

Foros, Øystein; Kind, Hans Jarle

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Upstream Partnerships among Competitors when Size Matters

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Øystein Foros, Hans Jarle Kind

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Poschingerstr. 5, 81679 Munich, Germany

Telephone +49 (0)89 2180-2740, Telefax +49 (0)89 2180-17845, email office@cesifo.de

Editors: Clemens Fuest, Oliver Falck, Jasmin Gröschl

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Upstream Partnerships among Competitors when Size Matters

Abstract

In several industries downstream competitors form upstream partnerships. An important rationale is that higher aggregate upstream volume might generate efficiencies that reduce both fixed and marginal costs. Our focus is on the latter. We show that if upstream marginal costs are decreasing in sales volume, then a partnership between downstream rivals will make them less aggressive. However, a partnership might nonetheless induce both partners and non-partners to charge lower prices. We also show that it might be better for two firms to form a partnership and compete downstream than to merge. Somewhat paradoxically, this is true if they compete fiercely in the downstream market with a third firm. The reason is that a merger is de facto a commitment to set higher prices. Under aggressive competition from the third firm, the members will not want to make such a commitment when upstream marginal costs are decreasing in output.

JEL-Codes: D010.

Keywords: upstream partnership, imperfect competition, endogenous marginal costs.

Øystein Foros
NHH Norwegian School of Economics
Bergen / Norway
oystein.foros@nhh.no

Hans Jarle Kind
NHH Norwegian School of Economics
Bergen / Norway
hans.kind@nhh.no

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1 Introduction

In several markets, we observe that competing firms seek upstream partnerships with downstream rivals. In software, electronic hardware, and pharmaceutical markets, rivals form upstream R&D joint ventures. Within telecommunications, competing operators create partnerships to generate new infrastructure. Competing newspapers and magazines cooperate on advertising and dissemination functions.² In grocery markets, retail rivals form upstream partnerships that take care of production, procurement and distribution of goods to their competing retail outlets.³ This makes the level of concentration higher at the upstream level than at the downstream level (retailing).

An important rationale for forming upstream partnerships with rivals arises when higher aggregate sales volume generates efficiencies that reduce fixed and/or marginal costs. Our focus is on the latter. Sources that make upstream marginal costs decreasing in output may be related to increased countervailing buyer power towards wholesalers and manufacturers. In the US multichannel TV market, for instance, per customer wholesale prices for a large firm like Comcast are 25% lower than those faced by smaller firms. This feature stimulates formation of upstream partnerships among smaller rivals (and provides incentives for downstream mergers as well).⁴ In other cases volume efficiencies have no bearing on wholesale charges, but are rather directly related to economies of scale in storage and transportation, and in production (when downstream firms are backward integrated), as well as to better utilization of logistic systems.⁵ An econometric analysis of the UK grocery market,

²In particular, in the US competing newspapers cooperate on advertising and circulation functions (Gentzkow, Shapiro and Sinkinson, 2014).

³See e.g. Clarke et al. (2002), Dobson and Waterson (1999), Foros and Kind (2008) and Doyle and Han (2013).

⁴The empirical works of Crawford and Yurukogly (2012) and Doudchenko and Yurukogly (2016) find evidence of decreasing marginal costs in the multichannel TV market and support for the hypothesis that size effects originate from economies of scale in seeking alternative supply (e.g. from backward integration). See also Katz (1987) for a theoretical analysis.

⁵One simple potential explanation relates to basic physical science and Galileo Galilei's "square-cube law". In the book *Dialogues Concerning Two New Sciences* from 1638 Galileo Galilei showed

in which the Competition Commission (2008) found a significant negative relationship between size in procurement/distribution and upstream unit costs.⁶ Another example is collection of user data – "big data" – where the capture of more users generates information input that improves quality and/or reduces costs.⁷ Size matters, so upstream partnerships among rivals are efficiency enhancing.

The aim of this paper is to analyze how economies of scale at the upstream level affect competition, the incentives to form upstream partnerships, both industry-wide and at a smaller level, and the profitability of a merger between upstream partners. The source of the scale effect (e.g. higher bargaining power or pure efficiency gains) is not decisive, so we will not go further into that discussion.

We set up a model where three firms compete in the downstream market. First, we show that each firm faces an opportunity cost of increasing the retail price: the higher the price a firm charges, the lower its sales volume, and the greater its marginal (upstream) costs. This implies that the firms have incentives to set lower prices than if marginal costs were independent of sales volume. It further implies that a firm which sells more than its rivals gains a competitive advantage, other things equal. Competition will consequently become relatively aggressive.

An upstream partnership reduces the size of this opportunity cost; if one firm sets a higher price and loses sales, part of the sales reduction is recaptured by its upstream partner. This positive volume effect for the upstream partner partly offsets the negative effect on upstream marginal costs of increasing the price and lowering the opportunity cost. Price competition is therefore less aggressive if there is an upstream partnership than if each firm operates its own upstream unit. However, this does not mean that the partnership firms will charge a higher price than in

that if the area of an object increases by a square, then the volume increases by a cube. See e.g. Besanko et al. (2009) for a discussion of distribution system applications.

⁶The details from this analysis are given in Competition Commission (2008, Appendix 5.3).

⁷Peter Norvig (Google's director of research) emphasizes the following: "We don't have better algorithms. We just have more data." (McAfee and Brynjolfsson, 2012). McKinsey (2011), in a survey on "big data", provides an example where a manufacturer may use data from sensors in products to provide proactive maintenance (before failure occurs or is noticed). Experience from one user is used to prevent other users from incurring maintenance costs.

the benchmark; on the contrary, due to economies of scale, they will charge lower prices. Note that the way that market size matters in the present model is analogous to how competition may become fierce between networks that are (at least partly) incompatible such that relative size matters (Katz and Shapiro, 1985, Farrell and Saloner, 1992, are early contributions).

If two firms have established an upstream partnership, they make higher profits compared to a benchmark without a partnership. Thus, they will have no incentives to unilaterally deviate (i.e. to break out from the upstream partnership and force the industry back to the benchmark). Taking this into account, we focus on the following:

- 1) If two firms have formed an upstream partnership, will they have incentives to behave as a merged company in the downstream market?
- 2) If two firms have formed an upstream partnership, will they have incentives to invite the outside firm into an industry-wide upstream partnership?
- 3) It is well known from the merger literature that in the absence of merger-specific efficiency gains, non-merging firms may benefit more from a merger than the merging firms (Deneckere and Davidson, 1985). This might create a hold-up problem, which could hinder a profit-enhancing merger from taking place. So, we ask, does there exist a similar hold-up problem in the formation of upstream partnerships?

The answer to the first question is that two partnership firms might be better off if they compete downstream than if they merge. Somewhat paradoxically, this is true if downstream competition is sufficiently fierce. The reason is that a merger *de facto* is a commitment to internalize the competitive effects the partners impose on each other. This induces them to increase their prices; thus they will sell less, and marginal upstream costs will increase. The rival, on the other hand, will sell more, achieve lower marginal costs and become more competitive. Under fierce price competition with the non-member, the partners do not want to make such a commitment.

To provide an answer to the second question, it should first be noted that upstream marginal costs are minimized if all firms are upstream partners. However, we

also show that if we have an industry-wide upstream partnership, and downstream competition is fierce, then two of the firms will profitably break out and set up their own upstream partnership in order to gain a competitive advantage over the third firm. This will be understood by rational market participants, and might prevent an industry-wide partnership from being formed in the first place.

To the third question, of whether there exists a hold-up problem that may prevent formation of an upstream partnership, the short answer is that it depends on the degree of competition and how important the size effect is. In absence of the size effect, there will be a similar hold-up problem as in the merger literature (see Deneckere and Davidson, 1985, and subsequent papers). In the presence of a size effect, a hold-up problem still exists as long as the degree of downstream competition is low. In contrast, there is no hold-up problem if downstream competition is sufficiently fierce.

The rest of the paper is organized as follows: Section 2 surveys related literature, and Section 3 provides a brief overview of upstream partnerships in the grocery industry. In Section 4 we present the basic model. In Section 5 we use a more specified model of demand; a spatial circular city model with three firms (Vickrey, 1964; Salop, 1979). In Section 6 we analyze the formation of the upstream partnerships. Section 7 concludes, and in the appendix we analyze an alternative demand specification (a representative consumer model).

2 Related literature

Cachon and Harker (2002) consider a model with two firms, where each firm's marginal costs are decreasing in own sales. Therefore each firm has incentives to capture a large share of the market, and this tends to create fierce price competition. Cachon and Harker show that in order to soften competition, the firms choose to outsource the production process to an external supplier.⁸ A similar effect is also present

⁸Arya, Mittendorf, and Sappington (2008) consider a framework consisting of a vertically integrated firm (with its own upstream unit) and a downstream rival. They show that the integrated firm may choose to buy the upstream input from the same supplier as the downstream rival rather

in our framework, since formation of an upstream partnership softens competition. Additionally, however, the partnership has an efficiency rationale, due to the fact that it reduces marginal costs for the members. As a further contrast to Cachon and Harker, we analyze the interplay between members and non-members by allowing for three firms.

Upstream size matters also in Katz (1987); a larger firm may achieve lower unit costs because it has an advantage compared to smaller rivals with respect to backward integration (or, more generally, economies of scale in seeking alternative supplies). Cost functions where upstream size matters for downstream competition are likewise crucial in the literature on endogenous upstream joint ventures. Bloch (1995) and Yi (1998) abstract from any link between sales volume and marginal costs, but simply assume a discrete reduction in marginal costs if one more firm joins an upstream partnership. Bloch shows that, in absence of side-payments, an asymmetric market structure may arise, where not all downstream firms join the upstream partnership. Unlike us, neither Bloch (1995) nor Yi (1998) investigate incentives for downstream cooperation.⁹

There is also a large more general literature where input joint ventures may be used to soften competition among members (see e.g. Priest, 1977 and Chen and Ross, 2003). Chen and Ross (2003) focus on the profitability of a joint venture compared to a full-scale merger. Competition authorities have been concerned that upstream partners may be in a position to use anti-competitive devices as a tool to hand over the degree of concentration at the upstream level to the downstream level, for instance through transfer pricing (see e.g. Foros and Kind, 2008, Doyle and Han, 2013, and Piccolo and Miklós-Thal, 2012, for applications to the grocery market). However, in sharp contrast to this literature we show that the firms may shy away from using such devices.

than producing it themselves at a lower cost. By choosing this strategy, the integrated firm discourages the external supplier from offering the input on favorable terms to the downstream rival.

⁹The literature on endogenous upstream joint ventures is closely related to the literature on endogenous mergers. Kamien and Zang (1990) assume that all firms simultaneously post bids for all other firms, while Chatterjee et al. (1993) is an early contribution to the literature on merger formation analyzed as a non-cooperatively extensive game.

Within the literature on so-called waterbed effects, as in the present paper, size matters. In Inderst and Valletti (2011) the interplay with independent suppliers implies that when a large retailer achieves a lower unit wholesale price, smaller rivals are charged correspondingly higher prices; i.e. a "waterbed effect". Since we do not analyze the interplay with suppliers in our model, a reduction in the marginal costs of the partners has no direct effect on the non-participating rival's marginal costs. The mechanism in the present paper is that if two firms establish an upstream partnership they achieve scale effects which imply that their marginal costs are reduced, so they optimally lower their retail prices. They thereby steal business from the non-participating rival, whose marginal costs consequently increase.¹⁰ Note that in this respect the present paper is related to the literature on raising rivals' costs (e.g. Salop and Scheffman, 1983).

The predictions from our model are relevant for several markets, but our main inspiration has been the grocery markets. For this reason the majority of the results are found by using a circular city model (Vickrey, 1964; Salop, 1979), which is an extension of Hotelling (1929) to more than two firms. The implied spatial competition seems reasonable for the grocery market (see, e.g., Kuksov and Pazgal, 2007). The arena of competition in retail grocery markets seems to be retail chains competing to sell a basket of goods to consumers, and the spatial demand function is derived from an explicit model of underlying individual consumer behavior. The disadvantage of spatial competition within this framework is the conventional assumptions of market coverage; the total size of the market is given. The most common alternative for demand specification is one with a representative consumer and quadratic utility, and we therefore check the robustness of our results within such a framework.

¹⁰Other papers on countervailing buyer power include Matthewson and Winter (1997), Chen (2003), Snyder (2006), Gans and King (2002), Dobson and Waterson (1997), Inderst and Wey (2007) and Dana (2012).

3 Application to the grocery market

In the grocery market, we have observed closer coordination and backward integration into distribution and production in several countries. Products are distributed in a continuous process through the value chain by using advanced logistical systems and optical scanning. Technological advances lead to lower upstream unit costs, and size matters. The greater the sales volume, the more profitable digitalization and automatization will be. Moreover, as argued above, there may exist economies of scale due to buyer power and/or better alternative supplies.

For the US grocery market, Ellickson (2007) accentuates three major innovations: the formation of chain stores, the supermarket format, and digitalized distribution systems. All these innovations resulted in lower unit costs, but required significant fixed cost investment. Large retailers therefore had an advantage compared to smaller ones. The Great Atlantic and Pacific Tea Company (A&P) led the development in the US. They integrated backward into wholesaling and production. The response from independent retailers was to form upstream wholesale partnerships¹¹, resulting in more equal prices between the chain format stores and the independent stores in the late 1930s. Then came the introduction of the supermarket format, which again shifted the balance in favor of the large chains (Ellickson, 2007). Today the grocery market is highly concentrated in most countries. Walmart's success has partly been explained by size advantage in what we label upstream activities; logistics, distribution, procurement and backward integration into production (Basker, 2007, Ellickson, 2016).¹² For such upstream activities (also labeled chain activities), a ten percent increase in volume reduces marginal costs by two percent (Basker, 2007).

The inspiration behind the present paper is found in the Norwegian grocery market; a market that used to be dominated by five retail chains, NorgesGruppen -

¹¹IGA, G&S, AWG and Wakefern, among others (Ellickson, 2016).

¹²As discussed above, Katz (1987) shows that access to alternative supply (through own backward integration or direct sourcing) may reduce marginal costs for large players. Basker (2007) emphasizes Walmart's advantage over smaller players when it comes to direct sourcing from global manufacturers. Such direct sourcing requires large fixed costs; large volumes are thus needed.

NG - (market share 39%), REMA (23%), COOP (23%), ICA (11%), and BUNNPRIS (4%).¹³ The largest chain, NG, started out as a pure upstream partnership among independent retailers as a response to the growth of competing retail chains; a parallel to how US independent retailers formed upstream partnerships in order to compete with A&P. The market players seem to agree that each chain's upstream costs depend on its sales volume in the retail market and that these costs have impact on the firms' ability to compete in the downstream market. This means that size matters for upstream marginal costs.

In Figure 1, we present estimates of the costs of the four largest chains in 2013.¹⁴ ICA, the smallest player with its own procurement and distribution system, had been struggling with a cost-disadvantage in these activities for a decade. Apparently, it was trapped in a negative lower-market-share-higher cost-lower-market-share loop.¹⁵ The figure shows that REMA had a margin of EUR 5.50 for a typical EUR 100 basket of goods. The rivals charged higher prices for the same basket, but nonetheless had lower margins. ICA was the most expensive retailer, and had a negative margin; it had significantly higher costs on procurement and logistics than its larger rivals and struggled to follow its rivals on price. This indicates that ICA had higher marginal costs. In contrast, if the size disadvantage only affects fixed costs, we should expect that ICA could follow its larger rivals on price (but not on profitability).¹⁶

¹³Source market shares: AC Nielsen, 2014.

¹⁴The cost estimates are made by the CEO of REMA (Ole Robert Reitan, 2014). Note that the estimates do not make a distinction between fixed and marginal costs.

¹⁵BUNNPRIS (4% market share) performed better than ICA (with a market share of 11%); this is presumably due to an upstream partnership with REMA.

¹⁶The largest newspaper in Norway (VG) has a price comparison portal for the retail grocery market, and ICA (RIMI) has higher prices than REMA and NG (KIWI). Henrik Andersen, as part of his master thesis at NHH, collected information from VG's price comparison portal from January 2009 to May 2014. In total, there were 12 observations. When focusing on the three low-price brands (REMA, KIWI (NG), RIMI (ICA)), RIMI had the highest prices for a basket of goods in 10 out of 12 observations. REMA had the lowest prices in 10 out of 12, while KIWI had the lowest prices in two out of 12. This supports the conjecture that ICA has a cost disadvantage also with respect to marginal costs.

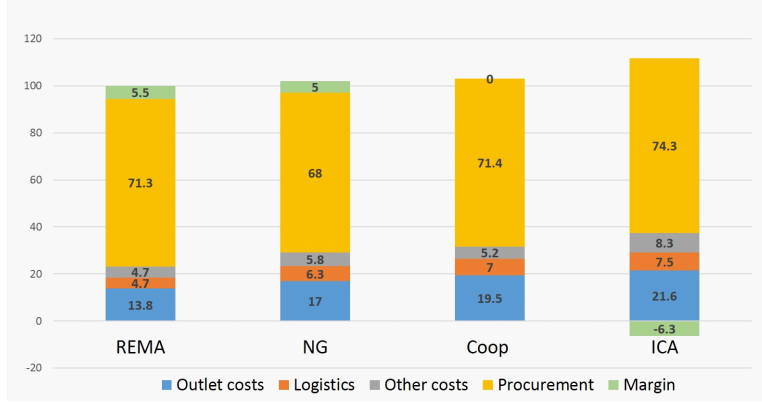


Figure 1: *Retail chain margins*

In January 2013, ICA announced an upstream partnership with NG (the largest player). The rival retail chains disliked the ICA-NG upstream partnership, and placed a lot of effort into convincing the Competition Authority to impose a ban.¹⁷ They maintained that if the partnership were allowed, it would significantly increase market concentration. The argument was that the partnership would increase the non-partners' unit upstream costs relative to those of ICA-NG and make them less competitive downstream.

In February 2014, one year after the partnership was announced, it was temporarily stopped by the Competition Authority while they were working on a final decision. In October 2014, still no final decision had been reached. Then the game changed: ICA's proposed deal with NG was cancelled. Instead, it merged with COOP. Interestingly, and consistent with what we find in this paper, the merger did not provoke the same objections from other firms in the industry as the proposed upstream partnership.

4 The basic model

We consider a context with three downstream firms, $i = 1, 2, 3$. Firm i 's demand is $D_i(\mathbf{p})$, where $\mathbf{p} = (p_1, p_2, p_3)$ is the vector of prices. We assume that the de-

¹⁷In fact, REMA and COOP reached a Dr. Strangelove agreement; if the competition authority had allowed the ICA-NG agreement, then a similar agreement would have detonated between COOP and REMA.

mand function D_i and the corresponding profit function, π_i , satisfy the following properties:

$$\frac{\partial D_i}{\partial p_i} < 0, \quad \frac{\partial D_i}{\partial p_j} > 0, \quad \frac{\partial D_j}{\partial p_i} < -\frac{\partial D_i}{\partial p_i} \quad \text{and} \quad \frac{\partial^2 \pi_i}{\partial p_i \partial p_j} \geq 0 \quad i, j = 1, 2, 3, i \neq j, \quad (1)$$

Condition (1) implies that the products are imperfect substitutes and that prices are strategic complements, as defined in Bulow et al. (1985). Throughout, we presuppose that all stability and second-order conditions hold (see e.g. Vives 1999, ch. 6).

The purpose of this paper is to analyze the consequences of upstream marginal costs being decreasing in output. Letting X_i denote the relevant upstream volume for firm i , we set upstream unit costs for firm i equal to $C(X_i) = c - \sigma X_i$, where $\sigma > 0$ ensures that $C'(X_i) = -\sigma < 0$. We assume that $c(X_i) \geq 0$ for all relevant values of X_i .

Normalizing downstream costs to zero, we can write the profit function of firm i as

$$\pi_i = [p_i - C(X_i)] D_i(\mathbf{p}). \quad (2)$$

In the following, we compare four regimes:

- *B*: In the benchmark, all three downstream firms operate their own upstream units. In this case the upstream volume (with superscript *B* for benchmark) is simply equal to own sales:

$$X_i^B = D_i^B(\mathbf{p}).$$

- *P*: Two of the firms are in an upstream partnership, while all three firms compete in the downstream market. We denote the members of the upstream partnership by m and m' , and the non-member by n , so upstream volumes equal

$$X_m^P = X_{m'}^P = D_m^P(\mathbf{p}) + D_{m'}^P(\mathbf{p}) \quad \text{and} \quad X_n^P = D_n^P(\mathbf{p}).$$

In this regime we assume, without loss of generality, that firms 1 and 2 are partners, while firm 3 is the non-partner.

- *M*: This regime is similar to *P* with one exception; the upstream partners now also cooperate in the downstream market (i.e., they behave as a merged company). Then,

$$X_m^M = X_{m'}^M = D_m^M(\mathbf{p}) + D_{m'}^M(\mathbf{p}) \text{ and } X_n^M = D_n^M(\mathbf{p}).$$

- *IP*: The firms have formed an industry-wide upstream partnership, but they compete in the downstream market. Hence, $X_i^{IP} = D_1^{IP}(\mathbf{p}) + D_2^{IP}(\mathbf{p}) + D_3^{IP}(\mathbf{p})$.

Note that we do not consider the trivial case where all three firms merge.

From equation (2) we find that the first-order condition for firm *i*'s downstream price equals:

$$\frac{\partial \pi_i}{\partial p_i} = \left[D_i + (p_i - C(X_i)) \frac{\partial D_i}{\partial p_i} \right] - D_i \Omega_i = 0, \quad (3)$$

where

$$\Omega_i = \underbrace{C'(X_i)}_{\div} \left(\underbrace{\partial X_i / \partial p_i}_{\div} \right) > 0.$$

The square bracket in (3) captures the conventional effect that a higher price increases the profit margin and reduces sales, while the term outside the bracket captures the fact that since a higher price reduces sales ($\partial X_i / \partial p_i < 0$), it also increases marginal costs ($C'(X_i) < 0$). This generates an opportunity cost equal to Ω_i per unit of output for firm *i*, making it optimal to set a lower price than what would otherwise be the case.

It is now interesting to compare the size of the opportunity costs under regime *B* and regime *P*. Using that $C'(X_i) = -\sigma$, for firm *i* under regime *B* we have

$$\Omega_i^B = -\sigma \left[\frac{\partial D_i^B}{\partial p_i} \right]. \quad (4)$$

If firm *i* is in a partnership with firm *j*, on the other hand, its opportunity costs equal

$$\Omega_i^P = -\sigma \left[\frac{\partial D_i^P}{\partial p_i} + \frac{\partial D_j^P}{\partial p_i} \right]. \quad (5)$$

Since the goods are imperfect substitutes ($\partial D_j^P / \partial p_i > 0$), it follows that $\Omega_i^P > \Omega_i^B$, other things equal. This indicates that the opportunity cost of increasing the price for a member in a partnership is lower than in the benchmark regime. In both cases, a negative direct effect of increasing the price is that marginal costs increase due to lower own sales. However, if firm i sets a higher price, its upstream partner in regime P , firm j , will sell more ($\partial D_j / \partial p_i > 0$). This positive volume effect partly offsets the negative effect on upstream marginal costs of increasing the price. If they have formed an upstream partnership, firms i and j thus have smaller incentives to undercut each other in the price game than in the benchmark. It is further intuitive and straight forward to show that undercutting incentives are even smaller if all three firms are upstream partners. We can state:

Proposition 1: *Other things equal, price competition is most aggressive ("small downstream margins") if each firm operates its own upstream unit, and least aggressive ("high downstream margins") if there is an industry-wide upstream partnership.*

The fact that competition becomes less aggressive if there is an upstream partnership, does not mean that the two partnership firms will charge a higher price than they would do in the benchmark case. On the contrary, we might expect them to charge a lower price since their upstream marginal production costs fall. To see this, note that in the benchmark case we have (c.f. equation (3))

$$\left. \frac{\partial \pi_i^B}{\partial p_i} \right|_{\mathbf{p}^{B*}} = \left[D_i^{B*} + (p_i^{B*} - (c - \sigma D_i^{B*})) \frac{\partial D_i^{B*}}{\partial p_i} \right] + D_i^{B*} \Omega_i^B = 0, \quad (6)$$

where for notational simplicity we have set $D_i^{B*} \equiv D_i^B(\mathbf{p}^{B*})$.

Consider instead regime P , and assume that firm i is in partnership with firm j . Evaluating $\frac{\partial \pi_i}{\partial p_i}$ around the benchmark equilibrium price yields:

$$\left. \frac{\partial \pi_i^P}{\partial p_i} \right|_{\mathbf{p}^{B*}} = \left[D_i^{B*} + (p_i^{B*} - (c - \sigma (D_i^{B*} + D_j^{B*}))) \frac{\partial D_i^{B*}}{\partial p_i} \right] + D_i^{B*} \Omega_i^P. \quad (7)$$

Combining (6) and (7) and using that $D_j^{B*} = D_i^{B*}$ we find

$$\left. \frac{\partial \pi_i^P}{\partial p_i} \right|_{\mathbf{p}^{B*}} = \sigma D_i^{B*} \left(\frac{\partial D_i^{B*}}{\partial p_i} + \frac{\partial D_j^{B*}}{\partial p_i} \right) < 0. \quad (8)$$

Compared to the benchmark case, firms 1 and 2 will thus set lower prices when they are upstream partners (the first-order condition for the non-partner is unchanged, and given by equation (6)). The non-member will consequently be worse off in regime P than in regime B ; it will have lower sales and higher marginal production costs. However, since prices are strategic complements, it may still charge a lower price than in the benchmark:

Proposition 2: *Suppose firms 1 and 2 form an upstream partnership. They will then charge lower prices than in the benchmark, while the price change for the non-partner is ambiguous.*

To further analyze the consequences of an upstream partnership, we need to use a more specified model of demand. In the next section we set up a circular city model (Vickrey, 1964; Salop, 1979) for this purpose. However, in the appendix we perform a robustness check by showing that the main results survive also with a representative consumer demand specification.

5 A circular city model of demand

We assume a circular city model (Vickrey, 1964; Salop, 1979) with a uniform distribution of consumers, a perimeter equal to 1, and a unitary density of consumers around the circle. The three firms are located equidistantly from each other. Throughout we restrict our analysis to outcomes with full market coverage (all consumers buy from one of the firms) and market-sharing (all three firms are active in the market). With linear transportation costs ($t > 0$), the location of the consumer who is indifferent between buying from firm i and firm j is given by $tx + p_i = t\left(\frac{1}{3} - x\right) + p_j$. This yields demand

$$D_i(\mathbf{p}) = \frac{1}{3} - \frac{2p_i - (p_j + p_k)}{2t}, \quad (9)$$

where $i, j, k = 1, 2, 3$. To ensure market sharing in all four regimes, we assume

$$t > t_c \equiv \frac{3}{2}\sigma.$$

5.1 Benchmark with no partnership (B)

With no partnership, profit for firm $i = 1, 2, 3$ equals

$$\pi_i^B = (p_i^B - C_i^B) D_i^B, \text{ where } c_i^B = c - \sigma D_i^B, \quad (10)$$

and its first-order condition is given by:¹⁸

$$\frac{\partial \pi^B}{\partial p_i} = \left[D_i(p) + (p_i - c_i^B) \frac{\partial D_i}{\partial p_i} \right] - D_i(p) \frac{\partial c_i^B}{\partial p_i} = 0. \quad (11)$$

Using that $\frac{\partial D_i}{\partial p_i} = -\frac{1}{t}$ we can solve equation (11) to find

$$p^B = c + \frac{t - 2\sigma}{3} \text{ and } D^B = \frac{1}{3}. \quad (12)$$

Inserting for (12) into (10) yields:

$$\pi^B = \frac{t - \sigma}{9}. \quad (13)$$

Equation (13) shows that profit is decreasing in σ ; the reason is that competition is intensified when size matters for marginal costs. This effect is analogous to how competition may become fierce between networks that are (at least partly) incompatible such that size matters (see Farrell and Saloner, 1992, and Katz and Shapiro, 1985, for early contributions).

5.2 Two firms in an upstream partnership (P)

With a two-firm partnership, profits for the members and the non-member are given by

$$\pi_m^P = (p_m^P - c_m^P) D_m^P, \text{ where } c_m^P = c - \sigma(D_1^P + D_2^P) \quad (14)$$

$$\pi_n^P = (p_n^P - c_n^P) D_n^P, \text{ where } c_n^P = c - \sigma D_n^P. \quad (15)$$

¹⁸ Assumption 1 ($t > 3\sigma/2$) ensures that the second-order condition is satisfied; $\frac{\partial^2 \pi^B}{\partial p_i^2} = -2 \frac{t-\sigma}{t^2} < 0$.

For firm $m = 1, 2$ we find

$$\frac{\partial \pi_m^P}{\partial p_m} = \left[D_m(p) + (p_m - c_m^P) \frac{\partial D_m}{\partial p_m} \right] - D_m(p) \frac{\partial c_m^P}{\partial p_m} = 0, \quad (16)$$

while the first-order condition for firm n is analogous to (11).

By solving $\frac{\partial \pi_m^P}{\partial p_m} = \frac{\partial \pi_n^P}{\partial p_n} = 0$, we can write:

$$p_m^P = p^B - \frac{4\sigma}{3} \frac{t - \sigma}{10t - 13\sigma} \text{ and} \quad (17)$$

$$p_n^P = p_m^P + \frac{2\sigma}{3} \frac{t}{10t - 13\sigma} = p^B - \frac{2\sigma}{3} \frac{t - 2\sigma}{10t - 13\sigma}. \quad (18)$$

The market-sharing requirement, $t > 3\sigma/2$, implies that $10t - 13\sigma > 0$. It thus follows from (17) that $p_m^P < p^B$. Even though the partnership members' incentive to engage in aggressive price competition is reduced compared to the benchmark case, the fact that they achieve lower marginal costs induces them to charge a lower price. This is in accordance with Proposition 2.

Inserting for (17) and (18) into (9) generates equilibrium demands

$$D_m^P = \frac{1}{3} + \frac{1}{3} \frac{\sigma}{10t - 13\sigma}, \quad D_n^P = \frac{1}{3} - \frac{2}{3} \frac{\sigma}{10t - 13\sigma}. \quad (19)$$

Compared to the benchmark, the members achieve lower marginal costs and sell more ($D_m^P > D^B$), while the opposite is true for the non-member ($D_n^P < D^B$). The members of the partnership are thus unambiguously better off and the non-member worse off than in the benchmark:

$$\pi_m^P = \frac{2(2t - \sigma)(5t - 6\sigma)^2}{9(10t - 13\sigma)^2} > \pi^B \quad (20)$$

$$\pi_n^P = \frac{(t - \sigma)(10t - 15\sigma)^2}{9(10t - 13\sigma)^2} < \pi^B. \quad (21)$$

Since $p_m^P < p^B$, it is clear that the consumers who would have bought from firm 1 or firm 2 under regime B will be better off under regime P .

What about the consumers who would have bought from firm 3 under regime B ? They are subject to two opposing price effects. On the one hand, since prices

are strategic complements and firms 1 and 2 charge less as partners than in the benchmark regime ($p_m^P < p^B$), firm 3 tends to set a lower price in regime P than in regime B as well. On the other hand, since firm 3 sells less ($D_n^P < D^B$), its marginal costs will now be higher. This tends to make it optimal for firm 3 to set a higher price. Using equations (12), (18) and (19) we find:

Proposition 3: *If firms 1 and 2 are upstream partners, they will have lower marginal costs, sell more and charge lower prices than they would in the benchmark.*

Compared to the benchmark, the non-partner will have higher marginal costs ($c_n^P > c^B$), sell less and

- (i) *charge a lower price ($p_n^P < p^B$) if $t > 2\sigma$*
- (ii) *charge a higher price ($p_n^P > p^B$) if $t < 2\sigma$ (i.e. if downstream competition is sufficiently fierce).*

If $t > 2\sigma$, such that $p_n^P < p^B$, all consumers face lower prices in the partnership regime than in the benchmark. Some consumers buy from the partnership members even if they are located closer to firm n (since $p_m^P < p_n^P$). However, these consumers are also better off than in the benchmark. This is clear since they prefer to buy from one of the partnership firms even though firm n charges a lower price than in the benchmark. In contrast, if $t < 2\sigma$, the consumers buying from firm n under regime P are worse off due to the partnership. Furthermore, some of the consumers who buy from firms 1 and 2 only if these firms are upstream partners are worse off too. Even if these consumers face a lower price than in the benchmark case, they would have preferred to buy from the closer outlet (firm n) if firm n charged the same price as in the benchmark (p^B).

In Appendix A1 we show that total consumer surplus is higher with an upstream partnership compared to the benchmark. We can state¹⁹:

¹⁹The mechanisms described here may be seen as a spiral effect. An increase in size reduces marginal costs. This leads to lower retail prices, which in turn lead to further increase in the number of customers in the downstream market. Through the business-stealing effect, this increases the marginal cost of the downstream rival. U.K. Office of Fair Trading (2007) discusses such an effect with respect to procurement conditions, and they argue that it has not been modelled formally

Proposition 4: *Suppose firms 1 and 2 are upstream partners. Aggregate consumer surplus is higher than in the benchmark, but some consumers would be better off in the benchmark if $t < 2\sigma$.*

Intentionally, we do not consider the effect of a partnership on total welfare. The reason is that we have not made any specific assumption about the source behind upstream marginal costs being dependent on size (see further discussion in the concluding remarks).

5.3 Two firms merge (M)

We now allow the upstream partners to cooperate in retail pricing; i.e. they behave as a merged company also in the downstream market.

The maximization problem of firm n and the merged firm is respectively

$$\max_{p_n} (p_n - c_n^P) D_n(p) \text{ and} \quad (22)$$

$$\max_{p_1, p_2} \sum_{m=1}^2 (p_m - c_m^P) D_m(p). \quad (23)$$

The first-order condition for firm n is still given by equation (11) from B . For the merging firms, $m = 1, 2$, the first-order condition with respect to p_m becomes ($m \neq m'$)

$$\frac{\partial \pi_{1,2}^M}{\partial p_m} = \left\{ \left[D_m(p) + (p_m - c_m^M) \frac{\partial D_m}{\partial p_m} \right] - D_m(p) \frac{\partial c_m^M}{\partial p_m} \right\} + I = 0, \quad (24)$$

in theoretical literature. Furthermore, they argue “it is not clear that such an effect would be necessarily harmful. The spiral effect could simply be a process in which lower prices are passed on to end customers allowing a buyer group’s members to grow. If such growth allows the buyer group to obtain even lower prices, which are then passed on to end customers once again, this would be a virtuous circle that benefits end customers. . . . If the fear is that more efficient firms drive out weaker retailers, this would simply reflect the process of competition”. This could be the effect in our model, but as we show, it may also hurt some customers, and, in fact, imply that a fraction of customers face higher prices.

where

$$I \equiv \underbrace{-D_{m'}(p) \frac{\partial c_m^M}{\partial p_m} + (p_{m'} - c_{m'}^M) \frac{\partial D_{m'}}{\partial p_m}}_{\text{cost and revenue internalization}}.$$

If the firms cooperated upstream only, prices would be chosen such that the sum of the terms in the curly brackets of (24) is zero - this corresponds to equation (16) above in the P regime. However, if the firms merge, they will also internalize the effect that a higher price p_m has on firm m' (and vice versa). This is captured by the variable I . The first term in this variable, $-D_{m'}(p) \frac{\partial c_m^M}{\partial p_m}$, is negative, and thus calls for a lower price if the firms merge than if they are partners. The intuition is that a higher p_m reduces sales of good m , and this increases the marginal cost of producing m' . This effect is internalized if the firms merge. The second term in I is the conventional revenue-internalizing effect (commonly labelled competitive effect); the merged firm takes into account the fact that an increase in p_m increases $D_{m'}$. Other things equal, this induces the merged firm to set higher prices than in regimes B and P . This term dominates, which most easily seen by evaluating the two internalization effects at the equilibrium prices from the P regime, given by (17) and (18). This gives us

$$\left. \frac{\partial \pi_{1,2}^M}{\partial p_m} \right|_{\mathbf{p}^P} = I|_{\mathbf{p}^P} = \frac{(2t - 3\sigma)(5t - 6\sigma)}{6t(10t - 13\sigma)} > 0, \quad (25)$$

implying that it is profitable for the merged firm to charge a higher price than in the P regime. The prices of goods 1 and 2 are consequently higher under M than under P , and it can be shown that this also induces firm n to charge a higher price. Consequently, a merger has the reasonable effect that it makes the consumers worse off compared to regime P .

Solving the firms' first-order conditions simultaneously, we find that equilibrium prices are given by:

$$p_m^M = p^B + \frac{2(t - \sigma)(t - 2\sigma)}{3(3t - 4\sigma)} > p^B \text{ if } t > 2\sigma \quad (26)$$

$$p_n^M = p^B + \frac{(t - 2\sigma)^2}{3(3t - 4\sigma)} > p^B. \quad (27)$$

From (26) we see that a merger increases the merging firms' prices compared to the benchmark regime if $t > 2\sigma$, but reduces them if $t < 2\sigma$. Firm n , on the other hand, will unambiguously charge a higher price compared to the benchmark if the rivals merge.

Inserting for equilibrium prices yields the following profit levels:

$$\pi_m^M = \frac{(t - \sigma)(5t - 6\sigma)^2}{18(3t - 4\sigma)^2} \quad (28)$$

$$\pi_n^M = \frac{4(t - \sigma)(2t - 3\sigma)^2}{9(3t - 4\sigma)^2} \quad (29)$$

What about firms 1 and 2's incentive to merge compared to forming an upstream partnership? At first glance, we may think that they prefer a merger (M). By merging, they will internalize the revenue and cost effects discussed above. However, there is a trade-off. When internalizing the competitive effects, the members set higher prices than in the P regime, all other things equal. This benefits the non-member, firm n . In turn, when firm n sells more, its marginal costs are reduced. Consequently, firm n tends to charge a lower price.

Comparing the profit for product m under P and M we find:

$$\pi_m^P - \pi_m^M \geq 0 \text{ if } t \leq \hat{t} \equiv \frac{1}{28} \left(\sqrt{65} + 45 \right) \sigma \approx 1.895\sigma$$

We have the following result:

Proposition 5: *The members prefer an upstream partnership (P) instead of a merger (M) if downstream competition is sufficiently fierce, i.e. $t < \hat{t} \approx 1.895\sigma$.*

We thus have the seemingly paradoxical result that if downstream competition is tough, then a merger between two partnership firms is unprofitable. The intuition is that when the members face fierce competition from the non-member, their opportunity cost of raising prices is high. Since a merger *de facto* commits the members to internalize the competitive effect between products 1 and 2, the members consequently prefer not to make such a commitment if competition with the non-member

is sufficiently fierce. However, it is straightforward to show that the members always prefer a merger compared to the benchmark case; $\pi_m^M - \pi^B > 0$.

5.4 Industry-wide upstream partnership (IP)

Let us now consider an industry-wide partnership (IP) where all three firms are upstream partners. The firms compete in the downstream market, and profit is given by

$$\pi_i^{IP} = (p_i^{IP} - c_i^{IP}) D_i^{IP}, \text{ where } c^{IP} = c - \sigma (D_1^{IP} + D_2^{IP} + D_3^{IP}). \quad (30)$$

The first-order condition for firm i is:

$$\frac{\partial \pi_i^{IP}}{\partial p_i} = \left[D_i(p) + (p_i - c^{IP}) \frac{\partial D_i}{\partial p_i} \right] - D_i(p) \frac{\partial c^{IP}}{\partial p_i} = 0$$

Recall from above that $\frac{\partial c^{IP}}{\partial p_i} = 0$ under market coverage. All three firms face identical costs, and the equilibrium price and profit become

$$p^{IP} = c - \sigma + \frac{t}{3}, \pi^{IP} = \frac{t}{9}. \quad (31)$$

An industry-wide partnership clearly minimizes marginal costs if $\sigma > 0$, and prices will therefore be lower and consumer surplus higher than in any of the regimes we have considered above. Let us next consider whether the industry-wide partnership is in the interest of the firms. Denoting aggregate industry profit by Π , we can use equations (21), (28) and (31) to find that

$$\Pi^{IP} - \Pi^P = 3\pi^{IP} - (2\pi_m^P + \pi_n^P) = \frac{(2t - 3\sigma)(100t - 123\sigma)\sigma}{9(10t - 13\sigma)^2} > 0.$$

This means that the industry as a whole is better off under IP than under P . Comparing (13) and (31) we further find that $\Pi^{IP} > \Pi^B$. We now have:

Proposition 6: *Upstream marginal costs are decreasing in the number of firms in an upstream partnership, and joint industry profit is higher in an industry-wide upstream partnership than in a partnership between only two of the firms.*

Proposition 6 indicates that we should expect an industry-wide partnership to be formed unless competition authorities raise objections.²⁰ However, this is a precipitate conclusion. To see why, note that the difference in profits for firm m under regime IP and P equals

$$\pi^{IP} - \pi_m^P = \sigma \frac{30t^2 - 95t\sigma + 72\sigma^2}{9(13\sigma - 10t)^2}.$$

We now have

$$\pi^{IP} - \pi_m^P < 0 \text{ if } t < \tilde{t} = \frac{\sqrt{385} + 95}{60}\sigma \approx 1.91\sigma. \quad (32)$$

If competition is sufficiently fierce, firms 1 and 2 will thus make higher operating profits if they break out of the IP regime and establish a partnership where firm 3 is excluded. The intuition for this result is that the closer rivals the firms are in the eyes of the consumers (i.e. the smaller is t), the stronger incentives there will be for two of the firms to keep the third firm out of the partnership in order to gain a competitive advantage. In principle, firm 3 could offer firms 1 and 2 a fixed fee if they commit to not breaking out of the IP regime, but such an agreement might be hard to achieve in practice (e.g. due to contractual problems or high legal costs). In the absence of a credible no break-out clause, NBO clause for short, we might thus expect regime P to arise instead of regime IP if $t < \tilde{t}$:

Remark 1: *Suppose that a credible NBO clause is infeasible. Then firms 1 and 2 might prefer regime P to regime IP if $t < \tilde{t}$.*

In a Bernheim and Whinston (1998) interpretation, we may think of IP as a case without exclusive dealing; where all downstream firms have access to the same upstream input. Another interpretation is that an industry-wide partnership may be considered as a competitively neutral system (e.g. where manufacturers like Coca Cola take care of own distribution to all retailers). In several grocery markets,

²⁰One reason why competition authorities might not allow an industry-wide partnership is that an IP regime could raise entry barriers. However, it is beyond the scope of this paper to analyze such issues.

we have seen a development from such a competitively neutral system to a system with backward integration, where large downstream chains establish their own distribution systems.²¹ We thus move from a situation where distribution costs are competitively neutral, to one where size matters. A development where distribution is undertaken by retailers rather than by manufacturers may have similar effects as moving from IP to P in our model.

Let us point out that it would be unprofitable for an individual firm to break out of an IP regime and integrate backwards if firms are ex ante symmetric, as assumed here. However, it can be shown that if we allow for exogenous differences among the downstream firms, the more efficient firm may have incentives to walk alone and undertake a cost-increasing backward integration in order to capture a competitive advantage.

6 Formation of upstream partnership

Above we have characterized outcomes with and without partnerships, but we have not looked at the question of how partnerships might be formed. The traditional approach in the merger literature (as in seminal papers by Salant, Switzer and Reynolds, 1983, and Deneckere and Davidson, 1985) is to assume that firms' incentives to form an upstream partnership (or merge) depend on whether total profit of the members is higher than in the initial benchmark case with no partnerships. However, with several potential market structures the formation of partnerships becomes more complex, as shown in the literature which analyzes endogenous mergers and endogenous upstream partnerships (Kamien and Zang, 1990, Chatterjee, Dutta and Sengupta, 1993, Bloch 1995, Yi, 1998, and subsequent papers). To consider a complete analysis where all firms choose between all possible constellations is beyond the scope of the present paper. Instead, we consider a non-cooperative extensive game; given that two firms have initiated and formed an upstream partnership (P)

²¹In the Norwegian market, the largest grocery chain, NG, wants to take care of all distribution to their own outlets (while previously a firm like Coca Cola provided distribution of their goods to all downstream firms).

at stage 1, they can choose between P , M , and IP at stage 2 (we make a distinction between whether or not a credible no break-out clause is feasible, which is relevant if $t < \tilde{t}$). At stage 3, firms compete in prices.²²

We solve the game through backward induction, and the outcome of the final stage is given from Section 5.1 (regime B), Section 5.2 (regime P), Section 5.3 (regime M), and Section 5.4 (regime IP).

When analyzing the second stage of the game, it is useful to keep in mind that if two firms have formed a partnership, their operating profits are higher than in the benchmark; $\pi_m^P > \pi^B$. If an upstream partnership (P) is established, it thus constitutes a Nash equilibrium; individual deviations to the benchmark are not profitable.

However, if the non-member benefits more than the members there may exist a hold-up problem which could prevent the partnership from being established at stage 1. This is well-known from the merger literature under price competition; if a merger does not lead to reduced marginal costs, all firms benefit, but the non-merging firms benefit more than the merging parties (Deneckere and Davidson, 1985).

Let us first find the outcomes of the second stage of the game in the absence of a credible NBO clause. Then firm 3 will not have incentives to pay firms 1 and 2 a fixed fee for joining the partnership if $t < \tilde{t}$, because it knows that they will have incentives to leave the IP regime.

For the sake of simplicity, we now set $t = 1$. From (32) we find that the criteria for NBO to be relevant, $t < \tilde{t}$, then correspond to $\sigma > \tilde{\sigma} = \frac{60}{\sqrt{385}+95} \approx 0.53$. The assumption that ensures market coverage and participation is $\sigma < 2/3$.

6.1 No NBO clause

Suppose that firms 1 and 2 have formed a partnership at stage 1. If the firms merge at stage 2, consumer prices will be higher than in any of the other regimes. Due to e.g. objections from the competition authorities, the merger regime might therefore

²²It follows from the timing structure that we do not consider the possibility that firms 1 and 2 first merge and then invite firm 3 to join their upstream partnership.

not be an available option. The outcome of the second stage would consequently depend on whether the merger regime is allowed.

The merger regime (M) is allowed

Suppose that firms 1 and 2 are allowed to merge. From equations (28) and (31) we find that $\pi_m^M - \pi^{IP} > 0$, so clearly they will not invite the third firm to join the partnership. The question is whether they prefer the M or the P regime. From (20) and (28) we find that $\pi_m^P - \pi_m^M \geq 0$ if $\sigma \geq \sigma_0 \equiv \frac{28}{\sqrt{65+45}} \approx 0.53$. The members thus choose to stay in the two-firm partnership if $\sigma \geq \sigma_0$, while they choose to merge if $\sigma < \sigma_0$.

Note that $\pi_n^M - \pi_m^M \geq 0$ if $\sigma \leq \sigma_1 \equiv \frac{3-\sqrt{2}}{6} \approx 0.26$. In this case there is a potential hold-up problem at stage 1, since all three firms prefer to be the non-member rather than one of the partnership members.

The merger regime (M) is not allowed

If merger is not allowed, the members might invite the non-member into an IP at stage 2. From equations (28) and (31) we find that this is the case if $\sigma \leq \sigma_2 \equiv \frac{60}{\sqrt{385+95}} \approx 0.52$. Otherwise, if $\sigma > \sigma_2$, firms 1 and 2 prefer to stay in the two-firm partnership ($\pi_m^P - \pi^{IP} \geq 0$).

There does not exist any hold-up problem at stage 1 when merger is not an option. All three firms want to be a member of the upstream two-firm partnership at stage 1 (since $\pi_m^P > \pi_n^P$ always holds).

We have:

Proposition 7: *Assume that an NBO clause is infeasible and that two firms have formed a partnership at stage 1. Suppose that*

- a) merger is allowed. The P regime is an equilibrium if $\sigma > \sigma_0 \approx 0.53$, while the M regime is an equilibrium if $\sigma \leq \sigma_0$.*
- b) merger is not allowed. The P regime is an equilibrium if $\sigma > \sigma_2 \approx 0.52$, while the IP regime is an equilibrium if $\sigma \leq \sigma_2$.*

6.2 With an NBO clause

Suppose that firms 1 and 2 have formed an upstream partnership at stage 1. If an NBO clause is feasible, such that firm 3 might agree to pay firms 1 and 2 a fixed fee for entering the partnership, the IP regime arises whenever this yields higher total industry profit than the alternatives.²³ From (28), (29) and (31) we have $\Pi^{IP} > \Pi^M$ if $\sigma > \sigma_3 \equiv \frac{7}{2\sqrt{7}+14} \approx 0.36$, while $\Pi^{IP} < \Pi^M$ if $\sigma < \sigma_3$.

At stage 2, the members of a P regime thus choose either to merge (if that is allowed) or to invite the third firm to join the partnership (recall that $\Pi^{IP} > \Pi^P$).

The merger-regime (M) is allowed

Firm 1 and 2 choose to merge if $\sigma < \sigma_3 \approx 0.36$ - in this case there is no room for side-payments from firm 3 which makes it possible to form an industry-wide partnership. This follows because $\Pi^M > \Pi^{IP}$ if $\sigma < \sigma_3$ (and $\pi_m^M \geq \pi_m^P$ for any $\sigma \leq \sigma_0 \approx 0.53$).

Now, suppose that $\sigma \in (\sigma_3, \sigma_0)$ and that the members of the P regime can make a take-it-or-leave-it offer to the non-member at stage 2. The fixed fee, f_m , from the non-member to the members will then be given by

$$f_m = \pi^{IP} - \pi_n^M = \frac{36\sigma^3 - 68\sigma^2 + 40\sigma - 7}{9(3 - 4\sigma)^2} > 0 \text{ for } \sigma \in (\sigma_3, \sigma_0).$$

If $\sigma > \sigma_0$ we likewise find

$$f_m = \pi^{IP} - \pi_n^P = \sigma \frac{225\sigma^2 - 356\sigma + 140}{9(10 - 13\sigma)^2} > 0 \text{ for } \sigma \in (\sigma_0, 2/3).$$

Provided that $\sigma > \sigma_3$ we will thus see an industry-wide partnership, and since $f_m > 0$, there will be no hold-up problem at stage 1: the initial members are better off than the initial non-member.

If the non-member can make a take-it-or-leave-it offer at stage 2, the fixed fee from the members to the non-member is

²³In principle, we may also consider whether side-payments are used to realize M if total industry profit is higher under M than under the alternative regimes. However, side-payments from the non-member to the members to ensure M would clearly violate the competition law. Consequently, we do not consider this alternative.

$$f_n = 2(\pi^{IP} - \pi_m^M) = -\frac{(7-9\sigma)(1-2\sigma)^2}{9(3-4\sigma)^2} < 0 \text{ for } \sigma \in (\sigma_3, \sigma_0), \text{ and}$$

$$f_n = 2(\pi^{IP} - \pi_m^P) = -2\sigma \frac{95\sigma - 72\sigma^2 - 30}{9(10-13\sigma)^2} < 0 \text{ for } \sigma \in (\sigma_0, 2/3).$$

Since $f_n < 0$, the members receive a fixed fee also when the non-member is in a position to make a take-it-or-leave-it offer. Consequently, there is no hold-up problem at stage 1 in this case either.

The merger-regime (M) is not feasible

Since $\Pi^{IP} - \Pi^P > 0$, joint profits will always be highest in an industry-wide partnership if merger is infeasible. If the members make a take-it-or-leave-it offer at stage 2, the fixed fee from the non-member becomes

$$f_m = \pi^{IP} - \pi_n^P = \sigma \frac{225\sigma^2 - 356\sigma + 140}{9(10-13\sigma)^2} > 0.$$

The fact that $f_m > 0$ means that there does not exist any hold-up problem: the members will be better off than the non-member.

Next, suppose that it is the non-member which makes a take-it-or-leave-it offer. We now have that payments from the members to the non-member equal

$$f_n = 2(\pi^{IP} - \pi_m^P) = -2\sigma \frac{95\sigma - 72\sigma^2 - 30}{9(10-13\sigma)^2} < 0 \text{ for } \sigma > \sigma_2 \text{ and}$$

$$f_n = 2(\pi^{IP} - \pi_m^P) = -2\sigma \frac{95\sigma - 72\sigma^2 - 30}{9(10-13\sigma)^2} > 0 \text{ for } \sigma < \sigma_2.$$

If $\sigma < \sigma_2 \approx 0.52$, the members will therefore accept to pay a fixed fee to the non-member to join the partnership. The reason for this is that the members make a higher operating profit in regime IP than in regime P if $\sigma < \sigma_2$. Consequently, a hold-up problem arises at stage 1, and this may obstruct the formation of P in the first place.

We state:

Proposition 8: *Assume that an NBO clause is feasible and that two firms have formed a partnership at stage 1. Suppose that*

a) merger is allowed. The IP regime is an equilibrium for $\sigma > \sigma_3 \approx 0.36$, while the M regime is an equilibrium if $\sigma < \sigma_3$.

b) merger is not allowed. The IP regime is an equilibrium for all relevant values of σ .

7 Concluding remarks

An important rationale for forming upstream partnerships is to generate cost efficiencies. Market players often argue that such cost efficiencies increase their ability to compete aggressively in the downstream market. This implies that size matters for costs that are used to calculate end-user prices; in standard terminology, that marginal costs are decreasing in size. In contrast, static economic literature typically assumes that marginal costs are constant (or increasing for a firm that operates close to its capacity constraints). In a dynamic setting there may not be any clear distinction between fixed and marginal costs. Firms might, for instance, choose between different logistics systems that vary from one which is purely manual (high per-unit cost) to a completely automatized system (low per-unit cost) that requires significant investments. Such unit-cost reducing investments might be unprofitable unless the sales volume is sufficiently large. Another example is wholesale tariffs, which often involve different types of fixed fees in addition to per-unit input prices. Under all-unit rebates (retroactive rebates) marginal costs may even be negative at a given threshold. Wholesale tariffs are not carved in stone, and previous sales might constitute an indicator of realistic future sales volumes. If this is the case, unit costs are *de facto* likely to depend on size. In practice, then, downstream firms may consider lump-sum fees from suppliers as affecting unit costs.

The aim of this paper is to analyze consequences of upstream scale effects, and we therefore do not dwell on the question of how the cost reductions are achieved. For this reason, we are careful when we discuss welfare effects of upstream partnerships. If the cause of reduced costs is higher buyer power towards manufacturers (these firms are not included in our model), rather than improved technological efficiency, we may expect that a reduction in profit among manufacturers will partially

counterweight the increased profit for the firms that establish a partnership.

McGuire and Staelin (1983), Moorthy (1988), Rey and Stiglitz (1988), Bonanno and Vickers (1988), and Shaffer (1991), among others, show how firms may commit to vertical restraints that, if observable, dampen downstream competition. From the literature on strategic delegation, for instance, we know that firms may non-cooperatively choose to implement competition-softening devices (e.g. transfer pricing as in Göx, 2000, or slotting allowances as in Shaffer, 1991, Foros and Kind, 2008, and Doyle and Han, 2014). In the appendix (Appendix A4) we show that in the benchmark case, without upstream partnership, strategic delegation (through the interplay with external suppliers) may - in the terminology of Fudenberg and Tirole (1984) - be used as a Top Dog strategy rather than as a Puppy Dog strategy. This is noteworthy, since Top Dog strategies are most commonly used under Cournot competition and not under price competition (see e.g. McGuire and Staelin, 1983, and Shaffer, 1991). However, the Top Dog result does not survive if we have an industry-wide partnership. This is due to the fact that the opportunity cost of increasing the price becomes weaker for a firm that enters an upstream partnership, as noted above. Joint sales reduction will be smaller, and the negative cost effects less pronounced. Then we are back to the conventional outcome under price competition; strategic delegation is used to soften competition (a Puppy Dog strategy).

8 References

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9 Appendix

9.1 A1 Consumer surplus under B and P

As long as we have market sharing, total consumer surplus depends on the average price and the average transportation costs. It is straightforward to show that the average price and the average transportation costs under B and P are:

$$p^B = \bar{P}^B = \left(c + \frac{t - 2\sigma}{3} \right)$$

$$\begin{aligned} \bar{P}^P &= p_m^P + (p_n^P - p_m^P) x_n^P = \\ &= p_m^P + \left(\frac{2t}{3(10t - 13\sigma)} (\sigma) \right) \left(\frac{1}{3} - \frac{2}{3} \frac{\sigma}{10t - 13\sigma} \right) \end{aligned}$$

$$\bar{T}^B = t \left(\frac{1}{12} \right)$$

$$\bar{T}^P = t \left(\frac{1}{12} + \frac{2}{9} \frac{(\sigma)^2}{(10t - 13\sigma)^2} \right)$$

Then, we have

$$\left(\bar{P}^P + \bar{T}^P \right) - \left(\bar{P}^B + \bar{T}^B \right) = -\frac{4}{9} \sigma \frac{25t^2 - 62t\sigma + 39\sigma^2}{(10t - 13\sigma)^2} < 0 \text{ as long as } t \geq t_c$$

Hence, total consumer surplus is higher under P than under B . This proves Proposition 4.

9.2 A2 Representative consumer demand

A potential disadvantage of the spatial competition framework used in the main text, is the assumption that the market is always covered. This raises two concerns. First, market coverage implies that even though marginal products costs and consumer prices are lowest in the IP regime, total output is the same ($D_1 + D_2 + D_3 = 1$) in all the regimes we consider. If we allow output to vary between the regimes, will

the *IP* regime then become so much more attractive that the results derived above will break down? Second, in order to achieve market coverage, all consumers must obtain a non-negative utility when they buy their preferred good. This amounts to requiring that transportation costs are not too high or, equivalently, that the goods are not too differentiated (for sufficiently high values of t , the circle will just consist of three local monopolies.).²⁴ Does this have any bearing on the results?

To check the robustness of our results, we now consider a representative consumer model, which is the main alternative to spatial models. In the spatial model, the results depend on the interplay between the willingness of consumers to substitute between goods (transportation costs) and the opportunity cost due to endogenous marginal costs. We thus need a pure index of substitutability to decode the transportation costs from the spatial competition framework (Hotelling, 1929; Vickrey, 1964; Salop, 1979). For this purpose the Shubik-Levitan (1980) utility function fits well, since it has a parameter which uniquely measures substitutability between goods. In contrast, in most other linear representative consumer demand systems one and the same parameter affects both the size of the market and the substitutability among goods (see e.g. discussion in Staelin, 2008).²⁵

Consumer utility is given by:

$$U(q_1, q_2, q_3) = v \sum_{i=1}^3 q_i - \frac{3}{2} \left[(1-b) \sum_{i=1}^3 q_i^2 + \frac{b}{3} \left(\sum_{i=1}^3 q_i \right)^2 \right]. \quad (33)$$

The parameter $v > 0$ is a measure of the market potential, $q_i \geq 0$ is the quantity purchased from retailer i , and $b \in [0, 1)$ is a measure of how differentiated the retailers are. At $b = 0$, the retailers are independent, while they are perceived to be identical in the limit $b \rightarrow 1$.²⁶

²⁴Suppose that firm i is located at point x_i on the circle. For all consumers who have firm i as their preferred choice, we must then have $\bar{v} - p_i - t|x - x_i| \geq 0$, where $\bar{v}$ is the reservation utility. This inequality defines the critical t -value.

²⁵Others using the Shubik-Levitan framework include Shaffer (1991) and Deneckere and Davidson (1985). Similar to us, Shaffer (1991) analyses retail grocery market price competition, and Deneckere and Davidson (1985) use the Shubik-Levitan utility function when they analyze the merger incentives of price-setting firms.

²⁶The merit of using the Shubik-Levitan utility function rather than a standard quadratic utility

Solving $\partial U/\partial q_i - p_i = 0$ for $i = 1, 2, 3$, we find

$$q_i = \frac{1}{3} \left(v - \frac{p_i}{1-b} + \frac{b}{1-b} \bar{p} \right), \quad (34)$$

where $\bar{p} = \frac{1}{3} \sum_{j=1}^3 p_j$. The demand function facing retailer i is thus a linear combination of his own price p_i and the average price, $\bar{p}$. Total demand equals $Q = \sum_{i=1}^3 q_i = v - \bar{p}$.

The firms' profit functions are still given by equation (10) in Regime B, equations (14) and (15) in Regime P, equations (28) and (29) in Regime M, and equation (30) in Regime IP. The algebraic expressions are not as neat as in the spatial competition framework, and to make them tractable we have set $\sigma = 1/2$. Below, we show that the main results (Propositions 3 - 6) hold also with the representative consumer specification. Thus, our findings do not critically depend on the spatial competition framework. This is true even though output now varies significantly between the regimes. The difference is largest between the *B* and the *IP* regime; output in the latter is more than 25 % larger than in the former. This is reassuring with respect to the first concern above.

However, in one respect, the circular city model might be somewhat misleading; it does not catch the case where the goods are independent or, more generally, very poor substitutes, c.f. the second concern above. In particular, under the circular city model we found that firms 1 and 2 always make higher profit if they merge than if they are part of an industry-wide upstream partnership. This cannot be true in the representative consumer framework; if $b = 0$, so that the goods are completely independent, there is no competition between the firms. The only effect of changing from regime *M* to *IP* for firms 1 and 2 will then, for any $\sigma > 0$, be to reduce costs (there is no revenue effect to internalize). More specifically, with the Shubik-Levitan utility function it can be shown (see calculations below) that operating profits for firms 1 and 2 in the two regimes equal:

$$\begin{aligned} \pi_m^M &= \frac{1}{4(3-2\sigma)} \text{ and } \pi^{IP} = \frac{3-\sigma}{4(3-2\sigma)^2} \\ \pi_m^M - \pi^{IP} &= -\frac{\sigma}{4(3-2\sigma)^2} < 0. \end{aligned} \quad (35)$$

function, is that market size does not vary with b . However, the qualitative results are invariant to which utility function we choose.

Since π_m^M is strictly lower than π^{IP} (for $\sigma > 0$), inequality (35) must by continuity hold also for at least slightly positive values of b . In contrast to the circular city framework, two partnership firms would thus, unless competition is sufficiently fierce, like the third firm to join even if they do not receive any side-payments.²⁷ Below, we calculate prices and profits with the Shubik-Levitan utility function (setting $\sigma = 1/2$), and hold the results up with Propositions 3-6.

9.2.1 Benchmark with no partnership (B)

Using (34) and maximizing (10) we find that equilibrium prices and profits in the benchmark case are given by

$$p^B = c + 2 \frac{3 - 4b}{15 - 11b} (v - c) \text{ and} \quad (36)$$

$$\pi^B = \frac{(3 - b)(15 - 17b)}{2(15 - 11b)^2} (v - c)^2. \quad (37)$$

All non-negativity constraints and second-order conditions hold for $b < 15/17 \approx 0.882$.²⁸ Consumer surplus equals

$$CS^B = \frac{9(3 - b)^2}{2(15 - 11b)^2} (v - c)^2. \quad (38)$$

9.2.2 Two firms in an upstream partnership (P)

Using (34) and maximizing (14) and (15) we find that in the partnership regime we have

$$p_m^P = p^B - \frac{(15 - 17b)(3 - 2b)(3 - b)^2}{(15 - 11b)z_{12}} (v - c) < p^B \text{ and} \quad (39)$$

$$p_n^P = p^B - \frac{4b(3 - 4b)(3 - b)(3 - 2b)}{(15 - 11b)z_{12}} (v - c), \quad (40)$$

²⁷From equations (47) and (49) below we find that $\pi_m^M - \pi^{IP} < 0$ for $b < 0.787$ when $\beta = 1/2$.

²⁸The profit margin is equal to $(p_3 - (c - \beta q_3)) = \frac{15 - 17b}{2(15 - 11b)} (v - c) > 0$ for $b < 17/15$ and the second-order condition is $\frac{d^2 \pi_i}{dp_i^2} = -\frac{(17b - 15)(3 - b)}{81(1 - b)^2} < 0$ for $b < 17/15$.

where $z_{12} \equiv 405 - 849b + 490b^2 - 62b^3$. The corresponding profit levels are

$$\begin{aligned}\pi_m^P &= \frac{2(15-16b)(3-b)(15-20b+3b^2)^2}{z_{12}^2} (v-c)^2 \text{ and} \\ \pi_n^P &= \frac{(3-b)(15-17b)(27-38b+6b^2)^2}{2z_{12}^2} (v-c)^2.\end{aligned}\quad (41)$$

Equations (39) - (41) hold for $b < \frac{19}{6} - \frac{1}{6}\sqrt{199} \approx 0.81554$.²⁹ Consumer surplus equals

$$CS^P = \frac{(7587 - 20574b + 17088b^2 - 4256b^3 + 324b^4)(3-b)^2}{2z_{12}^2} (v-c)^2. \quad (42)$$

We now find

$$q_n^P - q^B = -\frac{2b(3-2b)(3-b)^2}{(15-11b)z_{12}} (v-c) < 0 \quad (43)$$

$$(c - \sigma q_n^P) - (c - \sigma q^B) = \frac{b(3-2b)(3-b)^2}{(15-11b)z_{12}} (v-c) > 0 \text{ for } b > 0. \quad (44)$$

Equations (43) and (44) confirm that Proposition 3 (i) holds also with the alternative demand specification; $D_n^P < D^B$ and $c_n^P > c^B$. From (40) we immediately see that $p_n^P > p^B$ iff $b < 3/4$. This is equivalent to Proposition 3 (ii).

From equations (38) and (42) it can be shown that $CS^P > CS^B$ for all relevant values of b , and we have seen that $p_n^P > p^B$ if $b < 3/4$. This corresponds to Proposition 4.³⁰

9.2.3 Two firms merge (M)

In the merger regime, we can use equations (22), (23) and (34) to find that equilibrium prices are equal to

$$p_m^M = c + \frac{(3-5b)(15-20b+3b^2)}{2Z_{12}} (v-c) \text{ and} \quad (45)$$

²⁹The second-order conditions are $\frac{d^2\pi_m^P}{dp_m^2} = -\frac{(16b-15)(3-b)}{81(1-b)^2} < 0$ for $b < 15/16$ and $\frac{d^2\pi_n^P}{dp_n^2} = -\frac{(17b-15)(3-b)}{81(1-b)^2} < 0$ for $b < 15/17$, but the binding constraint is that firm n makes a non-negative profit margin; $(p_n^P - (c - \beta q_n^P)) = \frac{(15-17b)(27-38b+6b^2)}{2z_{12}} (v-c) > 0$ for $b < \frac{19}{6} - \frac{1}{6}\sqrt{199} \approx 0.81554$.

³⁰A caveat is in place here: With the Hotelling framework we have a continuum of heterogeneous consumers, from which we can readily identify demand from any given consumer. This is not the case with a representative consumer approach.

$$P_n^M = c + \frac{2(3-4b)(6-10b+3b^2)}{Z_{12}}(v-c), \quad (46)$$

where $Z_{12} = 90 - 207b + 137b^2 - 22b^3$. Profits can now be written as

$$\pi_m^M = \frac{(6-7b)(3-2b)(15-20b+3b^2)^2}{4Z_{12}^2}(v-c)^2 \text{ and} \quad (47)$$

$$\pi_n^M = \frac{(15-17b)(3-b)(6-10b+3b^2)^2}{2Z_{12}^2}(v-c)^2. \quad (48)$$

Equations (45) - (48) hold for $b < \frac{5}{3} - \frac{1}{3}\sqrt{7} \approx 0.78$.³¹

Comparing (41) and (47) it can be shown that $\pi_m^M < \pi_m^P$ if $0.50 < b < 0.69$. Thus, also in this case firms 1 and 2 might prefer a partnership rather than a merger, though the result does not hold all the way up to $b = 0.78$. Except for this, Proposition 5 still applies.

9.2.4 Industry-wide upstream partnership (IP)

The IP regime holds for all $b < 1$, and using (30) and (34) we find

$$p^{IP} = c + \frac{1-2b}{4-3b}(v-c) \text{ and } \pi^{IP} = \frac{5(1-b)(3-b)}{6(4-3b)^2}(v-c)^2. \quad (49)$$

Comparing equations (41) and (49) it can be shown that $\pi_n^P > \pi^{IP}$, that $\pi_m^P > \pi^{IP}$ if $b > 0.80$ (recall that regime P applies for $b < 0.815$), but that $(3\pi^{IP} - 2\pi_m^P - \pi_n^P) > 0$ for all relevant values of b . This confirms that Proposition 6 and Remark 1 hold also with a representative consumer approach.

9.3 A3 Strategic delegation

In the main text we abstracted from external upstream suppliers/manufacturers. We now introduce the interplay with vertically separated upstream suppliers/manufacturers.

From the literature on strategic delegation (McGuire and Staelin 1983; Moorthy,

³¹In the merger regime we have $\frac{d^2(\pi_m^M + \pi_{m'}^M)}{dp_m^2} = \frac{d^2(\pi_m^M + \pi_{m'}^M)}{dp_{m'}^2} = -\frac{45-60b+14b^2}{81(1-b)^2} < 0$ for $b < \frac{15}{7} - \frac{3}{14}\sqrt{30}$ and $\left(\frac{d^2(\pi_m^M + \pi_{m'}^M)}{dp_m^2}\right)\left(\frac{d^2(\pi_m^M + \pi_{m'}^M)}{dp_{m'}^2}\right) - \left(\frac{d^2(\pi_m^M + \pi_{m'}^M)}{dp_m dp_{m'}}\right)^2 = \frac{4(6-7b)(3-2b)}{243(1-b)^3} > 0$ for $b < 6/7$. However, the binding constraint is that $(p_n^M - (c - \beta q_n^M)) = \frac{(15-17b)(6-10b+3b^2)}{2Z_{12}}(v-c) > 0$ for $b < \frac{5}{3} - \frac{1}{3}\sqrt{7} \approx 0.78475$.

1988; Rey and Stiglitz, 1988; Bonanno and Vickers, 1988 and Shaffer, 1991, among others) we know that firms may commit to taking an observable action which softens competition. Let us concentrate on the "extreme" regimes; the benchmark (B) and industry-wide partnership (IP). The P -regime will be an intermediate case. In the benchmark regime we have three supplier-retailer pairs. Under an industry-wide partnership, we assume that members still have separate suppliers; therefore, we have three supplier-retailer pairs both under B and IP .

We follow Shaffer (1991), and assume that suppliers offer a homogeneous good to the downstream firms, and that there is perfect competition among suppliers (think of this as a large number of potential suppliers). Profit of downstream firm i is now

$$\pi_i = p_i D_i(\mathbf{p}) - (c + w_i - \sigma X_i) D_i(\mathbf{p}) + S_i,$$

where w_i is the per unit wholesale price, and S_i is the fixed fee specified in the contract between the downstream firm and the supplier. If $S_i > 0$, we have a slotting allowance. Profit to supplier s is then

$$\pi_s^S = w_i D_i(\mathbf{p}) - S_i,$$

where we have normalized marginal cost at the supplier level to zero.

We consider the following two-stage game analogous to Shaffer (1991): At stage 1, supplier s decides on the contract to offer downstream firm i , $T_i = (w_i, S_i)$, such that $\pi_i^S \geq 0$. At stage 2 the downstream firms compete in prices. The game is solved by using backward induction.

The benchmark regime

Let us start with the benchmark (B). At stage 2, firm i solves:

$$\max_{p_i} \pi_i^B = (p_i - c + \sigma D_i - w_i) D_i + S_i$$

With the circular city demand function, stage 2 equilibrium price is (similar for firms 2 and 3)

$$p_1^* = c + \frac{t - 2\sigma}{3} + \frac{w_1(3t - 2\sigma) + (w_2 + w_3)(t - 2\sigma)}{5t - 6\sigma}$$

At stage 1 perfect competition among potential suppliers implies $w_i D_i(\mathbf{p}) = S_i$ and supplier s then decides w_1 to maximize downstream firm 1's profit (see Shaffer, 1991, for details):

$$\max_{w_1} \pi_1^B = (p_1^* - c + \sigma D_1^*) D_1^*$$

The symmetric wholesale equilibrium price becomes

$$w^B = \frac{t - 2\sigma}{6}$$

If $\sigma = 0$, we have the outcome from Shaffer (1991), where the main result is that unit wholesale prices above marginal costs are used as a strategic delegation device to soften competition.³² This changes if the opportunity cost identified in the present paper is sufficiently strong; then the unit wholesale price becomes negative. If so, the downstream firms need to pay a fixed fee to their suppliers (i.e. $S < 0$). More generally, the opportunity cost effect identified in the present paper reduces the incentives for applying wholesale prices as a softening device.

Industry-wide partnership

With the spatial demand set-up, it is straightforward to show that we are back to the conventional outcome from Shaffer (1991). If we assume that the firms have separate supplier contracts, the equilibrium wholesale price becomes $w^{IP} = t/6$. If the members behave as a buyer group, the unit wholesale price may be used to ensure downstream monopoly prices.

³²See Kuksov and Pazgal (2007) for a similar set up with Hotelling competition.