

# Strategic Backward Integration

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## Abstract

We analyze the effects of downstream firms' acquisition of pure cash flow rights in an efficient upstream supplier when all firms compete in prices. With backward acquisition, downstream firms internalize the effects of their actions on their rivals' sales. Double marginalization is enhanced. While full vertical integration would lead to decreasing, passive backward ownership leads to increasing downstream prices and is more profitable, as long as competition is sufficiently intense. Downstream acquirers strategically abstain from vertical control, inducing the efficient supplier to commit to high prices. All results are sustained when upstream suppliers are allowed to charge two part tariffs.

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# 1 Introduction

Passive partial ownership across horizontally and vertically related firms is very common, but has traditionally not been of welfare concern, nor of concern in competition policy.<sup>1</sup> Whereas the anti-competitive effect of horizontal cross-shareholding on prices is hardly controversial, the effect of vertical ownership arrangements on pricing and foreclosure is much more so.<sup>2</sup>

By the classic Chicago challenge vertical mergers are competitively neutral at worst (Bork, 1978; Posner, 1976). Several arguments are around, however, of how vertical mergers can yield higher consumer prices, or even foreclosure. These rely on particular assumptions, such as additional commitment power of the integrated firm (Ordober et al., 1990), secret contract offers (Hart and Tirole, 1990), or costs of switching suppliers (Chen, 2001).<sup>3</sup>

Throughout, the authors compare a particular form of integration, namely from complete separation between the raider and the target firm to full joint ownership and control of the two. Partial ownership, either non-controlling or controlling, is not considered.

Even hindsight suggests, however, that empirically, partial vertical ownership between related firms is the rule rather than the exception.<sup>4</sup> Yet there is very little formal analysis on the allocation effects of partial interests. This is the focus of our research project.

Before moving on to the specifics reported in this paper, we should emphasize a general point on passive partial interests between vertically related firms. Unlike in the case of full merger, *the identity of the acquiring party matters in partial integration*. In particular, *passive forward ownership* of an upstream supplier in one of its customers induces *vertical coordination, by reducing double marginalization and thus downstream prices*. We demonstrate this in a companion paper (Hunold et al. (2012)). By sharp contrast, the results of this paper tell us that *passive backward ownership* induces exactly the opposite effect, namely *horizontal coordination, by exacerbating double marginalization and increasing downstream prices*.

This is our answer to one of the central questions addressed in this article: Is passive partial backward integration really as innocent as believed heretofore, with respect to anti-competitive effects such as increasing prices or foreclosure?

Towards this, we focus on passive ownership interests that price setting downstream firms may hold in their suppliers. Passive ownership involves pure cash flow rights, i.e. claims on the target's profits only, without controlling its decisions. We look at the pricing decisions of firms in a horizontally differentiated downstream market, and in an upstream homogeneous

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<sup>1</sup>Yet in 2011, Joaquín Almunia, the EU commissioner for competition policy, voiced that there is potentially an enforcement gap, as the EU Merger Regulation does not apply to minority shareholdings. See “Merger Regulation in the EU after 20 years”, co-presented by the IBA Antitrust Committee and the European Commission, March 10, 2011.

<sup>2</sup>See Flath (1991), or more recently Brito et al. (2010) or Karle et al. (2011) for a theoretical analysis of the profitability of horizontal partial ownership, and Gilo (2000) for examples and an informal discussion of the antitrust effects.

<sup>3</sup>Other explanations 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).

<sup>4</sup>Allen and Phillips (2000), for instance, identify 40 per cent of their sample of alliances, agreements and joint ventures as related to the exchange of a product or service.

product market where firms produce at differing levels of marginal costs. We concentrate on the case of effective upstream competition in which the difference in the marginal costs between the efficient supplier and its competitors restrict that supplier in its price setting.

Towards our main result, the reasoning is as follows: with an increasing participation in the profits of that efficient upstream supplier, the acquiring downstream firm softens its reaction to any upstream price increase. The upstream supplier incorporates this reaction by increasing its price. Only the effective price charged to the downstream firm cannot exceed the second efficient firm's marginal cost. Therefore, the nominal price charged by the efficient upstream firm can be higher. Thus, upstream competition is relaxed by passive backward integration. By virtue of the constraint on the efficient upstream firm's pricing activity, the two effects, softened reaction of the downstream acquirer, and increase in the upstream price, perfectly compensate each other.

Yet, as the downstream competitors are naturally served by the same efficient upstream firm, the acquirer also incorporates the effect of its own actions on the downstream competitors' sales. Its participation in the upstream supplier's sales to competitors reduces its incentive to steal from the competing firms. It thus raises its price above the price under vertical separation. Strategic complementarity in turn induces all downstream competitors to increase theirs.<sup>5</sup>

Beyond this central result, we show that as long as competition in both markets is sufficiently intense, the possibility to raise downstream prices incentivizes downstream firms to acquire passive interests in the efficient upstream supplier. Yet, in contrast to what one might expect, partial backward acquisition by a downstream firm does *not* invite the input foreclosure of downstream competitors. Indeed, via increasing equilibrium prices, the competitors tend to *benefit* from the acquiring firm's decision.

This acquisition, however, *takes place short of a level at which the downstream firm takes control over the upstream target's pricing decisions*. By contrast, if it did, the upstream firm would lose its power to commit to high transfer prices, and thus all downstream prices would decrease. Hence, in the setting analyzed here, *backward acquisitions have an anti-competitive effect only if they are passive*.

In the extension section, we show that backward acquisition is more profitable for the participating firms than full merger, and that all the effects hold even when the upstream suppliers are allowed to charge two-part tariffs, that in concentrated markets tend to alleviate the double marginalization problem. In all, we claim that the pricing consequences of passive backward integration should indeed be of concern to competition authorities.

The present analysis is related to Chen (2001). He investigates the effects of a full vertical merger in a similar setting. For such a merger to increase downstream prices, the

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<sup>5</sup>Flath (1989) shows that with successive Cournot oligopolies, constant elasticity demand and symmetric passive ownership, the effects cancel out, so in his model, pure passive backward integration has no effect. Greenlee and Raskovich (2006) confirm this invariance result for equilibria involving an upstream monopoly and symmetric downstream firms under competition in both, price and quantity. These invariance results would suggest that there is no need for competition policy to address passive vertical ownership. By contrast, we show that the invariance property of downstream prices does not apply within a more general industry structure involving upstream Bertrand competition with asymmetric costs.

unintegrated downstream rival needs to incur costs of switching between upstream suppliers. These switching costs allow the integrated firm to charge the downstream competitor an input price higher than that charged by the next efficient upstream supplier.

We show that for all downstream prices to increase, neither full vertical integration nor switching costs are necessary, nor does the input price charged to independent downstream firms need to increase. Indeed, partial backward integration without the transfer of control rights is effective in raising consumer prices when full integration is not, i.e. when the Chicago argument about the efficiency increasing effect of vertical mergers does hold. The reason is that by the very definition of passive ownership, only profit claims are transferred to downstream firms, but not control on upstream prices. In consequence, downstream firms can acquire profit claims of suppliers to relax downstream competition.

Separating control from ownership in order to relax competition is the general theme in the literature on strategic delegation. While that term was coined by Fershtman et al. (1991), our result is most closely related to the earlier example provided by Bonanno and Vickers (1988), where manufacturers maintain profit claims in their retailers through two-part tariffs, but delegate the control over retail prices towards inducing a softer price setting of the competitor. In the present case, strategic delegation involves backward oriented activities. The particular twist we add to that literature is that *the very instrument firms use to acquire control is used here short of implementing it*.

The competition dampening effect identified in the present paper relies on internalizing rivals' sales through a common efficient supplier. This relates to Bernheim and Whinston (1985)'s common agency argument. Strategic complementarity is essential in the sense that rivals need to respond with price increases to the raider's incentive to increase price. Indeed, acquiring passive vertical ownership is a fat cat strategy, in the terms coined by Fudenberg and Tirole (1984).

A different kind of explanation for backward integration without control is that transferring residual profit rights can mitigate agency problems, for example when firm specific investment or financing decisions are taken under incomplete information (Riordan, 1991; Dasgupta and Tao, 2000). Güth et al. (2007) analyze a model of vertical cross share holding to reduce informational asymmetries, and provide experimental evidence.<sup>6</sup> Whereas such potentially desirable effects of partial vertical ownership should be taken into account within competition policy considerations, we abstract from them for expositional clarity.

The remainder of this article is structured as follows: We introduce the model in Section 2. In Section 3, we solve and characterize the 3rd stage downstream pricing subgame. In Section 4, we solve for, and characterize the equilibrium upstream prices arising in Stage 2. We also derive the essential comparative statics with respect to the downstream firms' backward interests. In Section 5, we analyze a key element involved in the solution to the first stage of the game, namely the profitability of partial acquisitions. In the Extension Section

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<sup>6</sup>Höfler and Kranz (2011a,b) investigate how to restructure former integrated network monopolists. They find that passive ownership of the upstream bottleneck (legal unbundling) may be optimal in terms of downstream prices, upstream investment incentives and prevention of foreclosure. A key difference to our setting is that they keep upstream prices exogenous.

6, we first compare the results derived in the baseline model with those derived under full vertical integration. Second, we look at the effects of bans on upstream price discrimination common to many competition policy prescriptions. Third and fourth, we consider the effects of relaxing structural assumptions: We replace sequential by simultaneous pricing decisions, and then allow the upstream firms to charge observable two-part, rather than linear tariffs. The results remain unchanged. Fifth, we touch at the case in which upstream competition is ineffective, so that the efficient firm can exercise complete monopoly power.<sup>7</sup> Last, we briefly compare the effects of passive partial backward integration with those of passive partial horizontal integration. We conclude with Section 7. All proofs are removed to an appendix.

## 2 Model

Two symmetric downstream firms  $i, i \in \{A, B\}$  competing in prices  $p_i$  produce and sell imperfect substitutes obeying demands  $q_i(p_i, p_{-i})$ , that satisfy

**Assumption 1.**  $\infty > -\frac{\partial q_i(p_i, p_{-i})}{\partial p_i} > \frac{\partial q_i(p_i, p_{-i})}{\partial p_{-i}} > 0$  (*product substitutability*).

The production of one unit of downstream output requires one unit of a homogenous input produced by two suppliers  $j \in \{U, V\}$  with marginal costs  $c^j$ , who again compete in prices. Assume that  $c^U \equiv 0$  and  $c^V \equiv c > 0$ , so that firm  $U$  is more efficient than firm  $V$ , and  $c$  quantifies the difference in marginal costs between  $U$  and its less efficient competitor.<sup>8</sup> All other production costs are normalized to zero. Upstream suppliers are free to price discriminate between the downstream firms.

Let  $x_i^j$  denote the quantities firm  $i$  buys from supplier  $j$ , and  $w_i^j$  the associated linear unit price charged to  $i$  by supplier  $j$ .<sup>9</sup> Finally, let  $\delta_i^j \in [0, 1]$  denote the ownership share downstream firm  $i$  acquires in upstream firm  $j$ . Information is assumed to be perfect.

The game has three stages:

1. Downstream firms  $A$  and  $B$  simultaneously acquire ownership shares  $\delta_i^j$  of suppliers.
2. Suppliers simultaneously set sales prices  $w_i^j$ .
3. Downstream firms simultaneously buy input quantities  $x_i^j$  from suppliers, produce quantities  $q_i^j$ , and sell them at prices  $p_i$ .

Underlying the sequencing is the natural assumption that ownership is less flexible than prices are, and also observable by industry insiders. This is crucial, as in the following we employ subgame perfection to analyze how (pure cash flow) ownership affects prices. Yet the

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<sup>7</sup>In our companion paper Hunold et al. (2012), we consider ineffective competition and compare the effects of passive and controlling partial backward and forward integration.

<sup>8</sup>The symmetry assumption downstream, and the restriction to two firms downstream and upstream, respectively, are without loss of generality. One should be able to order the upstream firms by degree of efficiency, however. Rather than from  $V$ , the downstream firms could procure from the world market at marginal cost  $c$ .

<sup>9</sup>We show in Subsection 6.4 that the results extend to observable two part tariffs.

assumption that suppliers can commit to upstream prices before downstream prices are set is inessential here.

Upstream supplier  $j$ 's profit is given by

$$\pi^j = \sum_{i \in \{A, B\}} (w_i^j - c^j) x_i^j. \quad (1)$$

Downstream firm  $i$ 's profit, including the return from the shares held in upstream firms,

$$\Pi_i = \underbrace{p_i q_i(p_i, p_{-i}) - \sum_{j \in \{U, V\}} w_i^j x_i^j}_{\text{operational profit}} + \underbrace{\sum_{j \in \{U, V\}} \delta_i^j \pi^j}_{\text{upstream profit shares}}, \quad (2)$$

is to be maximized with respect to its own price  $p_i$ , subject to the constraint  $\sum_j x_i^j \geq q_i$ , so that input purchases are sufficient to satisfy quantity demanded.

We use the term *partial ownership* for an ownership share strictly between zero and one. We call *passive* an ownership share that does *not* involve control over the target firm's pricing strategy, and *active* one that does. The possibility to control the target's instruments is treated as independent of the ownership share in the target. With this we want to avoid the discussion of at which level of shareholdings control arises. That depends on institutional detail and the distribution of ownership share holdings in the target firm. Although a restriction of ownership shares to below  $1/2$  appears highly plausible for ownership to be passive, our results on passive ownership hold for any partial ownership share. See O'Brien and Salop (1999), as well as Hunold et al. (2012) for a discussion of when control arises.

Finally, we define an allocation to involve *effective (upstream) competition*, if the efficient upstream firm is constrained in its pricing decision by its upstream competitor, i.e. can charge effective unit input prices, as perceived by downstream firms, no higher than  $c$ .

An equilibrium in the third, downstream pricing stage is defined by downstream prices  $p_A^*$  and  $p_B^*$  as functions of the upstream prices  $w_i^j$  and ownership shares  $\delta_i^j$ ,  $i \in \{A, B\}; j \in \{U, V\}$  held by the downstream in the upstream firms, subject to the condition that upstream supply satisfies downstream equilibrium quantities demanded. In order to characterize that equilibrium, it is helpful to impose the following conditions on the profit functions:

**Assumption 2.**  $\frac{\partial^2 \Pi_i(p_i, p_{-i})}{\partial p_i^2} < 0$  (*concavity*)

**Assumption 3.**  $\frac{\partial^2 \Pi_i(p_i, p_{-i})}{\partial p_i \partial p_{-i}} > 0$  (*strategic complementarity*)

**Assumption 4.**  $\frac{\partial^2 \Pi_i(p_i, p_{-i})}{\partial p_i \partial p_{-i}} / \frac{\partial^2 \Pi_i(p_i, p_{-i})}{\partial p_i^2} > \frac{\partial^2 \Pi_{-i}(p_{-i}, p_i)}{\partial p_{-i} \partial p_{-i}} / \frac{\partial^2 \Pi_{-i}(p_{-i}, p_i)}{\partial p_{-i} \partial p_i}$  (*stability*)<sup>10</sup>

An equilibrium in the second, upstream pricing stage specifies prices  $w_i^{j*}$  conditional on ownership shares  $\delta_i^j$ ,  $i \in \{A, B\}; j \in \{U, V\}$ .

<sup>10</sup>The stability assumption implies that the best-reply function of  $i$  plotted in a  $(p_i, p_{-i})$  diagram is flatter than the best-reply function of  $-i$  for any  $p_{-i}$ , implying that an intersection of the best reply functions is unique.

We sometimes wish to obtain closed form solutions for the complete game, by using the linear demand specification

$$q_i(p_i, p_{-i}) = \frac{1}{(1+\gamma)} \left( 1 - \frac{1}{(1-\gamma)} p_i + \frac{\gamma}{(1-\gamma)} p_{-i} \right), \quad 0 < \gamma < 1, \quad (3)$$

with  $\gamma$  quantifying the degree of substitutability between the downstream products so that  $\gamma = 0$  if the two products are independent, and as  $\gamma \rightarrow 1$  the products become perfect substitutes. With this demand specification, Assumptions 1 to 4 are satisfied.

### 3 Stage 3: Supplier choice and the determination of downstream prices

Downstream firm  $i$ 's cost of buying a unit of input from supplier  $j$  in which it holds  $\delta_i^j$  shares is obtained by differentiating the downstream profit (2) with respect to the input quantity  $x_i^j$ , i.e.

$$\frac{\partial \Pi_i}{\partial x_i^j} = - \underbrace{w_i^j}_{\text{input price}} + \underbrace{\delta_i^j (w_i^j - c^j)}_{\text{upstream profit increase}}.$$

Thus, the unit input price  $w_i^j$  faced by downstream firm  $i$  is reduced by the contribution of that purchase to supplier  $j$ 's profits. Call  $-\frac{\partial \Pi_i}{\partial x_i^j}$  the *effective input price* downstream firm  $i$  is confronted with when purchasing from firm  $j$ . The minimal effective input price for downstream firm  $i$  is given by

$$w_i^e \equiv \min \left\{ w_i^U (1 - \delta_i^U), w_i^V (1 - \delta_i^V) + \delta_i^V c \right\}. \quad (4)$$

As natural in this context, firm  $i$  buys from the upstream supplier  $j$  offering the minimal effective input price. If both suppliers charge the same effective input price, we assume that  $i$  buys the entire input quantity from the efficient supplier  $U$ , as that supplier could slightly undercut to make its offer strictly preferable. Let  $j(-i)$  denote the supplier  $j$  from which the other downstream firm  $-i$  buys its input. Differentiating the two downstream firms' profits with respect to their own downstream price yields the two first order conditions

$$\frac{\partial \Pi_i}{\partial p_i} = (p_i - w_i^e) \frac{\partial q_i}{\partial p_i} + q_i(p_i, p_{-i}) + \delta_i^{j(-i)} (w_{-i}^{j(-i)} - c^{j(-i)}) \frac{\partial q_{-i}}{\partial p_i} = 0, \quad i \in \{A, B\}. \quad (5)$$

Observe that whenever  $\delta_i^{j(-i)} > 0$ , downstream firm  $i$  takes into account that changing its sales price affects the upstream profits earned via sales quantities  $q_{-i}$  to its competitor.<sup>11</sup>

By Assumptions 1–4, the equilibrium of the downstream pricing game is unique, stable and fully characterized by the two first order conditions for given input prices and owner-

<sup>11</sup>This effect is not present with quantity competition, as then  $q_{-i}$  is not a function of the strategic variable  $q_i$ .

ship shares. Note that strategic complementarity holds under the assumption of product substitutability if margins are non-negative and  $\frac{\partial^2 q_{-i}}{\partial p_i \partial p_{-i}}$  is not too negative (cf. Equation (5)). Also observe that if prices are strategic complements at  $\delta_A = \delta_B = 0$ , then strategic complementarity continues to hold for small partial ownership shares.

## 4 Stage 2: Determination of upstream prices under passive partial ownership

$V$  cannot profitably sell at a (linear) price below its marginal production cost  $c$ .  $U$  as the more efficient supplier can profitably undercut  $V$  at any positive upstream price. This implies that, in equilibrium,  $U$  supplies both downstream firms, and this at effective prices at most as high as  $c$ .<sup>12</sup> To simplify notation, let henceforth  $\delta_i \equiv \delta_i^U$  and  $w_i \equiv w_i^U$ . Let  $p_i^*(w_i, w_{-i} | \delta_A, \delta_B)$  denote the equilibrium prices of the downstream subgame as a function of the input prices. Formally,  $U$ 's problem is

$$\max_{w_A, w_B} \pi^U = \sum_{i=A, B} w_i q_i \left( p_i^*(w_i, w_{-i} | \delta_A, \delta_B), p_{-i}^*(w_{-i}, w_i | \delta_A, \delta_B) \right) \quad (6)$$

subject to the constraints  $w_i(1 - \delta_i) \leq c$ ,  $i \in \{A, B\}$  such that downstream firms prefer to source from  $U$ . Differentiating the reduced-form profit in (6) with respect to  $w_i$  yields

$$\frac{d\pi^U}{dw_i} = q_i(p_i^*, p_{-i}^*) + w_i \frac{dq_i(p_i^*, p_{-i}^*)}{dw_i} + w_{-i} \frac{dq_{-i}(p_{-i}^*, p_i^*)}{dw_i}. \quad (7)$$

Starting at  $w_i = w_{-i} = 0$ , it must be profit increasing for  $U$  to marginally increase upstream prices, because both  $q_i > 0$  and  $q_{-i} > 0$ . By continuity and boundedness of the derivatives, this remains true for not too large positive upstream prices. Hence if  $c$  is sufficiently small, then the constraints are strictly binding for any partial ownership structure, so there is *effective upstream competition*. In this case, the *nominal upstream equilibrium prices* are given by

$$w_i^* = c / (1 - \delta_i), \quad (8)$$

and the *effective upstream prices* both equal  $c$ . We assume this regime to hold in the core part of the paper.<sup>13</sup> In this regime,  $U$ 's profits are uniquely given by

$$\pi^U = \frac{c}{(1 - \delta_A)} q_A(p_A^*, p_B^*) + \frac{c}{(1 - \delta_B)} q_B(p_B^*, p_A^*), \quad (9)$$

and  $V$ 's profits are zero. We summarize in

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<sup>12</sup>This also implies that none of the downstream firms has an interest in obtaining passive shares from the unprofitable upstream firm  $V$ .

<sup>13</sup>Clearly, if  $\pi^U(w_A, w_B)$  is concave, one, or both of the constraints do not bind for  $c$  sufficiently large, in which case  $U$  can charge the unconstrained monopoly price below  $c$ . When both constraints do not bind, we are in the case of ineffective competition analyzed in Hunold et al. (2012).



**Lemma 1.** *The efficient upstream firm  $U$  supplies both downstream firms at any given passive partial backward ownership shares  $(\delta_A, \delta_B)$ . Under effective upstream competition, i.e. for sufficiently small  $c$ ,  $U$  charges prices  $w_i^* = c/(1 - \delta_i)$ ,  $i \in \{A, B\}$ , so that the effective input prices are equal to the marginal cost  $c$  of the less efficient supplier  $V$ .*

With these upstream prices, downstream profits reduce to

$$\Pi_i = (p_i - c) q_i + \delta_i \frac{c}{1 - \delta_{-i}} q_{-i}. \quad (10)$$

Observe that if firm  $i$  holds shares in firm  $U$  so that  $\delta_i > 0$ , its profit  $\Pi_i$ , via its upstream holding, *increases* in the quantity demanded of its rival's product  $q_{-i}$ . All else given, this provides for an incentive to raise the price for its own product. Formally, firm  $i$ 's marginal profit

$$\frac{\partial \Pi_i}{\partial p_i} = q_i + (p_i - c) \frac{\partial q_i}{\partial p_i} + \delta_i \frac{c}{1 - \delta_{-i}} \frac{\partial q_{-i}}{\partial p_i} \quad (11)$$

increases in  $\delta_i$ . Also, if  $\delta_i > 0$ , then the marginal profit of  $i$  increases in  $\delta_{-i}$ , as this increases the upstream margin earned on the product of  $-i$ . If the downstream products were not substitutable, i.e.  $\frac{\partial q_{-i}}{\partial p_i} = 0$ , the marginal profit and thus the downstream pricing would not be affected by backward ownership. As the products  $(i, -i)$  become closer substitutes,  $\frac{\partial q_{-i}}{\partial p_i}$  increases and the external effect internalized via the cash flow right  $\delta_i$  becomes stronger, and with it the effect on equilibrium prices.

In all, this yields the following central result:

**Proposition 1.** *Let Assumptions 1-4 hold and upstream competition be effective. Then*

- (i) *both equilibrium downstream prices  $p_i^*$  and  $p_{-i}^*$  increase in both  $\delta_i$  and  $\delta_{-i}$  for any non-controlling ownership structure,*
- (ii) *the increase is stronger when the downstream products are closer substitutes.*

The following corollary is immediate:

**Corollary 1.** *Any increase in passive ownership in  $U$  by one or both downstream firms is strictly anti-competitive.*

Proposition 1 is illustrated in Figure 1 for the case  $\delta_A > \delta_B = 0$ . The solid line is the inverted best-reply function  $p_B^r(p_A)^{-1}$  of  $B$  at a given  $\delta_A > 0$ . The dashed line is  $A$ 's best reply  $p_A^r(p_B)$  for  $\delta_A = 0$ , and the dashed-dotted line above this is  $A$ 's best reply for  $\delta_A \rightarrow 1$ . Hence, choosing  $\delta_A$  amounts to choosing the best-reply function  $p_A^r(p_B)$  in the subsequent pricing game. This becomes central when analyzing the profitability of acquisitions in the next section.

Before going on, we should emphasize that the nominal transfer prices charged here are higher for the firm with the larger interest in the efficient upstream supplier. This is interesting because, in view of its potential impact on foreclosure, the competition policy analyst usually considers dangerous preferentially low transfer prices between vertically related firms.

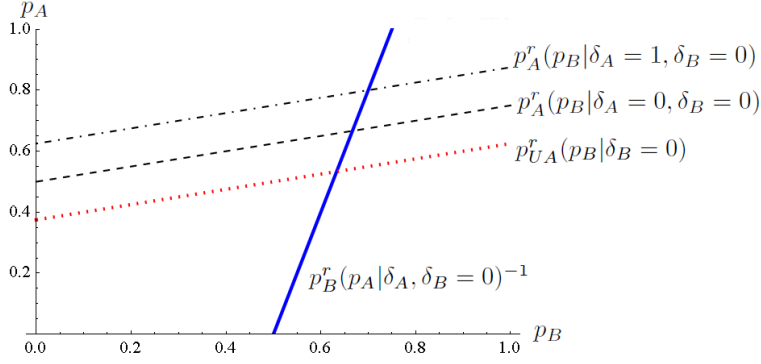


Figure 1: Best-reply functions of downstream firms  $A$ ,  $B$  and the vertically integrated unit  $UA$  for linear demand as in (3), with  $\gamma = 0.5$  and  $c = 0.5$ .

## 5 Stage 1: Acquisition of shares by downstream firms

Here we assess the profitability of downstream firms' backward acquisitions of passive stakes in upstream firms. We restrict our attention to the acquisition of stakes in firm  $U$ . This is easily justifiable within the context of our model: As both downstream firms decide to acquire input from the more efficient firm, the less efficient firm  $V$  does not earn positive profits in equilibrium. Hence, there is no scope for downstream firms to acquire passive interests in  $V$ .

Rather than specifying how bargaining for ownership stakes takes place and conditioning the outcome on the bargaining process, we determine the central incentive condition for backward acquisitions to materialize, namely that there are gains from trading claims to profits in  $U$  between that upstream firm and one of the downstream firms. For the sake of brevity, we abstain from modeling the ownership acquisition game, that would specify the redistribution of rents to the industry generated from passive backward integration.

In order to enhance the intuition, fix for the moment the stakes held by firm  $B$  at  $\delta_B = 0$ . Gains from trading stakes between  $A$  and  $U$  arise if the joint profit of  $A$  and  $U$ ,

$$\Pi_A^U(\delta_A | \delta_B = 0) \equiv p_A^* q_A^* + c q_B^*,$$

is higher at some  $\delta_A \in (0, 1)$  rather than at  $\delta_A = 0$ , where  $p_A^*$ ,  $q_A^*$  and  $q_B^*$  all are functions of  $\delta_A$ .<sup>14</sup> The drastic simplification of this expression results from the fact that a positive  $\delta_A$  just redistributes profits between  $A$  and  $U$ . The gains from trade between  $A$  and  $U$  can thus arise only via indirect effects on prices and quantities induced by increases in  $\delta_A$ . Why should there be such gains from trade at all?

The vertical effects of an increase in  $\delta_A$  between  $A$  and  $U$  are exactly compensating as the effective transfer price remains at  $c$  (Lemma 1). All that changes are  $A$ 's marginal profits. They increase in  $\delta_A$ , because with this  $A$  internalizes an increasing share of  $U$ 's sales to  $B$ . Again, this leads  $A$  to increase  $p_A$ , which in turn induces  $B$  to increase  $p_B$ . That price

<sup>14</sup>Passive backward ownership of  $A$  in  $U$  benefits  $B$  as  $A$  prices more softly. Our assessment of the profitability of backward ownership is conservative as this benefit cannot be extracted by  $U$  who can at most charge  $B$  a unit price of  $c$ . With commitment to exclusive supply from  $U$  or two-part tariffs,  $U$  can extract the profit increase of  $B$  through a higher marginal price or an up-front fee. See Subsection 6.4 for details.

increase is not only profitable to  $B$ , but eventually yields a net benefit to  $A$  and  $U$ . Intuition suggests that this competition softening effect increases the profits of  $U$  and  $A$  if competition in the industry is fierce. Indeed, evaluating  $d\Pi_A^U/d\delta_A$  at small  $c$  yields

**Proposition 2.** *An increasing partial passive ownership stake of firm  $i$  in firm  $U$  increases the combined profits of  $i$  and  $U$ , if upstream competition is sufficiently intense.*

This argument continues to hold if both downstream firms buy shares in the efficient upstream firm, under the obvious restriction that control is *not* transferred from  $U$  to any one of the downstream firms.<sup>15</sup>

**Corollary 2.** *Increasing partial passive ownership stakes of firms  $i$  and  $-i$  in firm  $U$  increase the industry profit  $\Pi_{AB}^U \equiv p_A^*q_A^* + p_B^*q_B^*$ , if upstream competition is sufficiently intense.*

Using the linear demand example introduced in (3), we can make explicit how our case assumption that upstream competition is intense enough relates to the intensity of downstream competition. Let  $\delta_{-i} = 0$ . Then the joint profits of firms  $i$  and  $U$  are maximized at a positive passive ownership share  $\delta_i$  if  $c < \gamma^2/4$ . For close to perfect downstream competition, i.e.  $\gamma$  close to 1, this implies that passive backward ownership is profitable for a range of marginal costs up to  $1/2$  of the industry's downstream monopoly price.

As a firm's backward interests confer a positive externality on the second firm's profits, the industry profits  $p_A^*q_A^* + p_B^*q_B^*$  are maximized at strictly positive passive ownership shares by both firms if the less restrictive condition  $c < \gamma/2$  holds. The fact that  $\gamma^2/4 < \gamma/2$  indicates the internalization of the positive externality on the downstream competitor when interests in the efficient upstream firm are acquired to maximize industry profits.

One might worry about the magnitude of the effect derived; also when many inputs are procured to produce a unit of the downstream product. Let us start with the baseline case, in which the downstream products are produced with only one input. Under the assumed close substitutability between the downstream products, the change in own demand induced by a price change is of the same order of magnitude as the change in the competitor's demand. In equilibrium, the former is weighted by the margin  $p_A - c$ , whence the latter is weighed by  $\frac{\delta_A}{1-\delta_B}c$ . The former can be easily dominated by the latter, even when the shares held by the downstream firms in the upstream efficient supplier are small.

Take now a 2–1 technology, in which the downstream product is produced by two inputs. Suppose that input 1 is produced in an industry structured as in the baseline model, and commodity 2 can be procured at a price of  $c_2$ . The effective downstream margin is now given by  $p_A - c - c_2$ , and can be easily dominated by  $\frac{\delta_A}{1-\delta_B}c$ . What matters is that the margin of the input on which backward integration takes place is relatively large when compared to the downstream margin. Note also that if a downstream firm integrates backward in the efficient supplier of each input, the overall effect is that of backward integration in case of a 1:1 technology.

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<sup>15</sup>In Subsection 6.1, we consider the effect of a transfer of control, and compare the outcome with the present one.

In passing, all of these results give rise to interesting hypotheses to be tested empirically. A particularly intricate one is that the externality alluded to here provides incentives to acquire passive shares in suppliers to competitors. While this hypothesis remains to be looked at empirically in detail, it could provide an explanation for the empirical puzzle demonstrated by Atalay et al. (2012) that a majority of backward acquisitions is *not* accompanied by physical product flows.

One also might want to speculate about the consequences of the effect derived here for the entry of firms downstream and upstream. Due to the externality generated on the outsiders by increasing prices, downstream entry may be invited rather than deterred. By contrast, upstream, the externality results from the fact that all downstream firms are supplied by the efficient firm. This tends to constitute an entry barrier.

## 6 Extensions

### 6.1 Effects of control

In this extension, we compare the effects of passive partial backward integration of one of the downstream firms (say  $A$ ) into the efficient upstream firm  $U$ , with those generated by a merger between the two firms. We first consider the merger.

Let the ownership structure under vertical integration be described by  $\{\delta_A = 1, \delta_B = 0\}$ , and let  $A$  control  $U$ 's pricing decisions. As  $U$  is more efficient than  $V$ , the fully integrated firm continues, as heretofore, to meet any positive price  $w_B^V$  charged by  $V$ . Under effective upstream competition, it is again optimal to set  $w_B^U = c$ . Yet, by virtue of being merged with  $U$ ,  $A$  takes account of the true input cost normalized to zero.<sup>16</sup>

Consider now the effect of full integration of  $A$  and  $U$  on downstream prices. Still faced with marginal input cost  $c$ ,  $B$ 's best response remains unchanged. Yet full integration has two countervailing effects on the setting of  $p_A$ . Upward price pressure arises because the integrated unit fully internalizes the upstream profit from selling to firm  $B$ , that is  $c q_B(p_B, p_A)$ . Conversely, downward price pressure arises because double marginalization on product  $A$  is eliminated, as the downstream costs,  $c q_A(p_A, p_B)$  under separation, are decreased to zero. Indeed, we show that the downward pressure is stronger when the own price effect dominates the cross price effect, yielding

**Proposition 3.** *Under Assumptions 1 to 4, a vertical merger between one downstream firm and  $U$  decreases both downstream prices, as compared to complete separation.*

As another consequence, observe that input foreclosure does not arise under vertical integration.

Returning to Figure 1, note that for any  $\delta_A > 0$ , the best response of the merged entity,  $p_{UA}^r(p_B)$ , represented by the dotted line in Figure 1, is located below the one arising under

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<sup>16</sup>In line with the literature – examples are Bonanno and Vickers (1988), Chen (2001), and Hart and Tirole (1990) – the integrated firm is considered unable to commit to an internal transfer price higher than its true marginal cost.

separation.

Proposition 3 is also contained in Chen (2001). Yet for an anti-competitive increase in downstream prices to occur in that model, Chen needs to assume that  $B$  has to make supplier specific investments to buy from  $U$ , so that the integrated firm can set  $w_B^U > c$  and still continue to be the exclusive supplier of  $B$ . By contrast, as we state in Proposition 1, downstream prices increase even without switching costs, once we allow for the separation of profit claims and control of the target. Summarizing:

**Corollary 3.** *Under Assumptions 1 to 4 and effective upstream competition, a vertical merger between one of the downstream firms and the efficient upstream firm leads to a decrease of all downstream prices when compared to those arising under vertical separation, whence any passive partial backward ownership of one or both downstream firms in the efficient supplier  $U$  leads to an increase in all downstream prices.*

We now turn to a comparison of the combined profits of  $A$  and  $U$  under full vertical separation and full integration. By Proposition 3, vertical integration decreases both downstream prices. This is not necessarily desirable for  $A$  and  $U$ , as long as the overall margins earned under vertical separation are below the industry profit maximizing level. In order to assess whether separation increases the combined profits  $\Pi_A^U$ , we ask whether, at vertical separation, it is profitable to move towards integration. Indeed, we can show that this is strictly unprofitable, as long as  $c$  is sufficiently small. By continuity, there exists an interval  $(0, \bar{c}]$  such that for any  $c$  in this interval vertical separation is more profitable than integration. Hence

**Lemma 2.** *A merger between  $A$  and  $U$  is less profitable than complete vertical separation if upstream competition is sufficiently intense.*

Combining Proposition 2 and Lemma 2 yields

**Corollary 4.** *Passive partial backward integration of firm  $i$  into firm  $U$  is more profitable than vertical integration, if upstream competition is sufficiently intense. Then, downstream firms have the incentive to acquire maximal backward interests, short of controlling the upstream firm  $U$ .*

As mentioned before, this result is nicely related to the literature on strategic delegation. The particular twist here is that *the very instrument intended to acquire control, namely the acquisition of equity in the target firm, is employed short of controlling the target. This benefits the industry, but it harms consumer welfare.*

**A remark on control with partial ownership.** The key driver behind Corollary 4 is that passive ownership preserves double marginalization, whereas a vertical merger eliminates it. It is common in the literature on vertical relations to assume that a merged entity cannot commit to internal transfer prices above marginal costs (see footnote 16).

This assumption is arguably less straightforward with controlling partial ownership, say when  $A$  has a block of voting shares of  $U$ . If downstream competition is sufficiently strong,

the shareholders of  $A$  and  $U$  collectively have an incentive to commit to a high transfer price  $w_A$ . However,  $A$  has an individual incentive to be charged a low price, or at least wants to be compensated with a fixed payment. If  $A$  cannot be compensated or commitment to a high price is not feasible as renegotiations remain possible,  $A$  will use its control to decrease  $w_A$ , its own input costs. In a standard bargaining framework, the price  $w_A$  decreases more, the more control  $A$  has over  $U$ , whereas the price for  $B$  remains unchanged as there is no conflict of interest over it among the shareholders of  $U$ .

## 6.2 Non-discriminatory upstream prices

Many competition laws require a firm to charge non-discriminatory prices. While by the U.S. Robinson-Patman Act, non-discrimination is a widely applied rule, Article 102 of the Treaty on the Functioning of the European Union restricts the application of the rule to dominant firms.

Clearly, under effective competition, symmetric passive ownership with  $\delta_A = \delta_B > 0$  may arise as an equilibrium. Supplier  $U$  then has no incentive to price discriminate. Yet, as we have shown in Proposition 1, symmetric passive ownership is clearly anti-competitive, so in this case, a non-discrimination rule has no effect at all, and in particular no pro-competitive effect.

Consider instead one of the firms', say  $A$ 's, incentive to acquire a backward interest in firm  $U$  when non-discrimination is effective and  $\delta_B = 0$ . Then  $U$  must charge a uniform price  $c$  if it wants to serve both downstream firms. This yields profits to  $A$  of

$$\Pi_A = (p_A - c) \cdot q_A + \delta_A c \cdot (q_A + q_B).$$

Differentiating with respect to  $p_A$  and  $\delta_A$  yields

$$\frac{\partial^2 \Pi_A}{\partial p_A \partial \delta_A} = c \cdot \left[ \frac{\partial q_A(p_A, p_B)}{\partial p_A} + \frac{\partial q_B(p_B, p_A)}{\partial p_A} \right]. \quad (12)$$

By Assumption 1, the own price effect dominates the cross price effect, and therefore the cross derivative in (12) is negative at  $\delta_A = 0$ . Thus marginally increasing  $\delta_A$  decreases the marginal profit of  $A$ . Hence, the best reply  $p_A^r(p_B | \delta_A)$  and, in consequence, both equilibrium downstream prices, decrease in  $\delta_A$  at  $\delta_A = 0$ . By continuity, this holds for small positive  $\delta_A$ . This result generalizes to all feasible  $\delta_A$  as long as  $\frac{\partial q_B}{\partial p_A} \leq \frac{\partial q_A}{\partial p_B}$  for  $p_A < p_B$ , e.g. in case of linear demand. Under this condition, if only one downstream firm has passive ownership in  $U$ , and  $U$  optimally serves both downstream firms, then such ownership is not anti-competitive under a non-discrimination rule.<sup>17</sup>

<sup>17</sup> $U$  wants to serve both downstream firms for a small  $\delta_i$ , given  $\delta_{-i} = 0$ . Once  $\delta_i$  becomes large,  $U$  may find it profitable to set a high nominal price at which only  $i$  wants to purchase. This makes  $-i$  dependent on  $V$ . In turn,  $V$  can raise the price charged to  $-i$  above  $c$ , yielding partial foreclosure. However, it is unclear whether partial foreclosure is an equilibrium. In a forthcoming paper, we will discuss in detail the effects of non-discrimination rules in the different case situations.

### 6.3 Simultaneous price setting

So far, we have assumed that upstream prices are set before downstream prices. Consider now that all prices are set simultaneously. In this situation, upstream firms take downstream prices as given. For  $U$ , increasing effective prices up to  $c$  does not affect quantity. Hence, effective equilibrium upstream prices must be equal to  $c$ . However, with simultaneous price setting, an equilibrium does only exist as long as the participation constraints of downstream firms are not violated at effective upstream prices of  $c$ .

**Lemma 3.** *Under effective competition, sequential and simultaneous setting of up- and downstream prices are outcome equivalent.*

Note that as long as the participation constraints of downstream firms do not bind, the simultaneous price setting is equivalent to the case in which downstream prices are set first, followed by upstream prices and, finally, downstream firms choose where to buy inputs.

### 6.4 Two-part tariffs

The assumption of linear upstream prices is clearly restrictive, as argued already in Tirole (1988). Caprice (2006) as well as Sandonis and Fauli-Oller (2006) have pointed out that with effective upstream competition, observable two part tariffs offered by the efficient supplier  $U$  implement downstream prices below the industry profit maximizers. One reason is that  $U$  does not want to offer marginal input prices as high so that they maximize industry profits, because downstream firm  $i$ 's alternative to sourcing from  $U$ , given its rival  $-i$  sources from  $U$ , is more valuable when  $U$  charges  $-i$  a higher marginal price. This induces  $U$  to lower the marginal prices below the industry profit maximizing level, in order to obtain more rents through the fixed fees.

Moreover, if  $U$  cannot offer exclusive contracts, a downstream firm will source inputs alternatively once the marginal input price charged by  $U$  exceeds the alternative input price. In our setting, this implies that without backward interests by a downstream firm,  $U$  cannot implement a marginal price above  $c$  to that firm. We show that in the case discussed heretofore,  $U$  indeed would like to offer marginal prices above  $c$ . Thus marginal input prices in equilibrium equal  $c$  and the fixed fee  $F$  equals zero, i.e. the transfer prices  $U$  charges are endogenously linear.

In what follows, we formally characterize the two-part contracting problem and show that passive backward ownership can increase downstream prices.

We start from complete vertical separation, so that  $\delta_A = \delta_B = 0$ , and maintain the assumptions that all contract offers are observable to all downstream firms upon acceptance; in particular that acceptance decisions are observed when downstream prices are set. A tariff offered by supplier  $j$  to downstream firm  $i$  is summarized by  $\{F_i^j, w_i^j\}$ , where  $F_i^j$  is the fixed fee downstream firm  $i$  has to pay the upstream firm  $j$  upon acceptance of the contract, and  $w_i^j$  continues to be the marginal input price. Denote by  $\pi_i^*(w_i^j, w_{-i}^k)$ ,  $j, k \in \{U, V\}$ , firm  $i$ 's reduced form downstream profits at downstream equilibrium prices as a

function of the marginal input price relevant for each downstream firm, but gross of any fixed payment. With the model constructed as in the main part of the paper, the Bertrand logic still holds:  $U$  can always profitably undercut any (undominated) offer by  $V$ , so in equilibrium  $U$  exclusively supplies both downstream firms. Yet if upstream competition is effective as assumed throughout,  $U$  is restricted by  $V$  in its price setting. We require that  $V$ 's offers, if accepted, yield it non-negative profits.

More formally, for given contract offers of  $V$  to firm  $A$  and  $B$ ,  $U$ 's problem is

$$\begin{aligned} \max_{f_A^U, f_B^U, w_A^U, w_B^U} \pi^U &= \sum_{i \in \{A, B\}} [w_i^U q_i + F_i^U] \\ \text{s.t.} \quad \pi_i^*(w_i^U, w_{-i}^U) - F_i^U &\geq \pi_i^*(w_i^V, w_{-i}^U) - F_i^V. \end{aligned} \quad (13)$$

$U$  has to ensure that each downstream firm's deviation to source from  $V$  is not profitable. In equilibrium, the profit constraints of both downstream firms must be binding, as otherwise  $U$  could profitably raise the respective fixed fee  $F_i^U$ , until downstream firm  $i$  is indifferent between its and  $V$ 's contract offer.

Let the contracts offered by upstream firms first be non-exclusive, so that an upstream firm cannot contractually require a downstream firm to exclusively procure from it. Then, setting a marginal input price  $w_i^U > c$  with  $F_i^U < 0$  cannot be an equilibrium, as  $V$  could profitably offer  $\{F_i^V = 0, w_i^V \in [c, w_i^U]\}$ , which would provide incentives to downstream firm  $i$  to accept  $U$ 's contract offer in order to cash in  $F_i^U$ , but to source its entire input at the marginal cost  $w_i^V$  offered by  $V$ .

The equilibrium contract offers made by  $V$  must be best replies to  $U$ 's equilibrium contract offers. Hence

**Lemma 4.** *If  $U$  offers two-part tariffs with  $w_i^U \leq c$ ,  $i \in \{A, B\}$ , then  $\{0, c\}$  is  $V$ 's unique non-exclusive counteroffer that maximizes the downstream firms' profits and yields  $V$  a non-negative profit.*

Using this insight and letting  $w_i \equiv w_i^U$  and  $F_i \equiv F_i^U$  to simplify notation,  $U$ 's problem reduces to

$$\max_{w_A, w_B} \pi^U = \underbrace{\sum_{i \in \{A, B\}} p_i^*(w_i, w_{-i}) q_i^*}_{\text{industry profit}} - \underbrace{\sum_{i \in \{A, B\}} \pi_i^*(c, w_{-i})}_{\text{outside options}} \quad (14)$$

subject to the no-arbitrage constraints  $w_i \leq c$ ,  $i \in \{A, B\}$ .

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  $V$  eventually yields downstream firms positive profits. Moreover, firm  $i$ 's outside option, the profit  $\pi_i^*(c, w_{-i})$  it would obtain when sourcing from  $V$ , increases in the rival's cost  $w_{-i}$ . Hence the marginal profit  $\partial \pi^U / \partial w_i$  is below the marginal industry profit. For  $c$  sufficiently small, the marginal industry profit is still positive when the arbitrage constraints are binding, i.e. at  $w_A = w_B = c$ . 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*. We summarize in

**Proposition 4.** *Let upstream competition be sufficiently intense. Then under vertical separation,  $\{c, 0\}$  is the unique symmetric equilibrium non-exclusive two-part tariff offered by both upstream to both downstream firms.*

As before, *sufficient intensity* of upstream competition is to be seen relative to the intensity of downstream competition. In our linear demand example, it suffices to have  $c < \gamma^2/4$ . In passing, this is also the condition ensuring the profitability of an initial increase of passive backward ownership  $\delta_i$  to  $i$  and  $U$ .

What does change if we allow for passive partial backward integration? As  $\{0, c\}$  is a corner solution, (at least some) passive backward integration does not change the efficient upstream firm's incentive to charge maximal marginal prices.

Moreover, recall that passive backward ownership of  $i$  in  $U$  exerts a positive externality on  $-i$  as  $i$  prices more softly – but only if  $-i$  sources from  $U$ . With two-part tariffs,  $U$  can extract the upward jump in  $-i$ 's payoffs by charging a positive fixed fee.<sup>18</sup> Assuming that commitment to only buy from  $U$  is not feasible, we obtain

**Lemma 5.** *Let upstream competition be sufficiently intense and  $\delta_i > \delta_{-i} = 0$ . The non-exclusive two-part tariff offered by  $U$  to  $i$  has  $w_i = c/(1 - \delta_i)$  and  $F_i = 0$ , and the tariff to  $-i$  has  $w_{-i} = c$  and  $F_{-i} > 0$ .*

Thus, when firm  $i$  has acquired a positive share, the effective input price  $U$  charges it remains at  $c$  as under linear tariffs. With non-exclusivity, a higher marginal input price is not feasible, as then firm  $i$  would buy the inputs from  $V$ , that continues to charge  $\{0, c\}$ . Hence Proposition 2 still applies and we obtain

**Corollary 5.** *Let upstream competition be sufficiently intense. Then partial passive ownership of downstream firm  $i$  in supplier  $U$  increases bilateral profits  $\Pi_i^U$  as well as industry profits  $\Pi_{AB}^U$  compared to complete separation, even if non-exclusive two-part tariffs are allowed for.*

Hence the results derived in the main part of the paper for linear tariffs are upheld with non-exclusive observable two-part tariffs, if competition is sufficiently intense. When upstream competition is less intense, it is optimal for  $U$  to charge effective marginal prices below  $c$  to reduce the downstream firms' outside options. Thus the no-arbitrage constraint  $w_i \leq c/(1 - \delta_i)$  is no longer binding, which is also the case when  $U$  offers exclusive two-part tariffs. Yet passive backward integration still relaxes downstream competition for given effective input prices. Moreover,  $U$  can still extract the positive externality of backward ownership on downstream competitors by raising either the fixed fee or the marginal price. Assuming that demand is linear and  $V$  offers  $\{0, c\}$ , one can show that passive backward

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<sup>18</sup> $U$  could also charge  $B$  marginal price above  $c$ , but only if commitment to exclusive dealing of  $B$  with  $U$  is possible. To remain consistent with the main part, we rule this out here, as does Chen (2001).

ownership is indeed both profitable and increases downstream prices for large parameter ranges of  $c$  and  $\gamma$  where contracts with effective marginal input prices above or below  $c$  result.<sup>19</sup>

## 6.5 Ineffective competition

In the baseline model, we have analyzed the effects of passive partial backward integration when there is *effective upstream competition*, as generated by a small difference  $c$  in marginal costs between the efficient firm  $U$  and the less efficient firm  $V$ , such that  $U$  was constrained in its pricing. We now sketch the case that the cost difference  $c$  is so large that  $U$  can behave as an unconstrained upstream monopolist.

Consider first complete vertical separation. With linear upstream prices, the well known double marginalization problem arises, so that the equilibrium downstream prices are above the level that maximizes industry profits, and approach the industry profit maximizing prices from above only as downstream competition tends to become perfect. For the industry, it is not desirable to further relax competition. Instead, it is desirable to reduce margins with, for example, resale price maintenance, passive forward integration, or observable two-part tariffs. With observable two-part tariffs,  $U$  can maximize the industry profits by choosing the marginal price in accordance to downstream competition and extracting all downstream profits through fixed fees. Hence the owners of  $U$  have no interest in backward ownership because the profits they can extract are already maximized.

The case with linear tariffs is less straightforward. As before, for given marginal input prices  $w_A$  and  $w_B$ , an increase in the passive backward ownership share  $\delta_A$  in the supplier reduces  $A$ 's effective input price, so that  $A$  has an incentive to lower its sales price. Yet a positive  $\delta_A$  also induces  $A$  to internalize its rivals' sales, so that  $A$  wants to increase its sales price. The first effect tends to dominate, so that downstream prices decrease in  $\delta_A$  for given (nominal) input prices. As  $U$  is unconstrained, it can adjust  $w_A$  and  $w_B$  in response to any ownership change until its marginal profits are zero again. Hence, both effects of an increase in  $\delta_A$  on downstream prices are internalized by the unconstrained upstream monopolist. This gives rise to invariant downstream prices in case of symmetric backward ownership.<sup>20</sup>

By contrast, with effective upstream competition in our model, only the first, marginal cost decreasing effect of an increase in  $\delta_A$  is counterbalanced by the efficient upstream firm  $U$ , and that perfectly. Hence the overall effect equals the second effect of internalizing the rivals' sales, and thus both downstream prices increase in  $\delta_A$ .

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<sup>19</sup>If  $V$  can also offer exclusive contracts, the analysis is more complicated. We simplify here to increase expositional clarity.

<sup>20</sup>For linear upstream tariffs and symmetric passive backward ownership in the monopoly supplier, Greenlee and Raskovich (2006) show that upstream and downstream price adjustments exactly compensate, so downstream prices stay the same independent of the magnitude of partial ownership and the intensity of downstream competition. In Hunold et al. (2012), we show that for linear demand, linear prices and upstream price discrimination, there is no incentive to acquire passive backward ownership in the monopoly supplier; moreover, consumer surplus increases with asymmetric backward ownership.

## 6.6 Comparing passive backward with passive horizontal integration

We have shown that passive backward integration of downstream firms, rather than inviting foreclosure, induces downstream horizontal coordination, leading to increasing downstream prices. One might be tempted to ask how this price change compares to that induced by direct passive horizontal integration. Let us compare the profits of the integrating downstream firm, say  $A$ , under the two forms of integration, with the same block share  $\delta_A > 0$ , and let  $\delta_B = 0$ . Under backward integration as heretofore, they are, at competitive upstream prices, given by

$$\Pi_A = (p_A - c) q_A + \delta_A c q_B, \quad (15)$$

whence under horizontal integration, they are given by

$$\Pi_A = (p_A - c) q_A + \delta_A (p_B - c) q_B. \quad (16)$$

By a first order argument,  $A$  internalizes the sales of  $B$  more under backward integration if  $c > p_B - c$ , i.e. if the upstream margin of product  $B$  is larger than its downstream margin. With linear demand and effective upstream competition, passive backward integration yields a higher price level than passive horizontal integration if  $c > g(\gamma)$ , where  $g$  is a decreasing function.<sup>21</sup> For a given upstream margin  $c$ , passive backward integration is more anti-competitive if downstream products are sufficiently close substitutes ( $g \rightarrow 0$  as  $\gamma \rightarrow 1$ ).

## 7 Conclusion

In this article, we consider vertically related markets with differentiated, price setting downstream firms, that produce with inputs from upstream firms supplying a homogeneous product at differing marginal costs. We analyze the impact on equilibrium prices of one or more downstream firms holding passive, that is non-controlling ownership shares in the efficient, and therefore common, supplier. In sharp contrast to earlier studies who focused either on Cournot competition or upstream monopoly, we find that if competition is sufficiently intense, *passive ownership leads to increased downstream prices and thus is strictly anti-competitive*. Also, *passive ownership is anti-competitive where a full vertical merger would be pro-competitive*.

Confronted with the choice between passive backward integration and a full vertical merger, the firms prefer the former. They voluntarily abstain from controlling the upstream firm, because this would do away with its power to commit to a high transfer price, that increases industry profit. *The very instrument typically employed to obtain control is used up to the point where control is not attained*. This brings an additional feature to the strategic delegation literature.

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<sup>21</sup>In fact,  $g(\gamma) = \frac{2-\gamma-\gamma^2}{6-\gamma-\gamma^2(2+\delta_A)}$ .

Our result is driven primarily by a realistic assumption on the upstream market structure, in which an efficient supplier faces less efficient competitors, allowing it to increase upstream prices only when the price increasing effect is absorbed by the downstream firm(s), via their claims on upstream cash flows. We show the result to be robust to changes in other assumptions such as linear upstream prices, and sequential price setting upstream and then downstream. Indeed, once allowing upstream firms to offer observable two-part tariffs, we find that the *equilibrium contracts are endogenously linear* if competition is sufficiently intense. Interestingly enough, under effective upstream competition, passive ownership in suppliers tends *not* to be anti-competitive under a non-discrimination clause.

For competition policy, it is important to recognize that anti-competitive passive ownership in common suppliers is profitable when there is both up- and downstream competition and thus foreclosure potentially *not* the main concern. Most importantly, proposing passive backward ownership in a supplier as a remedy to a proposed vertical merger tends *not* to benefit competition but eventually worsens the competitive outcome, as long as upstream competition is effective and the upstream supplier serves competitors of the raider. The reason is that full vertical integration tends to remove double marginalization via joint control, whilst partial backward integration tends to enhance that.

In the present setting, we abstract from other, potentially socially desirable motives for partial backward ownership. A particularly important effect is the mitigation of agency problems in case of firm-specific investments (Riordan, 1991; Dasgupta and Tao, 2000) such as investment in specific R&D. Indeed, Allen and Phillips (2000) show for a sample of US companies that vertical partial ownership is positively correlated with a high R&D intensity. Yet such potentially pro-competitive effects need to be weighed against the anti-competitive effects of passive backward integration presented here.

## Appendix: Proofs

*Proof of Proposition 1.* Suppose for the moment that only downstream firm  $i$  holds shares in  $U$ , i.e.  $\delta_i > \delta_{-i} = 0$ . The first order condition  $\frac{\partial \Pi_{-i}}{\partial p_{-i}} = 0$  implied by (11) and, hence, the best-reply  $p_{-i}^r(p_i)$  of  $-i$  is independent of  $\delta_i$ . In contrast, the marginal profit  $\frac{\partial \Pi_i}{\partial p_i}$  increases in  $i$ 's ownership share  $\delta_i$  for  $\delta_{-i} \in [0, 1)$ . This implies a higher best reply  $p_i^r(p_{-i}|\delta_i)$  for any given  $p_{-i}$ . By continuity,  $\frac{\partial p_i^r(p_{-i}|\delta_i)}{\partial \delta_i} > 0$ . Strategic complementarity of downstream prices implies that an increase in  $\delta_i$  increases both equilibrium prices. This argument straightforwardly extends to the case where both firms hold shares in  $U$  because then  $\frac{\partial^2 \Pi_i}{\partial p_i \partial \delta_{-i}} > 0$ .  $\square$

*Proof of Proposition 2.* Differentiating the combined profits of  $A$  and  $U$  with respect to  $\delta_A$  and using that  $\delta_B = 0$  yields

$$\frac{d\Pi_A^U}{d\delta_A} = \left( p_A^* \frac{\partial q_A}{\partial p_A} + q_A + c \frac{\partial q_B}{\partial p_A} \right) \frac{dp_A^*}{d\delta_A} + \left( p_A^* \frac{\partial q_A}{\partial p_B} + c \frac{\partial q_B}{\partial p_B} \right) \frac{dp_B^*}{d\delta_A}. \quad (17)$$

Clearly, at  $c = 0$ , the derivative is equal to zero as  $dp_i^*/d\delta_A = 0$  as the upstream margin is zero. To assess the derivative for small, but positive  $c$ , further differentiate with respect to  $c$  to obtain

$$\begin{aligned} \frac{d^2 \Pi_A^U}{d\delta_A dc} &= \frac{d}{dc} \left( p_A^* \frac{\partial q_A}{\partial p_A} + q_A + c \frac{\partial q_B}{\partial p_A} \right) \frac{dp_A^*}{d\delta_A} + \frac{d}{dc} \left( p_A^* \frac{\partial q_A}{\partial p_B} + c \frac{\partial q_B}{\partial p_B} \right) \frac{dp_B^*}{d\delta_A} \\ &+ \left( p_A^* \frac{\partial q_A}{\partial p_A} + q_A + c \frac{\partial q_B}{\partial p_A} \right) \frac{d^2 p_A^*}{d\delta_A dc} + \left( p_A^* \frac{\partial q_A}{\partial p_B} + c \frac{\partial q_B}{\partial p_B} \right) \frac{d^2 p_B^*}{d\delta_A dc}. \end{aligned}$$

Evaluating this derivative at  $c = 0$  yields

$$\frac{d^2 \Pi_A^U}{d\delta_A dc} \Big|_{c=0} = p_A^* \frac{\partial q_A}{\partial p_B} \frac{d^2 p_B^*}{d\delta_A dc} \Big|_{c=0},$$

because  $\frac{dp_A^*}{d\delta_A} \Big|_{c=0} = \frac{dp_B^*}{d\delta_A} \Big|_{c=0} = 0$  and  $p_A \frac{\partial q_A}{\partial p_A} + q_A = 0$  (this is the FOC of  $\pi_A$  with respect to  $p_A$  at  $c = 0$ ). Recall that  $\frac{dp_B^*}{d\delta_A} > 0$  for  $c > 0$  (Proposition 1) whereas  $\frac{dp_B^*}{d\delta_A} = 0$  at  $c = 0$ . By continuity, this implies  $\frac{d^2 p_B^*}{d\delta_A dc} \Big|_{c=0} > 0$ . It follows that  $\frac{d^2 \Pi_A^U}{d\delta_A dc} \Big|_{c=0} > 0$  which, by continuity, establishes the result.  $\square$

*Proof of Proposition 3.* The best response function of  $A$  under complete separation is characterized by

$$\frac{\partial \Pi_A}{\partial p_A} = (p_A - c) \frac{\partial q_A}{\partial p_A} + q_A = 0. \quad (18)$$

prices of  $c$ . When maximizing the integrated profit  $p_A q_A + w_B q_B$ , it is – as argued before – still optimal to serve  $B$  at  $w_B \leq c$  and, hence, the corresponding downstream price reaction is characterized by

$$p_A \frac{\partial q_A}{\partial p_A} + q_A + w_B \frac{\partial q_B}{\partial p_A} = 0. \quad (19)$$

Subtract the left hand side (lhs) of (18) from the lhs of (19) to obtain  $\Delta \equiv c \frac{\partial q_A}{\partial p_A} + w_B \frac{\partial q_B}{\partial p_A}$ . The symmetric fixed point under separation ( $\delta_A = \delta_B = 0$  and no shift in price control) has  $p_A = p_B$ . This implies  $\frac{\partial q_B}{\partial p_A} = \frac{\partial q_A}{\partial p_B}$ . Hence, at equal prices,  $\Delta$  is negative as  $-\frac{\partial q_A}{\partial p_A} > \frac{\partial q_A}{\partial p_B} > 0$  by Assumption 1 and  $w_B \leq c$ . A negative  $\Delta$  implies that the marginal profit of  $A$  under integration is lower and thus the integrated  $A$  wants to set a lower  $p_A$ . The best-reply function of  $B$  is characterized by

$$\frac{\partial \Pi_B}{\partial p_B} = (p_B - y) \frac{\partial q_B}{\partial p_B} + q_B(p_B, p_A) = 0 \quad (20)$$

with  $y = c$  under separation and  $y = w_B \leq c$  under integration of  $A$  and  $U$ . Hence the best reply function  $p_B^r(p_A)$  of  $B$  is (weakly) lower under integration. Taken together, strategic complementarity and stability (Assumptions 3 and 4) implies that the unique fixed point of the downstream prices under integration must lie strictly below that under separation.  $\square$

*Proof of Lemma 2.* We look at the joint profit  $\Pi_A^U$  of  $A$  and  $U$  when we move from vertical separation to vertical integration. Recall that under effective competition, the upstream firm, integrated or not, will always set the maximal input price  $w_B^* = c$  when selling to firm  $B$ , and this independently of any choice of  $w_A$ . Also recall that  $\Pi_A^U = p_A^* q_A(p_A^*, p_B^*) + c q_B(p_B^*, p_A^*)$ . Let the equilibrium downstream prices as a function of input prices be given by  $p_A^*(w_A, c) \equiv \arg \max_{p_A} p_A q_A(p_A, p_B^*) + c q_B - w_A [q_A + q_B]$  and  $p_B^*(c, w_A) \equiv \arg \max_{p_B} (p_B - c) q_B(p_B, p_A^*)$ . Note that  $w_A = 0$  yields the downstream prices under integration, and  $w_A = c$  those under separation.

The effect of an increase of  $w_A$  on  $\Pi_A^U$  is determined by implicit differentiation. This yields

$$\frac{d\Pi_A^{U*}}{dw_A} = \frac{d\Pi_A^{U*}}{dp_A^*} \frac{dp_A^*}{dw_A} + \frac{d\Pi_A^{U*}}{dp_B^*} \frac{dp_B^*}{dw_A}.$$

First, Assumptions 1-4 imply that at  $w_A = c$  and hence  $p_A^* = p_B^*$ , we have both  $\frac{dp_A^*}{dw_A} > 0$  and  $\frac{dp_B^*}{dw_A} > 0$  for  $c \geq 0$ . Second,

$$\frac{d\Pi_A^{U*}}{dp_A^*} = \underbrace{q_A(p_A^*, p_B^*) + (p_A^* - c) \frac{\partial q_A}{\partial p_A}}_{=0} + c \underbrace{\left[ \frac{\partial q_A}{\partial p_A} + \frac{\partial q_B}{\partial p_A} \right]}_{<0 \text{ at } p_A=p_B} < 0,$$

but approaches 0 as  $c$  goes to zero. Third,  $\frac{d\Pi_A^{U*}}{dp_B^*} = p_A^* \frac{\partial q_A}{\partial p_B} + c \frac{\partial q_B}{\partial p_B}$  is strictly positive for  $c$  sufficiently close to zero. In consequence,  $\left[ \frac{d\Pi_A^{U*}}{dp_B^*} \frac{dp_B^*}{dw_A} \right]_{w_A=c} > 0$  dominates  $\left[ \frac{d\Pi_A^{U*}}{dp_A^*} \frac{dp_A^*}{dw_A} \right]_{w_A=c} < 0$  as  $c$  goes to zero. Summarizing,  $\frac{d\Pi_A^{U*}}{dw_A} \Big|_{w_A=c} > 0$  for  $c$  sufficiently small. By continuity, decreasing  $w_A$  from  $c$  to 0 decreases  $\Pi_A^{U*}$  for  $c$  sufficiently small which implies that moving from separation to integration is strictly unprofitable.  $\square$

*Proof of Lemma 4.* Suppose that firm  $-i$  sources only from  $U$ . The most attractive contract that  $V$  can offer  $i$  must yield  $V$  zero profits, i.e.  $F_i^V = x_i^V \cdot (c - w_i^V)$ , with  $x_i^V$  denoting the quantity  $i$  sources from  $V$ . Given  $w_i^U \leq c$ , the arbitrage possibility due to multiple sourcing renders contracts with  $w_i^V > c$  and thus  $F_i^V < 0$  unprofitable as  $x_i^V$  would be 0. Recall that  $p_i^*(w_i, w_{-i})$  denotes the downstream equilibrium price of  $i$  as a function of the marginal input prices. The net profit of  $i$  when buying all inputs from  $V$  is given by

$$\Pi_i = (p_i^*(w_i^V, w_{-i}^U) - w_i^V) q_i(p_i^*(w_i^V, w_{-i}^U), p_{-i}^*(w_{-i}^U, w_i^V)) - F_i^V.$$

Substituting for  $F_i^V$  using the zero profit condition of  $V$  with  $x_i^V = q_i$  yields

$$\Pi_i = (p_i^*(w_i^V, w_{-i}^U) - c) q_i(p_i^*(w_i^V, w_{-i}^U), p_{-i}^*(w_{-i}^U, w_i^V)).$$

Increasing  $w_i^V$  at  $w_i^V = c$  is profitable if  $d\Pi_i/dw_i^V|_{w_i^V=c} > 0$ . Differentiation yields

$$d\Pi_i/dw_i^V = \frac{d\Pi_i}{dp_i^*} \frac{dp_i^*}{dw_i^V} + \frac{d\Pi_i}{dp_{-i}^*} \frac{dp_{-i}^*}{dw_i^V}.$$

Optimality of the downstream prices implies  $\frac{d\Pi_i}{dp_i^*} = 0$ . Moreover,  $\frac{dp_{-i}^*}{dw_i^V} > 0$  follows from the strategic complementarity of downstream prices, and with it, the supermodularity of the downstream pricing subgame. Finally,  $\frac{d\pi_i}{dp_{-i}^*} > 0$  follows directly from  $\frac{\partial q_i}{\partial p_{-i}} > 0$  (substitutable products). Combining these statements yields

$$\frac{d\Pi_i}{dw_i^V}|_{w_i^V=c} = \frac{d\Pi_i}{dp_{-i}^*} \frac{dp_{-i}^*}{dw_i^V} > 0.$$

This implies that raising  $w_i^V$  above  $c$  would be profitable for  $i$ . However, the no arbitrage condition and  $w_i^U \leq c$  renders this impossible. Analogously, decreasing  $w_i^V$  below  $c$  and adjusting  $F_i^V$  to satisfy zero profits of  $V$  is not profitable for  $i$ . In consequence, the contract offer of  $V$  most attractive to any downstream firm  $i$  is given by  $\{0, c\}$ .  $\square$

*Proof of Proposition 4.* Recall that for marginal input prices of  $w_i$  and  $w_{-i}$ ,  $i$ 's equilibrium downstream price is given by  $p_i^*(w_i, w_{-i})$ . Also recall that

$$\pi_i^*(w_i, w_{-i}) \equiv [p_i^*(w_i, w_{-i}) - w_i] q_i(p_i^*(w_i, w_{-i}), p_{-i}^*(w_{-i}, w_i))$$

and substitute for  $\pi_i^*(c, w_{-i})$  in (14) to obtain

$$\begin{aligned} \pi^U &= \sum_i p_i^*(w_i, w_{-i}) q_i(p_i^*(w_i, w_{-i}), p_{-i}^*(w_{-i}, w_i)) \\ &\quad - \sum_i (p_i^*(c, w_{-i}) - c) q_i(p_i^*(c, w_{-i}), p_{-i}^*(w_{-i}, c)). \end{aligned}$$

The first sum captures the industry profits and the second, as  $\{0, c\}$  is  $V$ 's tariff that maximizes the downstream firms' profits (Lemma 4), the value of each of the downstream firms'

outside option. An obvious candidate equilibrium tariff of  $U$  is  $\{F^* = c, w^* = 0\}$  to both downstream firms. This results in  $\pi^U = 2c q_i(p^*(c, c), p^*(c, c))$ . Let  $\{F^*, w^*\}$  denote alternative symmetric equilibrium candidates offered by  $U$ . Recall that  $w^* > c$  with  $F^* < 0$  is not feasible, as then the downstream firms would source all quantities from  $V$ . Towards assessing whether  $U$  would benefit from lowering  $w$  below  $c$  (and increasing  $F$ ), we differentiate  $\pi^U$  with respect to  $w$  at and evaluate it at  $w = c$ . If that sign is positive for  $w_i, i \in \{A, B\}$  separately and jointly, then  $U$  has no incentive to decrease its price below  $c$ . Differentiation of  $\pi^U$  with respect to  $w_i$  yields

$$\begin{aligned} \frac{d\pi^U}{dw_i} = & \frac{\partial p_i^*}{\partial w_i} q_i + p_i^* \left( \frac{\partial q_i}{\partial p_i} \frac{\partial p_i^*}{\partial w_i} + \frac{\partial q_i}{\partial p_{-i}} \frac{\partial p_{-i}^*}{\partial w_i} \right) + \frac{\partial p_{-i}^*}{\partial w_i} q_{-i} + p_{-i}^* \left( \frac{\partial q_{-i}}{\partial p_i} \frac{\partial p_i^*}{\partial w_i} + \frac{\partial q_{-i}}{\partial p_{-i}} \frac{\partial p_{-i}^*}{\partial w_i} \right) \\ & - \frac{\partial p_{-i}^*}{\partial w_i} q_{-i} - (p_{-i}^* - c) \left( \frac{\partial q_{-i}}{\partial p_{-i}} \frac{\partial p_{-i}^*}{\partial w_i} + \frac{\partial q_{-i}}{\partial p_i} \frac{\partial p_i^*}{\partial w_i} \right). \end{aligned} \quad (21)$$

Evaluating the derivative at  $w_i = w_{-i} = c$ , subtracting and adding  $c \frac{\partial q_i}{\partial p_i} \left( \frac{\partial p_i^*}{\partial w_i} + \frac{\partial p_{-i}^*}{\partial w_i} \right)$ , making use of downstream firm  $i$ 's FOC  $\frac{\partial \pi_i}{\partial p_i} = (p_i^* - c) \frac{\partial q_i}{\partial p_i} + q_i = 0$  and simplifying, we obtain

$$\frac{d\pi^U}{dw_i} = c \left( \frac{\partial q_i}{\partial p_i} \frac{\partial p_i^*}{\partial w_i} + \frac{\partial q_{-i}}{\partial p_{-i}} \frac{\partial p_{-i}^*}{\partial w_i} + \frac{\partial q_{-i}}{\partial p_i} \frac{\partial p_i^*}{\partial w_i} + \frac{\partial q_i}{\partial p_{-i}} \frac{\partial p_{-i}^*}{\partial w_i} \right) + (p_i^* - c) \frac{\partial q_i}{\partial p_{-i}} \frac{\partial p_{-i}^*}{\partial w_i}. \quad (22)$$

Substituting for  $p_i^* - c = -q_i / \frac{\partial q_i}{\partial p_i}$  from the FOC  $\frac{\partial \pi_i}{\partial p_i} = 0$  yields that  $\frac{d\pi^U}{dw_i} > 0$  iff

$$c < \frac{q_i}{-\left(\frac{\partial q_i}{\partial p_i} + \frac{\partial q_i}{\partial p_{-i}}\right)} \cdot \frac{\frac{\partial q_i}{\partial p_{-i}}}{-\frac{\partial q_i}{\partial p_i}} \cdot \frac{\frac{\partial p_i^*}{\partial w_{-i}}}{\frac{\partial p_i^*}{\partial w_i} + \frac{\partial p_{-i}^*}{\partial w_{-i}}}. \quad (23)$$

The rhs of (23) remains positive as  $c$  goes to zero. Hence (23) holds for  $c$  sufficiently small. This establishes the result.  $\square$

*Proof of Lemma 5.* With passive backward ownership  $\delta_A > \delta_B = 0$ , the important distinction is that when  $B$  buys from  $V$ ,  $A$  does not internalize the sales of  $B$ . Again, given that  $V$  charges  $\{0, c\}$ ,  $U$  sets the downstream firms indifferent with fees of

$$\begin{aligned} F_A &= \Pi_{A(U)}(w_A, w_B) - \Pi_{A(V)}(c, w_B), \\ F_B &= \Pi_{B(U)}(w_B, w_A) - \Pi_{B(V)}(c, w_A), \end{aligned}$$

where  $\Pi_{i(j)}^\delta, \Pi_{i(j)}$  are the reduced form total downstream profits of  $i$  when sourcing from  $j$  as a function of nominal marginal input prices. Substituting the fees in the profit function of  $U$



yields

$$\pi^U = \sum_{i \in \{A, B\}} \left[ p_i^* q_i (p_i^*, p_{-i}^*) \right] - \Pi_{A(V)}(c, w_B) - \Pi_{B(V)}(c, w_A). \quad (24)$$

As before, the profit consists of the industry profit  $\pi^I \equiv \sum_i p_i^* q_i$  less the off-equilibrium outside options. The optimal marginal input prices are characterized by

$$\begin{aligned} \partial \pi^U / \partial w_A &= \partial \pi^I / \partial w_A - \partial \Pi_B(c, w_A) / \partial w_A, \\ \partial \pi^U / \partial w_B &= \partial \pi^I / \partial w_B - \partial \Pi_A(c, w_B) / \partial w_B. \end{aligned}$$

For  $w_B = c$  and  $w_A = c/(1 - \delta_A)$ , the derivatives converge to (22), used in the Proof of Proposition 4, when  $\delta_A \rightarrow 0$ . Thus the derivatives are still positive when  $\delta_A$  increases marginally at 0. By continuity, the corner solutions are sustained for small backward integration shares and  $c$  sufficiently small. Moreover,  $F_A = \Pi_{A(U)}(c/(1 - \delta_A), c) - \Pi_{A(V)}(c, c) = 0$  and  $F_B = \Pi_{B(U)}(c, c/(1 - \delta_A)) - \Pi_{B(V)}(c, c/(1 - \delta_A)) > 0$  as  $A$  prices more aggressively when  $B$  sources from  $V$ , because then  $A$  does internalize sales via the profit part  $\delta_A w_B q_B$ . This logic extends to the case that also  $\delta_B$  increases at 0.  $\square$

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