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Backward Ownership, Uniform Pricing and Entry Deterrence

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Abstract

Entry deterrence can occur when downstream incumbents hold non-controlling ownership shares of a supplier which is commited to charge uniform prices to all downstream firms. The ownership shares imply a rebate on the input price for the incumbents through the profit participation. Such backward ownership induces the supplier to accommodate entry by charging a low uniform price to all downstream firms in case of entry. However, just the entry-accommodating behavior reduces entry profits and thereby can lead to market foreclosure. Based on this theory, the article reviews a merger case in the financial services industry and draws conclusions for regulation and competition policy.

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1 Introduction

Partial ownership arrangements among vertically-related firms are common, for instance in financial services, but their effects are still not fully analyzed by economists. I contribute by demonstrating the incentives of downstream firms to acquire financial interests in their suppliers, as well as the effects of these acquisitions on entry in the downstream market. I show that non-controlling backward ownership can lead to entry deterrence through input foreclosure and by this increase industry profits and harm consumers. Interestingly, this occurs when the efficient upstream firm is committed to supply all downstream firms at equal terms, i.e. without charging higher prices to entrants.

The intuition for this result is as follows: In a situation without ownership between upstream and downstream firms, a commitment of a supplier to charge uniform prices generally ensures a level-playing-field for the downstream firms and in particular newcomers. Consider now that one downstream firm owns a share of the supplier and another one does not. The downstream firm with backward ownership receives part of the input price back through the profit participation. A uniform *nominal* wholesale price implies a lower *effective* input price for the partially integrated downstream firm than for the non-integrated downstream firm, due to the implicit rebate. If the supplier is committed to a uniform wholesale price, it is equally committed to put the non-integrated downstream firm at a cost disadvantage.

For instance, if the incumbent downstream firms have non-controlling ownership shares of the common supplier, a non-integrated entrant must anticipate input prices that are effectively higher than for the incumbents. This disadvantage can deter entry. A commitment of the upstream firm to charge equal prices is important here. Instead, if a profit-maximizing upstream firm can freely price-discriminate and is not controlled in its price setting by the incumbent downstream firms, it can profitably raise the prices to the incumbents until the rebate implied by the ownership stakes is neutralized. In this case the effective downstream prices are equal for the incumbents and the (potential) entrants. Thus there is no barrier to entry.

Such a combination of a uniform price commitment by the upstream firm and ownership by the incumbent downstream firms can be advantageous for these firms. As entry can lead to a duplication of fixed costs and intensify competition, entry can decrease industry profits. In such a case the industry is collectively better off when deterring entry. However, an upstream firm may not fully internalize these disadavantages of downstream entry. Instead, it tends to benefit through an expansion of demand for its input, while entry of a downstream firm typically hurts the downstream competitors. An independent upstream firm therefore tends to accommodate too much entry in terms of industry profits. Non-controlling backward ownership of the incumbents in combination with a uniform price commitment of the upstream firm can thus be a profitable arrangement that reduces entry.

This theory can provide useful insights for the analyis of actual industries and institutional arrangements. First of all, the pattern that customers partially own their suppliers is present in various industries such as banks and payment providers (Greenlee and Raskovich, 2006), cable operators and broadcasters (Brito et al., 2016), as well as stock exchanges and clearing

houses (see section 7 for details).[1] Moreover, there are legal provisions in jurisdictions such as the U.S. and the E.U. which limit or forbid price discrimination among customers. These include general competition law (such as the Robinson Patman Act in the U.S. and Article 102 of the Treaty on the Functioning of the European Union), but also more specific regulations, for instance for financial clearing houses as well as self-commitments of firms.

A particular case in point is the acquisition of partial ownership by the London Stock Exchange Group (LSEG) of LCH.Clearnet Group (LCH). LCH is a clearing house that provides clearing services for financial products such as derivatives to trading venues, including LSEG, and their customers. The UK's Office for Fair Trading (OFT) investigated this case in 2012. In view of the non-discrimination obligation and fiduciary duties of LCH, the OFT sketched the theory of harm that LCH adopts a uniform price rise while LSEG reduces its trading fees for customers who trade on an LSEG venue and clear that trade through LCH. For these customers, the overall cost of trading and clearing with LSEG and LCH combined would be more attractive than remaining with a rival venue and LCH. However, the OFT eventually dismissed the foreclosure concerns. It seems that the OFT's analysis could have benefitted from a more rigorous analytical framework in this case.[2] For instance, according to the theory developed in this article, a foreclosure effect can materialize even without a change in the upstream prices in response to the change in the upstream ownership. Given the lack of economic literature in this respect, the present article could therefore be useful for a more refined foreclosure analysis in such cases of partial backward ownership and uniform pricing.

The remainder of this article is structured as follows. The next section covers the related literature and section 3 sets ups the model. Section 4 characterizes the entry decision and market outcome for the case of non-controlling partial ownership, downstream quantity competition, and uniform linear wholesale prices, while section 5 analyzes the profitability of such ownership acquisitions. Section 6 contains extensions such as downstream price competition, two-part tariffs, controlling backward ownership, and discriminatory upstream pricing. Section 7 contains a description of the above mentioned merger case in the financial services industry. Conclusions, including implications for regulation and competition policy, follow in section 8.

2   Literature

By the classic Chicago challenge (Bork, 1978; Posner, 1976), full vertical mergers are competitively neutral at worst. However, there are several arguments concerning how vertical mergers can yield higher consumer prices or even total foreclosure. Such arguments rely on particular assumptions such as additional commitment power of the integrated firm (Ordover et al., 1990), secret contract offers (Hart and Tirole, 1990) or costs of switching suppliers (Chen,

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[1]Such ownership arrangements are also present in industries with regulated access price levels, such as railways (Deutsche Bahn owning the network operator DB Netz). However, the theory of this article does not apply 1:1 to those.

[2]See section 7 for a more detailed discussion of this case.

2001).[3]

Baumol and Ordover (1994), Spiegel (2013) and Gilo et al. (2016) mainly consider the effects of controlling an upstream (or downstream) firm via partial - as compared to full - acquisition. They emphasize that with controlling partial acquisitions, a firm only internalizes parts of another firm's profits and losses, although it can fully distort its strategy to increase its own profit. As a consequence, dedicated foreclosure strategies (refusal to supply or bad terms of trade) can be more attractive when compared to full integration. By contrast, the emphasis of the present article lies on the effects of non-controlling acquisitions into an efficient upstream firm which serves all downstream firms at equal terms. Spiegel also studies partial non-controlling acquisitions, although his model differs in many respects from the one presented here. There is no entry in his model and the upstream firm can price discriminate. The downstream competitors may invest to boost sales. Within this very different model, he shows that non-controlling ownership can also reduce investment incentives of the non-integrated firm, but less than in case of controlling ownership.

Several effects of vertical ownership that do not involve foreclosure have been identified. Hunold and Stahl (2016) show that downstream prices can increase with non-controlling backward ownership in a structure involving both upstream and downstream price competition. Double marginalization is not reduced, as an upstream firm increases the prices to downstream firms with backward ownership. At the same time, however, the downstream firm internalizes the downstream ompetitors' sales through the upstream margin of the partially integrated supply. Hunold and Stahl show that such non-controlling backward ownership can be more profitable for the owners of the integrating firms than both the case of vertical separation and a full vertical merger. In other cases non-controlling backward ownership has no effect on downstream prices, for instance in case of an upstream monopolist (Greenlee and Raskovich, 2006) or downstream quantity competition (Flath, 1989). If backward ownership is controlling, it also tends to decrease double marginalization, as a full vertical merger typically would absent foreclosure effects (Hunold et al., 2012[4] and Brito et al., 2016).

Flath (1989) shows that within successive Cournot oligopolies, non-controlling forward integration of an upstream supplier in one of its customers reduces double marginalization and downstream prices, to the benefit of customers. Intuitively, if an upstream firm internalizes part of the downstream margin, it will set a lower upstream price. Instead, when there is asymmetric information between a manufacturer and its exclusive retailer, non-controlling forward integration may also increase prices as may allow them to commit to higher prices when competing against an independent firm (Fiocco, 2016).

Höffler and Kranz (2011a,b) study how to restructure former integrated network monopolists. They find that non-controlling ownership of the upstream bottleneck (legal unbundling) may be optimal in terms of downstream prices, upstream investment incentives and preven-

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[3]Other specifics include input choice specifications (Choi and Yi, 2000), two-part tariffs (Sandonis and Fauli-Oller, 2006), exclusive dealing contracts (Chen and Riordan, 2007), only integrated upstream firms (Bourreau et al., 2011) and information leakages (Allain et al., 2010).

[4]See section 6.1 of the working paper version wich is available here:
http://www.idei.fr/sites/default/files/medias/doc/conf/inra/stahl1.pdf (last accessed May 2017).

tion of foreclosure. A key difference to the setting in the present article is that they keep upstream prices exogenous.

A few articles have tangentially noted that non-controlling backward integration might involve foreclosure. Greenlee and Raskovich (2006) exclude cases in which the market structure would change in response to ownership changes.[5] In Hunold et al. (2012) we argued that an upstream firm that cannot discriminate against downstream firms may find it profitable to set a high nominal price at which only the partially integrated firm wants to purchase.[6] Brito et al. (2016) have also discovered that foreclosure of a downstream firm in case of asymmetric backward ownership and non-discriminatory upstream prices may occur.[7] To my knowledge, there is yet no article which thoroughly analyzes the effects of non-controlling backward ownership on entry deterrence by means of non-discriminatory upstream prices and, moreover, investigates the incentives of the firms to enter into such ownership arrangements.

There is an extensive literature discussing the pros and cons of allowing upstream firms to charge different prices to downstream firms. The general policy stance seems to be that price discrimination is more likely to have anti-competitive effects than uniform pricing. For instance, Article 102 of the Treaty on the Functioning of the European Union states that an abuse of a dominant position may, in particular, consist in applying dissimilar conditions to equivalent transactions. The economic literature is more differentiated and has pointed out cases where a ban on price discrimination can have negative welfare effects. For instance, Rey and Tirole (2007) argue that a non-discrimination law may have the perverse effect of restoring the monopoly power that it is supposed to fight. Such a law could benefit a monopolistic supplier because, by forcing it to sell further units at the same high price as the initial ones, it helps the supplier commit not to flood the market. Herweg and Müller (2014) instead argue that a non-discrimination law can improve welfare when the downstream firms are privately informed about their retail costs.[8] To my knowledge, there is not yet an analysis of the interaction between entry deterrence, uniform pricing and vertical integration. Indeed, in the model presented hereafter an obligation to charge uniform prices is not harmful absent vertical ownership arrangements.

3   Model

There are two symmetric incumbent firms A and B who compete in the downstream market. There is another potential downstream firm E which has to incur a fixed cost of ϕ to become active. Except for the fixed cost, E is symmetric to A and B.

The production of one unit of downstream output requires one unit of a homogenous input produced either by supplier U or by a competitive fringe (called V). The marginal cost

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[5]They do this with their Assumption 3.

[6]In response, the independent downstream firm would become dependent on the alternative supplier, which in turn could charge higher prices. We had conjectured in section 6.2 of our working paper (cf fn. 4) that this could yield an equilibrium with partial foreclosure.

[7]This is not the theme of their paper and they do not develop this argument further. It is also questionable whether foreclosure would be profitable in their setting, especially when allowing for non-linear tariffs.

[8]See their introduction section for a more detailed review of the literature on price discrimination.

of supplier U is normalized to 0, and that of the fringe is $c > 0$, meaning that firm U is more efficient than the fringe, and c is the difference in marginal costs between U and the less efficient fringe.[9] All other production costs are assumed to be zero. Throughout the article I assume that c is sufficiently small such that the efficient upstream firm U is restricted in its pricing by its competitor's marginal cost c (*effective upstream competition*).

I start with the reference case where downstream firms produce homogenous products and compete in quantities, while the upstream supplier charges a uniform linear price of w. The main results extend to price competition and two-part tariffs (section 6).

Let x_i^j denote the quantities that downstream firm i buys from supplier j, and w the linear unit prices charged by supplier U.[10] Information is assumed to be complete and information in previous stages is public knowledge in the next stage.

For given ownership shares (which are common knowledge), the pricing game has three stages:

1. Entrant E decides whether to enter at a fixed cost ϕ or stay outside.

2. Supplier U sets sales price w.

3. Downstream firms simultaneously buy input quantities x_i^j from the suppliers $j \in \{U, V\}$, produce quantities q_i and sell them.

I employ subgame perfection to analyze how ownership affects entry and competition. The efficient supplier U's profit is given by

$$\pi^U = w \sum_{i \in \{A,B,E\}} x_i^U. \tag{1}$$

The downstream price is a function of the total output $Q = q_A + q_B + q_E$ and given by $p(Q)$ with $p' < 0$.

Downstream firm i's profit, including the return from its shares δ_i held in the upstream firm U,

$$\Pi_i = \underbrace{p(Q)\, q_i - w\, x_i^U - c\, x_i^V}_{\text{operational profit}} + \underbrace{\delta_i\, \pi^U}_{\text{upstream profit share}}, \tag{2}$$

is to be maximized subject to the constraint $x_i^U + x_i^V \geq q_i$, whereby input purchases are sufficient to satisfy the quantity demanded. For expositional clarity, denote an unintegrated downstream firm i's profit by π_i.

Assume for now that only the incumbent downstream firms may have acquired partial non-controlling ownership shares ($\delta_A = \delta_B = \delta$ with $\delta \in [0, 1/2]$ and $\delta_E = 0$). I analyze

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[9]This way of modeling upstream competition can similarly be found in, for instance, Chen (2001); Hunold and Stahl (2016) as well as Sandonis and Fauli-Oller (2006).

[10]I start with the linear tariff case as it is more illustrative. There are two competing downstream incumbents and not only one in order to have a setting where absent entry there is not excessive double marginalization (in the sense of downstream prices above the level maximizing the sum of the profits of all firms).

the profitability of such an ownership arrangement later in section 5. The term *partial ownership* refers to an ownership share strictly between zero and one. *Non-controlling* refers to an ownership share that does *not* involve control over the target firm's pricing strategy (such as pure financial interests, non-voting shares) and *controlling* refers to one that does. Unless indicated otherwise, ownership is non-controlling, no matter how large the share is. This avoids the discussion concerning the level of shareholdings at which control arises, which depends on corporate law, the shareholder agreement and the distribution of ownership share holdings in the target firm.

For what follows, assume that the profit functions are strictly concave to satisfy standard regularity conditions such that the equilibrium is characterized by first order conditions and downstream quantities are strategic substitutes[11]. A sufficient assumption for this is linear demand $(p(Q) = 1 - Q = 1 - q_A - q_B - q_E)$.

4   Quantity setting, pricing and entry

Stage 3 quantity setting – without downstream entry

Consider that both incumbents source only from U at a price of w and that each owns a non-controlling share δ of U. This implies $x_i^V = 0$ and $x_i^U = q_i$. Differentiating the profit of downstream incumbent i with respect to q_i yields the FOC

$$\frac{\partial \Pi_i}{\partial q_i} \;=\; p(Q) + p'(Q)\, q_i - w\,(1 - \delta) = 0 \tag{3}$$

with $Q = q_A + q_B$. The *effective input price* when sourcing from U are given by $w^e \equiv w \cdot (1 - \delta)$. For $w^e \leq c$, the incumbents source from U. This is the only relevant case as otherwise supplier U would make zero profits and would prefer to charge a lower price. Note that the equilibrium downstream quantity Q^* can be characterized as a function of w^e when substituting for $w \cdot (1 - \delta)$ in (3).

Stage 2 upstream price setting – without downstream entry

Without entry, supplier U faces a downstream duopoly of the incumbents A and B. The profit of supplier U is given by

$$\pi^U(w) = w\, Q^*(w^e),$$

subject to the constraint that $w^e = w \cdot (1 - \delta) \leq c$. Note that the profit of U can be expressed in terms of w^e by substituting for w:

$$\pi^U(w^e) = \frac{1}{1 - \delta}\, w^e\, Q^*(w^e),$$

yielding the first order condition with respect to w^e of

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[11]The cross derivative must be negative: $\partial^2 \Pi_i / (\partial q_i \partial q_{-i}) < 0$ for $i \neq -i \in \{A, B, E\}$.

$$w^e \frac{\partial Q^*}{\partial w^e} + Q^* = 0. \tag{4}$$

This condition is independent of δ. The optimal unconstrained effective upstream price and the resulting downstream quantities are thus also independent of δ.

Lemma 1. *Without downstream entry and given effective upstream competition (c not too large), supplier U charges an effective price $w^e = c$ to the incumbents, as without backward ownership. Symmetric non-controlling backward ownership of U does not have any effect on the equilibrium output and the combined profits of supplier U and the downstream incumbents A and B.*

Stage 3 quantity setting – with downstream entry

Consider that the entrant is active while each of the incumbent downstream firms owns a non-controlling share $\delta > 0$ of U. The next lemma considers the case that the effective input price w^e of U is below c.

Lemma 2. *If the entrant E is active, the incumbents have backward ownership ($\delta > 0$) and supplier U charges a nominal price $w < c/(1-\delta)$, then the entrant's profit decreases in the backward ownership share δ of the incumbents.*

Proof. First consider the case $w \leq c$. All firms source from U, yielding FOCs

$$
\begin{align}
\frac{\partial \Pi_i}{\partial q_i} &= p(Q^*) + p'(Q^*) q_i - w(1-\delta) = 0, \; i \in \{A, B\} \tag{5} \\
\frac{\partial \Pi_E}{\partial q_E} &= p(Q^*) + p'(Q^*) q_E - w = 0, \tag{6}
\end{align}
$$

with $Q^* = q_A + q_B + q_E$. The assumption that the profit function Π_i, $i \in \{A, B, E\}$ is concave in q_i implies that the marginal revenue $p(Q^*) + p'(Q^*) q_i$ decreases in q_i. This implies that to fulfil both the incumbents' and the entrant's FOCs (5) and (6), it must be that $q_A = q_B > q_E$. By the same logic, the equilibrium quantities of the incumbents increase in δ. Given the assumption strategic substitutability ($\partial^2 \Pi_i / (\partial q_i \partial q_{-i}) < 0$), the quantity of the entrant decreases in δ. Total output increases as the average marginal costs in the industry decrease. To see this, sum the FOCs in (5) and (6) and divide by 3 to obtain

$$p(Q^*) + p'(Q^*) \frac{Q^*}{3} - \bar{c} = 0,$$

where $\bar{c}$ denotes the average input costs $[2w(1-\delta) + w]/3$. Given concavity of the profit functions, the average quantity $\frac{Q^*}{3}$, and thus total output, increases when the average costs decrease. The average costs decrease in δ. Likewise, the downstream price decreases in δ. As a consequence, the profit of the entrant E decreases in δ.

Now consider the case $c < w < c/(1-\delta)$. The entrant sources from the fringe, yielding the FOC (6) with $w = c$, while the incumbents' effective input costs $w(1-\delta)$ are still below

c. The same logic applies as for the above case $w \leq c$: The equilibrium quantities of the incumbents increase, while the quantity of the entrant decreases in δ. The entrant's profit thus also decreases in δ. □

Suppose now that supplier U charges a price of $w = c/(1-\delta)$. In equilibrium it must be that the entrant sources from the fringe at a price of c, while the incumbents source from U. This yields

Lemma 3. *If the entrant is active, the incumbents have backward ownership ($\delta > 0$) and supplier U charges a nominal price $w = c/(1-\delta)$, then all downstream firms have effective input costs of c and the entrant's profit is the same as without backward ownership ($\delta = 0$).*

Proof. If $\delta > 0$ and $w = c/(1-\delta)$, the incumbents source from U, the entrant from the fringe. Thus the effective input prices of all downstream firms equal c. This yields symmetric FOCs

$$\frac{\partial \Pi_i}{\partial q_i} = p(Q) + p'(Q)\, q_i - c = 0 \tag{7}$$

for all downstream firms just as without backward ownership ($\delta = 0$). □

Stage 2 upstream price setting – with downstream entry

If entry occurs, supplier U determines with its price setting whether it supplies the entrant or not. Supplier U is thus either best off when supplying all three downstream firms at a price $w \leq c$, or only the two incumbents at a price of w in the range $c < w \leq c/(1-\delta)$.

Lemma 4. *When each incumbent has a backward ownership share $\delta \in (0, \overline{\delta})$, with $\overline{\delta} > 0$ but not too large, supplier U is best-off when supplying all three downstream firms at a price of $w = c$.*

Proof. For $\delta = 0$ it is optimal for supplier U to charge a price of $w = c$ under the assumption that upstream competition is effective (the fringe costs c are so small that the fringe constrains U). Denote the corresponding upstream profit by $c \cdot (q_A^* + q_B^* + q_E^*)$. Suppose now that δ is positive, but very close to zero. U still does not want to charge a lower price than c (the marginal profit is still zero at the same effective price, see (4) for an illustration).

The downstream incumbents now would still buy at prices above c, namely at prices w^h in the interval $(c, c/(1-\delta)]$. Assume that U charges such a price. The downstream entrant now prefers to source from the fringe at an effecive price of $c < w^h$. Denote the resulting profit of U by $w^h \cdot \left(q_A^+ + q_B^+\right)$. Note that for δ close to zero, $w^h \in (c, c/(1-\delta)]$ is close to c, so that the upstream margin changed only by an arbitrarily small amount. The downstream quantities q_A^+ and q_B^+ are also still arbitrarily close to the quantities q_A^* and q_B^*, which resulted at a uniform input price of $w = c$ for all downstream firms. The reason is that the effective input costs of E have not changed, while those of A and B are in the interval $(c(1-\delta), c]$ and thus arbitrarily close to c. However, the input demand of supplier U is now reduced by about $\frac{1}{3}$ as the entrant sources from the fringe. For δ not too large, the upstream profit thus also dropped by about $\frac{1}{3}$, and is thus clearly higher at $w = c$ than at a higher price. □

Denote the equilibrium profit of the entrant in case of entry as a function of the incumbent's backward ownership by $\pi_E^*(\delta)$. Lemmas 2 and 4 together imply

Proposition 1. *The downstream entrant's profit $\pi_E^*(\delta)$ in case of entry decreases in the backward ownership share δ of the incumbents in an non-empty interval of δ starting at $\delta = 0$.*

Is it ever profitable for supplier U to charge a price above c at which it only serves the incumbents, but not the entrant? This could be profitable if the ownership share is very large. For instance, suppose that each downstream incumbent has a backward ownership share of $\delta = 1/2$. Now supplier U can either serve three firms at a price of c, or only the two incumbents at a price of up to $c/(1 - \delta) = 2c$. If the demand that U has when serving only the downstream incumbents is more than 50% of the output when serving all downstream firms, then the high input price of $2c$ is profitable. Note that the input costs differ across the two cases, and thus also the quantities per firm. When the incumbent charges a price of $2c$, all three downstream firms have effective input costs of c. Instead, when the incumbent charges a price of c, the two incumbents have effective input costs of $c/2$, and the entrant of c.

Using the linear demand specification $p(Q) = 1 - Q$ yields the following optimal price schedule for U when the entrant is active:[12]

$$
w = \begin{cases} c & 0 \leq \delta \leq \max\left(\frac{1}{3}, \tilde{\delta}(c)\right), \\ c/(1 - \delta) & \delta > \tilde{\delta}(c), \end{cases}
\tag{8}
$$

with $\tilde{\delta}(c) = \frac{5}{4} - \frac{3}{4c} + \frac{1}{4}\sqrt{17 + \frac{9}{c^2} - \frac{22}{c}}$. The higher the fringe costs c, the higher is the lowest share δ at which supplier U sets the maximal price ($\tilde{\delta}'(c) > 0$). The effective input costs of all downstream firms equal c at a high δ. There is thus a "level playing field" and no foreclosure: Backward ownership does not reduce the profit of the entrant (Lemma 3) for high non-controlling backward ownership shares. The entrant's profit is thus lowest for intermediate ownership shares just below $\tilde{\delta}$.

Figure 1 depicts the profits of supplier U and the entrant E as a function of the incumbents' non-controlling backward ownership δ for $c = 2/5$, which yields $\tilde{\delta} \approx 0.44$. As can be seen from the left graph, the supplier's profit is higher when serving all three downstream firms at $w = c$ for $\delta \lesssim \tilde{\delta}$. Right of this point (denoted by x in the graph), the supplier's profit is higher when only serving the two incumbent firms at $w = c/(1 - \delta)$, while the entrant sources from the fringe at costs of c. The resulting profit of the entrant decreases in δ up to $\tilde{\delta}$, but returns to the level without backward ownership for higher ownership shares (right graph).

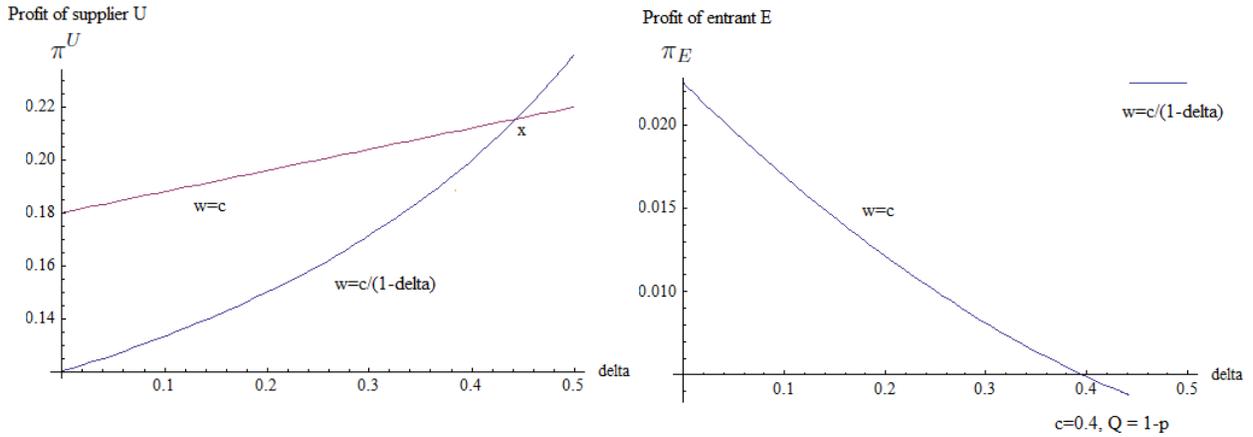[12]See Annex 1 for details of the calculation.

Figure 1: Profits as a function of the incumbents' non-controlling backward ownership

Stage 1: Entry decision

Entry occurs if $\pi_E^*(\delta) > \phi$. Suppose that the entry costs ϕ are sufficiently small such that the condition holds for $\delta = 0$. As the entrant's profit $\pi_E^*(\delta)$ decreases in δ in an interval starting at $\delta = 0$ (Proposition 1), there is a range of entry costs for which non-controlling backward ownership can deter entry.

Definition 1. Entry deterrence is feasible with symmetric non-controlling backward ownership if $\pi_E^*(\delta = 0) > \phi > \pi_E^*(\delta)$ for a $\delta \in (0, \frac{1}{2}]$.

Definition 2. An entry-reducing ownership structure is any $\delta^d \in (0, \frac{1}{2}]$ such that $\pi_E^*(\delta = 0) > \pi_E^*(\delta = \delta^d)$.

For example, with $c = 1/5$ and linear demand, entry occurs for $\phi < 0.04$ absent backward ownership, while entry occurs only for $\phi < 0.03$ when the incumbents each have non-controlling backward ownership of 27%. In other words, a downstream firm which would just still find it profitable to enter the market absent backward ownership ($\pi_E^*(\delta = 0) - \phi \approx 0$) must have 25% lower entry costs to still find entry profitable in case of such backward ownership of the incumbents.

5 Ownership acquisition

An ownership arrangement as described in Proposition 1 can deter entry: in case of entry the efficient supplier U charges lower uniform prices of $w = c$ instead of $w = c/(1 - \delta)$. However, these put the entrant at a cost disadvantage, as it does not receive the ownership discounts which only accrue to the incumbents.

Industry profit maximizing ownership allocation

Lemma 5. *Deterring entry increases industry profits if the competitive fringe is sufficiently competitive (c sufficiently small).*

Proof. The sum of profits of all firms in the industry (industry profits) is given by the industry revenues $Q\,p(Q)$ minus (i) the entry costs of ϕ – in case E enters – and (ii) the costs of fringe production – if a downstream firm sources from the fringe. Absent entry these costs do not accrue. Moreover, the industry has no intrinsic interest in entry as entry does not expand demand for a given price level (given homogenous products).[13] Given downstream competition, the downstream price which results at $w = 0$ is below the monopoly price which maximizes $Qp(Q)$. If the upstream fringe is sufficiently competitive (c sufficiently small), also the downstream price which results at $w = c$ is below the level which maximizes $Qp(Q)$. Absent backward ownership, entry simple decreases the downstream margin $p(Q) - c$ as output Q increases. This reduces industry revenues. In addition, the entry costs ϕ further reduce industry profits. □

An entry deterring ownership structure thus increases industry profits if the industry is sufficiently competitive. Interestingly, if entry does not occur, supplier U charges effective prices of c to the incumbents as without backward ownership (Lemma 1). The ownership arrangement thus does not have any effect on the market outcome, except for possibly deterring entry. Absent entry, the ownership arrangement only shifts profits between the industry incumbents and their owners. There is thus no cost for the incumbents of such a backward ownership arrangement, except for possible transaction costs (not modeled here - these could be close to zero in case of a simple sale of equity shares). As a consequence, if there is a positive probability that a reduction of the post-entry profits of an entrant makes entry unprofitable, such an ownership arrangement is clearly profitable for the incumbents. The next proposition summarizes this argument.

Proposition 2. *If the upstream fringe is sufficiently competitive (c sufficiently small) and there are no transaction costs for the ownership transfer, an entry reducing ownership structure leads to weakly higher industry profits than no backward ownership.*

A corollary to the above proposition is that efficient bargaining between the owners of the incumbent firms will result in backward ownership.

Decentral ownership acquisitions

Consider that the owners of U, A and B cannot jointly bargain over the ownership shares. Instead, imagine that now the owner of supplier U (or possibly the mandated management board of U) can make simultaneous take-it-or-leave-it offers to both downstream incumbents: The downstream firm can buy an ownership share δ of U at a price of t. The question here is whether there is an equilibrium in which both downstream firms accept the offers of U. In particular, one needs to assess whether a downstream firm accepts the offer, given the other downstream firm has accepted the offer, and whether overall the owners of the incumbents U, A and B are better off than without such offers.

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[13]Except possibly as an inefficient means of reducing double marginalization in case of too little competition.

Proposition 3. *Suppose that the fringe is sufficiently competitive such that entry reduces industry profits (c sufficiently small). Suppose further that entry deterring backward ownership structure exists which induces supplier U to charge a price of $w = c$ in case of entry. An owner of supplier U can profitably sell each downstream incumbent an ownership share δ of U in return for a transfer $t > 0$, and thereby increase the profits of the owners of each incumbent U, A and B.*

Proof. Let us first establish that the original owner of U can offer each downstream firm an ownership share δ with the effect that (i) entry is deterred if the shares are accepted by both downstream firms, but (ii) entry is not deterred if the offer is accepted by only one downstream firm. By construction of the proposition, there exists an entry deterring backward ownership structure which induces supplier U to charge a price of $w = c$ in case of entry. If only one incumbent has a backward ownership share of δ, and the other has none, supplier U will still charges a price of $w = c$, it is even less profitable to charge a higher price and only serve one instead of two firms at this price.

Analogously to the proof of Lemma 2, the profit of the entrant is strictly higher if only one incumbent has backward ownership of δ than if each of the incumbents has this backward ownership share and thus lower effective costs $(1 - \delta)c$:

$$
\begin{aligned}
(p\,(3q^*(c, c, (1 - \delta)c)) - c) \cdot q^*(c, c, (1 - \delta)c) > \\
(p\,(3q^*(c, (1 - \delta), (1 - \delta)c)) - c) \cdot q^*(c, (1 - \delta)c, (1 - \delta)c),
\end{aligned}
\tag{9}
$$

where $q^*(c_{own}, c_{other1}, c_{other2})$ the quantity of a downstream firm in case of three active downstream firms with effective input costs of c_{own}, and c_{other1} and c_{other2} of the two competitors.

Recall from Lemma 4 that U charges $w = c$ for ownership shares in an non-empty interval starting at 0. Recall further from Lemma 2 that the profit of the entrant decreases continuously in the ownership share δ when supplier U charges a price of $w = c$. By definition of an entry deterring ownership structure, entry is not deterred at $\delta = 0$. As a consequence, there exists a δ such that entry is deterred if both incumbents have backward ownership, but not if only one has:

$$
\begin{aligned}
(p\,(3q^*(c, c, (1 - \delta)c)) - c) \cdot q^*(c, c, (1 - \delta)c) > \phi > \\
(p\,(3q^*(c, c, (1 - \delta)c)) - c) \cdot q^*(c, (1 - \delta)c, (1 - \delta)c).
\end{aligned}
\tag{10}
$$

Let us consider that the original owner of U offers an ownership share δ which fulfills this condition (10). Let us now establish that there exists a transfer t such that both downstream firms accept the offer (δ, t), with the effect that both the original owner and each downstream firm are better off than without backward ownership and entry. Let $q^*(c, c)$ denote the equilibrium quantity of a downstream firm which results if two downstream firms are active and each has effective input costs of c. Given Cournot competition downstream, total output is higher in case of triopoly: $3q^*(c, c, c) > 2q^*(c, c)$. Supplier U's profits are thus lower in case of duopoly: $2q^*(c, c) \cdot c < 3q^*(c, c, c) \cdot c$. Given sufficient fringe competition (c not too large), the industry profits in case of a downstream duopoly are higher than in case of triopoly (even before entry costs): $2q^*(c, c)\,p(2q^*(c, c)) > 3q^*(c, c, c)\,p(3q^*(c, c, c))$. The

two downstream incumbents together can thus profitably compensate the original owner of supplier U for an arrangement that deters entry.

If a downstream incumbents accepts the offer (δ, t), given the other downstream incumbent has accepted, its resulting profit is

$$(p\left(2q^*(c, c)\right) - c) \cdot q^*(c, c) + \delta c q^*(c, c) - t,$$

where the first part contains the nominal input costs $\frac{c}{1-\delta} q^*$ minus the rebate on own inputs $\delta c \, q^*$ through the ownership participation.

$c(\frac{1-\delta-d)}{1-d}) =$

The second term is the profit participation from sales to the downstream competitor, and the third term is the transfer to the original owner of U in return for the ownership stake.

As argued above, the two downstream incumbents can profitably compensate the owner of U for an arrangement that deters entry. There must thus exist a transfer t which ensures that (i) the owner of U is not worse off when selling shares of δ which deter entry compared to entry accommodation at $\delta = 0$, and (ii) the profit of a downstream incumbent in case of deterrence is higher than the profit without any backward ownership and entry accommodation:

$$(p(2q^*(c, c)) - c) \cdot q^*(c, c) + \delta c q^*(c, c) - t > (p(3q^*(c, c, c)) - c) \cdot q^*(c, c, c). \qquad (11)$$

If a downstream incumbent rejects the offer, given the other incumbent has accepted, its resulting profit is

$$(p(3q^*(c, c, (1-\delta)c) - c) \cdot q^*(c, c, (1-\delta)c). \qquad (12)$$

As the profit of a Cournot player decreases when – other things equal – the input costs of a competitor decrease, it must be that the rejection-profit (12) is smaller than the right hand side of (11). This implies that there exists an offer (δ, t) which both downstream incumbents accept as the left hand side of (11) is larger than the rejection profit in (12). By construction, this offer makes each of the original owners of U, A and B better off compared to a situation without backward ownership (and subsequent entry). $\qquad \square$

Ownership acquisition of the entrant

An ownership acquisition of the entrant could neutralize backward ownership of the incumbents so that entry is no longer deterred. If an entry-deterring ownership arrangement is collectively profitable for supplier U and the downstream incumbents, then neutralizing it by selling shares to the entrant is clearly not collectively profitable. In principle, it could be that one owner of U sees an individual advantage in selling shares to the entrant. To prevent this, the owners could agree to not sell to other parties without joint consent, or agree to a contractual pre-emption right of the other owners. Moreover, it is questionable whether a new entrant would have the financial means to acquire an ownership stake of the supplier upon entry.

6 Extensions

Downstream competition in prices

Let us now turn to the case that there is imperfect price competition downstream. We will see that the main result of profitable entry deterrence with backward ownership carries through.

Assume that the demand of a downstream firm is now given by $q_i(p_i, p_j, p_k)$, with q_i decreasing in the own price p_i and increasing in the competitors' prices p_j and p_k. The profit of a downstream firm that has an ownership share δ of the efficient supplier U and sources all of its inputs from U is given by

$$\Pi_i \quad = \quad \underbrace{(p_i - w) \cdot q_i}_{\text{operational profit}} \quad + \quad \underbrace{\delta \left(w \sum_j q_j \right)}_{\text{upstream profit share}}. \tag{13}$$

Differentiating this profit with respect to p_i yields

$$\frac{\partial \Pi_i}{\partial p_i} = q_i + (p_i - w(1 - \delta)) \frac{\partial q_i}{\partial p_i} + \delta w \sum_{j \neq i} \frac{\partial q_j}{\partial p_i}. \tag{14}$$

As in case of quantity competition, supplier U still has an incentive to charge the highest possible price of $w = c/(1 - \delta)$ in case of a symmetric downstream duopoly with effective upstream competition (c sufficiently small). This yields a marginal profit for $i \in \{A, B\}$ of

$$\frac{\partial \Pi_i}{\partial p_i} = q_i + (p_i - c) \frac{\partial q_i}{\partial p_i} + c \frac{\delta}{1 - \delta} \sum_{j \neq i} \frac{\partial q_j}{\partial p_i}. \tag{15}$$

Different from the case of downstream quantity competition, δ effectively increases the marginal profit as the downstream rivals' sales increase in the price p_i. There is no such effect in case of quantity competition. This means that the marginal profit of a downstream firm competing in prices increases with non-controlling backward ownership, and so do equilibrium downstream prices (Hunold and Stahl (2016)). This is an anti-competitive effect in case of downstream price competition, which has to be accounted for here. In isolation, this effect of backward ownership may faciliate entry: The incumbents now react less aggressively to entry as higher prices lead to higher input sales to the entrant – which the incumbents partly internalize.

There is still scope for entry-deterrence as before. If the supplier U charges a price of $w = c$ following entry, downstream incumbents with backward ownership have a cost advantage of δc, which decreases an entrant's profit compared to the case of no backward ownership. For the following statements we partly use the linear demand specification

$$q_i = 100 \cdot \frac{1 + \gamma}{3} \left[1 - p_i - \frac{\gamma}{3 + m\gamma} \left(m - \sum_{j=1}^{m} p_j \right) \right] \tag{16}$$

with $m = 3$ in case of downstream entry and $m = 2$ otherwise. The parameter $\gamma > 0$ measures the closeness of substitution.

Lemma 6. *Assume that the downstream firms compete in prices and face demand as defined in (16). In case of entry and if the ownership shares are sufficiently small, supplier U charges a price $w = c$, which yields an entry profit with backward ownership of the incumbents that is lower than without it.*

Proof. Analogous to the proof to Lemma 4, it is optimal for supplier U to charge $w = c$ for positive, but sufficiently small backward ownership shares $\delta > 0$ of the incumbent downstream firms A and B. The downstream profits of the entrant are obtained by solving the system the FOCs of A and B as characterized in (15) and that of E (which is obtained by setting $\delta = 0$ in (15)) using the linear demand in (16).

The marginal profit of E with respect to δ at $\delta = 0$ is given by $-\frac{c\gamma(3+2\gamma)(18\,(1-c)+15\gamma(1-c))}{9(3+\gamma)(6+5\gamma)^2}$, which is negative in the relevant range of $\gamma > 0$ and $c < 1/2$. By continuity, the marginal profit is also negative for a slightly positive δ. This implies that there is an interval of ownership shares starting at 0 for which the entrant's profits are strictly lower than without backward ownership. $\qquad\square$

Lemma 6 implies that entry deterrence through passive backward ownership of the incumbents is also possible with downstream price competition for a certain range of entry costs. Note that the demand specification (15) implies that the market expands with a new firm – different from the previous case of homogenous quantity competition.[14] In particular, for equal prices of p, the total demand is higher by $(1 - p)/(3 + 2\gamma)$ when E is also active. A high degree of substitution γ implies that demand expansion is small. This yields

Lemma 7. *Entry deterrence by means of passive backward ownership is profitable for the incumbent firms if the upstream fringe is sufficiently competitive, in particular if $c < h(\gamma)$ with $h' > 0$ for the case of linear demand.*

Proof. Absent entry, passive backward ownership increases the joint profits of the incumbents U, A and B if c is sufficiently small (Corrollary 2 of Hunold and Stahl (2016)). It is thus sufficient to show that the duopoly profit without backward ownership ($\delta = 0$) is larger than the joint profits of these incumbents in case of entry. The joint incumbent profit in case of

- triopoly is given by the upstream profit $c\,3\,q^*(c, c, c)$ and the downstream profits of A and B of $2\,(p\,(3q^*(c, c, c)) - c)\,q^*(c, c, c)$, and in case of

- duopoly is given by upstream profit of $c\,2\,q^*(c, c)$ and downstream profits of

$$2\,(p\,(2q^*(c, c)) - c)\,q^*(c, c).$$

The change in the incumbent profit from duopoly to triopoly is thus the change in

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[14]It also allows for a consistent welfare analysis (see Höffler (2008) for details).

- upstream profits: $c \left(3 \, q^*(c, c, c) - 2 \, q^*(c, c)\right) > 0$, and

- downstream profits of A and B:

$$2 \left(p \left(3 q^*(c, c, c)\right) - c\right) q^*(c, c, c) - 2 \left(p \left(2 q^*(c, c)\right) - c\right) q^*(c, c) < 0.$$

The inequalities follow from the assumption of downstream substitution ($\gamma > 0$) and effective upstream competition (c not too large).

As c approaches zero, the increase in upstream profits because of an additional downstream firm approaches zero, whereas the change in downstream profits of the downstream incumbents does not approach zero. As a consequence, for c sufficiently small it is jointly profitable for the incumbents to deter entry. Comparing the joint incumbent profits for the case of linear demand (as stated in (16)) yields the function $h(\gamma) = \frac{108\gamma + 135\gamma^2 + 60\gamma^3 + 8\gamma^4}{324 + 648\gamma + 486\gamma^2 + 153\gamma^3 + 16\gamma^4}$ with $h' > 0$ for $\gamma > 0$. $\qquad\square$

For example, assume that $\gamma = 10$, $c = \frac{2}{5}$ and $\delta = \frac{3}{10}$. Supplier U optimally sets $w = c$ in case of entry, which implies that the entrant's profits are lower by 22% with passive backward ownership of the incumbents than without it ($\delta = 0$). As a consequence, if the entry costs amount to 78% or more of the entrant's post-entry profits absent backward ownership, such an ownership arrangement would deter entry. Moreover, the incumbents' profits are higher in case of this backward ownerhip arrangement absent entry as downstream price competition is relaxed – in addition to possibly deterring enty (see Table 1).

	Profit of A, B and U ... absent entry	...with entry	Post-entry profits E
$\delta = 0$	21.8	18.5	2.18
$\delta = \frac{3}{10}$	23.0	15.6	1.70

Table 1: Downstream price competition with $\gamma = 10$, $c = \frac{2}{5}$.

As we will see below when discussing non-linear tariffs, the entrant's profit can be reduced further with two-part tariffs.

Two-part tariffs

The results are upheld when the efficient supplier can charge two-part tariffs. This section is organized in four steps. It first explains how two-part tariffs work when there is fringe competition upstream; second, it explains the effect of backward ownership on two-part tariffs. Third and fourth, it discusses the market outcome with price and quantity competition downstream.

Two-part tariffs when there is fringe competition upstream

Supplier U optimally offers two-part tariffs that make each customer indifferent to individually deviating to the fringe supply at costs of c (the outside option). As the deviation profit depends on the prices charged by the other downstream firm(s) that still source from U,

there is contracting with externalities. The value of this alternative induces supplier U to charge marginal upstream prices below the level that induces industry maximizing downstream prices (Sandonis and Fauli-Oller, 2006). This is because the profit when sourcing from the fringe is lower when the competitors' marginal input costs are lower. This also means that supplier U – in spite of two-part tariffs – does not maximize industry profits with respect to entry.

Let us now formally characterize the two-part contracting problem. Consider first the case of complete vertical separation, whereby $\delta = 0$. Given the assumption that U charges uniform tariffs, the contract terms are effectively observable. As Caprice (2006), we assume that the acceptance decisions of the offers are observed by the downstream firms before they choose their downstream quantities (or prices).

A tariff offered by supplier U is summarized by $\{f, w\}$, where f is the fixed fee that a downstream firm has to pay to U upon acceptance of the contract, and w continues to be the marginal input price. Denote by $\pi_i^*(w_i, w_j, w_k)$ firm i's reduced form downstream profits at downstream equilibrium prices as a function of the marginal input price relevant for each downstream firm $i, j, k \in \{A, B, E\}$, albeit gross of fixed fees.

In case of three symmetric downstream firms – as it is the case without any backward ownership – U's problem is

$$
\begin{aligned}
\max_{F,w} \pi^U &= \sum_{i\in\{A,B,E\}} [wq_i + f] \\
s.t. &\quad \pi_i^*\left(w,\,w,\,w\right) - f \geq \pi_i^*\left(c,\,w,\,w\right).
\end{aligned} \tag{17}
$$

Supplier U has to ensure that each downstream firm's alternative (that is sourcing from the fringe) is not profitable, given that the other downstream firms still source from U. Given symmetry of the downstream firms for $\delta = 0$, the participation constraints are the same for all downstream firms. In equilibrium, these constraints must bind as otherwise U could profitably raise the respective fixed fee until each downstream firm is indifferent between its contract offer and sourcing from the fringe. Solving the bottom line of (17) for f in case of equality and substituting into the top line yields

$$
\max_w \pi^U = \underbrace{\sum_{i\in\{A,B,E\}} p_i^*(w,w,w)\, q_i^*}_{\text{industry profit}} - \underbrace{\sum_{i\in\{A,B,E\}} \pi_i^*\left(c,\,w,\,w\right)}_{\text{outside options}}. \tag{18}
$$

For $c = \infty$, the outside options equal 0 and U simply maximizes the industry profit by choosing appropriate marginal input prices. As c decreases, sourcing from the fringe eventually yields positive profits for the downstream firms. Moreover, firm i's outside option – namely the profit $\pi_i^*\left(c,\,w,\,w\right)$ that it would obtain when sourcing from the fringe – increases in the rivals' cost w. Hence, the marginal profit $\partial \pi^U / \partial w$ is below the marginal industry profit.

Two-part tariffs and backward ownership

Consider now the case that the two downstream incumbents have positive non-controlling ownership shares $\delta > 0$, while the entrant has none. As in the case of linear tariffs, supplier U foregoes a discrete amount of quantity and thus profits when not serving the entrant. Moreover, the benefit of charging higher uniform tariffs and serving only the incumbents, which receive a rebate through their upstream ownership, converges to zero as δ approaches 0. As a consequence, for $\delta > 0$ but sufficiently small, it must still be optimal for U to serve all three downstream firms, given the entrant is active.

To derive the equilibrium tariffs for this case, one has to account for generally different participation constraints (bottom line in (17)) of the downstream incumbents and the entrant. In particular, an incumbent chooses between sourcing from the fringe at marginal costs of c and sourcing from U at a tariff of effectively $\{(1 - \delta)f, (1 - \delta)w\}$, due to the implicit ownership rebate δ. The entrant can also choose between the fringe and U, but without the rebate. Intuitively, it is easier for U to induce the incumbents to accept its tariff than the entrant, and therefore the participation constraint of the entrant – if active – should bind first and determine the maximal fixed fee f for a given marginal price w.

The exact solution to the problem depends on whether the downstream firms compete in prices or quantities. Let us investigate the cases in turn.

Two-part tariffs in case of downstream price competition

Let the contracts offered by upstream firms be non-exclusive, whereby an upstream firm cannot contractually require a downstream firm to exclusively procure from it.[15] Then, for $\delta = 0$ setting a marginal input price $w > c$ with $f < 0$ cannot be an equilibrium as a downstream firm could accept U's contract offer, implying a transfer of $|f|$ from U to i, but to source its entire input at the marginal cost $c < w$ from the fringe.

For c sufficiently small, however, the marginal industry profit is still positive when the arbitrage constraints are binding, i.e. at $w = c$. Hence, the motive of devaluing the contract partners' outside options is dominated by the incentive to increase double marginalization, yielding the result that upstream tariffs are endogenously linear.[16]

In case of symmetric downstream firms which all have a non-controlling ownership share $\delta > 0$ one can show that the equilibrium upstream price equals $w = c/(1 - \delta)$ for both c and δ sufficiently small.[17] Consider now the case that the two downstream incumbents have positive non-controlling ownership shares $\delta > 0$, while the entrant has no upstream ownership. To achieve that the entrant buys from U, the supplier has to set a marginal price weakly below c, as for $w > c$ the entrant would effectively buy all quantities from the fringe at marginal costs of c. For c not too large, supplier U therefore optimally charges a marginal price of $w = c$. U optimally increases f until at least one of the downstream firms' participations

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[15]This is one of the two possibilities and has the neat resemblence to the linear case with $w = c$, as we will see below. I expect the same logic to carry through in the case of exclusivity clauses.

[16]See Proposition 5 in Hunold and Stahl (2016).

[17]The proof is analogous to that for Lemma 4 in Hunold and Stahl (2016).

constraints binds with equality. Intuitively, the incumbents are more inclined to buy from U as they receive a rebate δ on the payment to U. Assume that this is the case for the moment.[18] As a consequence, f is set such that for E the value of soucing from U equals its profit when sourcing from the fringe at costs of c while competing against the downstream incumbents with effective input costs of $c(1-\delta) < c$. Lower costs of the competitors lead to lower profits – also with two-part tariffs.[19] Using the linear demand specification yields

Lemma 8. *Assume that (i) downstream firms compete in prices, (ii) demand is given by (16), (iii) supplier U charges two-part tariffs and (iv) the fringe is sufficiently competitive (c not too large). There is an interval of passive backward ownership shares δ of the incumbents starting at* 0 *for which the profits of E are below the level without such ownership.*

For example, with parameters $\gamma = 10$, $c = \frac{1}{10}$, $\delta = \frac{2}{10}$, supplier U optimally serves all downstream firms at $w = c = \frac{1}{10}$. The profit of the entrant is 25% lower in this case compared to the case of no backward ownership, i.e. $\delta = 0$. The joint profits of U, A and B are 7% higher when entry is deterred compared to a situation with no backward ownership and entry.

Two-part tariffs in case of downstream quantity competition

The trade-off between fixed fee f and marginal price w depends on whether the downstream firms compete in prices or quantities.[20] In case of quantity competition, the supplier tends to set the marginal price w below the marginal fringe cost of c, and correspondingly will charge a positive fixed fee F.

In case of downstream quantity competition, competition is not softened by backward ownership, as the marginal profits of the downstream firms with respect to their strategic choice – quantity – are not affected, different from the case of price competition.

The optimal marginal price w nevertheless still depends on the backward ownership share δ. The supplier structures the tariff such that the downstream firms pay as much as possible. Given the restriction of a uniform tariff but asymmetric backward ownership, the effective tariffs generally differ. Note that a proportional rebate δ attached to a negative marginal price, i.e. a transfer to the downstream firm, actually means that the marginal input costs are lower for the entrant. For example: if $w = -3$ and $\delta = \frac{1}{3}$, the input cost is -3 for E, but $-3(1 - \frac{1}{3}) = -2$ for the incumbents. This makes the tariff more attractive for the entrant.

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[18]There is a countervailing effect at least for the case characterized in the lemma below – which does not dominate: When sourcing from U and not from the fringe, firm E benefits in that both incumbents internalize its sales and increase prices (see (15)). For A (and by analogy B), sourcing from U only brings the benefit of relaxed pricing of B (as E is not integrated).

[19]Again, there is the countervailing effect at least for the case characterized in the lemma below – which does not dominate: Even when E sources from the fringe, suppliers A and B still internalize each other's sales and increase prices to the benefit of all downstream firms (see (15)).

[20]One reason for this is that the downstream margins caused by the different forms of downstream competition generally differ, and thus the optimal upstream price. In addition, the trade-off is influenced by the outside options of the downstream firms. Supplier U wishes to make these less attractive by reducing the marginal price w against which a deviating firm has to compete.

On the other hand, the entrant has to incur the full fixed fee $f > 0$, which for the incumbents effectively only costs $(1 - \delta)f$.

For the case of linear demand ($p(q) = 1 - Q$) and for ownership shares that are not too large, supplier U optimally sets the fixed fee f equal to the deviation profit of the entrant, i.e. the profit when the entrant has input costs of c and competes against the incumbents with input costs of $w(1 - \delta)$: $\pi(c, w(1 - \delta), w(1 - \delta))$. The resulting effective input costs of the incumbent $w(1 - \delta)$ decrease as δ increases. As a consequence, the equilibrium profit of the entrant, which equals its deviation profit, decreases as δ increases (for δ not too large). Thus, it is possible to reduce the entrant's profit by means of passive backward ownership also in case of two-part tariffs. The reduction can be large. For example, for $c = 1/5$, passive shares of 20% of each of the incumbents reduce the post-entry profit by 28%.

Controlling backward ownership

The point of this article is that even non-controlling backward ownership can lead to entry deterrence downstream. If the downstream incumbents can influence the strategic decisions of the supplier, there can be more scope for entry deterrence, even when maintaining the assumption the U cannot price discriminate.

Suppose that without backward ownership U would be just indifferent between serving all three downstream firms at a price of $w = c$ and serving only the incumbents at a price of $w = c/(1 - \delta)$.[21] Now consider that in case of controlling partial ownership U ends up maximizing a weighted sum of the profits of its owners.[22] When internalizing the downstream profits partially, it becomes more desirable for U to set a lower price. As a consequence, there is a range of backward ownership shares for which U would charge

- a price of $w = c$ and reduce the entrant's profit in case of controlling partial backward ownership, but

- a price of $w = c/(1 - \delta)$ which does not reduce entry profits – if these shares are non-controlling.

Recall from Lemma 2 that the entrant's profit decreases in δ. As a consequence, the incumbents can reduce the entrant's profit more by choosing higher backward ownership shares in case of proportional control.

Upstream price discimination

Let us consider the case that supplier U can price discriminate between the downstream firms. Without backward ownership, there is no incentive to do so and all downstream firms would be charged a price of c, irrespective of entry. Instead, consider that the incumbents each have a backward ownership share of $\delta > 0$. Let us in turn analyze the following two uniform pricing cases post-entry.

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[21]Recall the optimal upstream price (8) that such a δ exists at least for the discussed case of of linear demand.

[22]This corresponds to the proportional control assumption in O'Brien and Salop (1999).

Supplier U charges $w = c/(1-\delta)$ in case of entry. The incumbents source from U, the entrant from the fringe. The effective input costs of all downstream firms are c. For U it is clearly profitable to deviate from uniform pricing and charge the entrant a price of c: The quantities of the incumbents do not change, but U increases its profit by c times the sales quantity of the entrant. The entrant earns the same profits as without backward ownership.

Supplier U would charge $w = c$ in case of entry. Supplier U serves all three downstream firms with a uniform price. However, it could serve the incumbents at a higher margin of up to $c/(1-\delta)$. As in the previous case, supplier U will charge $c/(1-\delta)$ to the incumbent – given effective upstream competition (c sufficiently small). The entrant then earns the same profits as without backward ownership.

In summary, if supplier U can price discriminate between incumbents and entrant, backward ownership does not deter entry.

7 Example: London Stock Exchange / LCH.Clearnet

The purpose of this short section is present a real-world example where the key assumptions of this model – in particular uniform upstream pricing and backward ownership – are satisfied.

LCH.Clearnet Group (LCH) is a clearing house active in the provision of clearing services for trade for trades executed on trading venues and over-the-counter (OTC) markets worldwide. In 2012, the UK's Office for Fair Trading (OFT) investigated an anticipated acquisition by London Stock Exchange Group (LSEG) of control of LCH. The below information is taken from the public decision of the OFT.[23]

Partial backward ownership

The following statements illustrate firms (including LSEG) which partially own the clearing house LCH at the same time use its services.

- *"As a result of the transaction and in accordance with an agreement entered into by the parties on 9 March 2012, LSEG will acquire up to 60 per cent of the issued share capital of LCH.Clearnet with existing shareholders continuing to hold 40 per cent" (par 4 of the OFT decision).*

- *"For its trading services in relation to products such as financial derivatives LSEG needs clearing services from LCH. The acquistion therefore involved a vertical relationship. Moreover, pre-transaction LCH.Clearnet was owned by 83 per cent of its clearing members and 17 per cent by trading venues" (par 119).*

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[23]"Anticipated acquisition by London Stock Exchange Group plc of Control of LCH.Clearnet Group Limited", Case ME/5464-12, The OFT's decision on reference under section 33(1) given on 14 December 2012"; Source (last accessed April 2017): https://assets.publishing.service.gov.uk/media/555de2f740f0b669c4000047/LSEG.pdf.

Non-discriminatory access

LCH must provide non-discriminatory access to its services due to regulatory obligations (par 23). This open-access provision can be found in the Articles of Association of LCH Clearnet.

- *"LCH.Clear-net's services must be offered on terms that are fair, reasonable, open and non-discriminatory, and on a basis such that LCH.Clearnet's risk is adequately controlled. No exchange will be favoured over any other and LSEG's trading services users will not be favoured over any other exchange's users" (par 131 of the OFT decision).*

Theory of harm

In relation to the foreclosure theory, the OFT discussed the cases of a discriminatory and a uniform price rise:

- *"In relation to a discriminatory price rise on third party trading venues, the OFT considers that not only would this strategy go against the open-access provision enshrined in the Articles of Association, it would not be profitable for LCH.Clearnet, and as such it would likely be against the fiduciary duties of the Board to engage in such a strategy." (par 147)*

- *"In relation to a uniform price rise by LCH.Clearnet applied indistinctly to all customers, that is, whether they use LSEG or not, the OFT considers this to be feasible. The theory of harm is that LCH.Clearnet adopts a uniform price rise with LSEG reducing its trading fees for customers who trade on a LSEG venue and clear that trade through LCH.Clearnet. For these customers, the overall cost of trading and clearing with LSEG and LCH.Clearnet combined would be more attractive than remaining with a rival venue and LCH.Clearnet" (par 148).*

- *"A uniform LCH.Clearnet price rise combined with an LSEG price drop is more likely to be profitable for LCH.Clearnet than the discriminatory price rise noted above. As such, a vote by LCH.Clearnet directors to do so may not be against their fiduciary duties to the company, nor would it contravene the open-access provision." (par 150)*

In summary, the OFT considered a uniform price rise as a more realistic action that LCH could take without breaching the non-discrimination obligation and fiduciary duties. However, the OFT eventually dismissed the foreclosure concerns and cleared the acquisition (par 252, 253). It seems that the OFT's analysis could have benefitted from a more rigorous analytical framework in this case. For instance, a foreclosure effect can materialize even without a change in the upstream prices in response to the change in the upstream ownership structure. In the model presented above, foreclosure can occur when the supplier charges a price equal to the fringe costs (c) both before and after the backward ownership acquisition.

8 Conclusion

This article illustrates how non-controlling partial backward ownership of a supplier can lead to entry deterrence when the supplier is committed to supply all downstream firms at equal terms. Foreclosure can occur in such a situation because downstream incumbents that hold non-controlling shares of their supplier receive a rebate on input prices through the implied profit participation. Interestingly, such backward ownership induces the supplier to charge a lower uniform price to all downstream firms in case of entry. It is just this accommodating behavior which reduces entry profits, such that entry can be deterred and may never occur in equilibrium.

An entry-deterring ownership structure can be profitable for the established industry as an upstream firm may on its own not fully internalize the effects of entry on the profits in the whole industry. Instead, it individually tends to benefit through an expansion of demand for its input, while entry of a downstream firm typically hurts the downstream competitors. Non-controlling backward ownership of the incumbents in combination with a uniform price commitment of the upstream firm can thus be a profitable arrangement for the established firms that reduces entry. This holds both with linear as well-as two-part tariffs charged by the efficient supplier. As there is a competitive fringe upstream, the downstream firm's outside options to sourcing from the efficient supplier are endogenous and depend on the offered tarriff. As a consequence, the efficient supplier does not maximize residual industry profits.

This theory relates well to actual industry arrangements. First of all, the pattern that customers partially own their suppliers is present in various industries such as cable operators and broadcasters (Brito et al., 2016), banks and payment providers (Greenlee and Raskovich, 2006), as well as stock exchanges and clearing houses (see section 7). Moreover, there are legal provisions in jurisdictions such as the U.S. and the E.U. which limit or forbid price discrimination among customers. These include general competition law (Robinson Patman Act in the U.S.), but also more specific regulations such as for financial clearing houses in Europe / Britain. Firms may also commit to uniform pricing themselves, as in case of voluntary fair-reasonable-and-non-discriminatory (FRAND) pricing commitments of standard setting organizations.

This article provides insights for competition authorities and regulators when assessing the potential effects of partial backward ownership in situations where the upstream firms are not allowed or self-committed to not price discriminate among competing downstream firms. Restrictions to charge uniform prices are in practise often seen as a means to ensure a level-playing-field for small and new firms – and thereby to foster competition and prevent input foreclosure.

A non-discrimination obligation or commitment might appear as the obvious safeguard to prevent input foreclosure when incumbent downstream firms partially own their supplier. The fear in such a case might be that the partially integrated downstream firms unduly influence the supplier's sales strategy such that independent downstream rivals receive worse offers. The contribution of this article is to show that just the opposite could well be the case:

A uniform pricing obligation can be a necessary means for achieving market foreclosure in case of backward ownership, especially when the ownership is purely financial, that is without any control rights. As a supplier individually (without internalizing the downstream profits) tends to charge lower prices to the non-integrated firms, a restriction to uniform prices can lead to higher effective prices for non-integrated entrants and therefore market foreclosure in case of partial backward ownership.

Restricting a supplier to charge uniform prices might therefore not be a cure in case of backward ownership, but rather the devil itself. An implication for policy makers and regulators is therefore to carefully assess and re-assess combinations of uniform upstream pricing and partial vertical ownership arrangements for their potential to foreclose downstream markets.

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