Full-line Forcing and Product Assortment in Vertically Related Markets*

Claire Chambolle[†] Hugo Molina[‡]

Preliminary Draft

December 10, 2018

Abstract

This article examines the effects of full-line forcing arrangements whereby a multi-product manufacturer requires a retailer to distribute its entire product line on the market. We highlight that the presence of buyer power is a key condition for the emergence of full-line forcing, which triggers exclusion of an efficient rival supplier to the detriment of both the retailer and the industry profit. We show that the retailer is able to counteract these adverse effects by expanding its stocking capacity. Among the policy implications drawn from our model, we argue that banning full-line forcing may be inefficient as it restores the retailer's incentive to restrict its stocking capacity for a rent-extraction motive.

*We thank Marie-Laure Allain, Özlem Bedre-Defolie, Alexandre de Cornière, Alon Eizenberg, Robin S. Lee, Laurent Linnemer, João Montez, Patrick Rey, Howard Smith, Thibaud Vergé, and Christian Wey for helpful discussions. We gratefully acknowledge support from the Agence Nationale de la Recherche (ANR) and the Deutsche Forschungsgemeinschaft (DFG) for the French-German cooperation project "Competition and Bargaining in Vertical Chains".

†INRA–UR1303 ALISS, 65 boulevard de Brandebourg 94205 Ivry-sur-Seine, France; CREST, Ecole Polytechnique; claire.chambolle@inra.fr.

‡Department of Economics, KU Leuven, hugo.molina@kuleuven.be.

1 Introduction

Selling products in packages to retailers is a convenient device for multi-product manufacturers who seek to impose their brand portfolio on the market. Such a practice, often referred to as full-line forcing or pure bundling strategy, appears to be widely used in vertical chains of various industries as reported by many competition cases both in Europe and in the United States. In 2005, a commitment decision adopted by the European Commission against commercial practices of The Coca-Cola Company (TCCC) provided evidence that: "[...] TCCC and its bottlers refused to supply a customer with only one of their brands unless the customer was willing to carry other carbonated soft drinks (CSDs) [...]".[1] Similarly, in the U.S. case law *Cablevision v. Viacom* (2013), Cablevision complained against Viacom's commercial practices which consisted in forcing it to buy less popular channels in order to offer Viacom's popular channels to consumers.[2] Inquiries conducted by the European Commission revealed analogous practices by which Google conditioned the licensing of its application store Google Play upon pre-installing other applications (e.g., Google Search, Google Chrome browser).[3] Through this bundling practice, Google was convicted to limit competition on the browser or search engine markets and condemned to pay a record fine of €4.34 billion in 2018. A few empirical studies have also revealed the use of such vertical practices. For instance, in the U.S. video rental industry, Ho, Ho and Mortimer (2012*a*,*b*) have analyzed the effects of contractual agreements requiring a rental store to buy all the release of a video distributor during the contract duration in exchange for a low per tape price.

From a competition policy perspective, the main concern about pure bundling strategies is the risk of rivals' foreclosure. As pointed out by the European Commission (§ 34) in the TCCC case presented above: "making the supply of the strongest TCCC brands conditional upon the purchase of less-selling CSDs and non-CSDs leads to foreclosure of rival suppliers [...] This reduces the variety for final consumers and avoids downward pressure on prices". The risk of foreclosure is indeed particularly worrisome when retailers are severely

[1] See. Case COMP/A.39.116/B2 – Coca-Cola.

[2] See U.S. District Court 2013.

[3] See http://europa.eu/rapid/press-release_MEMO-16-1484_en.htm.

constrained in capacity.[4] Potential anticompetitive bundling practices were also largely debated in several merger cases in Europe (e.g., Guiness-Grand Metropolitan, 1997; Procter and Gamble-Gillette, 2004; Pernod Ricard-Allied Domecq, 2004).

This article aims to analyze the role of full-line forcing as a competitive tool to foreclose a rival in vertically related markets. We examine a setting in which two competing manufacturers supply their products through a monopolist retailer. The multi-product manufacturer owns two differentiated products, that is, a leading brand (H) and a secondary brand (L). The single-product rival also produces a secondary brand (M) which generates more value than the secondary brand of the multi-product manufacturer (L) and less value than the leading brand (H). We first consider that the monopolist retailer has a limited shelf space: it only offers two among the three existing products to consumers. Although the welfare is maximized when the assortment HM is sold by the retailer, we show that the multi-product manufacturer may impose the assortment HL to the retailer by adopting a full-line forcing strategy. To show this, we assume that the multi-product manufacturer and its rival first simultaneously compete by offering slotting fees (i.e., upfront fixed payments) to secure a slot for their product(s) on the retailer's shelves.[5] The multi-product manufacturer may either offer a fee for each independent product together with a fee for the bundle (mixed bundling) or opt for a full-line forcing strategy, i.e. a unique slotting fee for the bundle (pure bundling). The retailer then chooses its product assortment and receives the corresponding fees from the selected manufacturer(s). Finally, the retailer and the selected manufacturer(s) bargain bilaterally and secretly over two-part tariff contracts.

If the multi-product manufacturer opts for a full-line forcing strategy, the retailer faces the following threat: distributing the secondary brand of the single-product manufacturer (M) implies to give up selling the leading brand (H). We find that, in equilibrium, the multi-product manufacturer may opt for a full-line forcing strategy, resulting in a product

[4] Further at § 35: "[...] this has the effect of making sales space in outlets harder to obtain for rival suppliers and of raising sale space prices for those suppliers."

[5] As in the FTC report (2001), 50% to 90% of all new grocery products would trigger the payment of slotting allowances. The FTC (2003) further mentions that: "[...] slotting allowances for introducing a new product nationwide could range from a little under [$]1 million to over 2 million, depending on the product category.

assortment HL and the exclusion of the rival's brand. This equilibrium is detrimental to the retailer, the rival, consumers and total welfare. This equilibrium is more likely to arise when (i) the retailer's bargaining power is high, (ii) the secondary brand of the single-product rival (M) is not too efficient, and (iii) the leading brand is a must-stock item. Otherwise, an equilibrium in which the multiproduct manufacturer opts for a mixed bundling strategy arises and results in the efficient product assortment HM.

We then assume that the retailer chooses its stocking capacity, i.e. the number of products to carry, in an *ex ante* stage. We prove that, irrespective of the manufacturer's strategy, when its bargaining power is low, the retailer prefers to restrict its capacity to either two or one slot, and the product assortment HM, HL or H may arise in equilibrium. Indeed, by restricting the number of products to carry, the retailer can then extract rent from the manufacturer(s) which engage in a fiercer competition to secure shelf space through the slotting fees. Now studying the interplay between the manufacturer's full-line forcing strategy and the retailer's capacity choice, we find that, interestingly, the retailer often prefers to expand its stocking capacity when it anticipates that the multi-product manufacturer would opt for a full-line forcing strategy. In doing so, the retailer is able to make ineffective a full-line forcing strategy because the multi-product manufacturer can no longer exclude its rival. The assortment of three products is thus offered in equilibrium which is optimal for welfare.

Our model brings new arguments for the competition policy debate both about full-line forcing and slotting fees practices. Indeed, we highlight that a ban on full-line forcing practices could increase the retailer's incentives to restrict its stocking capacity and, in turn, harm consumer surplus. In contrast, banning slotting fees always ensures that all products are offered to consumers in equilibrium, which *de facto* also eliminates any exclusionary effects of full-line forcing practices.

Two main motives are generally advanced in the literature to explain bundling strategies: discrimination and exclusion.[6] Our article directly relates to the second motive, and thus join to the "leverage theory" literature which highlights that a multi-product firm can profitably

[6]The seminal work by Adams and Yellen (1976) has first shown how a monopolist could have an incentive to bundle its products to better discriminate among consumers.

extend its monopoly position in one market to another market on which it faces actual or potential competition through a bundling strategy (e.g., Whinston, 1990; Choi, 1996; Carlton and Waldman, 2002; Nalebuff, 2004). Our article is also one of the few to analyse the leverage theory within a vertical channel. Closely related to our article is de Cornière and Taylor (2018) which, motivated by the Google-Android case, highlight a new rationale for bundling in a vertical chain. In their model, contracting frictions which directly limit the rent-extraction by the multi-product firm are key to explain the emergence of a profitable bundling strategy. Our article also shows that a full-line forcing strategy may foreclose an efficient rival's product, but in our setting, contracts are efficient. However, the existence of buyer power limits the multi-product firm rent extraction, which in turn explains the profitability of bundling in our model. Further away to our approach, Vergé (2002) extends the results of Carlton and Waldman (2002) to a setting of vertical relationships and highlights the use of full-line forcing as a tool to deter entry. This market foreclosure effect of bundling is also obtained by Ide and Montero (2018), but, in their approach, retail competition is the key for bundling to emerge in equilibrium.[7] Our modeling approach is also strongly related to a literature that analyzes the formation of buyer-seller networks in vertically related markets. Several articles have for instance analyzed the product assortment choice of retailers who face an exogenous capacity constraint. For instance, (e.g., Inderst and Shaffer, 2007; Marx and Shaffer, 2007; Chambolle and Villas-Boas, 2015) have shown that capacity constrained retailers would not offer the most efficient product assortment to consumers for buyer power motives. A few articles have further shown that the buyer power could also affect the size of the network.[8] Marx and Shaffer (2010) show that a retailer may find profitable to strategically restrict its stocking capacity to intensify the competition among suppliers on slotting fees and therefore extract a larger share of a lower industry profit. Ho and Lee (2018) develop a

[7] Absence retail competition, upstream firms are able to internalize their externalities and achieve the coordinated outcome as in the common agency literature (Bernheim and Whinston, 1985). Therefore, the multi-product supplier in their setting has no incentives to bundle its goods for exclusionary motives.

[8] Note that other factors affecting the buyer-seller network have also been emphasized in the literature. For example, Shepard (2016) highlights that adverse selection may discourage insurers from choosing high-quality hospitals in their networks. In a setting where the formation of links between an upstream and a downstream player involves mutual consent, Rey and Vergé (2017) show that the buyer-seller network structure crucially depends on the intensity of retail competition (see also Ramezzana, 2018).

setting in which an insurer first chooses its hospital network and then bargains within this network by threatening each member of replacement by other hospitals standing outside of the network. Again, they show that an insurer may have an incentive to narrow the size of its network to better extract rent from selected hospitals.[9] Interestingly, our vertical contracting and bargaining framework highlights appealing connections between the setting analysed by Marx and Shaffer (2010) and the solution concept developed in Ho and Lee (2018). In the same vein we find that a retailer can profitably restrict its stocking capacity to extract more rent from suppliers at the slotting fee competition stage. However, first and foremost our article highlights that a full-line line forcing strategy also directly impacts the market structure. Moreover, we highlight the interactions between the seller's marketing strategy and the retailer's stocking capacity choice and their combined effect on the market structure.

The article is organized as follows. Section 2 presents the model and notations. Section 3 highlights that a full-line forcing strategy can arise in equilibrium when the retailer is capacity constrained. Section 4 extends our model to analyze the retailer's choice to restrict its stocking capacity whether or not the multi-product manufacturer uses a full-line forcing strategy. Then, Section 5 discusses various implications in terms of competition policy and concludes.

2 The Model

We consider a market structure in which two manufacturers $i = \{1, 2\}$ compete to sell their products to a monopolist downstream firm, D, which resells to consumers. Products sold on the market are vertically differentiated and can either be of quality $q = \{H, M, L\}$ with $H > M > L > 0$. Manufacturer 1 is a multi-product firm which offers H and L, and manufacturer 2 is a single-product firm which produces M. We assume that D purchases and distributes at most two of the three existing products available on the upstream market,

[9] The use of network size restrictions for a buyer power motive is also analyzed by Ghili (2018) and Liebman (2018) under alternative frameworks. However, as in Ho and Lee (2018), the gain in bargaining leverage of a downstream firm stems from a similar mechanism, i.e., the ability to play upstream suppliers off against each other by exerting threats of replacement during negotiations.

i.e., it has $k = 2$ available slots.[10] This assumption is motivated by the fact that retailers often face capacity constraints in practice. Indeed, among all existing products, only a subset is usually present on retailers' shelves and sold to consumers. In this basic model, D cannot choose its stocking capacity; for instance it cannot further restrict its capacity to $k = 1$ slot. We then describe a more general model in which D chooses the number of slots it offers to manufacturers (cf. Section 4).

Industry Profits. The primitive profit functions which represent the maximum industry profit (i.e., the profit of a fully integrated industry) generated by each assortment of products are denoted as follows: Π^q when only product $q = \{H, M, L\}$ is sold on the market; Π^{HM}, Π^{HL} and Π^{ML} when HM, HL or ML are respectively offered on the market. We make the following assumptions:

Assumption A1 *Among all potential single product assortment, H generates the highest industry profit:*

$$\Pi^H > \Pi^M \geq \Pi^L > 0$$

Assumption A2 *Among all potential assortments of two products, HM generates the highest industry profit:*

$$\Pi^{HM} \geq \Pi^{HL} > \Pi^{ML} > 0$$

Assumption A3 *Any assortment of two products generates more profit for the industry than one of these products alone. Furthermore, products can be either imperfect substitutes or independent, which implies that any assortment of two products does not yield more surplus than the sum of industry profits generated by each product, e.g., $\Pi^H + \Pi^L \geq \Pi^{HL} > \Pi^H$.*

Timing and information. In what follows, we assume that manufacturer 1 can use two selling strategies when dealing with D: (i) a component strategy, or (ii) a full-line forcing strategy. If manufacturer 1 adopts a component strategy, it can sell either H, or L, or HL,

[10] As in Marx and Shaffer (2010), we assume that the sale of one product requires one slot of shelf space: a slot enables a manufacturer to satisfy consumers' demand for its product; without a slot, it cannot make any sales.

which is similar to a mixed bundling strategy. If instead manufacturer 1 chooses a full-line forcing strategy, it only offers HL, which is similar to a pure bundling strategy. We present below a short form game including 2 stages.

- Stage 1: Manufacturers simultaneously compete in slotting fees for an indivisible slot per product. Manufacturer 1 can either choose a component strategy by offering independent fees for each product and a fee for the bundle of goods, i.e., (S^H, S^L, S^{HL}); or a full line forcing strategy in which a unique fee S^{HL} is offered for the bundle of goods. Note that we restrict the space of slotting fees to positive values.[11] Manufacturer 2 offers S^M. Given its stocking capacity, $k = 2$, D accepts or rejects these offers.

- Stage 2: Given its product assortment decision, D engages in simultaneous bilateral negotiations with manufacturers to determine wholesale contracts. Contracts are secret and consist of a fixed fee F_i^q.

Equilibrium concept. Due to the presence of contracting externalities when D's assortment choice includes imperfect subtitutes products from different manufacturers, we use the bargaining protocol à la Horn and Wolinsky (1988), commonly referred to as the "Nash-in-Nash" bargaining solution, to determine wholesale contracts in stage 2.[12] This bargaining framework can be formulated as a "delegated agent" model in which delegates are sent by firms to negotiate wholesale tariffs on their behalf without being able to communicate with one another (even those coming from the same firm).[13] As negotiations are secret, it is assumed that each pair of delegates has passive beliefs over deals reached elsewhere, i.e., if an unexpected outcome arises from a bilateral negotiation delegates involved in the transaction do not revise their beliefs about all other secret deals (McAfee and Schwartz, 1994).[14] All

[11] Full-line forcing arises when no slotting fee is offered for separated products.

[12] This terminology has been coined by Collard-Wexler, Gowrisankaran and Lee (2017) as the solution of this bargaining model corresponds to a Nash equilibrium in prices negotiated by pairs of firms according to the Nash bargaining solution (Nash, 1950).

[13] More precisely, firms allocate one delegated agent to each bilateral negotiation.

[14] In other words, delegated agents conjecture the equilibrium outcome for other negotiations in all circumstances.

agreements being formed by pairs of delegated agents are considered to be binding.[15] We rely on Collard-Wexler, Gowrisankaran and Lee (2017) to motivate the use of this modelling approach. By extending the work of Binmore, Rubinstein and Wolinsky (1986) to bilateral oligopolies with contracting externalities, they show that a pure-strategy perfect Bayesian equilibrium with passive beliefs of a Rubinstein alternating offers game exists and converges to the "Nash-in-Nash" bargaining solution as the time between offers is sufficiently short.[16]

Combined with the competition for slots in stage 1, our setting enables products that are not offered in equilibrium to play a role in the division of surplus within the supply chain. Indeed, with a limited number of available slots D can generate a threat of not carrying all manufacturers' products on its shelves. Using the presence of outside alternatives, D may be able to replace a manufacturer's product if displeased with its offer. When credibly exercised, this threat can serve as a tool to stimulate competition between manufacturers, thereby strengthening D's bargaining power. Our framework thus closely relates to the literature on bargaining with outside options (e.g., Shaked and Sutton, 1984; Binmore, 1985; Binmore, Shaked and Sutton, 1989). This literature makes a distinction between (i) the *status quo* payoff of a bargainer which corresponds to his position if the negotiation lasts forever without reaching an agreement (i.e., no loss-no gain),[17] and (ii) a bargainer's outside option which refers to his best alternative if he unilaterally opts out from the bargaining process. Since D may gain bargaining leverage from the presence of non-offered products, the surplus division mechanism in our 2-stage game shares similarities with what Binmore, Shaked and Sutton (1989) refer to as the "deal-me-out" predictor of a bargaining outcome (i.e., outside options only affect outcomes if at least one bargainer receives less than his best

[15] In contrast to other bargaining concepts such as those proposed by Stole and Zwiebel (1996), Inderst and Wey (2003), or de Fontenay and Gans (2014), contract terms are neither revised, nor contingent upon bargaining breakdowns that could occur in the buyer-seller network structure determined in stage 1.

[16] This non-cooperative game-theoretic foundation for the "Nash-in-Nash" applies to environments that exhibit contracting externalities in which firm profits are affected by the set of agreements being formed but not by terms of trades (e.g., negotiations over fixed fees). Existence of a perfect Bayesian equilibrium with passive beliefs under such a Rubinstein alternating offers model is ensured when (i) there are always gains from trade between every pair of firms and, (ii) the surplus obtained by a firm from an agreement is (weakly) lowered as additional agreements are formed. In our setting, A3 satisfies these conditions.

[17] Other terminologies such as "disagreement point", "threat point", or "impasse point" are also employed (Binmore, Rubinstein and Wolinsky, 1986).

exit opportunity).

Contracts are efficient. As previously mentioned, our setting corresponds to a short form of a game in which D would instead bargain over an efficient two-part tariff contract (w_i, F_i) for each product with each manufacturer. In such a full game, wholesale prices are efficiently set at marginal cost and quantities sold would maximize the vertically integrated industry profit (as previously determined) regardless of the manufacturer's selling strategy.[18] Therefore, this full game is strictly equivalent to the short form game just presented in which the manufacturer and the retailer simply bargain over the lump-sum tariff to share the optimal industry profit.

Proceeding backwards, we first solve our 2-stage game in Section 3 and highlight the existence of a full-line forcing equilibrium when D has committed itself to distributing $k = 2$ products among H, M, and L. We then demonstrate in Section 4 that $k = 2$ may arise as an equilibrium of a more complex game with a preliminary stage in which D can choose its stocking capacity $k = \{1, 2, 3\}$.

3 Full-line forcing equilibrium

We first characterize a potential equilibrium in which manufacturer 1 would opt for a component selling strategy in Section 3.1. We then characterize another potential equilibrium in which manufacturer 1 would instead opt for a full-line forcing strategy in Section 3.2. We then derive in Section 3.3 the conditions of existence for these two equilibria.

[18] As shown by Bernheim and Whinston (1985) and O'Brien and Shaffer (1997), in a vertical structure where manufacturers sell to a common retailer, bilateral efficiency requires that wholesale unit prices are set to marginal cost, which in turn induces the retailer to set retail prices at their monopoly levels. This result moreover applies under secret or public contracts.

3.1 Component strategy

We solve the game backward starting with the bargaining stage between D and upstream manufacturer(s) for all potential selected product assortments of two products: $\{HM, HL, ML\}$. Because slotting fees (potentially) paid by manufacturers in stage 1 are not conditional on agreements being reached, they play no role in the negotiation stage. Henceforth, the parameter $\alpha \in [0, 1]$ denotes the bargaining weight of D in each bilateral negotiation with manufacturers.

***D* has chosen *HM*.** We consider the bilateral negotiations between manufacturer 1 and D for H, and manufacturer 2 and D for M. The division of surplus in each negotiation is determined by the split-the-difference rule for transferable utility games (Muthoo, 1999)[19] and equilibrium lump-sum transfers, denoted by F_i^{HM} solve the following system of equations:

$$(1-\alpha)\left(\Pi^{HM} - F_1^{HM} - F_2^{HM} - (\Pi^M - F_2^{HM})\right) = \alpha F_1^{HM}$$
$$(1-\alpha)\left(\Pi^{HM} - F_1^{HM} - F_2^{HM} - (\Pi^H - F_1^{HM})\right) = \alpha F_2^{HM}$$

The above split-the-difference rule equalizes the gains from trade of each bargainer to their ratio of bargaining weights, $\frac{\alpha}{1-\alpha}$. The term $\Pi^{HM} - F_1^{HM} - F_2^{HM} - (\Pi^M - F_2^{HM})$ is the gain that D withdraws from trading with H when also dealing with M (rather than what it would obtain by selling M alone, i.e. $\Pi^M - F_2^{HM}$) whereas F_1^{HM} is the gain that manufacturer 1 withdraws from trading with D rather than not selling anything. Indeed, in stage 2 when HM was selected by D at the end of stage 1, the manufacturer 1 can no longer expect to sell its product L in case of disagreement. The equilibrium fixed fees of these bilateral negotiations are given by:

$$\begin{aligned} F_1^{HM} &= (1-\alpha)\left(\Pi^{HM} - \Pi^M\right) \\ F_2^{HM} &= (1-\alpha)\left(\Pi^{HM} - \Pi^H\right) \end{aligned} \tag{1}$$

Gross equilibrium profits obtained in stage 2, i.e. absent slotting fees, are denoted π_D^{HM} for D and π_i^{HM} for each manufacturer i. The superscript relates to the considered assortment.

[19] The split-the-difference rule is derived from the maximization of the asymmetric Nash product.

Gross equilibrium profits are thus:

$$\pi_D^{HM} = \Pi^{HM} - F_1^{HM} - F_2^{HM}; \quad \pi_1^{HM} = F_1^{HM}; \quad \pi_2^{HM} = F_2^{HM} \tag{2}$$

***D* has chosen *ML*.** Similarly to the previous case, D engages in bilateral bargains with each manufacturer for one product, i.e. with manufacturer 1 for L and manufacturer 2 for M. Equilibrium fixed fees resulting from these two negotiations are thus given by:

$$F_1^{ML} = (1-\alpha)\left(\Pi^{ML} - \Pi^{M}\right)$$
$$F_2^{ML} = (1-\alpha)\left(\Pi^{ML} - \Pi^{L}\right)$$

and corresponding profits of firms are obtained as follows:

$$\pi_D^{ML} = \Pi^{ML} - F_1^{ML} - F_2^{ML}; \quad \pi_1^{ML} = F_1^{ML}; \quad \pi_2^{ML} = F_2^{ML} \tag{3}$$

***D* has chosen *HL*.** Under this product assortment, there is only one pair of player who bargains (i.e., manufacturer 1 and D). Therefore, we consider only one negotiation over a fixed fee, denoted by F_1^{HL}, which solves:

$$(1-\alpha)\left(\Pi^{HL} - F_1^{HL}\right) = \alpha F_1^{HL}$$

The equilibrium fixed fee is thus:

$$F_1^{HL} = (1-\alpha)\Pi^{HL}$$

There is *de facto* a negotiation over a bundle here. Considering that manufacturer 1 sends two delegates that cannot communicate with eachother to bargain with D here becomes a strong assumption when it involves the same party on both sides. Moreover, in doing so, the manufacturer would compete with itself and it would only bring him a lower profit.[20]

[20] The manufacturer 1 would obtain a total profit $(1-\alpha)(\Pi^{HL} - \Pi^{H}) + (1-\alpha)(\Pi^{HL} - \Pi^{L}) \leq (1-\alpha)\Pi^{HL}$.

Corresponding equilibrium profits are derived as follows:

$$\pi_D^{HL} = \Pi^{HL} - F_1^{HL}; \quad \pi_1^{HL} = F_1^{HL}; \quad \pi_2^{HL} = 0 \tag{4}$$

To focus on the most interesting case, we do the following technical assumption:

Assumption A4 *The marginal contribution of M to the industry profit Π^{HM} is lower than its marginal contribution to the industry profit Π^{ML}, i.e., $\Pi^{ML} - \Pi^{L} \geq \Pi^{HM} - \Pi^{H}$.*

Under A4, absent slotting fees, D never selects the two secondary brands ML which enables to simplify our equilibrium analysis.[21] Among these three assortments $\{HM, HL, ML\}$, and absent any slotting fees D, the comparison of equilibrium profits in (2), (3), and (4) leads to the following lemma:

Lemma 1 *Absent slotting fees, D would always choose the assortment HM when manufacturer 1 opts for a component selling strategy.*

Proof. From A2 and A3 we have $\pi_D^{HM} \geq \pi_D^{HL}$. Furthermore, under A4 we obtain that $\pi_D^{HM} > \pi_D^{ML}$. ■

We now go backward to solve the stage 1. Manufacturer 1 would be better off if D had decided to carry HL. As a result, it has an incentive to affect D's assortment decision by offering slotting fees. We consider that manufacturer 1 is able to offer a menu of slotting fees $S_1 = (S^H, S^L, S^{HL})$, where S^H denotes a fee to secure one slot for H, S^L is a fee to secure one slot for L, and S^{HL} is a fee to secure slots for both H and L. Note that this is equivalent to a mixed bundling strategy because we allow S^{HL} to differ from the sum of slotting fees $S^H + S^L$.[22] Similarly, manufacturer 2 can offer a fee denoted by $S_2 = S^M$ to secure one slot

[21] Although selecting ML generates the lowest industry profit Π^{ML}, D may in some cases obtain a larger share of this smaller pie. The relative gain from trade of D with each manufacturer might indeed be lower, which strenghtens its bargaining position. In practice, this technical assumption is relevant only for $\alpha < \frac{1}{2}$.

[22] Considering mixed bundling rather than independent pricing is key to ensure that a Nash equilibrium in pure strategies always exists under A1 to A4. The nonexistence of equilibrium in pure strategies under independent pricing was shown by Jeon and Menicucci (2012) in a related setting with independent products.

for M. Assuming that D accepts at most two slotting fees[23], we solve stage 1 and obtain the following lemma:

Lemma 2 *When manufacturer 1 opts for a component selling strategy, there is a unique equilibrium in which manufacturers offer:*

$$\begin{aligned} S_1^{HM} &= \{0, 0, (1-\alpha)\Pi^{HL} - (1-\alpha)\left(\Pi^{HM} - \Pi^{M}\right)\} \\ S_2^{HM} &= max\{0, \Pi^{HL} - \alpha\Pi^{HM} - (1-\alpha)\Pi^{H}\} \end{aligned}$$

D selects the product assortment HM and receives the corresponding fees. Equilibrium profit of firms are:

$$\Pi_D^{HM} = \begin{cases} \Pi^{HL} - (1-\alpha)\left(\Pi^{HM} - \Pi^{M}\right) & if\ \ \Pi^{HL} - \alpha\Pi^{HM} - (1-\alpha)\Pi^{H} > 0 \\ (1-\alpha)\left(\Pi^{H} + \Pi^{M}\right) - (1-2\alpha)\Pi^{HM} & otherwise \end{cases}$$

$$\Pi_1^{HM} = (1-\alpha)\left(\Pi^{HM} - \Pi^{M}\right)$$

$$\Pi_2^{HM} = \begin{cases} \Pi^{HM} - \Pi^{HL} & if\ \ \Pi^{HL} - \alpha\Pi^{HM} - (1-\alpha)\Pi^{H} > 0 \\ (1-\alpha)\left(\Pi^{HM} - \Pi^{H}\right) & otherwise \end{cases}$$

Proof. We provide a sketch of the proof and refer to Appendix A for further details on the existence and uniqueness of this equilibrium. Let us consider first that $S^H = S^L = 0$ by relying on the following insights. As without slotting fees D would choose assortment HM, manufacturer 1 does not need to pay any fee to secure a slot for H. Moreover, manufacturer 1 is not willing to pay a slotting fee to replace H by L as it would be worse off. However, manufacturer 1 is willing to pay at most a tariff $\bar{S}^{HL}$ to secure a slot for both H and L. Formally, $\bar{S}^{HL}$ is derived as follows $\pi_1^{HL} - \bar{S}^{HL} = \pi_1^{HM} \Leftrightarrow \bar{S}^{HL} = (1-\alpha)\Pi^{HL} - (1-\alpha)\left(\Pi^{HM} - \Pi^{M}\right)$. Similarly, manufacturer 2 is willing to pay up to $\bar{S}^{M}$ to stay on D's shelves which satisfies $\pi_2^{HM} - \bar{S}^{M} = \pi_2^{HL} \Leftrightarrow \bar{S}^{M} = (1-\alpha)\left(\Pi^{HM} - \Pi^{H}\right)$. To determine the winner of D's slots, we thus need to compare: (i) D's profit from carrying HL, i.e., $\pi_D^{HL} + \bar{S}^{HL}$, and (ii)

[23]In our analysis, we allow manufacturers to offer a tariff to monopolize D's shelf space with one product; We show in Appendix A that this never arises in equilibrium.

D's profit obtained from offering HM, i.e., $\pi_D^{HM} + \bar{S}^M$. As $\pi_D^{HM} + \bar{S}^M > \pi_D^{HL} + \bar{S}^{HL}$, manufacturer 2 wins the competition and can always secure a slot for M and therefore the assortment HM is always chosen in equilibrium. In equilibrium, manufacturer 1 offers $S_1^{HM} = \{0, 0, (1-\alpha)\Pi^{HL} - (1-\alpha)\left(\Pi^{HM} - \Pi^M\right)\}$, and manufacturer 2 chooses a tariff S_2^{HM} such that $\pi_D^{HM} + S_2^{HM} \geq \pi_D^{HL} + \bar{S}^{HL} \Leftrightarrow S_2^{HM} = \max\{0, \Pi^{HL} - \alpha\Pi^{HM} - (1-\alpha)\Pi^H\}$. ■

Lemma 2 shows that, when $\alpha > \frac{\Pi^{HL} - (1-\alpha)\Pi^H}{\Pi^{HM}}$, which is always true when α is close enough to 1, manufacturer 2 does not need to pay any slotting fee to ensure that M is selected by D (i.e., $S_2^{HM} = 0$). Being strong enough in its negotiations, D is able to extract a large share of the surplus generated by bilateral contracts with manufacturers without exercizing its outside option (i.e., to replace M by L). D is instead mostly concerned by the size of the industry profit because it captures a large share of it anyway. Therefore, the surplus sharing rule within the supply chain yields the same outcome as the "Nash-in-Nash" bargaining solution with the product assortment HM. In contrast, when $\frac{\Pi^{HL} - (1-\alpha)\Pi^H}{\Pi^{HM}} > \alpha$, which is always true when α is close to 0, manufacturer 2 has to pay a positive slotting fee to ensure its presence on D's shelves. Such a situation arises because D's bargaining power is sufficiently weak such that it can get a higher profit from exerting its outside option. Thus, the threat to replace HM by L affects the division of surplus even if it is never sold in equilibrium. This equilibrium is similar to the "deal-me-out" outcome of Binmore, Shaked and Sutton (1989).

Under the component selling strategy, manufacturer 1 is unable to generate its preferred outcome, that is, D carrying HL in equilibrium. We show below that this outcome may emerge when manufacturer 1 instead opts for a full-line forcing strategy.

3.2 Full-line forcing strategy

If manufacturer 1 opts for a full-line forcing strategy (i.e refuses to sell its two products on a stand-alone basis), D can choose among two potential product assortments: either HL or M only. Because manufacturer 1 offers its products in a single package, D is prevented from carrying and reselling only one of its two products. At the bargaining stage:

***D* has chosen *HL*.** When D selects HL, there is just one bilateral negotiation involving manufacturer 1 and D; equilibrium profits are thus given by (4).

***D* has chosen *M*.** Again, if D selects M, there is just one bilateral negotiation between manufacturer 2 and D for the fixed fee of M, denoted by F_2^M, which solves:

$$(1-\alpha)\left(\Pi^M - F_2^M\right) = \alpha F_2^M$$

The equilibrium fee equals $F_2^M = (1-\alpha)\Pi^M$ and corresponding equilibrium profits are given by:

$$\pi_D^M = \Pi^M - F_2^M; \quad \pi_1^M = 0; \quad \pi_2^M = F_2^M \tag{5}$$

Comparison of (4) and (5) leads to the following lemma:

Lemma 3 *In the absence of any slotting fee, D always chooses the assortment HL when manufacturer 1 opts for a full-line forcing strategy.*

Proof. A3 implies that $\pi_D^{HL} > \pi_D^M$. ■

Because manufacturer 2 is excluded from the market when D chooses to carry HL, it has an incentive to affect D's assortment decision by offering a fee S^M and secure a slot for M. Similarly, manufacturer 1 is allowed to pay a fee $S_1 = (\emptyset, \emptyset, S^{HL})$ to ensure that D will carry its bundle of goods HL. Solving stage 2, we obtain the following lemma:

Lemma 4 *When manufacturer 1 opts for a full-line forcing strategy, the unique equilibrium of the game is such that manufacturer 1 and 2 offer respectively $S_1^{HL} = max\{0, \Pi^M - \alpha\Pi^{HL}\}$ and $S_2^{HL} = (1-\alpha)\Pi^M$ and D chooses the assortment HL. Equilibrium profits are given by:*

$$\mathit{\Pi}_D^{HL} = \begin{cases} \mathit{\Pi}^M & \text{if } \frac{\mathit{\Pi}^M}{\mathit{\Pi}^{HL}} > \alpha \\ \alpha \mathit{\Pi}^{HL} & \text{otherwise} \end{cases}$$

$$\mathit{\Pi}_1^{HL} = \begin{cases} \mathit{\Pi}^{HL} - \mathit{\Pi}^M & \text{if } \frac{\mathit{\Pi}^M}{\mathit{\Pi}^{HL}} > \alpha \\ (1-\alpha)\mathit{\Pi}^{HL} & \text{otherwise} \end{cases}$$

$$\mathit{\Pi}_2^{HL} = 0$$

Proof. The maximum fee that manufacturer 2 is willing to pay to secure a slot for M is determined as follows $\pi_2^M - \bar{S}^M \geq \pi_2^{HL} \Rightarrow \bar{S}^M = (1-\alpha)\Pi^M$. Similarly, manufacturer 1 is willing to offer a fee up to $\pi_1^{HL} - \bar{S}^{HL} = 0 \Leftrightarrow \bar{S}^{HL} = (1-\alpha)\Pi^{HL}$ to secure slots for its bundle of goods. Because, $\pi_D^{HL} + \bar{S}^{HL} > \tilde{\pi}_D^M + \bar{S}^M$, manufacturer 1 always wins the competition and ensures the carriage of its bundle. In equilibrium, manufacturer 2 offers its maximum amount $\bar{S}^M$ and manufacturer 1 chooses a slotting fee S_1^{HL} such that $\pi_D^{HL} + S_1^{HL} = \pi_D^M + \bar{S}^M \Leftrightarrow S_1^{HL} = \max\{0, \Pi^M - \alpha\Pi^{HL}\}$. ■

When $0 > \Pi^M - \alpha\Pi^{HL} \Leftrightarrow \alpha > \frac{\Pi^M}{\Pi^{HL}}$, manufacturer 1 does not need to offer a slotting fee to ensure the presence of its bundle of goods on D's shelves. In contrast, when $\Pi^M - \alpha\Pi^{HL} > 0$, manufacturer 1 has to pay a strictly positive slotting fee to win the competition for slots. As a result, even if manufacturer 2 is always foreclosed from the market, its presence can affect the equilibrium sharing of profits. Under the full-line forcing regime, the division of surplus thus coincides with the "deal-me-out" outcome of Binmore, Shaked and Sutton (1989).

Note that, although manufacturer 2 is foreclosed from the market, it offers a higher slotting fee than in the component regime ($S_2^{HL} > S_2^{HM}$) under A3. Indeed, in choosing a full-line forcing strategy, manufacturer 1 is not guaranteed to secure a slot for H as it is the case in the component regime. Therefore, manufacturer 1 will engage in a fiercer competition with manufacturer 2 by offering a higher slotting fee for its bundle of goods ($S_1^{HL} > S_1^{HM}$). Such a result contrasts with de Cornière and Taylor (2018) who show that a multi-product manufacturer can, by offering a bundle of complementary products, induce its upstream rival to compete less fiercely. Our results differ because A3 implies that our products are either (imperfect) substitutes or independent.

3.3 Equilibrium selling strategy

From Lemma 2 and 4, we compare the manufacturer 1's profit when playing either a component or a full-line forcing strategy. When $0 > \Pi^M - \alpha\Pi^{HL}$, manufacturer 1 obtains a higher profit from using a full-line forcing strategy because it sells HL without offering any slotting fee to D. In contrast, when $\Pi^M - \alpha\Pi^{HL} > 0$ manufacturer 1 has to pay a slotting fee to secure slots for HL but a full-line forcing strategy remains dominant when $\Pi^{HL} - (1-\alpha)\Pi^{HM} > \alpha\Pi^M$. Combining these conditions, we obtain the following proposition:

Proposition 1 *An equilibrium in which manufacturer 1 chooses a full-line forcing strategy exists if and only if the following condition is satisfied:*

$$\alpha > min\{\frac{\mathit{\Pi}^M}{\mathit{\Pi}^{HL}}, \frac{\mathit{\Pi}^{HM} - \mathit{\Pi}^{HL}}{\mathit{\Pi}^{HM} - \mathit{\Pi}^M}\} \tag{6}$$

Manufacturer 1 opts for a component selling strategy otherwise. A full-line forcing is more likely to arise in equilibrium when:

(i) D's buyer power is high.

(ii) Manufacturer 1's secondary brand is a close substitute to manufacturer 2's brand.

(iii) Manufacturer 1's leading brand is a must-stock item.

Proof. Because $\min\{\frac{\Pi^M}{\Pi^{HL}}, \frac{\Pi^{HM}-\Pi^{HL}}{\Pi^{HM}-\Pi^M}\} \in [0,1[$ under A1-A3, a full-line forcing equilibrium never exists when $\alpha \to 0$ but always exists when $\alpha \to 1$. Again, when L and M are close substitutes, i.e., $\Pi^{HL} \to \Pi^{HM}$, a full-line forcing forcing equilibrium exists for all $\alpha \in [0, 1]$. Finally, when H is a must-stock item, the marginal contribution of each secondary brand is reduced and, in the limit, Π^{HL} or Π^{HM} are close to Π^H. Again, a full-line forcing equilibrium exists for all $\alpha \in [0, 1]$. ■

Proposition 1 states that the bargaining weight of D is key to explain why a full-line forcing equilibrium exists. The insight is as follows. In the component regime, manufacturer 1 pays no slotting fee for its product H regardless of D's bargaining weight. In contrast, in the full-line forcing regime and when α is low, D's threat to exercise its outside option (i.e., replace HL by M) becomes credible which induces manufacturer 1 to offer a positive slotting fee. In the extreme case where $\alpha \to 0$, manufacturer 1 has to offer a slotting fee up to Π^M. Therefore, it becomes too costly for manufacturer 1 to use the full-line forcing strategy when D is weak. Proposition 1 highlights that the leverage theory of bundling, which was dismissed by the Chicago School criticism, is restored whenever the buyer power of retailers is high enough. We further analyze this issue in Section 5.1.

When Π^{HL} increases toward Π^{HM}, the threshold in (6) above which a full-line forcing equilibrium arises decreases. In contrast, an increase in Π^M, which in turn increases Π^{HM}, makes this threshold increase and a component selling strategy arises more often in equilibrium.

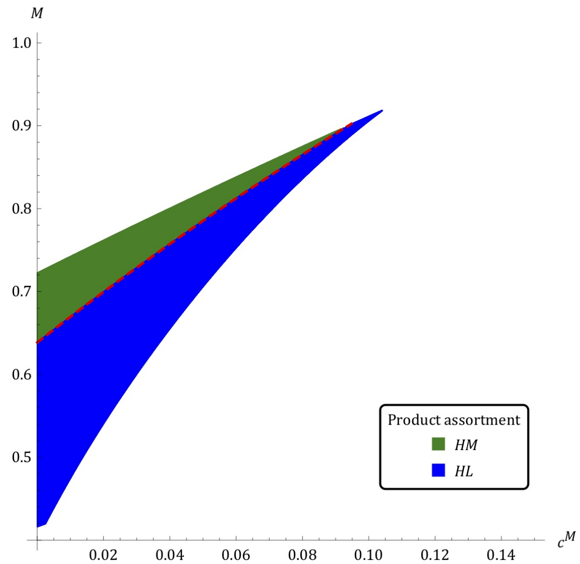
When H is a must-have item as compared to the secondary brands, the latter generate almost no value and therefore one can consider that Π^{HL} or Π^{HM} are close to Π^H. The threshold above which the full-line forcing equilibrium exists decreases because it is then easier for manufacturer 1 to use its must-have brand to impose its full-line of products.

Corollary 1 *D always loses from manufacturer 1's full-line forcing practice.*

Proof. See Appendix B for a complete proof. ■

Because, as shown previously, manufacturer 1 opts for a full-line forcing strategy only when D is sufficiently powerful, D cannot benefit from the strong competition in slotting fees. Instead, the full-line forcing practice enables manufacturer 1 to increase D's gain from trade in the bargaining: in case of breakdown D is left with 0 profit; this strategy switches the sharing of profits in favor of manufacturer 1 and D obtains a smaller share of a smaller pie (HL instead of HM).

Figure 1: Equilibrium outcome with a stocking capacity of $k = 2$



(a) $\alpha = 0.2$ (b) $\alpha = 0.4$

Notes: These figures are drawn from a setting of vertical product differentiation with parameter values $c^H = 0.15$, $c^L = 0$, $H = 1$, $L = 0.4$, $M \in [L, H[$, and $c^M \in [c^L, c^H]$.

Illustrative example. Let us now discuss the insights drawn from Proposition 1 in a simple setting of vertical product differentiation with standard assumptions on consumer behavior and production costs of firms. We consider that product $q = \{H, M, L\}$ is produced at a constant marginal cost c^q where $c^H > c^M > c^L = 0$. As in the vertical differentiation model pioneered by Mussa and Rosen (1978), each consumer purchases at most one unit of a good. We specify the following linear consumer utility function: $U(\theta, q, p^q) = \theta q - p^q$, where θ denotes the marginal willingness to pay for quality which is assumed to be uniformly distributed over $[0, 1]$, and p^q is the price of product q. We define the corresponding industry profit outcomes in Appendix C. Figure 1 is drawn for $c^H = 0.15$, $H = 1$, and $L = 0.4$. In the x-axis, c_M varies between $c^L = 0$ and c^H and, in the y-axis, M varies between L and H. The colored area represents the set of parameters for which A1 to A4 are valid. In blue is the area in which a full-line forcing strategy equilibrium arises, and in green, the area in which a component strategy equilibrium arises. As stated previously, this illustrative example shows that the full-line forcing area shrinks when D is weaker. Furthermore, we can see that a full-line forcing never emerges when manufacturer 2's product is sufficiently efficient, that is, its quality-level M is high enough compared to its production cost c^M. Indeed, in such a case, it becomes too costly for manufacturer 1 to exclude its rival's product through a full-line forcing strategy.

4 Stocking capacity choice

In this section, we consider an *ex ante* stage, denoted stage 0, in which D chooses publicly its stocking capacity, that is, the number of slots k available for the distribution of manufacturers' products. The stocking capacity can be interpreted as a long-run strategic decision which may represent the shelf space dedicated to a given product category. For instance the shelf space dedicated to soft drinks or detergents might reflect a strategic positioning of the chain vis-à-vis consumers and competitors.[24] In the same vein as A1 to A3, we work under the following conditions:

Assumption A5 *The largest industry profit is generated when all products are offered to consumers, i.e., $\Pi^{HML} > \Pi^{HM}$. These products are either independent or imperfect susbtitutes which implies that $\Pi^{H} + \Pi^{ML} \geq \Pi^{HML}$, $\Pi^{HM} + \Pi^{L} \geq \Pi^{HML}$, and $\Pi^{HL} + \Pi^{M} \geq \Pi^{HML}$.*

The case in which D chooses a stocking capacity of $k = 2$ has already been studied in Section 3. In what follows, Section 4.1 first solves the last stage of the game under the two other levels of stocking capacity, that is $k = 1$ and $k = 3$. In Section 4.2, we determine D's stocking capacity decision under the assumption that full-line forcing practices are not feasible. This benchmark setting enables to highlight that restricting the stocking capacity can be an appealing strategy for D to extract rent from manufacturers through the competition for slots. Then, Section 4.3 analyses the interplay between D's stocking capacity decision and manufacturer 1's full-line forcing strategy.

[24] Such a choice may also represent the adoption of a specific retail format (e.g., supermarket, hypermarket, or discounters) that directly affects the number of products offered to consumers.

4.1 Bargaining and product assortment decision

4.1.1 When $\boldsymbol{k} = 1$

The equilibrium lump sum transfer negotiated between D and manufacturer i supplying product q is as follows:

$$
\begin{aligned}
& (1-\alpha)\left(\Pi^q - F_i^q\right) = \alpha F_i^q \\
\Leftrightarrow \quad & F_i^q = (1-\alpha)\Pi^q
\end{aligned}
\tag{7}
$$

Without slotting fees, D always chooses to sell product H on its shelves. However, manufacturer 2 can attempt to gain a slot by offering a slotting fee for its product M and in turn this may push manufacturer 1 to offer a slotting for its product H. When $k = 1$ manufacturer 1 may offer a couple of slotting fees (S^H, S^L) whereas manufacturer 2 offers S^M. The equilibrium is summarized in the following lemma:

Lemma 5 *When D's stocking capacity is $k = 1$, D always chooses the product assortment H in equilibrium. Manufacturer 1's slotting fees are $S_1^H = (max\{0, \Pi^M - \alpha\Pi^H\}, 0)$ and manufacturer 2's slotting fee equals $S_2^H = (1-\alpha)\Pi^M$. Equilibrium profits of firms are given by:*

$$
\Pi_D^H = \begin{cases} \Pi^M & \text{if } \Pi^M - \alpha\Pi^H > 0 \\ \alpha\Pi^H & \text{otherwise} \end{cases} \quad ; \quad \Pi_1^H = \begin{cases} \Pi^H - \Pi^M & \text{if } \Pi^M - \alpha\Pi^H > 0 \\ (1-\alpha)\Pi^H & \text{otherwise} \end{cases} \quad ; \quad \Pi_2^H = 0
$$

Proof. Because it gets a higher profit when selling H rather than L, manufacturer 1 does not have incentives to affect D's assortment decision through the use of slotting fees for L and therefore $\bar{S}^L = 0$. However, manufacturer 2 is ready to offer a slotting fee $\bar{S}^M = (1-\alpha)\Pi^M$ to replace H by M and secure D's unique slot. Manufacturer 1 is ready to offer a slotting fee up to $\bar{S}^H = (1-\alpha)\Pi^H$ to be on D's shelves and therefore always win the competition. In equilibrium, manufacturer 1 offers $S_1^H = (\max\{0, \Pi^M - \alpha\Pi^H\}, 0)$ to ensure its presence on D's shelves and manufacturer 2 offers $S_2^M = (1-\alpha)\Pi^M$. ■

4.1.2 When $k = 3$

D's bilateral negotiations with manufacturer 1 for HL and manufacturer 2 for M are determined by the following system:

$$(1-\alpha)\left(\Pi^{HML} - F_1^{HML} - F_2^{HML} - \left(\Pi^{M} - F_2^{HML}\right)\right) = \alpha F_1^{HML}$$
$$(1-\alpha)\left(\Pi^{HML} - F_1^{HML} - F_2^{HML} - \left(\Pi^{HL} - F_1^{HML}\right)\right) = \alpha F_2^{HML}$$

The equilibrium lump-sum transfers determined in these two bilateral negotiations are:

$$\begin{aligned} F_1^{HML} &= (1-\alpha)\left(\Pi^{HML} - \Pi^{M}\right) \\ F_2^{HML} &= (1-\alpha)\left(\Pi^{HML} - \Pi^{HL}\right) \end{aligned} \tag{8}$$

All products being always sold in equilibrium under A5, there is no competition in slotting fees and therefore we obtain the following lemma:

Lemma 6 *When D chooses a stocking capacity of $k = 3$, all products are distributed in equilibrium. All slotting fees offered by manufacturers for the carriage of their products are* 0*, and equilibrium profits of firms are given by:*

$$\Pi_D^{HML} = \Pi^{HML} - F_1^{HML} - F_2^{HML}; \quad \Pi_1^{HML} = F_1^{HML}; \quad \Pi_2^{HML} = F_2^{HML}$$

4.2 Stocking capacity choice without full-line forcing

We now analyze D's stocking capacity choice, that is the number of available slots $k = \{1, 2, 3\}$ that D will offer to manufacturers. As previously stated, we first consider a setting in which full-line forcing practices are not feasible to exclusively focus on D's strategic decision. In addition to assumptions A1 to A5, this *ex ante* stage is solved under the following condition:

Assumption A6 *The marginal contribution of M to the industry profit Π^{HML} is lower than its marginal contribution to the industry profit Π^{HM}, i.e., $\Pi^{HM} - \Pi^{H} \geq \Pi^{HML} - \Pi^{HL}$.*

Similarly to A4, this technical assumption ensures that absent slotting fees, D always selects HML rather than the assortment HM which enables to simplify our equilibrium analysis.[25] Among all three potential assortments HML, HM, H that respectively emerge in equilibrium for $k = 3$, $k = 2$ and $k = 1$, absent slotting fees, D would always choose $k = 3$ and offer the assortment HML. However, we have shown that D would receive positive slottings fees in equilibrium HM when $k = 2$ and equilibrium H when $k = 1$. Comparing D's profit in the three cases, we obtain the following proposition:

Proposition 2 *D has an incentive to restrict its stocking capacity to $k = 2$ or $k = 1$ when its bargaining power vis-à-vis manufacturers is low. Formally, it chooses:*

- *$k = 1$ if $\min\{\alpha_0, \alpha_1, \alpha_2, \alpha_3\} > \alpha > 0$ or $\min\{\alpha_0, \alpha_3\} > \alpha > \alpha_1$;*
- *$k = 2$ if $\min\{\alpha_0, \alpha_1, \alpha_4\} > \alpha > \alpha_2$ or $\min\{\alpha_1, \alpha_4\} > \alpha > \alpha_0$;*
- *$k = 3$ otherwise;*

where $\alpha_0 = \frac{\Pi^M}{\Pi^H}$, $\alpha_1 = \frac{\Pi^{HL} - \Pi^H}{\Pi^{HM} - \Pi^H}$, $\alpha_2 = \frac{\Pi^{HM} - \Pi^{HL}}{\Pi^{HM} - \Pi^M}$, $\alpha_3 = \frac{\Pi^{HML} - \Pi^{HL}}{2\Pi^{HML} - \Pi^{HL} - \Pi^M}$, $\alpha_4 = \frac{\Pi^{HML} - \Pi^{HM}}{2\Pi^{HML} - \Pi^{HL} - \Pi^{HM}}$.

Proof. See Appendix D for further details. ■

Proposition 2 states that D never restricts its stocking capacity when its bargaining power α is high enough. The reason is the following. Lemma 2 and 5 have shown that when D is sufficiently powerful, it never receives any positive slotting fee(s) from manufacturer(s). In such a case, the division of surplus in the vertical chain is thus entirely governed by the "Nash-in-Nash" bargaining solution. From (1), (7), and (8), we can see that the lump-sum transfers perceived by a manufacturer under the "Nash-in-Nash" bargaining solution are proportional to their marginal contribution to the industry profit. Hence, when α is high, under A5 and A6, D is able to decrease the marginal contribution of each product when they are imperfect substitute by expanding its stocking capacity, which increases its

[25] Although selecting HM generates a lower industry profit (A5), D may obtain a larger share of a smaller pie. D's relative gain from trade with each manufacturer might indeed be reduced, which strenghtens its bargaining position. In practice, this technical assumption is relevant only for $\frac{1}{2} > \alpha$.

bargaining power vis-à-vis the manufacturers. In contrast, when D's bargaining power is lower, restricting the stocking capacity can serve to extract rent from manufacturers through the competition for slots. Although such a strategy shrinks the industry profit to be split, it always ensures a positive profit for D, even when $\alpha \to 0$. Indeed, as shown in Lemma 2 and 4, manufacturer 2 always offers a positive slotting fee to maintain (or attempt to maintain) its product M on D's shelves whenever $k \neq 3$.

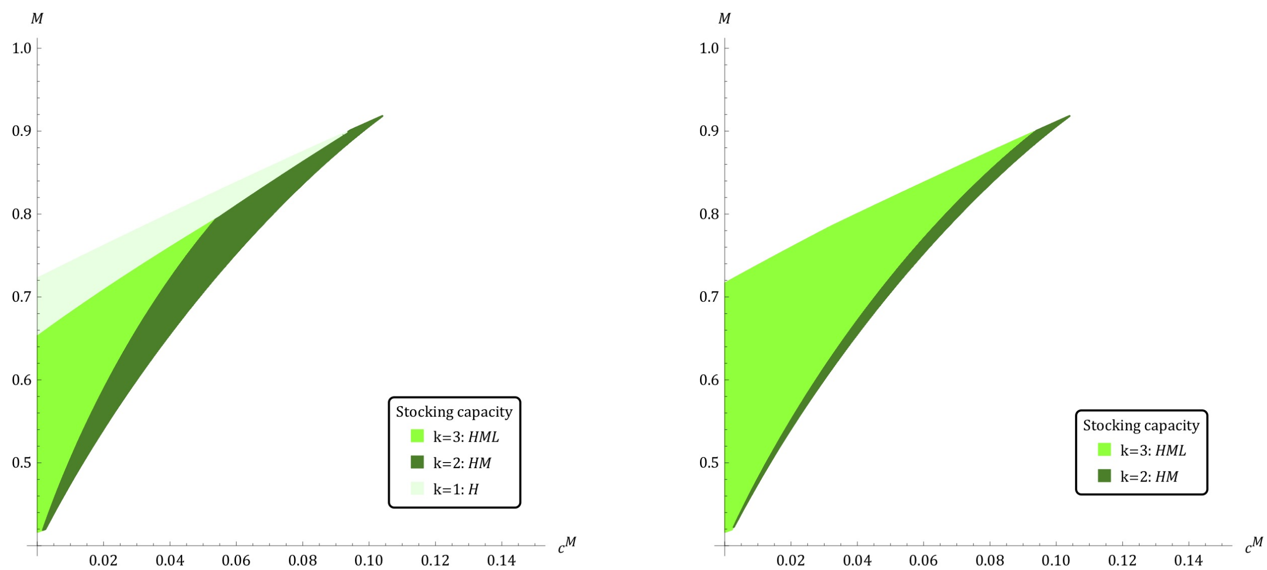
This result highlights a close relationship between the size of the buyer-seller network and the distribution of bargaining power in the vertical chain. The use of network size restrictions as a rent-extraction device has previously been analyzed by Marx and Shaffer (2010).[26]. As in our framework, the mechanism by which a downstream firm plays off manufacturers against each other to gain bargaining leverage stems from the auctioning of a limited number of slots. More recently, other approaches based on the ability of a downstream firm to threat its suppliers of replacement by their rivals during the negotiation stage have also lead to the emergence of this bargaining leverage (e.g., Ho and Lee, 2018; Ghili, 2018; Liebman, 2018).[27] Although the extraction of the rent by a downstream player hinges on different modeling assumptions, there is actually a close connection between these bargaining models and the approach used in this article. In particular, it can be shown that the surplus division rule of our 3-stage game coincides with that of the "Nash-in-Nash with threat of replacement" bargaining solution developed by Ho and Lee (2018) (see Appendix ??? for further details). Initially motivated by the ability of a downstream firm to commit to deal with a limited number of suppliers and to go back and forth between *all* upstream firms during negotiations, we believe that our framework can provide a new grounding for their solution concept.

Illustrative example. Figure 2.a and Figure 2.b illustrate our result obtained in Proposition 2 by showing that an increase in D's bargaining weight from $\alpha = 0.2$ to $\alpha = 0.4$ undermines D's incentives to restrict its stocking capacity. New insights can be drawn from

[26] See also Gal-Or (1997, 1999)

[27] Interestingly, this result does not emerge in Rey and Vergé (2017). Instead, the benefit of excluding an upstream manufacturer from a retailer's network in their bilateral duopoly framework is to avoid profit dissipation. This arises when the intrabrand competition is fierce, which either leads to a market structure with downstream foreclosure or pairwise exclusivity.

Figure 2: D's stocking capacity choice without full-line forcing



(a) $\alpha = 0.2$ (b) $\alpha = 0.4$

Notes: These figures are drawn from the setting of vertical product differentiation presented in Section 3.3 with parameter values $c^H = 0.15$, $c^L = 0$, $H = 1$, $L = 0.4$. The x-axis represents the marginal cost of product M, that is $c^M \in [c^L, c^H]$. The y-axis corresponds to the quality of product M, that is $M \in [L, H]$.

the analysis of Figure 2.a in which any type of stocking capacity may emerge in equilibrium. We can see that the stocking capacity is restricted at its narrowest level $k = 1$ as product M becomes more efficient (i.e., high quality M closer to H and/or low cost $c^M \to c^L = 0$). Although this gain in M's efficiency has positive effects on potential industry profits to be split when $k = 2$ (HM) and when $k = 3$ (HML) because the marginal contribution of product M to the industry profit becomes higher, D would have to pay a higher lump sum payment to manufacturer 2 if it chooses a stocking capacity of $k = 3$ or $k = 2$. When $k = 1$, however, D is always guaranteed to secure a profit of Π^M (see Lemma 5) which renders this level of stocking capacity more attractive for D as the efficiency of M gets higher. In contrast, when M decreases Figure 2.a reveals that $k = 1$ is no longer the best choice for D which either chooses to restrict its stocking capacity to $k = 2$ when c^M is high or to $k = 3$ when c^M is low. When c^M is high, M is relatively close from product L and therefore the manufacturer 2 has to pay a high slotting fee to maintain its presence on D's shelves (see from Lemma 2) and this why D selects $k = 2$. However, when c^M is low, because selling M is highly valuable, D cannot expect a high slotting fee from manufacturer 2, and thus prefers switching to $k = 3$.

4.3 Stocking capacity choice with full-line forcing

We now allow manufacturer 1 to opt for a full-line forcing strategy after observing the capacity choice of D.[28] It is worth noting that, among the potential levels of stocking capacity $k = \{1, 2, 3\}$, D's profit can only affected by manufacturer 1's full-line forcing strategy under $k = 2$. Indeed, if D chooses a capacity choice $k = 1$ or $k = 3$, a full-line forcing is irrelevant to the equilibrium outcome because either one or all products can be carried on D's shelves. The following proposition sheds light on an interplay between manufacturer 1's selling strategy and D's stocking capacity choice:

Proposition 3 *Full-line forcing practices mitigate D's incentives to restrict its stocking capacity to $k = 2$. Instead, D prefers to increase the level of its stocking capacity to $k = 3$ which annihilates the harmful effects of such a selling strategy. Formally, it chooses:*

- $k = 1$ *if* $min\{\alpha_0, \alpha_1, \alpha_2, \alpha_3\} > \alpha > 0$ *or* $min\{\alpha_0, \alpha_3\} > \alpha > \alpha_1$*;*
- $k = 2$ *if* $min\{\alpha_1, \alpha_3, \alpha_4, \alpha_5\} > \alpha > \alpha_2$*;*
- $k = 3$ *otherwise.*

where $\alpha_5 = \frac{\Pi^M}{\Pi^{HL}}$*.*

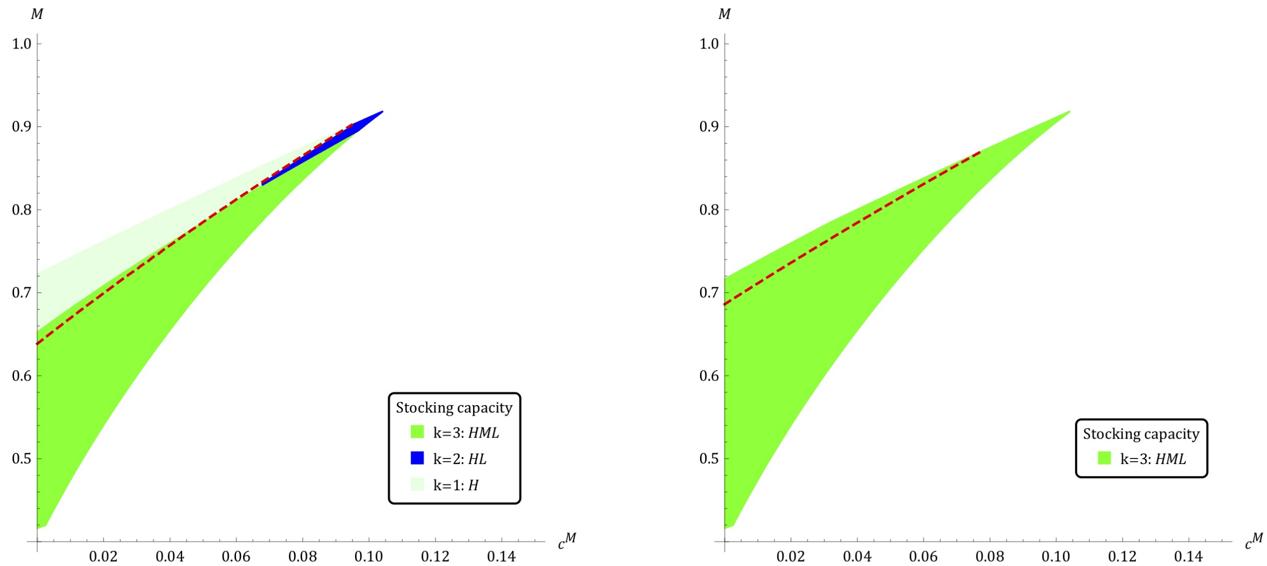
Proof. See Appendix D for details. From the comparison of Proposition 2 and 3, we see that the area in which $k = 1$ remains unchanged. In contrast, the area in which $k = 2$ arises shrinks because $\alpha_0 > \alpha_5$. ■

[28] In practice however, such a stocking capacity adjustment may be difficult to implement in the short-run (e.g., large investment cost to expand the stocking capacity) or the manufacturer's product line might also expand through firm's proliferation of brands strategy. In such a case our initial setting with exogenous stocking capacity and our Proposition 1 can apply. Note that we could alternatively consider a game in which manufacturer 1 first commit on its selling strategy before D's stocking capacity choice. Here again expanding its capacity would enable D to couteract a full-line forcing strategy and therefore our main insights remain valid.

This result highlights that a restriction in D's stocking capacity is less likely to arise in equilibrium when a full-line forcing is adopted by manufacturer 1. Note first that it is never optimal for D to further restrict its stocking capacity to $k = 1$ when facing a full-line forcing practice because it would at best be able to capture the same profit level Π^M. As previously shown in Corollary 1, D is harmed by full-line forcing practices and may thus prefer to expand its stocking capacity to $k = 3$ when it would instead choose $k = 2$ absent full-line forcing. This proposition thus brings new insights to the literature on both exclusionary bundling and buyer-seller network structure in vertically related markets: the latter might be used to counteract adverse effects generated by the former. Note also that, as shown in Proposition 2, D may optimally choose a stocking capacity of $k = 3$ even if full-line forcing forcing is not feasible. In such a case, this decision *de facto* offsets the effects of full-line forcing. Although D's incentives to choose $k = 2$ are lowered, such a strategy may still be adopted for the reason mentionned previously: it is an appealing rent-extraction device when D's bargaining power vis-à-vis manufacturers is weak. We use our stylized setting to provide further insights.

Illustrative example. As previously, Figure 3 depicts the equilibrium outcome of our game under two different values of α. In both cases, we know from Figure 1 that below the red dashed curve a full-line forcing equilibrium arises whenever the stocking capacity equals $k = 2$. In the case where $\alpha = 0.2$, Figure 3.a shows that the area in which $k = 2$ shrinks compared to Figure 2.a, which considerably lessens the emergence of full-line forcing practices in equilibrium. This result illustrates findings drawn from Proposition 3 which states that D expands its stocking capacity to avoid adverse effects generated by full-line forcing. However, Figure 3.a also shows that D's strategy to counteract such practices may be dominated by its incentives to keep its stocking capacity at a level of $k = 2$ for a buyer power motive. Indeed, we know from Lemma 4 that playing off manufacturers against each other provides a profit of Π^M to D, which becomes more attractive as M's efficiency increases. Finally, we can see from Figure 6.b that when $\alpha = 0.4$, all products are offered to consumers and full-line forcing never arise in equilibrium. When D is powerful, even though the manufacturer finds

Figure 3: D's stocking capacity choice with full-line forcing



(a) $\alpha = 0.2$ (b) $\alpha = 0.4$

Notes: These figures are drawn from the setting of vertical product differentiation described in Section 3.3 with parameter values $c^H = 0.15$, $c^L = 0$, $H = 1$, $L = 0.4$. The x-axis represents the marginal cost of product M, that is $c^M \in [c^L, c^H]$. The y-axis corresponds to the quality of product M, that is $M \in [L, H]$.

it more profitable to impose a full-line forcing strategy (Proposition 1), D is also more likely to expand its stocking capacity to $k = 3$.

5 Policy implications

Full-line forcing practices have been intensively debated by competition authorities. In this section, we briefly come back on the Chicago School argument claiming that a large firm may have the ability, but not the incentive, to leverage its dominance on one product by tying it to another competitive product. Our article contributes to the post-Chicago literature which highlights that full-line forcing might be profitable. We then analyze in our model the effects of banning full-line forcing practices as well as slotting fees and derive their implications for competition policy.

To determine the effects of such policies on consumers surplus, we restrict our analysis to the case of a uniform distribution of consumer's tastes presented in our illustrative example. We denote CS^q the consumers surplus when the assortment q is offered. In that case, we obtain the following lemma:

Lemma 7 *Under A1 to A3, we obtain the following ranking:* $CS^{HML} > CS^{HM} > CS^{HL} > CS^{H}$.

Proof. See Appendix C. ■

5.1 The Chicago School critique

We follow the standard Chicago School critique framed by Bowman (1957), Posner (1976), and Bork (1978). Initially developed in environments where products are perfect complement, the Chicago School argument applies equally to the case of independent goods. The formal setting is as follows. Manufacturer 1 is a monopolist on the market for product H; it also produces good L which competes with manufacturer 2's product M on an independent market. Goods M and L are homogenous but M is produced at a strictly lower cost than L. In our setting, these assumptions can translate into:

Assumption A7 (Chicago School) *Among all potential single product assortment:*

$$\Pi^H > 0, \quad \Pi^M \geq \Pi^L > 0$$

Products M and L are homogenous and independent from product H:

$$\Pi^{ML} = \Pi^M \quad \text{and} \quad \Pi^H + \Pi^M = \Pi^{HM} > \Pi^H + \Pi^L = \Pi^{HL}$$

Under A7, the Chicago School criticism states that manufacturer 1 cannot profitably bundle H and L to extend its monopoly power on product H to its secondary product L. The analysis is made under the assumption that $\alpha = 0$, that is manufacturers make take-it-or-leave-it offers to a buyer (denoted by D in our model). Analyzing a "component case", because H is independent from M and L, manufacturer 1 sets the monopoly price for H and captures all the surplus Π^H. On the competitive market, manufacturer 1 is ready to set a price for L up to its marginal cost, which leaves the surplus Π^L to the buyer. Manufacturer 2's optimal pricing behavior thus requires to set a tariff such that it obtains $\Pi^M - \Pi^L$ for the purchase of M. In equilibrium, the buyer chooses the product assortment HM and manufacturer 1 obtains a profit of Π^H. In the case where manufacturer 1 opts for a full-line forcing, we know that the minimum price manufacturer 2 is willing to charge equals its marginal cost, leaving a surplus of Π^M to the buyer. Hence, manufacturer 1 can set a price for its bundle of goods HL to capture a profit of $\Pi^H + \Pi^L - \Pi^M$. In equilibrium, manufacturer 2 is foreclosed from the market and D gets Π^M. It is immediate to see that the full-line forcing enables manufacturer 1 to exclude its competitor, however, this strategy cannot be optimal as $\Pi^H \geq \Pi^H + \Pi^L - \Pi^M$.

Proposition 1 of our article shows that full-line forcing can be an optimal selling strategy for manufacturer 1 under the condition that the buyer's bargaining power is sufficiently high. Because A1 to A4 encompasse A7 when $\Pi^H > \Pi^M$ is satisfied, we obtain the following result:

Proposition 4 *When products are independent and the buyer is powerful, that is:*

$$\alpha > \frac{\Pi^M - \Pi^L}{\Pi^H}$$

manufacturer 1 can profitably exclude its rival through a full-line forcing strategy.

Proof. See Appendix E.1. ■

Therefore, the presence of buyer power explains the profitability of the full-line forcing strategy and answers the Chicago critique in its own setting (under A7). When $\alpha \to 1$ under full-line forcing, D only needs to compare the industry profit accepting the bundle, i.e, Π^{HL} with the industry profit refusing it, i.e. Π^M. Because $\Pi^H + \Pi^L > \Pi^M$, D accepts the bundle and manufacturer 1 is always better off as it gets a profit of $(1-\alpha)\Pi^{HL}$ instead of $(1-\alpha)\Pi^H$ under the component regime.

Many articles have previously addressed the Chicago School critique, offering solid grounds to the so-called "leverage theory".[29] A bunch of articles have first shown that bundling is used by a multi-product firm to behave more agressively towards a potential entrant, which in turn may deter entry (e.g., Whinston, 1990; Nalebuff, 2004; Choi, 1996, 2004). Other articles have pointed out that the leverage theory may hold when the incumbent cannot perfectly extract the rent from consumers. This is also the core argument in our article: imperfect rent-extraction arises as we consider that manufacturers interact with a powerful downstream firm in the vertical chain.

5.2 Banning full-line forcing practices

We first analyze the effects of a ban on full-line forcing when the stocking capacity of D is fixed to $k = 2$ as in Section 3. From Figure 1, we have seen that a full-line forcing arises, impliying that the inefficient product assortment HL is offered to consumers instead of HM. In such a case, we derive the following proposition:

Proposition 5 *When $k = 2$, a ban on full-line forcing practices guarantees that the efficient assortment HM is always offered by D, which improves the industry profit and consumer surplus.*

Proof. Straightforward from A2 and Lemma 7. ■

Propositions 1 and 5 clearly call for a ban on full-line forcing practices when D's buyer power is strong as a full-line forcing equilibrium is more likely to arise. However, when we take into account that D's stocking capacity can be adjusted, the effects of banning full-line forcing practices become more ambiguous. Indeed, we have shown that when full-line forcing are not feasible (e.g., under a ban) D could have incentives to restrict its capacity to $k = 2$ and offer the product assortment HM instead of HML. This can be seen directly from the comparison of the corresponding Figure 2.b with Figure 3.b, or Figure 2.a and Figure 3.a. We obtain the following proposition:

[29]Fumagalli, Motta and Calcagno (2018) provide a detailed survey of this literature.

Proposition 6 *Under a ban of full-line forcing practices, D may further restrict its stocking capacity to improve its bargaining power vis-à-vis manufacturers, which harms the industry profit and consumer surplus.*

Proof. Straightforward from A5 and Lemma 7. ■

Surprisingly, because full-line forcing disciplines D's incentives to restrict its stocking capacity, banning such practices may rather harm welfare. In an environement where a downstream firm can easily expand its stocking capacity in the short-run, Proposition 6 rather call for a "laissez-faire" on full-line forcing practices. Moreover, as we have seen previously, D is more likely to expand its capacity as its buyer power is large, which is precisely the condition under which full-line forcing practices can be employed by manufacturer 1.

5.3 Banning slotting fees

Slotting fees constitute a highly debated practice for competition authorities. Despite a thorough investigation on slotting fees conducted in 2003, the FTC still refrains from issuing slotting allowance guidelines. In contrast, the European Guidelines on vertical restraints in 2010 recommend a case by case analysis if the retailer or the manufacturer concerned has a market share larger than 30%.[30] This cautious attitude of competition authorities reflects the conflicting views on slotting fees which may have anti-competitive as well as efficiency enhancing effects. In our model again the impact of a ban on slotting fees is quite ambiguous. We first analyze the effects of a such a policy when D's stocking capacity is fixed to $k = 2$ as in Section 3. We know from Lemma 4 that D always selects the product assortment HL when manufacturer 1 opts for a full-line forcing strategy. But, when D's bargaining power is low, such a selling strategy is costly to implement because of D's threat to credibly exercise its outside option (i.e., replace HL with M). As stated in Proposition 1 and shown in Figure 1, the corresponding slotting fee to ensure the presence of HL on D's shelves may induce manufacturer 1 to instead opt for a component strategy. However, in the situation

[30] See the European Commission's "Guidelines on Vertical Restraints" (2010), p.59, paragraphs 203-208.

where slotting fees are banned, a full-line strategy becomes always costless. We thus obtain the following result:

Proposition 7 *When $k = 2$, banning slotting fees enables manufacturer 1 to use a full-line forcing strategy which decreases the industry profit and consumer surplus.*

Proof. Straightforward from A2 and Lemma 7. ■

These effects, however, are reversed when D is able to adjust its stocking capacity. Indeed, without any slotting fees, D is unable to exploit the rent from its shelf space scarcity and extract additional surplus by stimulating upstream competition. As a result, D has no incentive to restrict its stocking capacity and always choose to carry all products on its shelves, which in turn prevents manufacturer 1 from triggering any exclusionary effects through a full-line forcing strategy. We thus obtain our second result:

Proposition 8 *When slotting fees are banned, D has no incentive to strategically restrict its stocking capacity which in turn annihilates any foreclosure effects generated by full-line forcing practices to the benefit of the industry profit and consumer surplus.*

Proof. Straightforward from A5 and Lemma 7. ■

Interestingly, both policies have opposite effects. When the retailer cannot adjust its stocking capacity, a ban on full-line forcing practices is efficient whereas a ban on slotting fees hurts welfare. Conversely, when stocking capacity may be adjusted by the retailer, banning full-line forcing practices is harmful whereas Proposition 8 highlights that banning slotting fees efficiently defeats both stocking capacity restriction and full-line forcing practices.

6 Concluding remarks

Appendix

A Component Equilibrium

A.1 Existence

Assume the equilibrium is as described in Lemma 2:

Manufacturer 1 offers a menu of slotting fees $S_1^{HM} = (S^H, S^L, S^{HL}) = (0, 0, (1-\alpha)\Pi^{HL} - (1-\alpha)\left(\Pi^{HM} - \Pi^M\right))$. Manufacturer 2 offers $S_2^{HM} = S^M = \max\{0, \Pi^{HL} - \alpha\Pi^{HM} - (1-\alpha)\Pi^H\}$ for one slot for M. D selects H and M and receive the corrresponding fees, then F_1^{HM} and F_2^{HM} are negotiated.

Equilibrium profit of firms are

$$\Pi_D^{HM} = \begin{cases} \Pi^{HL} - (1-\alpha)\left(\Pi^{HM} - \Pi^M\right) & \text{if } \Pi^{HL} - \alpha\Pi^{HM} - (1-\alpha)\Pi^H > 0 \\ (1-\alpha)\left(\Pi^H + \Pi^M\right) - (1-2\alpha)\Pi^{HM} & \text{otherwise} \end{cases}$$

$$\Pi_1^{HM} = (1-\alpha)\left(\Pi^{HM} - \Pi^M\right)$$

$$\Pi_2^{HM} = \begin{cases} \Pi^{HM} - \Pi^{HL} & \text{if } \Pi^{HL} - \alpha\Pi^{HM} - (1-\alpha)\Pi^H > 0 \\ (1-\alpha)\left(\Pi^{HM} - \Pi^H\right) & \text{otherwise} \end{cases}$$

Deviations by D Given S_1^{HM} and S_2^{HM}, we check that D has no incentive to deviate toward another assortment HL or ML.

- If D deviates toward HL, it gets a profit $\pi_D^{HL} + S^{HL}$. Given that $\pi_D^{HL} = \alpha\Pi^{HL}$, the deviation profit of D is $\Pi^{HL} - (1-\alpha)\left(\Pi^{HM} - \Pi^M\right) \leq \Pi_D^{HM}$ under A2 and A3. A deviation by D toward HL is not profitable.
- If D deviates toward ML, it gets a profit $\pi_D^{ML} + S^L + S^M$. Under A4, $\pi_D^{ML} < \pi_D^{HM}$ in Stage 2, and therefore $\pi_D^{ML} + S^L + S^M \leq \pi_D^{HM} + S^H + S^M$ because $S^L = S^H = 0$. A deviation by D toward ML is not profitable.

Deviations by manufacturer 1.

- Unilateral deviations in slotting fees.
  - If manufacturer 1 deviates toward $S^H > 0$, D still selects HM. Manufacturer 1 is strictly worse off than with $S^H = 0$ because it ends up paying a higher slotting fee.
  - If manufacturer 1 deviates toward $S^L > 0$, this could affect D's assortment choice by replacing M by L, and the deviation profit obtained by manufacturer 1 would be $\pi_1^{ML} - S^L < \pi_1^{HM}$; such

a deviation is not profitable.

  - If manufacturer 1 deviates toward $S^{HL} > (1-\alpha)\Pi^{HL} - (1-\alpha)\left(\Pi^{HM} - \Pi^{M}\right)$, the assortment HL would be chosen by D instead of HM. However, manufacturer 1 is willing to offer at most $\bar{S}^{HL} = \pi_1^{Hl} - \pi_1^{HM} = (1-\alpha)\Pi^{HL} - (1-\alpha)\left(\Pi^{HM} - \Pi^{M}\right)$. Such deviation is not profitable. If $S^{HL} < (1-\alpha)\Pi^{HL} - (1-\alpha)\left(\Pi^{HM} - \Pi^{M}\right)$, the assortment HL remains unselected by D and this deviation is not profitable.

- Multilateral deviations in slotting fees. First note that a raise on both S^H and S^L is equivalent to a raise in S^{HL}. Moreover, if manufacturer 1 raises both S^H and S^{HL} it won't be profitable neither if HL is accepted nor if HM is accepted as slotting fees will be too high. For instance if $S^H > 0$, now manufacturer 1 is willing to offer at most $\bar{S}^{HL} = \pi_1^{HL} - \pi_1^{HM} + S^H = (1-\alpha)\Pi^{HL} - (1-\alpha)\left(\Pi^{HM} - \Pi^{M}\right) + S^H$. In that case, D selects the assortment HL but 1 obtains a profit $(1-\alpha)\left(\Pi^{HM} - \Pi^{M}\right) - S^H$ which is not profitable.

Deviation by manufacturer 2.

- If manufacturer 2 deviates toward $S^M > \max\{0, \Pi_{HL} - \alpha\Pi_{HM} - (1-\alpha)\Pi_H\}$, then HM is still selected by D and manufacturer 2 is worse off because of the higher slotting fee paid.

- If manufacturer 2 deviates to $S^M < \max\{0, \Pi_{HL} - \alpha\Pi_{HM} - (1-\alpha)\Pi_H\}$, D selects instead HL, and manufacturer 2 gets 0 profit. This deviation is not profitable.

There is no deviation toward a single product assortment q Although we assumed in the main analysis that a manufacturer can at most obtain one slot per product, we check the robustness of our equilibrium if a manufacturer could attempt to monopolize the market with a single product.

- Deviation by manufacturer 2 to monopolize the market with M. Manufacturer 2 could offer a slotting fee to secure the two slots and try to monopolize the market. To do so, it would be ready to offer a slotting fee up to $\bar{S}^M = (1-\alpha)\Pi^M - \Pi^{HM} + \Pi^{HL}$. If D accepts, it obtains a profit of $\alpha\Pi^M + (1-\alpha)\Pi^M - \Pi^{HM} + \Pi^{HL} = \Pi^M - \Pi^{HM} + \Pi^{HL}$. But, if instead D selects HL, it gets a profit of $(1-\alpha)\left(\Pi^{M} - \Pi^{HM}\right) + \Pi^{HL}$ which is strictly higher. There is no such deviation.

- Deviation by manufacturer 1 to monopolize the market with H.

  If manufacturer 1 deviates by offering a tariff to monopolize the market with H only, it expects to earn $(1-\alpha)\Pi^H - \bar{S}_1^H > (1-\alpha)\left(\Pi^{HM} - \Pi^{M}\right)$ and therefore is ready to offer up to $\bar{S}^H = (1-\alpha)(\Pi^H + \Pi^M - \Pi^{HM}$. If D accepts, it would obtain a profit of $\Pi^H + (1-\alpha)\left(\Pi^{M} - \Pi^{HM}\right) < \Pi_D^{HM}$. D is never willing to accept.

A.2 Uniqueness

The above equilibrium is not unique for two reasons:

- Manufacturer 1 can offer strictly positive values of S^L in equilibrium as long as this does not switch the assortment decision of D either toward ML or HL.
- Manufacturer 1 can choose to offer $S^{HL} > \bar{S}^{HL}$ and Manufacturer 2 a higher slotting fee $S^M < \bar{S}^M$ such that D is just indifferent between the assortments HM and HL.

However, these equilibria rely on a weakly dominated strategy for manufacturer 2 and the equilibrium presented above is selected by the trembling-hand selection criterion.

- No equilibrium with the assortment ML

  Under A4, D strictly prefers HM to ML in stage 2. This is also the case for manufacturer 1 which is strictly better off selling H than L as $\pi_1^{HM} > \pi_1^{ML}$. Therefore, manufacturer 1 never wants to offer a slotting fee to replace H by L. Manufacturer 2 has a slot in both HM and ML, because slotting fees cannot be made contingent to which rival's product is offered by D, manufacturer 2 cannot trigger a deviation to ML even if it would find profitable to do so.

- No equilibrium with the assortment HL

  As manufacturer 1 is better off with such assortment, it is ready to pay up to $\bar{S}^{HL} = (1-\alpha)\Pi^{HL} - (1-\alpha)(\Pi^{HM} - \Pi^M)$ and $S^H = 0$ to maintain such potential equilibrium. However, M is ready to offer up to π_2^{HM} to D to obtain a slot and comparing the profit of D in the two situations $\pi_D^{HL} + \bar{S}^{HL} = \Pi^{HL} - (1-\alpha)(\Pi^{HM} - \pi^M) < \pi_D^{HM} + \pi_2^{HM} = (2\alpha-1)\Pi^{HM} + (1-\alpha)\Pi^{HM} + (1-\alpha)\Pi^H$ under A1-A2.

B Proof of Corollary 1

- If $\Pi^{HL} > \alpha\Pi^{HM} + (1-\alpha)\Pi^H$, D obtains $\Pi_D^{HM} = \Pi^{HL} - (1-\alpha)(\Pi^{HM} - \Pi^M)$ under the component regime (see Lemma 2) and $\Pi_D^{HL} = \alpha\Pi^{HL}$ under the full-line forcing regime (see Lemma 4). Under A1-A3, it is straightforward that $\Pi_D^{HM} > \Pi_D^{HL}$.
- If $\Pi^{HL} < \alpha\Pi^{HM} + (1-\alpha)\Pi^H$, D obtains $\Pi_D^{HM} = (2\alpha-1)\Pi^{HM} + (1-\alpha)(\Pi^H + \Pi^M)$ under the component regime. In the full-line forcing regime, D obtains:
  - $\Pi_D^{HL} = \alpha\Pi^{HL}$ when $\alpha\Pi^{HL} > \Pi^M$. A2 and A3, it is immediate that $\Pi_D^{HM} > \Pi_D^{HL}$.
  - $\Pi_D^{HL} = \Pi^M$ when $\alpha\Pi^{HL} < \Pi^M$. Comparing the profits in the two cases, we obtain that $\Pi_D^{HL} > \Pi_D^{HM}$ if $\frac{\alpha}{1-\alpha} < \frac{\Pi^{HM}-\Pi^H}{\Pi^{HM}-\Pi^M} \Rightarrow \alpha < \frac{\Pi^{HM}-\Pi^H}{2\Pi^{HM}-\Pi^H-\Pi^M}$. However, in that case, the joint profit of the pair $1-D$ is Π^{HL} under full-line forcing whereas it is $\alpha\Pi^{HM} + (1-\alpha)\Pi^H > \Pi^{HL}$ under

the component regime. Given that the joint profit decreases with the full-line forcing strategy, it cannot be profitable for both manufacturer 1 and D.

C Illustrative Example

In what follows, we determine the optimal industry profit under each market structure (i.e., the maximum profit for the vertically integrated structure).

- When only one product of quality q is sold to consumers, the primitive profit function Π^q is determined by solving the following maximization problem

$$\max_{p^q}\ (p^q - c^q)\ (1 - \frac{p^q}{q})$$

- When instead two qualities are offered on the market, the primitive profit function Π^{HM} is obtained from

$$\max_{p^H,p^M}\ \left(p^H - c^H\right)\ x^H\ +\ \left(p^M - c^M\right)\ x^M$$

  where $x^H = 1 - \frac{p^H - p^M}{H-M}$ and $x^M = \frac{p^H - p^M}{H-M} - \frac{p^M}{M}$. We proceed similarly for Π^{HL} and Π^{ML}.

- When the three qualities are offered on the market, the primitive profit function Π^{HML} is recovered from

$$\max_{p^H,p^M,p^L}\ \left(p^H - c^H\right)\ x^H\ +\ \left(p^M - c^M\right)\ x^M ++\ \left(p^L - c^L\right)\ x^L$$

where $x^H = 1 - \frac{p^H - p^M}{H-M}$ and $x^M = \frac{p^H - p^M}{H-M} - \frac{p^M - p^L}{M-L}$, and $x^L = \frac{p^M - p^L}{M-L} - \frac{p^L}{L}$.

The following table provides industry profits and surpluses under each market structure:

Industry	$\{q\}$	$\{HM\}$
Profit	$\frac{(q-c^q)^2}{4q}$	$\frac{M\left(M(H-2c^H)+(H-c^H)^2\right)+c^M(Hc^M-2Mc^H)}{4M(H-M)}$
Surplus	$\frac{(q-c^q)^2}{8q}$	$\frac{(c^H-c^M-H+M)(c^H(H-2M)+H(c^M-H+M))}{8(H-M)^2} + \frac{(Hc^M-Mc^H)^2}{8M(H-M)^2}$

D Proof of Proposition 2 and Proposition 3

We first define the following thresholds:

- $\alpha_0 = \frac{\Pi^M}{\Pi^H}$
- $\alpha_1 = \frac{\Pi^{HL} - \Pi^H}{\Pi^{HM} - \Pi^H}$
- $\alpha_2 = \frac{\Pi^{HM} - \Pi^{HL}}{\Pi^{HM} - \Pi^M}$
- $\alpha_3 = \frac{\Pi^{HML} - \Pi^{HL}}{2\Pi^{HML} - \Pi^{HL} - \Pi^M}$
- $\alpha_4 = \frac{\Pi^{HML} - \Pi^{HM}}{2\Pi^{HML} - \Pi^{HL} - \Pi^{HM}}$

Note first that in all cases $\Pi_D^{HML} = (1-\alpha)(\Pi^{HL} + \Pi^M) - (1-2\alpha)\Pi^{HML}$.

- Under the full-line forcing regime, i.e. if (6) is satisfied:
  - If $\alpha_0 < \alpha$, we show that $\Pi_D^{HML} > \Pi_D^{HL} = \alpha\Pi^{HL} > \Pi_D^H = \alpha\Pi^H$. It is immediate that the retailer always chooses $k = 3$.
  - If $\alpha > \alpha_0$, $\Pi_D^{HL} = \Pi^M = \Pi_D^H$ and comparing these profits with Π_D^{HML}, we find that $k = 3$ is chosen if and only if $\alpha > \alpha_3$. If D's bargaining power is low enough, either $k = 2$ or $k = 1$ can indifferently arise in equilibrium; however the Pareto criterion selects $k = 2$.
- Under the component regime, i.e. if (6) is not satisfied:
  - If $\alpha < \min\{\alpha_0, \alpha_1\}$, D obtains $\Pi_D^H = \Pi^M$ when $k = 1$, $\Pi_D^{HM} = \Pi^{HL} - (1-\alpha)(\Pi^{HM} - \Pi^M)$ when $k = 2$ and Π_D^{HML} when $k = 3$. $k = 3$ arises in equilibrium when $\alpha > \max[\alpha_3, \alpha_4]$, $k = 2$ arises in equilibrium when $\alpha_4 > \alpha > \alpha_2$ and $k = 1$ arises in equilibrium when $\alpha < \min[\alpha_2, \alpha_3]$.
  - If $\alpha_1 < \alpha < \alpha_0$, D obtains $\Pi_D^H = \Pi^M$ when $k = 1$, $\Pi_D^{HM} = (1-\alpha)(\Pi^H + \Pi^M)_(1-2\alpha)\Pi^{HM}$ when $k = 2$ and Π_D^{HML} when $k = 3$. $k = 3$ arises in equilibrium when $\alpha > \alpha_3$, $k = 2$ never arises in equilibrium because $\Pi_D^{HML} > \Pi_D^{HM}$, $k = 1$ arises in equilibrium when $\alpha < \alpha_3$.
  - If $\alpha_0 < \alpha < \alpha_1$, D obtains $\Pi_D^H = \alpha\Pi^H$ when $k = 1$, $\Pi_D^{HM} = \Pi^{HL} - (1-\alpha)(\Pi^{HM} - \Pi^M)$ when $k = 2$ and Π_D^{HML} when $k = 3$. $k = 3$ arises in equilibrium when $\alpha > \alpha_4$, $k = 2$ arises in equilibrium when $\alpha < \alpha_4$. $k = 1$ never arises in equilibrium as $\Pi_D^H < \Pi_D^{HM}$.
  - If $\alpha > \max[\alpha_0, \alpha_1]$, D obtains $\Pi_D^H = \alpha\Pi^H$ when $k = 1$, $\Pi_D^{HM} = (1-\alpha)(\Pi^H + \Pi^M)_(1-2\alpha)\Pi^{HM}$ when $k = 2$ and Π_D^{HML} when $k = 3$. Only $k = 3$ arises in equilibrium because $\Pi_D^H < \Pi_D^{HM} < \Pi_D^{HML}$.

E Extensions

E.1 Proof of Proposition 4

Component case. Consider that the buyer engages in bilateral bargains with manufacturers to determine prices of their products. In the case where manufacturer 1 sells separately its products H and L, there are two simultaneous bilateral negotiations. A first negotiation involves the buyer and manufacturer 1 for product H. Because H faces no competition, status quo payoffs of each bargainer are 0 and the buyer and manufacturer 1 obtain respectively $\alpha\Pi^H$ and $(1-\alpha)\,\Pi^H$. A second negotiation involves the buyer and either manufacturer 1 for its product L or manufacturer 2 for its product M. In contrast to the first negotiation, the buyer benefits from an outside option which enables it to threat a manufacturer of replacement if unsatisfied by its offer. To account for this feature, we use our 2-stage game presented in Section 2. Proceeding backwards, no bargainer has a positive status quo payoff in the negotiation stage. We thus obtain the following bargaining outcomes: when the buyer and manufacturer 1 negotiate for L they respectively obtain $\alpha\Pi^L$ and $(1-\alpha)\,\Pi^L$; similarly, when the buyer and manufacturer 2 negotiate for M they respectively capture $\alpha\Pi^M$ and $(1-\alpha)\,\Pi^M$. Considering stage 1, the maximum payment that manufacturer 1 is willing to offer for selecting product L is $(1-\alpha)\,\Pi^L$. To ensure that the buyer will select M, manufacturer 2 has to offer a fee up to $\max\{0, \Pi^L - \alpha\Pi^M\}$. In equilibrium, the buyer purchases HM and obtains a surplus of $\max\{\alpha\left(\Pi^H + \Pi^M\right), \alpha\Pi^H + \Pi^L\}$, manufacturer 1's profit is $(1-\alpha)\,\Pi^H$ and manufacturer 2's profit is $\min\{(1-\alpha)\,\Pi^M, \Pi^M - \Pi^L\}$. Note that when $\alpha = 0$, we obtain payoffs of the standard Chicago School setting. This framework thus generalizes the model to any distribution of bargaining power.

Full-line forcing case. In the case where manufacturer 1 uses a full-line forcing to impose the purchase of its product L, the buyer engages in only one negotiation with either manufacturer 1 or manufacturer 2. As in the component case, the buyer benefits from an outside option and can play off manufacturers against each other. Using our 2-stage game, we proceed backwards and first solve the negotiation stage. Because there is only one negotiation, bargainers have no positive status quo payoffs. Therefore, when the buyer and manufacturer 1 negotiate for HL they respectively obtain $\alpha\left(\Pi^H + \Pi^L\right)$ and $(1-\alpha)\left(\Pi^H + \Pi^L\right)$; similarly, when the buyer and manufacturer 2 negotiate for M they respectively obtain $\alpha\Pi^M$ and $(1-\alpha)\,\Pi^M$. In stage 1, the highest slotting fee that manufacturer 2 is willing to offer is $(1-\alpha)\,\Pi^M$. To ensure that its bundle of good is purchased, manufacturer 1 has to offer a payment equals to $\max\{0, \Pi^M - \alpha\left(\Pi^H + \Pi^L\right)\}$. In equilibrium, the buyer purchases the bundle of goods and obtains a surplus of $\max\{\alpha\left(\Pi^H + \Pi^L\right), \Pi^M\}$, manufacturer 1's profit is $\min\{(1-\alpha)\left(\Pi^H + \Pi^L\right), \Pi^H + \Pi^L - \Pi^M\}$, and manufacturer 2 is excluded from the market.

Equilibrium selling strategy. From the comparison of manufacturer 1's profit under each selling strategy, we obtain that it will opt for a full-line forcing if $\min\{(1-\alpha)\left(\Pi^H + \Pi^L\right), \Pi^H + \Pi^L - \Pi^M\} > (1-\alpha)\,\Pi^H \Leftrightarrow \min\{(1-\alpha)\,\Pi^L, \alpha\Pi^H + \Pi^L - \Pi^M\} > 0$. Because $(1-\alpha)\,\Pi^L > 0$, this condition boils down to $\alpha\Pi^H + \Pi^L - \Pi^M > 0 \Leftrightarrow \alpha > \frac{\Pi^M - \Pi^L}{\Pi^H}$.

References

Adams, William James, and Janet L. Yellen. 1976. “Commodity Bundling and the Burden of Monopoly.” *Quarterly Journal of Economics*, 90(3): 475–498.

Bernheim, Douglas B., and Michael D. Whinston. 1985. “Common Marketing Agency as a Device for Facilitating Collusion.” *Rand Journal of Economics*, 16(2): 269–281.

Binmore, Kenneth George. 1985. “Game-Theoretic Models of Bargaining.” , ed. Alvin E. Roth, Chapter 13: Bargaining and coalitions, 269–304. Cambridge University Press.

Binmore, Kenneth George, Ariel Rubinstein, and Asher Wolinsky. 1986. “The Nash Bargaining Solution in Economic Modelling.” *RAND Journal of Economics*, 17(2): 176–188.

Binmore, Kenneth George, Avner Shaked, and John Sutton. 1989. “An Outside Option Experiment.” *Quarterly Journal of Economics*, 104(4): 753–770.

Bork, Robert H. 1978. *Antitrust Paradox: A Policy at War With Itself.* Basic Books.

Bowman, Ward S. 1957. “Tying Arrangements and the Leverage Problem.” *Yale Law Journal*, 67(1): 19–36.

Carlton, Dennis W., and Michael Waldman. 2002. “The Strategic Use of Tying to Preserve and Create Market Power in Evolving Industries.” *RAND Journal of Economics*, 33(2): 194–220.

Chambolle, Claire, and Sofia Berto Villas-Boas. 2015. “Buyer power through the differentiation of suppliers.” *International Journal of Industrial Organization*, 43(1): 56–65.

Choi, Jay Pil. 1996. “Preemptive R&D, Rent Dissipation, and the "Leverage Theory".” *Quarterly Journal of Economics*, 111(4): 1153–1181.

Choi, Jay Pil. 2004. “Tying and Innovation: A Dynamic Analysis of Tying Arrangements.” *Economic Journal*, 114(492): 83–101.

Collard-Wexler, Allan, Gautam Gowrisankaran, and Robin S. Lee. 2017. “"Nash-in-Nash" Bargaining: A Microfoundation for Applied Work.” forthcoming at *Journal of Political Economy.*

de Cornière, Alexandre, and Greg Taylor. 2018. “Upstream Bundling and Leverage of Market Power.” Unpublished.

de Fontenay, Catherine C., and Joshua S. Gans. 2014. “Bilateral Bargaining with Externalities.” *Journal of Industrial Economics*, 62(4): 756–788.

Fumagalli, Chiara, Massimo Motta, and Claudio Calcagno. 2018. *Exclusionary Practices. The economics of Monopolisation and Abuse of Dominance.* Cambridge University Press.

Gal-Or, Esther. 1997. "Exclusionary Equilibria in Health-Care Markets." *Journal of Economics & Management Strategy*, 6(1): 5–43.

Gal-Or, Esther. 1999. "Mergers and Exclusionary Practices in Health Care Markets." *Journal of Economics & Management Strategy*, 8(3): 315–350.

Ghili, Soheil. 2018. "Network Formation and Bargaining in Vertical Markets: The Case of Narrow Networks in Health Insurance." Unpublished.

Ho, Justin, Katherine Ho, and Julie Holland Mortimer. 2012*a*. "Analyzing the Welfare Impacts of Full-line Forcing Contracts." *Journal of Industrial Economics*, 60(2): 468–498.

Ho, Justin, Katherine Ho, and Julie Holland Mortimer. 2012*b*. "The Use of Full-Line Forcing Contracts in the Video Rental Industry." *American Economic Review*, 102(2): 686–719.

Ho, Katherine, and Robin S. Lee. 2018. "Equilibrium Provider Networks: Bargaining and Exclusion in Health Care Markets." forthcoming at *American Economic Review.*

Horn, Henrik, and Asher Wolinsky. 1988. "Bilateral Monopolies and Incentives for Merger." *RAND Journal of Economics*, 19(3): 408–419.

Ide, Enrique, and Juan-Pablo Montero. 2018. "A Theory of Foreclosure and Wholesale Bundling." Unpublished.

Inderst, Roman, and Christian Wey. 2003. "Bargaining, Mergers, and Technology Choice in Bilaterally Oligopolistic Industries." *RAND Journal of Economics*, 34(1): 1–19.

Inderst, Roman, and Greg Shaffer. 2007. "Retail Mergers, Buyer Power and Product Variety." *Economic Journal*, 117(516): 45–67.

Jeon, Doh-Shin, and Domenico Menicucci. 2012. "Bundling and Competition for Slots." *American Economic Review*, 102(5): 1957–1985.

Liebman, Eli. 2018. "Bargaining in Markets with Exclusion: An Analysis of Health Insurance Networks." Unpublished.

Marx, Leslie, and Greg Shaffer. 2007. "Rent shifting and the order of negotiations." *International Journal of Industrial Organization*, 25(5): 1109–1125.

Marx, Leslie, and Greg Shaffer. 2010. "Slotting Allowances and Scarce Shelf Space." *Journal of Economics & Management Strategy*, 19(3): 575–603.

McAfee, R. Preston, and Marius Schwartz. 1994. "Opportunism in Multilateral Vertical Contracting: Nondiscrimination, Exclusivity, and Uniformity." *American Economic Review*, 84(1): 210–230.

Mussa, Michael, and Sherwin Rosen. 1978. "Monopoly and product quality." *Journal of Economic Theory*, 18(2): 301–317.

Muthoo, Abhinay. 1999. *Bargaining Theory with Applications.* Cambridge University Press.

Nalebuff, Barry. 2004. "Bundling as an Entry Barrier." *Quarterly Journal of Economics*, 119(1): 159–187.

Nash, John F. 1950. "The Bargaining Problem." *Econometrica*, 18(2): 155–162.

O'Brien, Daniel P., and Greg Shaffer. 1997. "Nonlinear Supply Contracts, Exclusive Dealing, and Equilibrium Market Foreclosure." *Journal of Economics & Management Strategy*, 6(4): 755–785.

Posner, Richard A. 1976. *Antitrust Law: An Economic Perspective.* University of Chicago Press.

Ramezzana, Paolo. 2018. "Contracting, Exclusivity and the Formation of Supply Networks with Downstream Competition." Unpublished.

Rey, Patrick, and Thibaud Vergé. 2017. "Secret contracting in multilateral relations." Unpublished.

Shaked, Avner, and John Sutton. 1984. "Involuntary Unemployment as a Perfect Equilibrium in a Bargaining Model." *Econometrica*, 52(6): 1351–1364.

Shepard, Mark. 2016. "Hospital Network Competition and Adverse Selection: Evidence from the Massachusetts Health Insurance Exchange." Unpublished.

Stole, Lars A., and Jeffrey Zwiebel. 1996. "Intra-firm Bargaining under Non-binding Contracts." *Review of Economic Studies*, 63(3): 375–410.

Vergé, Thibaud. 2002. "Portfolio Effects and Merger Control: Full-line Forcing as an Entry-Deterrence Strategy." Unpublished.

Whinston, Michael D. 1990. "Tying, Foreclosure, and Exclusion." *American Economic Review*, 80(4): 837–859.