Abstract

What determines product variety in vertically related markets? We study a model in which rival manufacturers bid for distribution at retailers who compete for final consumers. Product variety comes at the cost of fierce retail competition, because rival manufacturers are unable to internalize all contracting externalities. Non-inferior brands, therefore, might not get distribution in equilibrium even though consumers have a strict preference for variety. We illustrate how the problem of exclusion disappears under an industry-wide ban on slotting allowances or with an upstream horizontal merger.

1 Introduction

Product variety is a key concern in competition policy, for example in cases related to abuse of dominance, or the appraisal of horizontal mergers. In the background, there is a vast literature on product variety in industrial organization, going back to Hotelling (1929) and Chamberlain (1933). This literature studies the link between product variety and competition in models where manufacturers also sell directly to final consumers. In today’s economy, however, powerful retailers often act as gatekeepers to final markets. Product variety, therefore, often depends on not only manufacturers’ choice of product attributes, but also retailers’ choice of distribution.

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In this paper, we present a theory of product variety rooted in the vertical relations between manufacturers and retailers. We take product characteristics as fixed, and scrutinize the way in which equilibrium distribution depends on upstream and downstream competition. Contracts are assumed to be observable. The central mechanism in our model is a novel trade-off between product variety and competition. In essence, reducing variety enhances the firms’ collective ability to internalize contracting externalities that occur whenever consumers see brands and retailers as substitutes. Our approach also admits policy applications, because the firms’ preferred way to resolve this trade-off depends on the set of admissible contracts and the industry’s concentration level.

The idea and contribution of our model is perhaps best understood in light of the literature on “competing vertical structures.” In these models, like in ours, two manufacturers can sell their brands through two retailers, who can stock one brand each (e.g., due to scarce shelf space or single sourcing strategies). Brands as well as retailers are imperfect substitutes, and manufacturers can offer non-linear contracts (e.g., two-part tariffs). In contrast to this literature, however, we do not impose an exclusive one-to-one relationship between a manufacturer and its designated retailer – instead we allow both manufacturers to make contract offers to both retailers, even though each retailer will stock at most one brand in equilibrium. The central question, then, is whether the retailers decide to stock brands from different manufacturers, or whether one manufacturer will be the exclusive supplier of both retailers.

Why would both retailers turn down the same manufacturer when consumers have a preference for variety and equally value the two differentiated brands? Our explanation is as follows. When the retailers sell one brand each, manufacturers have an incentive to cut per-unit wholesale prices to give their retailer a competitive edge. Fierce retail competition in turn dissipates the profits that firms can share through fixed fees. However, if one manufacturer were the exclusive supplier of both retailers, she could dampen retail competition by increasing her wholesale price, without worrying about the rival manufacturer’s response. The maximized one-brand industry profit could then be shared with the retailers, as compensation for rejecting the rival manufacturer’s offers. This exclusivity strategy is relatively more advantageous for the three active firms when retail competition is fierce, and when brands are relatively similar. In these situations, consumers find only a single brand at the retail shelves.

The paper proceeds as follows. Section 1.1 relates our approach to the literature.

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Section 2 presents the model. Section 3 studies the main tension between variety and competition (3.1), and provides some illustrative examples (3.2). Section 4 considers policy applications to vertical restraints and horizontal mergers. Section 5 concludes.

1.1 Literature connections

Our paper relates to several strands of the vertical relations literature.

The question of how many upstream firms will be active in equilibrium is considered also in the extensive literature on so-called “naked” exclusion (cf. Rasmussen et al., 1991; Segal and Whinston, 2000). In this setting, an incumbent supplier offers exclusivity contracts to buyers in the hope of foreclosing a more efficient entrant (who can supply a homogeneous product). Following Fumagalli and Motta (2006), who introduced the case in which buyers are competing retailers, several authors study the relationship between exclusion and product differentiation (e.g., Abito and Wright, 2008; Wright, 2008; Argen- ton, 2010). An implicit assumption in these models, however, is that the entrant is not yet active at the contracting stage. When denied distribution, the entrant is a passive victim of the incumbent’s strategy. As pointed out by Spector (2011), this timing is at odds with many important cases in which well-established suppliers are denied market access. In our model, manufacturers make simultaneous bids for distribution,\(^2\) and the level of product differentiation determines equilibrium product variety. For example, we find that exclusion is more likely when brands are close substitutes, which is in line with Wright’s (2008) conclusion.

Our work relates also to the literature on explicit exclusive dealing (O’Brien and Shaffer, 1997; Bernheim and Whinston, 1998). This literature looks at two manufacturers offering non-linear contracts to a single retailer (“common agency”). A key result is that both manufacturers can obtain distribution by offering their brands at marginal cost in return for positive fixed fees, leaving the retailer free to internalize all pricing externalities. In our model, in contrast, retail competition creates externalities that cannot readily be solved by such “residual claimant” contracts, or by any two-part tariffs as long as both brands are sold.\(^3\)

\(^2\)See also Spector (2011) for such a model in which buyers are end users.

\(^3\)Bernheim and Whinston (1998, Section IV and V) show that exclusion and exclusive dealing can become pertinent even without retail competition whenever there are other contracting externalities in play (e.g., risk sharing).
There is also a small literature on single sourcing in retail markets, which has focused on how the profitability of committing to stock only a single brand depends on bargaining power and contract sophistication (e.g., Inderst and Shaffer, 2007; Marx and Shaffer, 2010). Again, there are two suppliers and a monopolistic retailer, so single sourcing automatically denies distribution to the rejected supplier. We do not focus on the single sourcing decision, but rather on how product variety depends on the level of retail competition in a single sourcing environment. While one would perhaps expect retail competition to alleviate the problem of exclusion, our model only partly supports this view. Clearly, going from one to two single-sourcing retailers doubles the amount of available shelf space, which at least makes it possible for both suppliers to obtain distribution. On the other hand, for a given number of retailers, exclusion becomes more likely as retail competition intensifies (i.e., when consumers see retailers as closer substitutes).

Finally, the contracting game in our model shares many features with the "bidding games" in; e.g., Miklós-Thal et al. (2011), Rey and Whinston (2013), and Gabrielsen and Johansen (2015). Motivated by the rise of retail buyer power, these authors consider models in which retailers make contract offers to a common manufacturer. Moreover, terms of trade are contingent on the number of retailers active in equilibrium, which again depends on the level of retail competition and the set of admissible contracts.4 The bidding game in our model, in contrast, is between manufacturers who offer contracts contingent on the number of brands that eventually obtains distribution. Note, however, that our model also speaks to the issue of buyer power. Due to their position as gatekeepers to the final market, the retailers can take large shares of the industry profit, for example by requiring that manufacturers offer slotting allowances.

2 Model

We consider a vertically related market with two manufacturers, A and B, and two retailers, 1 and 2. Manufacturers produce their brands at constant marginal cost \( c_A = c_B = c \geq 0 \). We normalize the retailers’ distribution costs to zero.

Each manufacturer has the capacity to serve both retailers. A retailer, in contrast, can stock at most one brand, either A or B. This assumption might reflect that retailers

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4 See also Marx and Shaffer (2007), who first considered the retail bidding game with non-contingent contracts.
have pre-committed to single sourcing, or simply that shelf space is scarce.\textsuperscript{5} We refer to the situations in which retailers stock the same brand and different brands as “one-brand” and “two-brand,” respectively. In any one-brand situation, the other brand is not available to final consumers.

The timing of events is as follows:

1. Each manufacturer makes contract offers to both retailers.

2. Each retailer either accepts the offer from one manufacturer, or rejects both offers.

3. Accepted contracts are implemented, and the retailers compete in the final market.

We assume that the manufacturers’ Stage 1 contract offers and the retailers’ Stage 2 accept/reject decisions are publically observable. Our solution concept is subgame perfect Nash equilibrium, though we additionally use focal point arguments or the coalition proofness refinement (see Bernheim et al. (1987)) to pin down unique equilibria at some stages.

The central trade-off between variety and competition that we explore in our model holds with Bertrand as well as Cournot competition in the retail market. We consider Bertrand competition in the main model, because the two-brand subgames are more intuitive in this case. In Section 3.2.1, we illustrate the Cournot case with a linear demand example. Let $D^s_{ij}(p)$ be the direct demand for brand $i \in \{A, B\}$ at retailer $j \in \{1, 2\}$ in market structure $s = O, T$; for One-brand and Two-brand, respectively.

We assume that $D^s_{ij}(p)$ has a negative and finite own-price effect ($\partial D^s_{ij}/\partial p_{ij} < 0$) and a positive cross-price effect ($\partial D^s_{ij}/\partial p_{ik} > 0$ and $\partial D^s_{ij}/\partial p_{hj} > 0$, for $k \neq j \in \{1, 2\}$ and $h \neq i \in \{A, B\}$). Moreover, we will take for granted that $D^s_{ij}(p)$ and the resulting retail profit functions satisfy standard assumptions to ensure that the Stage 3 Bertrand game has a unique equilibrium for any vector of wholesale prices (see, e.g., Vives, 2005). The retailers may well be seen as imperfect substitutes from the perspective of final consumers, and the degree of substitution can be an important determinant of the equilibrium market structure.

In the baseline model, manufacturers use two-part tariffs, which we allow to be contingent on whether the realized market structure is a one-brand or two-brand situation. We think this is a natural assumption in our setting, as an unexpected change in market

\textsuperscript{5}See, e.g., Shaffer (2005) for a discussion on the scarcity of shelf space.
structure (e.g., the foreclosure of a manufacturer) should prompt the remaining firms to update their terms of trade.\textsuperscript{6} In addition, under a restriction to single two-part tariffs, the above game admits no subgame perfect equilibrium in pure strategies.\textsuperscript{7}

Formally, let the contract offer from manufacturer \(i\) to retailer \(j\) in market structure \(s\) be \(\tau_{ij}^s = w_{ij}^s q_{ij} + F_{ij}^s\) for \(q_{ij} \geq 0\); i.e., \(\tau_{ij}^O\) applies when both retailers accept offers from manufacturer \(i\), while \(\tau_{ij}^T\) applies when at most one retailer accepts an offer from manufacturer \(i\).

There are four possible equilibrium brand/retailer configurations:\textsuperscript{8} the two-brand cases \(\{A1, B2\}\) and \(\{B1, A2\}\), and the one-brand cases \(\{A1, A2\}\) and \(\{B1, B2\}\). As a tie-break rule, we posit that retailers prefer to carry different brands whenever one-brand and two-brand cases yield the same profits. We assume that both two-brand configurations are equally profitable. We also assume that, in any two-brand configuration, both channels equally contribute to industry profits (symmetry).

Following the above definitions, \(D_{ij}^T(p_{i1}, p_{h2})\) is the demand faced by retailer \(j = 1, 2\) when \(j\) stocks brand \(i\) while the other retailer stocks the other brand \(h\). We define the maximal industry profit in this two-brand case as

\[
\Pi^T \equiv \max_{p_{i1}, p_{h2}} \{ (p_{i1} - c) D_{i1}^T (p_{i1}, p_{h2}) + (p_{h2} - c) D_{h2}^T (p_{i1}, p_{h2}) \}.
\]

Let \(p^{T*}\) be the vector of two-brand profit maximizing retail prices. \(D_{ij}^O(p_{i1}, p_{i2})\) is similarly retailer \(j\)'s demand when only manufacturer \(i = A, B\) gets distribution. The maximal industry profit in this one-brand case is

\[
\Pi^O_i \equiv \max_{p_{i1}, p_{i2}} \{ (p_{i1} - c) D_{i1}^O (p_{i1}, p_{i2}) + (p_{i2} - c) D_{i2}^O (p_{i1}, p_{i2}) \}.
\]

Let \(p^{O*}\) be the vector of one-brand profit maximizing retail prices. Note that the two cases share a first order condition for the optimal \(p_{i1}\), equal to

\[
D_{i1}^s + (p_{i1} - c) \frac{\partial D_{i1}^s}{\partial p_{i1}} + (p_{x2} - c) \frac{\partial D_{x2}^s}{\partial p_{i1}} = 0, \tag{1}
\]

where \(x = h\) in the two-brand case and \(x = i\) in the one-brand case. We assume

\[
\Pi^O_A + \Pi^O_B > \Pi^T > \Pi^O_A = \Pi^O_B,
\]

\textsuperscript{6}See Miklos-Thal et al. (2011, p. 9) for a discussion of contingent contracts.

\textsuperscript{7}See Schutz (2013) for a rigorous argument.

\textsuperscript{8}In addition, there are five configurations that cannot arise in equilibrium: four in which one brand is sold at one retailer while the two other firms are inactive, and one in which none of the firms are active.
i.e., final consumers see brands as (imperfect) substitutes (i.e., they have “love for variety”). Let \( \Pi^s(w^s_{ij}, w^s_{hk}) \) denote the industry flow profit in market structure \( s = T, O \). We assume that the function \( \Pi^s(w^s_{ij}, w^s_{hk}) \) is quasi-concave, and that there exist wholesale prices that can induce the maximal industry profit in both market structures; i.e., \( \exists (w^T_{ij}, w^T_{hk}) \) such that \( \Pi^T(w^T_{ij}, w^T_{ij}) = \Pi^T \), and \( \exists (w^O_{ij1}, w^O_{ij2}) \) such that \( \Pi^O(w^O_{ij1}, w^O_{ij2}) = \Pi^O \). Finally, we assume that, for any equal wholesale prices below the industry profit maximizing level, a two-brand structure yields higher industry profits than a one-brand structure (because consumers have a preference for variety).

3 Analysis

We now solve the model, starting from the Stage 3 retail pricing game. In any subgame where both retailers have accepted a contract offer, the profit of retailer \( j \) selling brand \( i \) is \( (p_{ij} - w^s_{ij}) D^s_{ij}(p) - F^s_{ij} \). The first order condition for \( p_{ij} \) is therefore

\[
(p_{ij} - w^s_{ij}) \frac{\partial D^s_{ij}}{\partial p_{ij}} + D^s_{ij} = 0.
\]

Let \( p_{ij}(w^s) \) be the resulting equilibrium price, where either \( w^T = (w^T_{ij}, w^T_{hk}) \) or \( w^O = (w^O_{ij}, w^O_{ik}) \).

Note also that for the retailer’s pricing incentives to be aligned with the industry profit maximizing incentives, it has to be the case that (1) coincides with (2) when evaluated at the industry profit maximizing retail prices; i.e.,

\[
D^s_{ij}(p^{**}) + \frac{\partial D^s_{ij}}{\partial p_{ij}} \bigg|_{p=p^{**}} \left( p^{**}_{ij} - c \right) \frac{\partial D^s_{xk}}{\partial p_{ij}} \bigg|_{p=p^{**}} = D^s_{ij}(p^{**}) + \frac{\partial D^s_{ij}}{\partial p_{ij}} \bigg|_{p=p^{**}} \left( p^{**}_{ij} - w^s_{ij} \right)
\]

for \( x = i, h \). This implies that the wholesale prices that induce the industry profit maximizing retail price on brand \( i \in \{A, B\} \) in the two-brand and one-brand situations, respectively, are

\[
w^T_{ij} = c + \left( p^{**}_{hk} - c \right) \frac{\partial D^T_{hk}}{\partial p_{ij}}, \quad w^O_{ij} = c + \left( p^{**}_{ik} - c \right) \frac{\partial D^O_{ik}}{\partial p_{ij}}.
\]
Given our demand assumptions, the last terms on the right hand sides in (3) are positive. Intuitively, wholesale prices should exceed marginal cost to internalize competition between brands and retailers in the two-brand case, and between retailers in the one-brand case.

Our next step is to see how these “first-best” wholesale prices compare with the equilibrium prices, marked by upper bars, in the two-brand and one-brand subgames.

Two-brand subgames. In any candidate two-brand equilibrium, the manufacturers’ wholesale prices must be mutual best responses (in the standard Nash-sense) in maximizing the joint profits of each manufacturer’s channel. If not, one manufacturer could increase the profits of his channel by changing the wholesale price, and adjusting the fixed fee to keep the retailer’s acceptance decision – and the market structure – unchanged.

Consequently, consider the $ij$-channel. Manufacturer $i$ chooses $w_{ij}^T$ to maximize

$$
\pi_{ij} = (p_{ij} (w_T^T) - c) D_{ij}^T (p_{ij} (w_T^T), p_{hk} (w_T^T)).
$$

The first order condition (dropping function arguments for brevity) can be written as

$$
\frac{\partial p_{ij}}{\partial w_{ij}} \left[ D_{ij}^T + (p_{ij} - c) \frac{\partial D_{ij}^T}{\partial p_{ij}} \right] + (p_{ij} - c) \frac{\partial D_{ij}^T}{\partial p_{hk}} \frac{\partial p_{hk}}{\partial w_{ij}} = 0.
$$

By using the retailer’s first order condition in (2) inside the brackets, we get

$$
(w_{ij}^T - c) \frac{\partial D_{ij}^T}{\partial p_{ij}} \frac{\partial p_{ij}}{\partial w_{ij}} + (p_{ij} - c) \frac{\partial D_{ij}^T}{\partial p_{hk}} \frac{\partial p_{hk}}{\partial w_{ij}} = 0,
$$

or

$$
w_{ij}^T = c + \frac{(p_{ij} - c) \frac{\partial D_{ij}^T}{\partial p_{hk}} \frac{\partial p_{hk}}{\partial w_{ij}}}{\frac{\partial D_{ij}^T}{\partial p_{ij}} \frac{\partial p_{ij}}{\partial w_{ij}}} \quad (4)
$$

Comparing (4) to (3) gives the following result.

**Lemma 1.** $w_{ij}^T \neq w_{ij}^{T*}$, such that $\Pi^T < \Pi^T$.

The intuition is straightforward. As long as brands are substitutes, competition between manufacturers drive the equilibrium wholesale prices below the industry profit maximizing level. Yet, as in Bonanno and Vickers’ (1988) seminal model, equilibrium wholesale prices remain above cost to dampen price competition between the retailers.\(^9\)

\(^9\)Rigorous proofs for $w_{ij}^T < w_{ij}^{T*}$ and $w_{ij}^T > c$ can be found in Rey and Stiglitz (1995) and Bonanno and Vickers (1988), respectively.
The result is a “semi-competitive” equilibrium, where the joint profit of the four firms are below the maximal level.

One-brand subgames. In any candidate one-brand equilibrium, the exclusive manufacturer would like to set wholesale prices to make the industry profit as large as possible. If not, she could change the wholesale prices, adjust the fixed fees to make the retailers as well off as before the change, and thereby strictly increase her own profit. Manufacturer \(i\)'s objective is

\[
\pi_i = (p_{ij}(w^O) - c) D_{ij}^O(p_{ij}(w^O), p_{ik}(w^O)) \\
+ (p_{ik}(w^O) - c) D_{ik}^O(p_{ij}(w^O), p_{ik}(w^O)),
\]

and the first order condition for \(w_{ij}\) can, again by exploiting (2), be written as

\[
\frac{\partial p_{ij}}{\partial w_{ij}} \left[ (w_{ij} - c) \frac{\partial D_{ij}^O}{\partial p_{ij}} + (p_{ik} - c) \frac{\partial D_{ik}^O}{\partial p_{ij}} \right] + \frac{\partial p_{ik}}{\partial w_{ij}} \left[ (w_{ik} - c) \frac{\partial D_{ik}^O}{\partial p_{ik}} + (p_{ij} - c) \frac{\partial D_{ij}^O}{\partial p_{ik}} \right] = 0.
\]

The manufacturer can satisfy this condition by setting, for \(j \neq k \in \{1, 2\}\):

\[
w_{ij} = c + \frac{(p_{ik} - c) \frac{\partial D_{ik}^O}{\partial p_{ij}}}{-\frac{\partial D_{ij}^O}{\partial p_{ij}}},
\]

which proves the following result.

Lemma 2. \(w_{ij}^0 = w_{ij}^{0*}\), such that \(\Pi_i^O = \Pi_i^O\).

It is well known that a single manufacturer who offers observable two-part tariffs can fully internalize retail competition, and induce the industry profit maximizing outcome (e.g., Mathewson and Winter, 1984).\(^{10}\)

3.1 Equilibrium product variety

One-brand equilibria. If one of the manufacturers insists on inducing a one-brand structure (for instance by offering only a one-brand tariff, or equivalently, offer two-brand tariffs with low wholesale prices) the other manufacturer cannot gain by trying to induce a

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\(^{10}\)Note that both Lemma 1 and 2 hinge on the assumption of observable contract offers. If contracts are unobservable, equilibrium wholesale prices can be lower in both the two-brand and one-brand subgames.
two-brand structure.\textsuperscript{11} When seeking to prove the existence of one-brand equilibria, we may therefore restrict attention to a game where both manufacturers offer only one-brand tariffs.

Lemma 2 pins down the wholesale prices in any one-brand equilibrium to the industry profit maximizing level. The competition on the fixed fees at the contracting stage takes a Bertrand-like form, and no manufacturer can earn positive profits in equilibrium. If not, the inactive manufacturer could marginally undercut the fixed fees of the active manufacturer, obtain distribution, and earn positive profits. One-brand equilibria always exist and they must include wholesale prices at \( w_{ij}^O = w_{ij}^* \), and (negative) fixed fees that transfer all profits to retailers.\textsuperscript{12}

**Two-brand equilibria.** In essence, one-brand equilibria always exist because the two-brand tariffs of one manufacturer can be set to make deviations to that structure unattractive - leaving the rival no choice but to compete head to head on one-brand fixed fees. Since both wholesale prices in a one-brand structure are set by the same manufacturer, a two-brand equilibrium must be immune to deviations to the optimal one-brand structures.

In any two-brand equilibrium, both retailers must be indifferent between all tariffs. If not, at least one of the manufacturers would be able to profitably increase a two-brand fixed fee, without altering acceptance decisions at stage 2 of the game. This property simplifies the process of establishing a necessary condition for the existence of two-brand equilibria in our model. Denote the profits of the indifferent retailers by \( \pi_j \). The wholesale prices from Lemma 1 pin down the channel profits in any candidate two-brand equilibrium, which by our assumptions on the symmetry of demand is \( \frac{\Pi^T}{2} \).

Consider now the following inequality, where \( \pi_j \) is the profit of one indifferent retailer:

\[
\frac{\Pi^T}{2} - \pi_j \geq \Pi^O - 2\pi_j. \tag{6}
\]

We posit that (6) must be satisfied from the perspective of both manufacturers in any two-brand equilibrium. The left-hand side of (6) are the profits of a manufacturer in the two-brand structure induced by the offered contracts. The right-hand side are the profits

\textsuperscript{11}Low two-brand wholesale prices from one manufacturer reduces the profits the rival manufacturer can generate following a deviation to two-brand.

\textsuperscript{12}Note that profits need not be equally distributed among the two retailers. In fact, any distribution of the downstream profits that amount to \( \Pi^O \) can sustain a one-brand equilibrium. The reason for this is that it is the joint “cost” of persuading both retailers to accept that is relevant when an excluded manufacturer considers the attractiveness of a deviation (reducing fixed fees).
of a manufacturer following deviation to an optimal one-brand structure (the industry profits less the profits of each retailer). As long as this inequality holds, the tariffs offered resist deviations to any one-brand structure at Stage 1. An additional requirement is that the tariffs satisfying (6) do not induce negative manufacturer profits.

Two-brand equilibria can therefore only exist when inequality (6) can hold without implying negative manufacturer profits. Solving the inequality wrt. \( \pi_j \), we get \( \pi_j \geq \Pi^O - \frac{\Pi^T}{2} \). When this holds with equality, we have the lower bound on retailer profits that deter manufacturer deviations to one-brand structures. Let us now consider the profits of the manufacturers in cases where (6) is satisfied, and retailers are left with the lower bound profits. The profits of one manufacturer are then \( \pi^T_i = \frac{\Pi^T}{2} - \left( \Pi^O - \frac{\Pi^T}{2} \right) \), which is non-negative whenever \( \Pi^T \geq \Pi^O \). A necessary condition for the existence of two-brand equilibria is therefore that industry profits in two-brand structures exceed the optimal industry profits in one-brand structures. Whenever this condition is violated, profitable deviations to one-brand structures are available for all two-brand tariffs that manufacturers could offer without inducing negative profits. Intuitively, the condition is more likely to be satisfied when brands are not too close substitutes. In section 3.2 we illustrate this with a quadratic utility example.

**Proposition 1.** One-brand equilibria always exist and are characterized by monopoly pricing on the distributed brand and zero upstream profits. Two-brand equilibria exist if and only if the two-brand industry profits weakly exceed the one-brand integrated industry profits, \( \Pi^T \geq \Pi^O \).

**Profit-sharing in two-brand equilibria.** The condition \( \Pi^T \geq \Pi^O \) is required for two-brand equilibria to exist, but it does not fully characterize profit sharing among firms in these equilibria. It is straightforward to show that a continuum of two-brand equilibria that give retailers profits larger than the lower bound \( \Pi^O - \frac{\Pi^T}{2} \) exist. More precisely, any profit distribution where \( \pi_j \in [\Pi^O - \frac{\Pi^T}{2}, \Pi^O] \) and corresponding manufacturer profits \( \pi^T \in [\Pi^T - \Pi^O, \Pi^T - \Pi^O] \) can support a two-brand equilibrium.\(^{13}\) The two-brand equilibria where retailers earn exactly \( \Pi^O - \frac{\Pi^T}{2} \) are preferred by manufacturers to any other equilibrium of our model.

\(^{13}\)If retailers are offered profits of \( \in (\Pi^O - \frac{\Pi^T}{2}, \Pi^T - \Pi^O] \), manufacturers earn negative profits in the case of a deviation to one-brand. We therefore make the assumption that equilibrium tariffs are required to be credible in the sense that manufacturers would be able to pay the fixed fees if called upon.
**Focal equilibria and coalition proofness.** We note that all two-brand equilibria are strictly preferred by manufacturers over their one-brand counterparts whenever $\Pi^T > \Pi^O$. We argue therefore that two-brand equilibria are focal whenever they exist. Moreover, this can be extended to the choice between different two-brand equilibria: For manufacturers at stage 1, the equilibrium with the highest manufacturer profits ($\pi^T = \Pi^T - \Pi^O$) would be a focal point. This outcome would also be the result if we applied the concept of coalition proofness (for applications to similar game structures, see for instance Rey and Vergé, 2017 and Segal and Whinston, 2000). At stage 1, we must search for a Nash-equilibrium preferred by a coalition of the two manufacturers, and this is indeed the one leaving maximum profits upstream. In the following we will sometimes posit a unique prediction of outcomes (one-brand with no upstream profits for $\Pi^T < \Pi^O$ and two-brand with maximum upstream profits for $\Pi^T \geq \Pi^O$) based on this insight.

### 3.2 Quadratic utility example

Let us provide an illustrative example. Suppose that a representative consumer has utility function $V = y + U$, in which $y$ is a composite good and

$$U = \sum_{ij} q_{ij} - \frac{1}{2} q_{ij}^2 - \sum_{i \in \{A, B\}} dq_{i1}q_{i2} - \sum_{j \in \{1, 2\}} bq_{A_j}q_{B_j} - bd (q_{A1}q_{B2} + q_{A2}q_{B1}),$$

where $q$'s are quantities consumed of the brand/retailer combinations. The parameter $b \in (0, 1)$ is the consumer’s willingness to substitute between brands, while $d \in (0, 1)$ is substitution across retailers. The product $bd$ measures the rate of substitution between different brands at different retailers. The utility function $U$ displays “love for variety,” and has been widely used in IO since Dixit (1979).\(^{14}\) Maximizing $V$ wrt. the budget $I = \sum_{ij} p_{ij}q_{ij} + y$ (normalizing $p_y = 1$) yields inverse demand

$$p_{ij} = 1 - q_{ij} - bq_{hj} - dq_{ik} - bdq_{hk}, \quad (7)$$

for $i \neq h \in \{A, B\}$ and $j \neq k \in \{1, 2\}$. For the two-brand situations we set $q_{ik} = q_{hj} = 0$, and invert the system (7) to get

$$D^T_{ij}(p) = \frac{1 - bd - p_{ij} + bdp_{hk}}{1 - b^2d^2}. \quad (8)$$

\(^{14}\)Applications in vertical models include Dobson and Waterson (2007) and Gabrielsen and Johansen (2015).
Similarly for one-brand situations we set $q_{hj} = q_{hk} = 0$ and get

$$D_{ij}^O(p) = \frac{1 - d - p_{ij} + dp_{ik}}{1 - d^2}. \quad (9)$$

Given the symmetric demand functions (8) and (9), all prices and fixed fees will be symmetric. When setting $c = 0$, it is straightforward to compute that the first-best wholesale prices are

$$w^{T^*} = \frac{bd}{2} < \frac{d}{2} = w^{O^*},$$

and that maximal industry profits are

$$\Pi^T = \frac{1}{2 (1 + bd)} > \frac{1}{2 (1 + d)} = \Pi^O.$$

In the one-brand case, we have from Lemma 1 (and can easily confirm) that $w^O = d/2$ and $\Pi^O = 1/(2 + 2d)$. For the two-brand case, it is straightforward to show that

$$\bar{\Pi}^T = \frac{b^2d^2 (1 - bd)}{4 - 2bd - b^2d^2} < w^{T^*},$$

$$\Pi^T = \frac{4 (2 - b^2d^2) (1 - bd)}{(1 + bd) (b^2d^2 + 2bd - 4)^2} < \Pi^T.$$

When plotting the existence threshold for a two-brand equilibrium; i.e., $\Pi^T = \Pi^O$, in the $(b, d)$-space, we get the following picture:

![Equilibrium product variety with quadratic utility.](image)

In Figure 1, we have $\Pi^T < \Pi^O$ (i.e. only one-brand equilibria exist) in the upper right corner and $\Pi^T \geq \Pi^O$ (both types of equilibria exist) elsewhere. Intuitively, when $b$ is high, the benefit of variety is small, while the cost of competition is high. For a given

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15We discuss the equilibrium fixed fees for this example in Section 4.1.
$b$, exclusion becomes more likely as $d$ increases, as fully internalizing retail competition becomes relatively more valuable. In the limit where $bd \rightarrow 1$, exclusion of one brand yields monopoly profits, while any two-brand setting converges to the Bertrand outcome.

### 3.2.1 Cournot competition

We can also use this example to illustrate that our main result holds with retail competition in quantities, which mainly changes the dynamics of the two-brand subgames. From (7), the inverse demand in a two-brand subgame is

$$p_{ij} = 1 - q_{ij} - bdq_{hk}.$$ 

Given this demand, it is easy to show that maximization of bilateral channel profits under the same best-response logic now yields wholesale prices below marginal cost ($= 0$):

$$w_T = \frac{b^2 d^2}{4 + 2bd - b^2 d^2} < 0$$

Because retailers’ decisions are strategic substitutes, each manufacturer sets a low wholesale price to enhance her market share (e.g., Fershtman and Judd, 1987). These wholesale prices yield the following industry profit:

$$\Pi^T = \frac{4(2 - b^2 d^2)}{2(4 + 2bd - b^2 d^2)^2}$$

In the one-brand subgames, it is still the case that the active manufacturer can use her wholesale prices to maximize the industry profits; i.e., $\Pi^O = 1 / (2 + 2d)$. When plotting $\Pi^T = \Pi^O$ in the $(b, d)$-space, we get

![Figure 2: Equilibrium product variety with retail quantity competition.](image)
The dashed red line shows the threshold in the Bertrand model. In other words, there is still exclusion with retail Cournot competition, albeit marginally less than in the Bertrand case. There are two opposing effects behind this result, both through the two-brand industry profits. All else equal, Cournot competition is weaker than Bertrand competition, which raises profits. Yet, wholesale prices are lower under Cournot competition, which reduces profits. In our example, the former effect outweighs the latter, and two-brand Cournot industry profits exceed $\Pi^O$ for a slightly larger cut of the $(b, d)$-space.

4 Applications

Our analysis in Section 3 shows that both brands can reach the market only if $\Pi^T \geq \Pi^O$. Policy measures that ensure $\Pi^T \geq \Pi^O$ can therefore be benign from a consumer welfare perspective. In the following, we suggest several ways in which this condition can be satisfied.

4.1 Banning slotting allowances

A key feature of the equilibrium contracts in Section 3 is that manufacturers transfer profits to retailers with negative fixed fees – often called slotting allowances (or listing fees, pay-to-stay fees, etc.). In the quadratic utility case, for example, slotting allowances are always part of the one-brand equilibrium contracts ($\bar{F}^O = -d/(4 + 4d) < 0$), and of the equilibrium two-brand contracts when brands and retailers are fairly close substitutes.\textsuperscript{16} Slotting allowances are controversial in the policy debate,\textsuperscript{17} partly because of their potential adverse impact on product variety. One common argument is that many manufacturers cannot afford large slotting allowances, and that retailers’ requirements for such payments therefore limit the range of products available to final consumers (see; e.g., Federal Trade Commission, 2001; The Economist, 2015). Several countries have sought to

\textsuperscript{16}Specifically, the equilibrium two-brand fixed fee is (in the coalition-proof two-brand equilibrium when it exists):

$$\bar{F}^T = \frac{d}{2(d + 1)(bd + 1)(b^2d^2 + 2bd - 4)},$$

in which $\theta \equiv (-2b^5d^5 - 3b^5d^4 + 2b^4d^4 - 3b^4d^3 + 12b^3d^3 + 12b^3d^2 - 12b^2d^2 + 8b^2d - 16bd - 16b + 16)$ is negative when $bd$ is sufficiently high.

\textsuperscript{17}See Bloom et al. (2000) for a discussion of potential pros and cons of slotting allowances, and Chambolle and Christin (2017) for a review of the recent literature.
regulate the use of slotting allowances in recent years. For example, Australia, Belgium, France, Italy, Spain, and many others have banned slotting allowances in the grocery sector through laws against “unfair trading practices.”

Consider a ban on slotting allowances in our model. What remains true is that, in any one-brand situation, the active manufacturer must earn zero profits. If not, the inactive manufacturer could re-enter the market, weakly increase her own profit, and make the retailers at least as well off. When slotting allowances are banned (i.e., $F^O \geq 0$ is required), however, the zero profit requirement implies one-brand wholesale prices equal to marginal cost, $w^O = c$. This means that the one-brand equilibrium industry profits are below the maximum level, $\Pi^O < \Pi^O$.

In the two-brand situation, the restriction $F^T \geq 0$ can either bind or not. If it does not bind, then wholesale prices are still given by $w^T_{ij}$, which we know are above $c$ (see Equation (4)). If it does bind, then manufacturers are in effect using linear contracts, which entails double marginalization ($p > w > c$) because competition is imperfect both in the upstream and downstream sector. It follows that $w^T > c$ when slotting allowances are banned. From our basic assumptions about industry flow profits, we therefore get the following result.

**Proposition 2.** When slotting allowances are banned, $\Pi^T > \Pi^O$ and one-brand equilibria cannot exist. In other words, a ban on slotting allowances weakly increases product variety.

The intuition is straightforward. When the opportunity to pay slotting allowances is gone, an exclusive manufacturer can no longer disentangle the objectives of maximizing and redistributing the one-brand industry profit. As a result, the exclusive manufacturer’s ability to compensate retailers for the loss of variety is reduced and deviations to one-brand structures become less attractive. While this mechanism is somewhat more indirect than the policy argument that manufacturers cannot afford to pay slotting allowances, our model still supports the view that slotting allowances can be used to keep viable products off the retail shelves. Consequently, a ban on slotting allowances can promote product variety (and weakly reduce prices), and improve consumer welfare.\(^{19}\)

\(^{18}\)Specifically, the quasi-concavity of $\Pi^O (w^T_{ij}, w^T_{ij})$ and $\Pi^T (x, x) > \Pi^O (x, x) \forall x \in (c, w^*)$.

\(^{19}\)Shaffer (2005) finds a similar result in a context where a large incumbent manufacturer faces competition from a fringe of small manufacturers.
4.2 Upstream horizontal merger

Our model speaks also to how product variety might be affected by a horizontal merger among manufacturers.\(^{20}\) This is an example of how mergers can have “non-price effects,” which is one of the most contentious topics in contemporary merger policy.\(^ {21}\) The 2010 US Horizontal Merger Guidelines largely focus on a consolidated manufacturer’s incentive to withdraw a product from the market, thereby reducing product variety.\(^ {22}\) According to the Guidelines, this outcome is more likely if the merged firm’s brands are close substitutes. This argument sees manufacturers as selling directly to final consumers, for example in a Bertrand-Nash oligopoly. When manufacturers instead rely on retailers for distribution, the logic might be entirely different.

What happens in our model if manufacturers A and B merge? The situation is then similar to a one-brand subgame, with the exception that the upstream monopolist now has two brands in its portfolio. Nevertheless, the logic behind Lemma 2 still applies, and wholesale prices at the industry profit maximizing level are sustainable. The merged firm will therefore always sell both brands, one at each retailer, to exploit consumers’ willingness to pay for variety.

**Proposition 3.** With an upstream multiproduct monopolist, \(\bar{\Pi}^T = \Pi^T\) and one-brand equilibria cannot exist. In other words, an upstream horizontal merger weakly increases product variety.

In our model, a horizontal merger can affect product variety by preventing exclusion. We can interpret this result as follows. Suppose that A and B are national brand manufacturers catering to a set of local markets, each controlled by two retailers. Consider the pre-merger situation. In local markets where consumers see retailers as close substitutes, the cost of distributing both brands can outweigh the benefit of variety from the firms’ perspective (\(\Pi^T < \Pi^O\)). In such markets, where one brand is excluded if manufacturers are separated, the merger doubles product variety. In local markets where retail competition is weaker, both brands are always sold and the merger does not affect variety.

An interesting feature of this result is thus that it is exactly when brands are close substitutes that a horizontal merger among manufacturers can have a benign effect on

\(^{20}\) See Inderst and Shaffer (2007) for a model of retail mergers and product variety.

\(^{21}\) See; e.g., the OECD’s (2018) report “Considering non-price effects in merger control.”

\(^{22}\) Alternatively, a merger can lead firms to reposition their products (i.e., changing characteristics), see Gandhi et al. (2008) for a formal analysis.
product variety and consumer welfare. In the example from Section 3.2, for example, a variety-enhancing merger is possible if and only if $b \gtrless 0.7$. This goes against the conventional wisdom that mergers among closer competitors should be more detrimental for consumer welfare.

5 Concluding remarks

In this article, we have analyzed how the intensity of competition, the set of available supply contracts, and the ownership structure at the manufacturing level can affect product variety in a setting where retailers act as bottlenecks. The central mechanism of our model is that firms face a trade-off between the provision of variety and the ability to internalize competition through appropriately designed supply contracts. The relative sizes of the industry profits that can be realized in equilibrium in the different market structures is what determines the scope for variety.

In our benchmark, where manufacturers offer (unrestricted) two-part tariffs, the competition between manufacturers lead to equilibrium prices below the level that maximizes industry profits whenever both brands obtain distribution. In contrast, when one brand is excluded the remaining manufacturer is able to fully internalize competition. Altering the ownership structure, the intensity of competition, and the available types of supply tariffs will typically affect the relative sizes of the profits that can be sustained in the different types of market structures.

We find that when competition is relatively intense, no equilibrium where both brands obtain distribution exists in the benchmark model. Banning the firms from using slotting allowances (negative fixed fees) reduces the benefits of exclusion, thus making structures where both brands are sold the unique type of equilibrium. Finally, an upstream merger eliminates the potential of exclusion to arise in equilibrium because the merged manufacturer is able to reap the benefits of larger variety without having to deal with upstream competition.
References


