alpha) + \alpha\widehat{\Upsilon}_i^L) & if\, l > l_2 \end{array}$$

(16)

Proof. see Appendix 7.2.2. ∎
We then check that the corresponding profits for retailers 1 and 2 are strictly higher than their status-quo profit in the bargaining. We show that the retailer 2 may find profitable to precipitate a breakdown with L and simply bargain with H if $l < l_3$ where l_3 is such that $\widehat{\Upsilon}_i^L = C3$.[24] We finally obtain the following lemma:

Lemma 9 *If the retailer 2 has chosen to bargain first with L, there is an equilibrium* $(H1, L2)$ *if* $l > l_3$ *and an equilibrium* $(H1, H2)$ *if* $l \leq l_3$.

In the next section, we first determine the optimal order of bargaining for the retailer 2 and then check that anticipating this choice, 1 always chooses to bargain first with H.

4.3   Game (II) Equilibria

To derive equilibria of game (II), we now compare profits obtained by the retailer 2 in the two sequences, $\pi_2^{H,(H1,L1,H2,L2)}$ and $\pi_2^{L,(H1,L1,L2,H2)}$. Comparing

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[24]The exact value of C3 is given in appendix 7.2.2.

retailer's profit, we obtain a new threshold of quality l_4 defined by $\widehat{\Upsilon}_i^L = C4$. [25] . Ordering the different thresholds l_1, l_2, l_3 and l_4 obtained in the previous section, we obtain the following lemma:

Lemma 10 *Whatever $\alpha \in]0,1]$ and $l \in [0,h]$, $l_3 < l_4 \leq l_1 \leq l_2$.*

Proof. See Appendix 7.2.3. ■

In our illustrative example, thresholds are represented graphically in appendix 7.2.4.
A comparison of retailer 2' profits then leads to the following lemma :

Lemma 11 *If $l < l_4$, retailer 2's best response is to choose to bargain first with H and if $l \geq l_4$ retailer 2's best response is to choose to bargain first with L.*

Proof. See appendix 7.2.3. ■

Since the retailer 1 arbitrarily starts in the bargaining process, he always has an incentive to choose to bargain first with the higher quality producer H. First, if he anticipates that 2 will also choose to bargain first with H (if $l \leq l_4$), then, by symmetry, his best response is also to bargain first with H. Second, if he anticipates that 2 will choose to bargain first with L (if $l > l_4$), two equilibria $(H1, L2)$ or $(L1, H2)$ could arise, but the retailer 1 gets a strictly higher profit bargaining first with H. We thus obtain the following proposition:

Proposition 12 *If $l \leq l_4$, the optimal sequence of bargaining is (H-1,L-1, H-2, L-2) and the equilibrium of game (II) is (H1,H2).*
If $l > l_4$, the optimal sequence of bargaining is (H-1,L-1, L-2, H-2) and the equilibrium of game (II) is (H1,L2).

Proof. Immediate from above. ■

Note that, on equilibrium, each retailer succeeds in his first bargaining. Indeed, when a retailer succeeds in his first bargaining, he always benefits from a strictly positive outside option profit from his potential bargaining with the second producer. In case his first negotiation fails, the whole sequence of negotiation would start again but the retailer would have no status-quo profit.

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[25]The exact value of C4 is given in appendix 7.2.3.

Comparative statics shows that l_4 tends towards $\bar{l}$ when α goes to 1. However, comparing l_4 to the threshold $\widetilde{l}$ obtained when retailers first commit on which product they sell in their shelves, as in game (I), we obtain the following proposition:

Proposition 13 *Producers' differentiation in order to improve buyer power is even more likely when retailers do not commit ex-ante on which product they stock but rather use all their outside options in the bargaining.*

Proof. We prove in appendix 7.2.3 that $l_4 < \widetilde{l}$. ∎

In the general case, the threshold l_4 strictly increases in α and the insight is exactly the same as in the previous section. When retailers' buyer power is strong, it is less likely that they will use producers' differentiation as a device to improve their buyer power. Comparative statics analysis gives that when $\alpha \to 0$, l_4 tends towards a threshold $\underline{l}$ such that $3\widehat{\Upsilon}_i^L + \widehat{\Upsilon}_i^H = \Upsilon_{12}^{H*} + \Upsilon_{12}^{L*}$. In that case, retailers have almost no exogenous bargaining power, however they still have a positive status-quo in their bargaining with each producer since they are not committed towards any of them. In the sequence $(H-1, L-1, H-2, L-2)$ the status-quo profit of retailer 2 is $\alpha\widehat{\Upsilon}_2^L$ which is strictly increasing in l. In the sequence $(H-1, L-1, L-2, H-2)$, the status-quo profit of firm 2 is independent of l.[26] Thus as l is closer to l^* even if the pie the retailer 2 can share with L is smaller than the pie he could share with H he captures a greater profit bargaining first with L and second with H. Thus, even for l smaller than l^* the second retailer will choose to bargain first with L. Concerning surplus and welfare, potential damages are worse in game (II) than in game (I) since retailer 2 choice to stock L may also hurt total industry profit (when $l < l^*$).

5   Downstream Competition

This section shows that our main results are robust if we introduce competition between retailers. This is shown solving game (I).[27] This section highlights the main changes introduced in game (I) when there is downstream competition between retailers, and more details are provided in Appendix 7.3.

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[26]Note that in game (II), the status-quo profit of firm 2 is independent of l as $l < l_2$.

[27]Indeed, to take into account downstream competition in game (II) is rather complex and is left for future research.

We assume that each retailer and her chosen producer bargain sequentially over a non linear contract (q_i^K, T_i^K). In this framework, quantities correspond to a Cournot competition equilibrium. Let $\widehat{\Phi}_2^L$ (resp. $\widehat{\Phi}_1^H$) denote the equilibrium joint profits of producer L and retailer 2 (resp. retailer 1 and producer H) when both retailers stock differentiated products. Let Φ_i^{H*} denote bilateral joint profits when both retailers buy from the same producer H. Let Φ_i^{Hm} (where m stands for monopoly) denote the joint profits a monopolist retailer would realize with the producer H. We obtain the following lemma:

Lemma 14 *When retailer* 1 *supplies from H:*

- *If the retailer* 2 *supplies from L, she gets a profit* $\pi_2^L = \alpha \widehat{\Phi}_2^L$;

- *If the retailer* 2 *supplies from H, she obtains:* $\pi_2^H = \alpha \Phi_i^{H*} + \frac{\alpha(1-\alpha)}{(1+\alpha)}(\Phi_i^{H*} - \Phi_i^{Hm})$.

Proof. See appendix 7.3. ∎

Comparing retailer 2's profit in the two cases, we highlight two main differences in comparison to the downstream separated market case. First, in the competition case, there still exist a threshold, $\overline{l^c}$ (where c stands for competition) such that the $\widehat{\Phi}_2^L \geq \Phi_2^{H*}$ if $l \geq \overline{l^c}$. However, contrary to the separated market case, two effects are in favor of the differentiation: (1) the reduction of cost thanks to the cost convexity and, (2) a differentiation effect that tends to relax downstream competition. Still, the differentiation strategy is not chosen by the retailer 2 if the downgrading in quality is too high (if $l < \overline{l^c}$). Comparing the share of joint profits the retailer is able to capture in the competition case, as $\Phi_2^{H*} < \Phi_i^{Hm}$ whatever the cost function, the retailer 2 always gets a smaller share of the pie when he deals with H rather than with L. This is the second difference with the separated market case: here cost convexity is not a necessary condition for the retailer to obtain a smaller share of the pie when dealing with H rather than with L. Indeed, outside of the cost convexity effect, there is a quantity effect. In case of a breakdown in the bargaining between H and 2, H bargains only with 1, and both knowing it, they now agree on a quantity corresponding to the monopoly level. This effect tends to increase the producer H status-quo profit when he bargains with both retailers and thus to decrease the share of the joint profits each retailer obtains in equilibrium. We thus obtain the following proposition:

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Proposition 15 *With competitive externalities at the downstream level, retailers may choose to differentiate only in purpose of raising their buyer power towards their supplying producer. Contrary to the separated market case, this effect also arises when producers' cost are linear or weakly concave.*

Proof. See appendix 7.3. ■

When analyzing the consequences for consumer surplus in the framework of our illustrative example, we show that producer's differentiation may hurt consumer surplus when the cost convexity is not too strong. Indeed, when production costs are convex, producers' differentiation allows a retailer to lower the marginal cost and the latter economies are partly passed through to consumers.

6   Conclusion

This article first highlights a new source of buyer power. Indeed, convexity of costs (or capacity constraints) at the production level explains why larger retailers have a greater buyer power towards producers (see Inderst and Wey (2005)), but we prove here that it also guarantees that producer's market power increases with the number of his outlets. We thus show that by choosing producers' differentiation, this may be a source of buyer power for retailers. This result holds either if retailers can first commit on the product they stock, or if they only choose the order of their bargaining with the different producers. Second, in a framework where producers offer products differentiated in quality, this paper shows that retailers may choose to differentiate their product lines with the only purpose to raise their buyer power. Indeed, a retailer may have an incentive to supply towards a lower quality good producer because the latter will have in equilibrium a lower market power than the high quality good producer, due to a smaller number of outlets. This incentive is even larger when retailers do not commit ex-ante on which product they stock. In fact, we show that product differentiation to increase buyer power is even more likely in this case.

The results in this article imply that a capacity constrained retailer may not always offer the "best product" for consumers. When production costs are convex, producers' differentiation allows a retailer to lower the marginal cost and the latter economies may be partly passed through to consumers. However, the total effect on consumers and welfare is still negative as long as the

degree of convexity is not too strong. In another framework where producers would offer horizontally differentiated products and one of them would be less efficient, a retailer could also improve her buyer power in supplying from the less efficient producer. Such a strategy could also harm consumer surplus and welfare.

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7   Appendices

7.1   Game (I)

7.1.1   Proof of lemma 1

¿From maximizing the Nash program in (4), we obtain the two first order conditions:

$$(1-\alpha)\frac{\partial \Pi_i^K/\partial w_i^K}{\Pi_i^K} + \alpha\frac{\partial \pi_i^K/\partial w_i^K}{\pi_i^K} = 0 \tag{17}$$

$$(1-\alpha)\frac{\partial \Pi_i^K/\partial T_i^K}{\Pi_i^K} + \alpha\frac{\partial \pi_i^K/\partial T_i^K}{\pi_i^K} = 0 \tag{18}$$

where (18) can be rewritten as

$$(1-\alpha)\pi_i^K = \alpha\Pi_i^K. \tag{19}$$

Using (17) and (19), we obtain

$$\frac{\partial \Upsilon_i^K}{\partial w_i^K} = 0 \Leftrightarrow \frac{\partial P_i^K(q_i^K)}{\partial q_i^K}q_i^K + P_i^K(q_i^K) - \frac{\partial C(q_i^K)}{\partial q_i^K} = 0. \tag{20}$$

From (2) we know that: $w_K^i = \frac{\partial P_i^K(q_i^K)}{\partial q_i^K}q_i^K + P_i^K(q_i^K)$ when $q_i^K = q_i^{Km}$.
Substituting in (19) and (20), we get:
$\widehat{w}_K^i = \frac{\partial C(q_i^K)}{\partial q_i^K}\big|_{q_i^K = q_i^{Km}(\widehat{w}_K^i)}$ and $\pi_i^K = \alpha\Upsilon_i^{K*}$

7.1.2   Proof of proposition 2

Rewriting the Nash program (8), we obtain the symmetric equilibrium tariff

$$T_i^{K*} = T_j^{K*} = \frac{(1-\alpha)P(q_i^{K*}+q_j^{K*})q_i^{K*} + \alpha C(q_i^{K*}+q_j^{K*}) + \alpha(1-\alpha)\widehat{\Upsilon}_i^K}{1+\alpha} \tag{21}$$

Replacing in (13) and using $\Upsilon_i^{K*} = P(q_i^{K*}+q_j^{K*})q_i^{K*} - \frac{1}{2}C(q_i^{K*}+q_j^{K*})$, we obtain (10) by symmetry.

7.1.3 Proof of lemma 3

By definition, when $l = 0$, $\widehat{\Upsilon}_2^L = 0$. We then prove that if $l = h$, $\widehat{\Upsilon}_2^L > \Upsilon_2^{H*}$ in two steps as two changes are induced when retailer 2 stocks L rather than H.

(i) Assume that the marginal cost w_2^{H*} and optimal quantities q_2^{H*} are unchanged, then, if $l = h$, the choice of L has a strictly beneficial effect through the cost convexity. The cost reduction would simply be: $-C(q_2^{H*}) + C(2q_2^{H*})/2 > 0$. Thus, $\widehat{\Upsilon}_2^L(q_2^{H*}(w_2^{H*})) > \Upsilon_2^{H*}(q_2^{H*}(w_2^{H*}))$.

(ii) When 2 stocks L, the marginal cost is reduced from w_2^{H*} to $\widehat{w}_2^L$ and thus optimal quantities increase from q_2^{H*} to $\widehat{q}_2^L$ and we know that $\widehat{\Upsilon}_2^L\left(\widehat{q}_2^L\left(\widehat{w}_2^L\right)\right) > \widehat{\Upsilon}_2^L\left(q_2^{H*}\left(w_2^{H*}\right)\right)$ since $\widehat{w}_2^L$ maximizes the vertically integrated profits.

¿From (i) and (ii) we have proved that when $l = h$, $\Upsilon_2^{H*}\left(q_2^{H*}\left(w_2^{H*}\right)\right) < \widehat{\Upsilon}_2^L\left(\widehat{q}_2^L\left(\widehat{w}_2^L\right)\right)$.

7.1.4 Illustrative example

- When the two retailers stock H

The equilibrium contract is $w_i^{K*} = \frac{c}{1+c}$ and $T_i^{K*} = \frac{2+c(1-\alpha)-2(1+c)^2\alpha^2}{4(1+c)^2(2+c)(1+\alpha)}$ for $i = 1, 2$. Equilibrium total joint profit is $\Upsilon_{12}^{H*} = \frac{1}{2+2c}$ and $\Upsilon_1^{H*} = \Upsilon_2^{H*} = \frac{\Upsilon_{12}^{H*}}{2}$ The share of the joint profits with the producer the retailer captures $\gamma = \frac{2\alpha(1+\alpha(1+c))}{(1+\alpha)(2+c)} < \alpha$ and γ strictly decreases with c.

Consumer surplus is $S^* = \frac{1+2c}{4(1+c)^2}$.

- If one retailer stocks L

The equilibrium contract is $\widehat{w}_1^H = \frac{c}{2+c}$ and $\widehat{T}_1^H = \frac{2-c}{4(2+c)^2}$ between H and 1 and $\widehat{w}_2^L = \frac{cl}{2l+c}$ and $\widehat{T}_{12}^L = \frac{(2l-c)l^2}{4(2l+c)^2}$ between 2 and L. Equilibrium joints profits are: $\widehat{\Upsilon}_1^L = \widehat{\Upsilon}_2^L = \frac{l^2}{2(c+2l)}$
$\widehat{\Upsilon}_1^H = \widehat{\Upsilon}_2^H = \frac{1}{2(c+2)}$. In this example, our main assumption is always true: $\widehat{\Upsilon}_2^L(l)$ strictly increases in l.
$\widehat{S} = \frac{1}{2}\left(\frac{1+c}{(2+c)^2} + \frac{l^2(c+l)}{(c+2l)^2}\right)$. The latter equilibrium outcome values are all strictly increasing in l.

- To sum-up equilibrium values are:

$$\widehat{\Upsilon}_1^L = \widehat{\Upsilon}_2^L = \frac{l^2}{2(c+2l)}$$
$$\widehat{\Upsilon}_1^H = \widehat{\Upsilon}_2^H = \frac{1}{2(c+2)}$$
$$\Upsilon_{12}^{H*} = 2\Upsilon_1^{H*} = 2\Upsilon_2^{H*} = \frac{1}{2+2c}$$
$$\Upsilon_{12}^{L*} = \frac{l^2}{2(c+l)}$$

- The formulae of the main thresholds are:

$$\widetilde{l} = \frac{cX}{(\sqrt{((2+c)(1+2c(1+c)) - \alpha(1+c)^3)}X - X}$$

where

$$X = (2 - \alpha + (1-\alpha)c);$$

and

$$\bar{l} = \frac{1 + \sqrt{1 + 2c + 2c^2}}{2(1+c)}$$

$$l^* = \frac{1 + \sqrt{1 + 2c + 3c^2 + c^3}}{2 + 3c + c^2}$$

We do not give the explicit value of thresholds l^s and l^{s2} since their expressions are complex and not instructive. As $c \to \infty$, $l^s \to 0$ while $\bar{l} \to \frac{1-\alpha}{\sqrt{(2-\alpha)(1-\alpha)}}$. The difference $l^{s2} - \bar{l}$ strictly decreases in c and $l^{s2} - \bar{l} \to 0$ as $c \to \infty$.

7.2 Game (II)

7.2.1 Sequence (H-1,L-1,H-2,L-2)

The status-quo profits in the bargaining (H-i) are derived from the solving of the subgame $(L-1, H-2, L-2)$.

- In case of a breach between H and 2. The sequence $(L-1, L-2)$ gives the following status-quo profit to retailer 2:
$\pi_2^{L,(L-1,L-2)} = \frac{\alpha(\Upsilon_{12}^{L*} - (1-\alpha)\widehat{\Upsilon}_i^L)}{1+\alpha}$ and H has no status-quo profit.

- In case of a breach between L and 1. The sequence $(H-2, L-2)$ takes place, and, anticipating a success between H and 2, L and 1 have no status-quo in their bargaining.

The status-quo profits of firms H and i thus are:
$$\pi_i^{L,(Li,Hj,Lj)} = \alpha \widehat{\Upsilon}_i^L;$$

$$\Pi_j^{H,(Li,Hj,Lj)} = \frac{(1-\alpha)(\widehat{\Upsilon}_i^H(1+\alpha)-\alpha^2\widehat{\Upsilon}_i^L-\alpha(\Upsilon_{12}^{L*}-\widehat{\Upsilon}_i^L))}{1+\alpha}.$$

Equilibrium $(H-1, H-2)$ profits are given in lemma 6.

None of the retailers has any incentive to precipitate a breakdown and negotiate only with L iif:
$\pi_i^{H,(H1,L1,H2,L2)} \geq \pi_i^{L,(L-i,H-j,L-j)}$, thus if $\widehat{\Upsilon}_i^L \geq C1$ where $C1$ is:

$$C1 = \frac{(1-\alpha)\Upsilon_{12}^{L*}}{3+\alpha^2} + \frac{(1+\alpha)\Upsilon_{12}^{H*} - (1-\alpha^2)\widehat{\Upsilon}_i^H}{\alpha(3+\alpha^2)} \tag{22}$$

7.2.2 Sequence (H-1,L-1,L-2,H-2)

We first solve the bargaining between H and 1 when both anticipate that 2 will succeed in his bargaining with L. The status-quo profits are derived from the subgame $(L-1, H-2, L-2)$. Indeed, in case of a breach between H and 1, 2 always chooses to bargain first with H rather than with L. Since he hasn't played yet, he can choose freely this order of negotiation and thus we only need to analyze the subgame $(L-1, H-2, L-2)$. The sequence $(L-1, H-2, L-2)$ gives the following status-quo profit:
$\pi_1^{L,(L1,H2,L2)}$ and $\Pi_2^{H,(L1,H2,L2)}$ previously defined. $(L1-H2)$ is always an equilibrium of this subgame.

Second, we solve the bargaining between L and 2 when both know that H had succeeded with 1. In that case, we analyze the subgame $(H-1, L-1, H-2)$.[28] $C2$ is defined as:

$$C2 = \frac{\Upsilon_{12}^{H*} - (1-\alpha)\widehat{\Upsilon}_i^H}{\alpha(1+\alpha)} \tag{23}$$

- If $\Upsilon_i^L \geq C2$, there is an equilibrium $(L1, H2)$ and status-quo profits are:
  $\pi_2^{H,(H1,L1,H2)} = \alpha \widehat{\Upsilon}_i^H$ and $\Pi_2^{L,(H1,L1,H2)} = (1-\alpha)\widehat{\Upsilon}_i^L$

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[28]Note here that in case of a breach between L and 2, 1 has already chosen to bargain first with H and this information has been made public, so that when re-negotiating, he cannot change the order of his negotiation and thus only the subgame $(H-1, L-1, H-2)$ (and not (L-1,H-1,H-2)) is considered.

- If $\Upsilon_i^L < C2$, there is an equilibrium $(H1, H2)$ and status-quo profits are:
$\pi_2^{H,(H1,L1,H2)} = \frac{\alpha(\Upsilon_{12}^{H*} - (1-\alpha)\widehat{\Upsilon}_i^H)}{(1+\alpha)}$ and $\Pi_2^{L,(H1,L1,H2)} = 0$

Equilibrium $(H-1, L-2)$ profits are given in lemma 8. We check that the retailer 2 's profit when bargaining with L is always higher than his status-quo profit he would get precipitating a breakdown with L and thus bargaining only with H: $\pi_2^{L,(H1,L1,L2,H2)} \geq \pi_2^{H,(H1,L1,H2)}$. We thus obtain a threshold l_3 defined by $\widehat{\Upsilon}_i^L = C3$ where

$$C3 = \frac{\alpha(\Upsilon_{12}^{H*} - (1-\alpha)\widehat{\Upsilon}_i^H)}{1+\alpha}. \tag{24}$$

7.2.3 Equilibria of game (II)

Comparing retailer 2's equilibrium profits according to the order of his negotiations with his producers, $\pi_2^{H,(H1,L1,H2,L2)}$ and $\pi_2^{L,(H1,L1,L2,H2)}$, we obtain a threshold l_4 defined as follows: $\widehat{\Upsilon}_i^L = C4$ where

$$C4 = \frac{(1-\alpha)\Upsilon_{12}^{L*}}{3+\alpha^2} + \frac{(1+\alpha)\Upsilon_{12}^{H*} - (1-\alpha^2)\widehat{\Upsilon}_i^H}{3+\alpha^2} \tag{25}$$

- Proof of lemma 10

l_2 is such that $\widehat{\Upsilon}_i^L = C2$ where

$$C2 = \frac{\Upsilon_{12}^{H*} - (1-\alpha)\widehat{\Upsilon}_i^H}{\alpha(1+\alpha)}. \tag{26}$$

l_3 is such that $\widehat{\Upsilon}_i^L = C3$ where

$$C3 = \frac{\alpha(\Upsilon_{12}^{H*} - (1-\alpha)\widehat{\Upsilon}_i^H)}{1+\alpha}. \tag{27}$$

It is immediate that $l_3 < l_2$ as $C3 < C2$ and both C3 and C2 are independent of l.
l_1 is defined by $\widehat{\Upsilon}_i^L = C1$ where $C1$ is:

$$C1 = \frac{(1-\alpha)\Upsilon_{12}^{L*}}{3+\alpha^2} + \frac{(1+\alpha)\Upsilon_{12}^{H*} - (1-\alpha^2)\widehat{\Upsilon}_i^H}{\alpha(3+\alpha^2)}. \tag{28}$$

Let first prove that l_1 and l_4 are both uniquely defined. The proof is derived below for l_1 and is identical for l_4.

$\widehat{\Upsilon}_i^L = C1$ can be rewritten as:

$\widehat{\Upsilon}_i^L - \frac{(1-\alpha)\Upsilon_{12}^{L*}}{3+\alpha^2} = C1'$ where $C1'$ does not depend on l. The left hand part

is $\frac{\widehat{\Upsilon}_i^L(3+\alpha^2)-(1-\alpha)\Upsilon_{12}^{L*}}{3+\alpha^2}$. By assumption, both $\widehat{\Upsilon}_i^L$ and Υ_{12}^{L*} strictly increase in l

and due to cost convexity, we know also that:

$\widehat{\Upsilon}_i^L \geq \frac{\Upsilon_{12}^{L*}}{2}$ and thus $\frac{\widehat{\Upsilon}_i^L(3+\alpha^2)-(1-\alpha)\Upsilon_{12}^{L*}}{3+\alpha^2} > A$ where :

$A = \frac{(1+\alpha)^2\Upsilon_{12}^{L*}}{2(3+\alpha^2)}$.

A strictly increases in l and thus l_1 is uniquely defined.

Comparing expressions of $C1$ and $C4$, it is immediate that $l_4 < l_1$.

As $\Upsilon_{12}^{H*} > \Upsilon_{12}^{L*}$, let B denote a higher bound for $C4$ where $B = \frac{(1-\alpha)\Upsilon_{12}^{H*}}{3+\alpha^2} + \frac{(1+\alpha)\Upsilon_{12}^{H*}-(1-\alpha^2)\widehat{\Upsilon}_i^H}{3+\alpha^2}$.

$$B \leq C2$$
$$\Rightarrow \frac{(1-\alpha)(3(\Upsilon_{12}^{H*}-\widehat{\Upsilon}_i^H)+\widehat{\Upsilon}_i^H(\alpha+\alpha^2+\alpha^3)+\alpha\Upsilon_{12}^{H*}}{\alpha(1+\alpha)(3+\alpha^2)} \geq 0$$

which is always true since $\Upsilon_{12}^{H*} \geq \widehat{\Upsilon}_i^H$ and thus $l_2 > l_4$. Finally it is also immediate that $C4 > C3$ and thus, $l_4 > l_3$.

- Proof of proposition 13

Comparing l_4 to $\widetilde{l}$, we obtain:

$$\widetilde{l} \geq l_4 \Rightarrow 2\Upsilon_{12}^{H*} - 2\widehat{\Upsilon}_i^H(1-\alpha) \geq (1+\alpha)\Upsilon_{12}^{L*} \qquad (29)$$

As we focus on convex cost function, we have $\Upsilon_{12}^{L*} < 2\widehat{\Upsilon}_i^L$. Replacing in the above inequality we now prove that:

$$\Rightarrow \Upsilon_{12}^{H*} - 2\widehat{\Upsilon}_i^H(1-\alpha) \geq 2(1+\alpha)\widehat{\Upsilon}_i^L$$
$$\Rightarrow \Upsilon_{12}^{H*} - \widehat{\Upsilon}_i^H(1-\alpha) \geq (1+\alpha)\widehat{\Upsilon}_i^L$$
$$\Rightarrow \Upsilon_{12}^{H*} \geq \widehat{\Upsilon}_i^H + \widehat{\Upsilon}_i^L - \alpha(\widehat{\Upsilon}_i^H - \widehat{\Upsilon}_i^L)$$

We know from section 3.3 that $\widetilde{l}$ goes to l^* when α tends towards zero and thus reaches its minimum defined by $\Upsilon_{12}^{H*} = \widehat{\Upsilon}_i^H + \widehat{\Upsilon}_i^L$. Thus whatever, the value of α, we have $l_4 > \widetilde{l}$.

7.2.4 Illustrative case

Thresholds and equilibria area are represented in the following graphic, for $\alpha = \frac{1}{2}$.

Game II:
Illustrative example: α=0,5
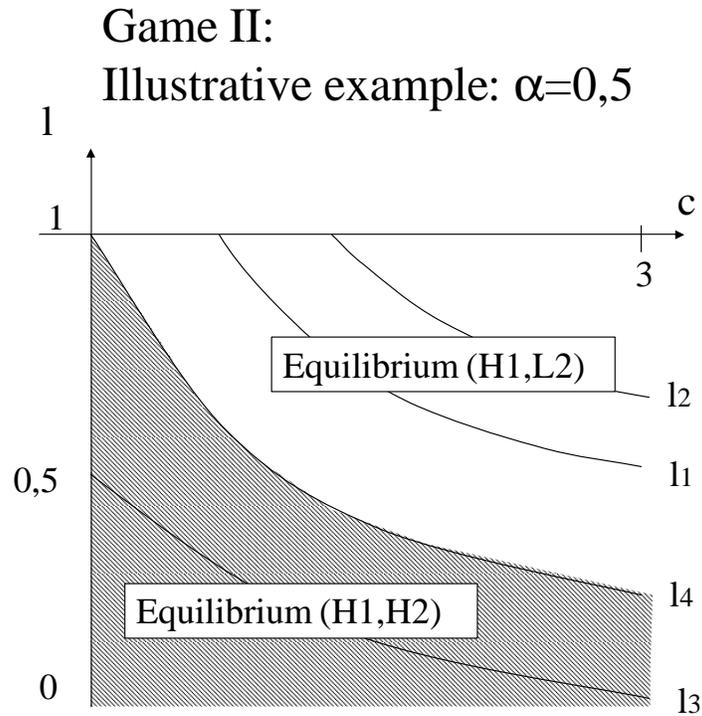
Figure 2: Thresholds in Game (II) for $\alpha = \frac{1}{2}$

7.3 Extension to Downstream Competition

We choose here the framework of assumptions used by de Fontenay and Gans (2005). Details of the analytical proof are available in their paper. Still we need to adapt their analysis to our vertical differentiation framework.
The demand structure is as follows:

- When only good H is sold in the final market, consumers buy the good H as long as $S(\theta) \geq 0$ and thus the total demand for good H is

$Q^{HH} = \int_{\frac{P_i^K}{k}}^{\bar{\theta}} f(\theta)d\theta$. Let $P^{HH}\left(Q^{HH}\right)$ denote the corresponding inverse demand function for good H on the market. In equilibrium, the total quantity offered equals demand, and so $Q^{HH} = \sum_i q_i^{HH}$.

- In case the two products are now offered in the market, the consumer θ now compares his surplus if he buys the product H, $S^H(\theta) = \theta h - P_1^H$, or the product L, $S^L(\theta) = \theta l - P_2^L$. The consumer that exactly indifferent between buying H or L has a type $\widetilde{\theta} = \frac{P_1^H - P_2^L}{h-l}$. Total demand for good H at 1 is thus $q_1^H = \int_{\widetilde{\theta}}^{\bar{\theta}} f(\theta)d\theta$ and the total demand for good L at 2 is thus $q_2^L = \int_{\frac{P_2^L}{l}}^{\widetilde{\theta}} f(\theta)d\theta$. Let $P_1^H\left(q_1^H, q_2^L\right)$ and $P_2^L\left(q_1^H, q_2^L\right)$ denote the corresponding inverse demand functions.

- Proof of lemma (14):

In case (H, L), the bargaining equilibrium leads to the optimal quantities that respectively maximize bilateral joint profits :

$$\Phi_2^L = P_2^L(q_1^H, q_2^L)q_2^L - C(q_2^L) \tag{30}$$

$$\Phi_1^H = P_1^H(q_1^H, q_2^L)q_1^H - C(q_1^L) \tag{31}$$

This simply leads to the optimal Cournot quantities. Let $\widehat{\Phi}_1^H$ and $\widehat{\Phi}_2^L$ denote the corresponding equilibrium value. As no firm has any status-quo in his bargaining with the other, retailers and producers simply share their joint profit according to $(\alpha, 1 - \alpha)$.

In case (H, H), the bargaining equilibrium leads to the optimal quantities that respectively maximize the following bilateral joint profits :

$$\Phi_1^H = P^{HH}(q_1^H, q_2^H)q_1^H - C(q_1^H + q_2^H) \tag{32}$$

$$\Phi_2^H = P^{HH}(q_1^H, q_2^H)q_2^H - C(q_1^H + q_2^H) \tag{33}$$

Let Φ_i^{H*} $(i = 1, 2)$ denote the corresponding equilibrium value. As producer H has a status-quo in his bargaining, let rewrite the first order condition as :

$$(1 - \alpha)\frac{\frac{\partial \Pi_i^H}{\partial T_i^H}}{\Pi_1 2^H - \Pi_i^{Hm}} + \alpha\frac{\frac{\partial \pi_i^H}{\partial T_i^H}}{\pi_i^H} = 0 \tag{34}$$

where

$$\Pi_1 2^H = T_1^H + T_2^H - C(q_1^H + q_2^H) \tag{35}$$

and

$$\Pi_i^{Hm} = (1 - \alpha)\Phi_i^{Hm} \tag{36}$$

Solving equation (34) we obtain (14).

- Illustrative example

In our illustrative case, we obtain:

$\widehat{\Phi}_1^H = \frac{(2+c)(c+(2-l)l)^2}{2(c^2+(4-l)l+2c(1+l))^2}$

$\widehat{\Phi}_2^L = \frac{(1+c)^2 l^2 (c+2l)}{2(c^2+(4-l)l+2c(1+l))^2}$

$\Phi_i^{Hm} = \frac{1}{4+2c}$

$\Phi_i^{H*} = \frac{(1+c)}{(3+2c)^2}$