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by

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On the Costs and Benefits of Vertical Integration.*

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Abstract

We consider a setting where two upstream firms may vertically integrate or contract with a single downstream distributor. Under vertical integration the integrated firm may offer to share the downstream capacity with its upstream rival. Each firm may or may not have a positive outside option by bypassing the existing distributor. We show that the equilibrium never entails vertical integration and all upstream firms will sign vertical contracts with the common distributor. This result contrasts with results from previous literature, suggesting that vertical integration and sharing can be an equilibrium. Implications for welfare are also considered.

JEL classification numbers: L14, L22, L95

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1 Introduction

Vertical integration may have its benefits and costs. Apart from internalizing the traditional vertical externalities[1], vertical integration enables full control of the down-

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[1]See Tirole (1988), chapter 4.

stream asset, and allows the integrated firm to dictate the use of its downstream firm. Especially, if the downstream firm owns an essential facility that cannot easily be copied by upstream rivals, an integrated firm can choose whether to share the facility with its rivals or whether to foreclose rivals. Exploring this idea, Chen and Ross (2000) show that a vertically integrated firm may benefit from sharing its downstream facility with its upstream rivals. When sharing involves savings in fixed costs for the upstream rival, a simple sharing contract can be signed that not only allows the integrated firm to appropriate these savings, but also allows competition to be dampened so as to increase industry profit above the non-cooperative level. Sometimes, a vertically integrated firm will choose to foreclose upstream rivals. Intuitively, this happens when upstream rivals have no outside opportunities and the 'dampening-of-competition' effect from sharing does not allow industry profit to exceed the monopoly profit of the vertically integrated firm's product.

When arguing for these benefits from vertical integration Chen and Ross (2000) do not explicitly take into consideration the costs of vertically integrating in the first place.[2] There are several potentially important factors that tends to reduce the profitability of vertical integration. First, the decision to buy a downstream essential facility may induce a bidding contest that may drive up the price of the downstream firm so as to reduce the benefits discussed above. Second, many authors have shown that upstream rivals may achieve perfect collusive pricing by appropriate vertical contracts (as opposed to vertical integration) with a single common downstream firm (Bernheim and Whinston (1985, 1995), O'Brien and Shaffer 1999, Gabrielsen (1997)). However, even if upstream firms can achieve collusive pricing using vertical contracts, the degree to which upstream firms can extract the benefits from this from the downstream firm, critically depends on the upstream firms' outside opportunities. A firm's outside option is defined as what he can realize outside

[2]For examples see Bonanno and Vckers (1988) and Ordover et al. (1990). Bonanno and Vickers (1988) consider whether two upstream firms should vertically integrate or separate with one downstream firm each. When considering vertical integration there is no competition for the downstream asset, hence upstream firms basically integrate for free. In spite of this, these authors find that vertical separation is an optimal strategy due to the strategic benefits from delegation.

the relationship with the downstream firm. Hence, vertical contracting also has its benefits and costs.

In sum, from received theory we do not know whether vertical integration would be a wiser strategy in the settings studied in the common agency literature, or whether vertical separation[3] would be preferable to integration in the setting studied by Chen and Ross (2000). What is common in the two settings is that the benefits of integration on the one side and vertical contracting on the other, depend on the outside opportunities for the upstream firms. In this paper we set out to study these benefits in detail and how they relate to firms' outside opportunities. In doing so we take a step back from the analysis performed by Chen and Ross (2000) and analyze the initial decision to vertically integrate or not. This allows us to determine the optimal vertical structure.

In line with Chen and Ross (2000) and the common agency literature cited above, we consider a setting where there are two upstream rivals and one incumbent downstream firm that can distribute the (potentially differentiated) goods of the upstream firms to consumers. Each firm can decide to integrate vertically with the downstream firm, and then potentially induce a bidding contest for the downstream asset. If one firm integrates, its rival may be offered to share the downstream facility or the rival may decide to bypass the existing distributor by building an alternative distribution system. If none of the firms decides to integrate, each firm may still bypass, but either firm may also contract with the existing distributor. We set out to answer the following type of questions: When is vertical integration and sharing of a downstream facility an optimal strategy for an upstream firm? When should an upstream firm instead opt for a vertical contract with the distributor, and when should bypass be an optimal strategy? Finally, we are also investigating the welfare consequences of the equilibrium strategies of the upstream firms.

As it turns out, in this paper as in the literature referred to above, the optimal strategies for the firms depend on what their outside opportunities are. Before presenting our results, it may therefore be useful to look at what the received literature

[3] Vertical separation is a term introduced by Bonanno and Vickers (1988) to denote a situation where upstream firms do not integrate vertically with their distributors.

have shown.

The common agency literature started with the seminal paper by Bernheim and Whinston (1985). In this model two upstream rivals offer contracts to a common downstream firm. If either firm is rejected by the downstream firm, each firm can immediately and costlessly contract with an alternative distributor and by doing so be able to earn non-negative profits. In equilibrium, both firms will contract with the same downstream unit, and the collusive outcome will be realized. Moreover, the firms is able to extract all profit from the downstream firm. Essentially, each upstream firm is able to extract the value of their outside option plus a share of the remaining collusive profit.

At the other extreme, if alternative access to consumers is prohibitively costly for the upstream rivals, the downstream distributor will use his power to pit the upstream firms against each other (Bernheim and Whinston 1998; O'Brien and Shaffer 1997). The collusive output is still realized, but now each upstream firm only can extract his product's incremental contribution to the collusive industry profit. The incremental profit of each product may be small or large, depending on how close substitutes the products of the two upstream rivals are. In the special case of homogeneous product, each product's incremental profit is zero, and the distributor ends up appropriating the entire monopoly profit.

In between those two extremes, when alternative access is neither costless or prohibitively high, Gabrielsen (1997) shows that there is a cutoff for the costs of alternative access above (below) which either of the sharings depicted above apply. Gabrielsen (1997) assumes that once firms have decided to use a common retailer there is a cost of changing the distribution system, at least in terms of foregone profits of waiting. In a infinite horizon model it is shown that if waiting costs are sufficiently high, firms earn their increment, and when waiting costs are below a certain threshold, the firms achieve full rent extraction.

Studying the benefits of strategic alliances in the airline industry, Chen and Ross (2000) take as point of departure that one of the upstream rival has integrated with the downstream firm.[4] The rival incurs a fixed and sunk cost by bypassing the

[4]Ordover et al (1990) have argued that a firm may benefit from integrating vertically and give

downstream structure. They show that if the rival's product will contribute to the industry profit or the rival has a positive outside opportunity, the integrated firm can improve his profit by offering to share his downstream capacity with its rival. The sharing contract involves a capacity constraint for the rival, and a non-negative payment from the rival to the integrated firm. The contract can be constructed so as to leave the rival exactly indifferent between accepting the sharing contract and bypassing.[5] The capacity constraint efficiently reduces output of the rival, but the integrated firm is unable to commit to reducing his own output to such an extent that the collusive output is realized. However, as long as the fixed cost of bypassing is strictly positive, some collusion is achieved, and sharing the downstream facility can be an optimal strategy.

Now, taking a step back and investigating the profitability of vertical integration in this setting we show that vertical integration is never a part of an equilibrium strategy for the upstream firms. Moreover, foreclosure will never occur, neither will bypass and both upstream firms will always contract with a common downstream distributor. The basic intuition is that any outcome produced by vertical integration and sharing or foreclosure of rivals can be replicated, and in most cases improved upon, by simple vertical contracts. This result is robust to any assumptions regarding the firms' outside opportunities. However, the *division* of profits between the downstream and upstream firms is highly sensitive to upstream firms' outside opportunities. In addition to characterize the symmetric cases, when either both or none of the upstream firms have outside opportunities, we also characterize an unique division of profits in the asymmetric case where only one of the upstream rivals has a non-negative outside option. The latter constitute a contribution to the common agency literature.

The model produces quite depressing result regarding consumers' surplus and welfare. In all equilibria collusive or monopoly pricing prevail. Hence, in the present setting vertical integration and sharing as in Chen and Ross (2000) would improve

rival upstream firms market power over rival downstream firms.

[5] Actually these authors show that this can be done in the two special cases of homogeneous and independent products, bu the result is more general than this.

welfare

The issues analyzed in this paper are particularly relevant for the European gas industry, where recent liberalization and deregulation have prompted more competition between the big suppliers for access to the assets of existing distributors. Traditionally the big suppliers of gas in Europe have enjoyed local monopolies into national markets. This has mainly been due to the size of investments needed to build pipelines from the gas and oil fields to each regional market. Moreover, on the distribution side, national markets have been, and still are, dominated by a few dominant downstream distributors (e.g. Gaz de France, British Gas, Ruhrgas), that have had long-term contracts with gas suppliers (mainly seller groups from Russia, Algeria, the Netherlands and Norway).

Recently, the EU commission has installed measures intended to stimulate competition among European gas suppliers. These include the sharing of pipelines and other facilities, enforce renegotiation of wholesale contracts, etc. All these measures are intended to give more suppliers access to the same market and thereby prompt competition. This development raises several concerns for the suppliers of natural gas. The risk of being foreclosed from former lucrative markets have lead them to consider alternative strategies, as vertical integration or looser vertical and horizontal relations (joint ventures, strategic alliances) with local distributors and rival upstream suppliers.

2 The model

There are two upstream firms (suppliers) denoted by firm 1 and 2, and one downstream firm D (distributor). The downstream firm has the ability to link the upstream firms' products to the end users. We normalize the production and distribution costs to zero. Each upstream firm can sell their product through the existing distributor either jointly or exclusively. If the product of any upstream firm is distributed exclusively through the downstream firm, we will consider two alternative assumptions about alternative access. Either alternative access for an upstream firm is impossible, or a firm can access an alternative distribution channel by paying a

fixed cost I_i, $i = 1, 2$. In the latter case access can be provided immediately.

Each upstream firm may also integrate vertically with the downstream firm and if a firm chooses to do so, it may offer its upstream rival to share the capacity of the downstream firm. We will assume that the existing downstream firm has sufficient capacity to supply the consumers when prices are at marginal production costs. We also assume that if an upstream firm decides to take his outside option, he can do this immediately and without further costs (e.g. waiting), but a firm will of course only consider doing this if the outside option is non-negative. This implies that we assume that either alternative access is costless or prohibitively costly.[6]

The timing of events is as follows. At stage one each firm decide whether to initiate a bidding contest for the downstream firm or not. The downstream firm may reject any tender offer presented by the upstream firms. If a bidding contest is initiated by one of the upstream firms, the downstream firm is bought by the upstream firm with the highest bid above the reservation price of the downstream unit.[7] At stage two either one of the firms have integrated vertically or none. If no integration, each firm may offer a contract to the downstream firm or bypass by paying I_i. A contract is a two-part tariff $\{T, w\}$ with a fixed fee T and a wholesale price w per unit of sales, and contracts are not publicly observed.[8] Since contracts are unobservable, equilibrium contracts will always involve wholesale price equal to marginal costs (zero) (see Katz (1991)). We will allow for the possibility that firms can offer contract pairs, T_i^E, T_i^C, where T_i^E is the payment from the distributor to firm i if it handles product i exclusively and T_i^C if both products are accepted by the distributor. On the other hand, if firm i has integrated with the downstream firm,

[6]This may seem like a strong assumption. However, as shown by Gabrielsen (1997) there exists a cutoff point of the cost of changing distribution system above (below) which the two assumptions are correct.

[7]If a bidding contest is initiated, we apply a standard result from auction theory (see ....); D will be acquired by the firm with highest willingness to pay and at the reservation price of the firm with the lowest willingness to pay. Of course, we must also have that this price exceeds the reservation price of D. $D's$ reservation price is determined by the highest profit he can get by refusing to sell.

[8]This means that we rule out the possibility that contracts can be used for strategic delegation purposes, see Bonanno and Vickers (1988).

firm i may offer to share the capacity of the downstream firm with firm j, or force him to bypass. A sharing contracts involves a capacity constraint for the rival and a payment from the rival j to the integrated firm i. At stage three under integration the outsider either has been offered a sharing contract or not. If no sharing contract is offered, the outsider will bypass if he has a positive outside option, if not he is foreclosed from the market. If a sharing contract is offered, the outsider either accepts or refuses this contract, and if the sharing contract is refused the outsider may bypass. Under no integration the independent downstream firm may accept and refuse any contract that is offered to him with the limitation that exclusive contract can only be accepted exclusively. If an upstream firm is rejected at this stage he may still bypass by investing I_i. Finally, at stage four the downstream firm maximizes profits given the outcome from stages one through three.

An attractive feature of the following model is that we rely on very general cost and demand functions. Basically what we use is general results on aggregate profits produced by standard models of imperfect competition, and only the relative sizes between these profit levels will be of importance. If only one firm is active in the market, the monopoly profit of that firm's product can be realized and will be denoted by π_i^m. The collusive industry profit will be denoted by π^c. The level of this profit will generally depend on the degree of differentiation between the two upstream firms' products. In the extreme case of perfect substitutes we have that $\pi^c = \pi_1^m = \pi_2^m$. At the other extreme, when products are unrelated, we have that $\pi^c = \pi_1^m + \pi_2^m$. Generally we will assume that the degree of product differentiation is in between these two extremes such that $\pi_1^m + \pi_2^m > \pi^c > \pi_i^m$.

If either both firms bypass, or one bypasses and the other contracts with the existing downstream firm, aggregate industry profit is denoted by π^d. This profit is equal to the duopoly profit achieved from any standard oligopoly model of imperfect competition. With homogeneous products and price competition $\pi^d = 0$, and with Cournot competition $\pi_i^m > \pi^d > 0$. With unrelated products $\pi^d = \pi^c = \pi_1^m + \pi_2^m$ irrespective of the competitive mode, but again we will assume that product differentiation is 'intermediate', in the sense that we have $\pi^c > \pi^d > 0$.

Finally, as discussed in the introduction, Chen and Ross (2000) find that firms

can achieve imperfect collusion with integration and sharing. The intuition is that the integrated firm can effectively limit the output of its rival by offering him a sharing contract with limited capacity, but is unable to commit himself to a limited output. Let π^s denote the aggregate industry profit in this case. Generally the size of π^s will depend on how much capacity the integrated firm must give the rival in order to keep him indifferent with his bypass option. The bypass option for a firm is given by $\pi_i^o = \gamma_i \pi^d - I_i$, where γ_i is firm $i's$ share of the duopoly profit π^d and I_i the investment cost of bypassing. Clearly and assuming that $\pi_i^o = \gamma_i \pi^d - I_i \geq 0$, the capacity that must be given to the rival can be smaller the larger his investment cost, the smaller the duopoly profit π^d and the smaller the market share the rival would achieve when bypassing. If competition is Cournot with homogeneous products and π_i^o is small, a very tight capacity constraint can be allotted to the rival. If so, the integrated firm would set output close to the monopoly level, and π^s will be close to the monopoly profit π^m. The higher π_i^o the larger capacity the rival must be given and π^s will approach π^d as I_i approaches zero. When products are differentiated enough it is obvious that π^s may be bigger than any individual monopoly profit and will approach $\pi^c = \pi_1^m + \pi_2^m$ as products become almost independent. To sum up, we have:

$$\begin{aligned} \pi_1^m + \pi_2^m &> \pi^c > \pi_i^m \\ \pi^c &> \pi^s > \pi^d \gtreqless \pi_i^m \end{aligned}$$

Clearly, from stage one there are two potential outcomes; either one of the firms has integrated with the distributor or none of them has. Let us first analyze the case where no firm has integrated.

2.1 No vertical integration

Under no integration, we must look at the outside options for the firms. First we will assume that there is no bypass option for either of the upstream firms. Then we have the setup of O'Brien and Shaffer (1997) and Bernheim and Whinston (1998). Then we have:

Proposition 1 *Suppose that* $\pi_i^o < 0$, $i = 1, 2$. *Then, both firms contract with* D *and equilibrium profits are* $\pi_i = \pi^c - \pi_j^m \geq 0$ *and* $\pi_D = \sum_i \pi_i^m - \pi^c \geq 0$.

Proof: See Bernheim and Whinston (1998) and O'Brien and Shaffer (1997).

If the firms have no outside option the collusive profit can be realized, and each firm will earn his product's incremental contribution to the industry profit. When the upstream firms have no alternative, the downstream firm uses his power to pit the upstream firms against each other. Then each firm can extract at most the contribution his product makes to the industry profit. The contribution of each product is the difference between the industry profit when both products are sold and what the downstream and the rival upstream firm can create. Thus, each firm have incentives to offer the downstream firm a contract that induces him to maximize industry profit, because this also will maximize the contribution of each product. Hence, collusive prices are realized.

Now look at the other extreme where both upstream firms have a non-negative outside opportunity that they immediately can turn to if rejected by the downstream firm. Then we have the following result:

Proposition 2 *When* $\pi_i^o \geq 0$ *and* $\pi_j^o \geq 0$ *both firms contract with* D. *Then equilibrium profits are* $\pi_D = 0$ *and* $\pi_i = \alpha_i \pi^c \geq \gamma_i \pi^d$, $\sum_i \alpha_i = \sum_i \gamma_i = 1$.

Proof: See Bernheim and Whinston (1985).

We see that the possibility of alternative access for the upstream firms dramatically changes the strategic environment. The existence of a non-negative outside option for the firms makes the threat of bypassing if rejected by the distributor credible, and upstream firms are now able to extract all downstream rent. Note also that bypassing need not be very profitable for the upstream firms. In fact, even if bypassing would result in harsh competition so as to drive π^d very low and π_i^o close to zero, the threat would work. The driving force is that each firm credibly threatens to destroy the market profit, and hence the profitability of any exclusive arrangements with the rival firm, if they were rejected by the downstream distributor.

The result in Proposition 2 relies on the ability of the upstream firms to offer contract pairs, i.e. one contract for the case where the downstream firm accepts

selling both product, and one where it selects to be an exclusive dealer for one firm.[9] Since any of the upstream firms would not be satisfied will less than the outside option in an exclusive relationship with the downstream firm, the downstream firm cannot earn anything by threatening to drop any of the products. Put in a different way, his threat point becomes zero. This means that the downstream firm also will accept zero profit if he becomes a common distributor for the upstream firms. Consequently, it cannot be an equilibrium unless all profit is extracted from the downstream firm.

Note however, that there are multiple equilibria in this game. In fact any split of the collusive profit so that each upstream firm at least earns his outside option will constitute an equilibrium outcome.

Now there is a third interesting case, and that is when only one of the upstream firms has a positive outside option. With homogeneous products there is no loss in industry profit by foreclosing one of the products, but with differentiated products there is. Intuitively, we should also expect to see an equilibrium where both products are sold in this game. The following result depict the outcome of this game.

Proposition 3 *Suppose that* $\pi_i^o \geq 0$ *and* $\pi_j^o < 0$. *Then, both firms contract with* D *and equilibrium profits are* $\pi_j = \pi^c - \pi_i^m$, $\pi_D = \max\{0, \gamma_j\pi^d + \pi_i^m - \pi^c\}$, *and* $\pi_i = \min\{\pi^c - \gamma_j\pi^d, \pi_i^m\} > \pi_1^o$.

Proof: Suppose first that the firms offer one contract each. Since j has no outside option and i can earn $\gamma_i\pi^d - I_i$ outside the relationship, contracts must satisfy:

$$\begin{aligned} T_i &\geq \gamma_i\pi^d - I_i \\ T_j &\geq 0 \end{aligned}$$

Moreover, since both producers would want to be accepted given these contracts we must have that the distributor indeed will accept both producers, i.e.

$$\begin{aligned} \pi^c - T_i - T_j &\geq \pi_i^m - T_i \\ \pi^c - T_i - T_j &\geq \gamma_j\pi^d - T_j \end{aligned}$$

[9] For details on this, see Bernheim and Whinston (1985). Note that the result in Proposition 1 does not rely on the ability to offer contract pairs, see Bernheim and Whinston (1998) for details.

Solving these inequalities yield:

$$\begin{aligned} T_i &\leq \pi^c - \gamma_j \pi^d \\ T_j &\leq \pi^c - \pi_i^m \end{aligned}$$

For these contract to be feasible we must have that $\pi^c - \gamma_j \pi^d \geq \gamma_i \pi^d - I_i \iff \pi^c + I_i \geq \pi^d$ and $\pi^c - \pi_i^m \geq 0$ which is always true. Moreover, we must have that the distributor's profit must be positive, i.e.,

$$\begin{aligned} \pi_D &= \pi^c - T_i - T_j = \pi^c - \left(\pi^c - \gamma_j \pi^d\right) - \left(\pi^c - \pi_i^m\right) = \gamma_j \pi^d + \pi_i^m - \pi^c \geq 0 \\ &\Updownarrow \\ \pi_i^m &\geq \pi^c - \gamma_j \pi^d \end{aligned}$$

Consequently, when $\pi_i^m \geq \pi^c - \gamma_j \pi^d$ the proposed contracts constitute an equilibrium. When $\pi_i^m < \pi^c - \gamma_j \pi^d$ the zero profit constraint for the distributor requires $T_i \leq \pi_i^m$, and in this case firm i offers $T_i = \pi_i^m$ and the distributor earns zero. QED.

Summing up the results from the three propositions above reveals that the profit earned by the two firms and the distributor depend critically on the upstream firms outside opportunities. When both firms have even the slightest possibility of alternative access that they immediately can turn to, the distributor can be fully exploited and the downstream firm earns zero profit. When the upstream firm has no alternative access, the downstream firm can earn some rent, and the more so the closer substitutes the two products are. In the limiting case of perfect substitutes, the downstream firm will capture the entire monopoly profit. When only one firm has a positive outside opportunity, the degree of differentiation determines the sharing of profit. Now, the firm with no outside opportunity will be able to extract its increment to the industry profit. The firm with a positive outside opportunity will generally be able to extract more than this, but the profit is limited upward by the 'stand-alone' monopoly profit of that firm.

For example, when the products are perfect substitutes and Cournot competition would prevail in the case of bypass, we have that $\pi_i^m > \pi^c - \gamma_j \pi^d$ because $\pi_i^m = \pi^c$ and $\pi^d > 0$. This limits the amount that firm j can extract and also the amount that i can extract, because the distributor can choose to represent j exclusively.

Now, as products become more differentiated, firm j will extract more as his increment increases. Hence j always appropriate the additional gain from including his product. The other thing is that the threat point of the distributor from excluding i is reduced as j captures more profit. This enables firm i to extract more from the distributor, and when products are differentiated enough to make the inequality $\pi_i^m < \pi^c - \gamma_j \pi^d$ hold, firm i is in fact able to extract the entire monopoly profit of his product and the distributor would earn zero.

Ranking the outcomes of Proposition 1-3 for the distributor, it is worst for him when both upstream firms have positive outside options and best when none of them has. The case where only one have a positive outside option falls in between.

2.2 Firm i is vertically integrated

If firm i has vertically integrated with the existing distributor, the integrated firm has control and may force firm j to bypass or offer to share the downstream capacity. Chen and Ross (2000) show that sharing a downstream facility may enable the firms to increase the industry profit compared to case where firm j bypasses. For the rival firm to go along with such an offer he must earn at least as much as what he earn by bypassing, i.e. $\pi_j \geq \gamma_j \pi^d - I_j$. If the rival have a positive outside option, sharing will always be optimal. Second, even if the rival has no outside option, sharing may be an equilibrium outcome. This will happen when aggregate industry profit under sharing is larger than the monopoly product of product i. Let p_i denote the price that firm i has paid for the downstream firm D.The following result generalizes the result of Chen and Ross (2000).[10]

Proposition 4 *If firm i has integrated with D and i) $\pi_j^o \geq 0$ or ii) $\pi_j^o < 0$ and $\pi^s \geq \pi_i^m$ the firms share i's asset and equilibrium profits are $\pi_i = \pi^s - p_i - (\max\{0, \gamma_j \pi^d - I_j\})$ and $\pi_j = \pi_j^o = \max\{0, \gamma_j \pi^d - I_j\}$. If iii) $\pi_j^o < 0$ and $\pi^s < \pi_i^m$, j is foreclosed and i earns $\pi_i = \pi_i^m - p_i$.*

[10] Chen and Ross (2000) only consider the special cases when the product are perfect substitutes and independent products.

Proof: First consider the case when $\pi_j^o \geq 0$. Then the optimal sharing contract involves giving the rival exactly this profit. Sharing involves partial collusion and the realization of aggregate profit π^s, hence the profit for the integrated firm is $\pi_i = \pi^s - p_i - (\gamma_j \pi^d - I_j)$. Then consider the case when $\pi_j^o < 0$ and $\pi^s \geq \pi_i^m$. In this case the rival cannot bypass, but adding his product will expand industry profit beyond the monopoly profit of firm i. In this case it is optimal for the integrated firm to share the downstream asset. The optimal sharing contract involves extracting all profit from the rival which the rival would accept, and the profit for the integrated firm is $\pi_i = \pi^s - p_i$. Hence, summing up these two cases the profit of the firms are $\pi_i = \pi^s - p_i - (\max\{0, \gamma_j \pi^d - I_j\})$ and $\pi_j = \pi_j^o = \max\{0, \gamma_j \pi^d - I_j\}$. When $\pi_j^o < 0$ and $\pi^s < \pi_i^m$, there is nothing to gain from sharing and since the rival has no outside option, he can and will be foreclosed, and the integrated firm earns $\pi_i = \pi_i^m - p_i$ and the rival zero. QED.

When firm i has integrated, sharing will occur whenever j has a positive outside opportunity. Sharing may also be an equilibrium outcome even if j has a negative outside opportunity. This happens when aggregate industry profit is higher when both products are sold than the monopoly profit of product i. In Chen and Ross (2000) contracts between the integrated firm i and its rival consists of a capacity constraint and a non-negative side payment from the rival to the integrated firm. Thus by offering a sharing agreement of this kind, the integrated firm is able to restrict the output of its rival, but he is generally unable to restrict its own output. Hence, the fully collusive output cannot be sustained as an equilibrium outcome. Sometimes, the restriction to non-negative payments from j to i is suboptimal. If payments could go the other way around, i.e., from the integrated firm to the rival, aggregate profit could sometimes be higher. This is easy to see when products are perfect substitutes. In this case, non-negative payments would require the rival to provide a positive output to make him indifferent between his outside option and the sharing contract, and the side payment would be zero. If payments could go the other way around, the integrated firm could basically 'bribe' the rival to stay out of the market, and the monopoly profit could be realized. As products become more differentiated, for a given outside opportunity, there is less and less loss involved

with granting the rival production capacity, because the rival's production would expand industry profit. In the case of independent products this is evident. Now industry profit will benefit from the rival producing his monopoly output.

However, in line with Chen and Ross (2000), we will retain the assumption of non-negative side payments from the rival to the integrated firm.

Now we are ready to determine the optimal actions for the firms at stage 1 and eventually compute the equilibrium price for the distributor's asset.

2.3 Equilibrium outcomes

We now turn to stage 1 of the game where each firm decides whether to initiate a bidding contest for the downstream asset. Since each firm can choose to integrate or not, we have two possible outcomes from stage 1. Either one firm integrates or none. Furthermore, each firm may have a positive or negative outside option.

First we study the situation where none of the firms have an outside options, i.e. $\pi_i^o < 0$, $i = 1, 2$. If so we know from Proposition 1 that absent any integration each firm will earn his incremental contribution to the collusive profit, i.e., $\pi_i = \pi^c - \pi_j^m \geq 0$. Second, we know from Proposition 4 that if integration occurs, the non-integrated firm j will be foreclosed by its integrated rival i if $\pi^s \leq \pi_i^m$, and that a sharing agreement will be made if $\pi^s > \pi_i^m$.

Consider first the foreclosure case when $\pi^s \leq \pi_i^m$. An integrating firm i would earn $\pi_i^m - p_i$,by integrating and zero otherwise. Consequently, firm i be willing to pay $p_i \leq \pi_i^m$. Hence, i has the highest willingness to pay if $\pi_i^m \geq \pi_j^m$, in which case i would offer $p_i^* = \pi_j^m$. The distributor can by rejecting all bids earn $\pi_D = \sum_i \pi_i^m - \pi^c$, and he will accept firm i's offer if

$$\begin{array}{ccc} \pi_j^m & \geq & \sum_i \pi_i^m - \pi^c \\ & \Updownarrow & \\ \pi^c & \geq & \pi_i^m \end{array}$$

which is always true. Thus, if firm i integrates, j will be foreclosed and firm i

will earn

$$\pi_i = \pi_i^m - p_i^* = \pi_i^m - \pi_j^m$$

This is a profitable strategy for firm i when

$$\begin{aligned} \pi_i^m - \pi_j^m &\geq \pi^c - \pi_j^m \\ &\Updownarrow \\ \pi_i^m &\geq \pi^c \end{aligned}$$

i.e., never. Hence, when $\pi^s \leq \pi_i^m$ vertical integration is never profitable, and no firm will enter into a bidding contest for the downstream firm.

Next consider the case where integration would result in a sharing arrangement, $\pi^s > \pi_i^m$. A sharing contract would yield zero profit to the non-integrated firm as his outside option is negative. Therefore, an integrating firm would earn $\pi^s - p_i$ and zero otherwise. Both firms will end up offering $p_i^* = \pi^s$ if a contest is initiated, and hence would earn zero profit if successful. Therefore, initiating a bidding contest in this case is not profitable. To sum up, we have:

Proposition 5 *Suppose that $\pi_i^o < 0$ and $\pi_j^o < 0$. Then no firm will integrate vertically and no firm will bypass. Both upstream firms will sign vertical contracts with the common distributor and equilibrium profits are:*

$$\begin{aligned} \pi_i &= \pi^c - \pi_j^m \\ \pi_D &= \sum_i \pi_i^m - \pi^c \end{aligned}$$

Then, assume that both firms has positive outside options, i.e. $\pi_i^o \geq 0$, $i = 1, 2$. Then if no firm integrates, we have from Proposition 2 above that equilibrium profits in the contracting subgame will be $\pi_i = \alpha_i \pi^c$. Note that when both firms have positive outside options, no integration would mean that D earns zero. Hence, D will be selling his firm for any non-negative price in this case. Suppose then that i integrates. Then we have from Proposition 3 above that i shares the capacity of the integrated firm with j. If so, firm i would earn $\pi_i = \pi^s - p_i - (\gamma_j \pi^d - I_j)$ when

integrating and exactly his outside option if not. Comparing these two yields that integration is better for firm i when:

$$\begin{aligned} \pi^s - p_i - (\gamma_j \pi^d - I_j) &\geq \gamma_i \pi^d - I_i \\ &\Updownarrow \\ p_i &\leq \left(\pi^s - \pi^d\right) + I_i + I_j > 0 \end{aligned}$$

Note that the reservation price is symmetric in i and j, hence both firms will have the same willingness to pay for the downstream firm. Now, assume that D is sold at $p_i^* = \left(\pi^s - \pi^d\right) + I_i + I_j \geq 0$ to firm i, which shares its capacity with j. As noted above, the reservation price of D is zero, so he would accept. If so the firms earn:

$$\begin{aligned} \pi_i &= \pi^p - p_i^* - (\gamma_j \pi^d - I_j) = \pi^s - \left(\pi^s - \pi^d + I_i + I_j\right) - (\gamma_j \pi^d - I_j) \\ &= \gamma_i \pi^d - I_i \\ \pi_j &= \gamma_j \pi^d - I_j \end{aligned}$$

i.e. both firms will earn exactly their outside options. Since each firm can increase its profit by contracting with the distributor instead, no firm would initiate a bidding contest for the downstream firm in this case. Then we have:

Proposition 6 *When both firms have positive outside options, vertical integration never occurs and equilibrium profits is as in Proposition 2.*

Finally, suppose that $\pi_i^o \geq 0$ and $\pi_j^o < 0$. In this case we have from Proposition 4 that if $\pi^s < \pi_i^m$ firm j knows that if i integrates he will be foreclosed. If i integrates in this case, we therefore have that $\pi_i = \pi_i^m - p_i$. Since i can always choose to take his outside option, we must have that

$$\begin{aligned} \pi_i^m - p_i &\geq \gamma_i \pi^d - I_i \\ &\Updownarrow \\ p_i &\leq \pi_i^m - \gamma_i \pi^d + I_i \end{aligned}$$

If j integrates, he will share with i and earn $\pi_j = \pi^s - p_j - (\gamma_i \pi^d - I_i)$. This must be non-negative and we have

$$p_j \leq \pi^s - \gamma_i \pi^d + I_i$$

Comparing the two reservation prices, we see that firm i has the highest willingness to pay if:

$$\begin{aligned} \pi_i^m - \gamma_i \pi^d + I_i &\geq \pi^s - \gamma_i \pi^d + I_i \\ &\Updownarrow \\ \pi_i^m &\geq \pi^s \end{aligned}$$

which exactly is the condition for being in this case. The intuition is that since j has no outside option, firm $i's$ reservation price for the downstream asset reflects that he is bidding for a monopoly right. For firm j the benefits of winning the bidding contest is less since firm i will be around in the market one way or another. Realizing that, an integrated firm j will accommodate firm i by sharing the downstream capacity. Firm i therefore offers firm j's maximal willingness to pay, i.e., $p_i^* = \pi^s - \gamma_i \pi^d + I_i$ for D. D can however turn this offer down. D would accept if

$$\begin{aligned} \pi^s - \gamma_i \pi^d + I_i &\geq \gamma_j \pi^d \\ &\Updownarrow \\ \left(\pi^s - \pi^d\right) + I_i &\geq 0 \end{aligned}$$

i.e. always. Hence, if i integrates at this price j is foreclosed and earns zero. Under integration therefore i earns $\pi_i = \pi_i^m - p_i = \pi_i^m - \left(\pi^s - \gamma_i \pi^d + I_i\right)$. This must be higher than contracting, i.e., we must have

$$\pi_i^m - \left(\pi^s - \gamma_i \pi^d + I_i\right) \geq \min\{\pi^c - \gamma_j \pi^d, \pi_i^m\}$$

Suppose $\min\{\pi^c - \gamma_j \pi^d, \pi_i^m\} = \pi_i^m$. If so we must have

$$\begin{aligned} \pi_i^m - \left(\pi^s - \gamma_i \pi^d + I_i\right) &\geq \pi_i^m \\ &\Updownarrow \\ \gamma_i \pi^d - I_i &\geq \pi^s \end{aligned}$$

which is never true. Then suppose $\min\{\pi^c - \gamma_j\pi^d, \pi_i^m\} = \pi^c - \gamma_j\pi^d$. If so we must have

$$\begin{aligned} \pi_i^m - \left(\pi^s - \gamma_i\pi^d + I_i\right) &\geq \pi^c - \gamma_j\pi^d \\ &\Updownarrow \\ \pi_i^m - \pi^s - I_i &\geq \pi^c - \pi^d \end{aligned}$$

which is never true, hence vertical integration can never be optimal when $\pi_i^m > \pi^s$.

Then consider the case where $\pi_i^m < \pi^s$. If so, vertical integration would always result in a sharing contract irrespective of who integrates. Firm j would earn zero in a sharing contract with an integrated i, and i would earn his outside option in a sharing with an integrated j. Hence, firm i would prefer integration if

$$\begin{aligned} \pi^s - p_i &\geq \gamma_i\pi^d - I_i \\ &\Updownarrow \\ p_i &\leq \pi^s - \gamma_i\pi^d + I_i \end{aligned}$$

whereas j would integrate if

$$p_j \leq \pi^s - \gamma_i\pi^d + I_i$$

Suppose i integrates at price $p_i^* = \pi^s - \gamma_i\pi^d + I_i$. If so, the upstream firms will earn

$$\begin{aligned} \pi_i &= \pi^s - \left(\pi^s - \gamma_i\pi^d + I_i\right) = \gamma_i\pi^d - I_i \\ \pi_j &= 0 \end{aligned}$$

This is an optimal strategy for firm i when

$$\gamma_i\pi^d - I_i \geq \min\{\pi^c - \gamma_j\pi^d, \pi_i^m\}$$

which obviously never holds.

Then we have:

Proposition 7 *Suppose that $\pi_i^o \geq 0$ and $\pi_j^o < 0$. No integration will occur and both firms contract with D and the firms earn the payoff in Proposition 3.*

As we can see from Proposition 6 vertical integration is never part of an equilibrium strategy in the asymmetric case. Even though firm i could integrate and even foreclose its rival, it is never profitable to do so. The firm can always be made strictly better off by exploiting his bypass option in the contracting game with the downstream distributor.

3 Discussion and concluding remarks

As the preceding analysis has shown, vertical integration should never be a part of an equilibrium strategy for any of the upstream firms. Vertical integration leads to an inefficient outcome for the firms, an outcome that always can be replicated and even improved upon by a vertical contract. This result stands in relative sharp contrast to the recent results obtained by Chen and Ross (2000). Ignoring the integration decision, these authors argue that an integrated firm can share its downstream capacity with an upstream rival if the rival has a positive outside opportunity or if sale of the rival's product will expand industry profit above the monopoly profit. We have shown that the initial decision to integrate in these circumstances is wrong from the firm's perspective.

This result implies that there must be other motives for vertical integration and sharing contracts than the 'dampening-of-competition' effect pointed out by Chen and Ross (2000). The list of alternative explanations is abundant, but one is the danger of opportunistic behavior by the authorities. If firm can vertically integrate in times when competition is absent, the costs of vertical integration would be less for the firms and the costs of disintegrating the industry would be higher for the authorities. It would presumably be much harder for authorities to take measures to stimulate competition in a vertically integrated industry than when vertical structures are governed by contracts.

Our analysis highlights the importance of analyzing not only the decision to vertically integrate and its benefits but also taking into account the costs of vertical integration. Vertical integration may be beneficial in circumstances where it can create control over essential assets, but if these assets only can be acquired through

bidding contests with rivals, the benefits of vertical integration may be superseeded by its costs.

Our no vertical integration result is robust to alternative assumptions regarding the costs of alternative access of the upstream firms because any outcome under vertical integration can be replicated by vertical contracts. Obviously, to generate this result one need contracts that are general enough, and if such contracts for exogeneous reasons should not be available to the firms, it may be possible to generate equilibria with vertical integration also in the setting studied here. This and other issues are left for future research.

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