Collaborate or Consolidate: Assessing the Competitive Effects of Production Joint Ventures*

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Abstract

We analyze a symmetric joint venture in which firms facing external competition collaborate in input production. Under standard regularity conditions, the collaboration leads to higher profits than a horizontal merger, whereas the effect on prices and quantities depends on the form of downstream competition. When firms compete in prices, downstream prices for all firms are higher following a symmetric joint venture than following a merger. The reverse result may obtain under quantity competition. In light of our results regarding profits, we provide reasons why firms might still wish to merge: imperfect information, cost synergies, and organizational asymmetries.

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1 Introduction

Collaboration via joint production can present an attractive alternative for rival firms contemplating a horizontal merger, particularly for large firms concerned with an antitrust challenge. U.S. antitrust guidelines distinguish competitor collaborations from mergers, stating that in contrast to mergers, collaborations generally preserve some form of competition among participants.[1] Production collaboration involves agreements where parties produce through common production facilities or a jointly controlled company while remaining separated in other facets of operation.[2]

Consider as an example, the mobile wireless industry. In the U.S., whereas small or medium sized mergers have frequently been approved by the competition authorities, the Department of Justice and Federal Communications Commission have been less permissive with regard to mergers that would reduce the number of major nationwide competitors (for instance, in 2011, blocking AT&T's attempted acquisition of T-Mobile and in 2014 showing resistance to its potential acquisition by Sprint).[3] In Europe, where nationwide merger attempts have achieved varying degrees of success, a common alternative arrangement that has been viewed as favorable by policy makers is for rivals to share their underlying wireless networks while continuing to compete downstream.[4] Such an arrangement has been observed less commonly in the U.S., with the notable exception of a scrutinized and approved 2013 joint venture between the two major Alaskan-based mobile wireless

[1] See the U.S. Antitrust Guidelines for Collaborations Among Competitors (2000).

[2] The more recent collaboration guidelines issued by Canada (2009) and the European Commission (2011) suggest that production collaborations may vary in form and scope and include among them subcontracting arrangements where one party retains another to produce products on its behalf.

[3] See Wyatt, E. "Wireless Mergers Will Draw Scrutiny, Antitrust Chief Says." *New York Times*, B3. January 30, 2014. Retrieved February 15, 2016. ⟨http://dealbook.nytimes.com/2014/01/30/wireless-mergers-will-draw-scrutiny-antitrust-chief-says/⟩.

[4] For instance, in its report on wireless market structure and network sharing, the OECD indicated a preference for network sharing relative to merger. See OECD, 2014, p. 7. Annex 2 in the OECD report lists major attempted mobile wireless mergers in the OECD between 2005 and 2014.

providers, GCI and ACS Wireless, who perhaps fearing that a merger between them would be disallowed due to the presence of only one major competitor (AT&T) opted to combine their upstream assets instead (Baker et al., 2014).[5]

It is by now well established in the economics literature that production collaboration may engender anti-competitive effects as great as those of a horizontal merger (Bresnahan and Salop, 1986; Reynolds and Snapp, 1986; O'Brien and Salop, 2000; Chen and Ross, 2003). Antitrust agencies also recognize that such collaborations can have competitive effects identical to those that would arise if the participants merged and delineate circumstances under which competitor collaborations should be treated as mergers. A prevalent view, however, is that a production joint venture that is not found to be per se illegal, should almost surely be allowed if the participants would be permitted to merge.[6] Historically, collaborations that are not treated as mergers have been considered to be procompetitive and have faced relatively few legal challenges. Notably, Werden (1998) could not identify a single case in which a joint venture not treated as a cartel or merger was dissolved by court order following an antitrust challenge. Similarly, in the second half of the twentieth century, European regulators cleared or exempted almost all joint ventures that reached the formal decision stage, while finding that the majority of horizontal cases infringed Article 81 prohibiting restriction to competition (Carree, et al., 2010).

In this manuscript, we make a positive comparison of the potential competitive impact of production collaboration with that of a horizontal merger between two firms in an oligopoly setting. In seeking a better understanding of production joint ventures, we

[5]In 2014, following Verizon Wireless entry into Alaska, the two companies merged. See "Alaska Communications to exit wireless, will sell spectrum and subs to GCI." *FierceWireless*. December 5, 2014. Retrieved February 15, 2016. ⟨http://www.fiercewireless.com/story/alaska-communications-exit-wireless-will-sell-spectrum-and-subs-gci/2014-12-05⟩.

[6]See, for instance, Shapiro and Willig (1990). The U.S. Guidelines for Collaborations define agreements of a type that always or almost always tends to raise price or reduce output as per se illegal. Werden (1998) has observed that the only per se illegal joint ventures are those that are merely cartels which involve no efficiency-enhancing integration.

find that the treatment of joint ventures as mergers could lead antitrust practitioners to approve anti-competitive collaborations or to deny those that may be pro-competitive. To add structure to our analysis, we focus on production joint ventures in which the outcome of collaboration is a product that is transferred to participants for independent marketing or used by them as an input in the autonomous production and retail of downstream goods. Such "input" collaboration is an exceedingly common method of organization in various industries. In addition to our aforementioned wireless industry example, other instances of input joint ventures include collaborations between automobile manufacturers who set up joint manufacturing facilities to produce separately branded automobiles; media proprietors who obtain news from jointly owned news agencies; and petroleum companies that share crude oil refining facilities but separately market and distribute fuel.

In Section 2 below, we show that two firms competing in differentiated substitute products who also face an additional oligopolistic rival would prefer to collaborate via a symmetric input joint venture and continue to compete downstream than to merge. Unlike a horizontal merger, which affects profits and prices by internalizing downstream competition between the merging products, the input joint venture achieves higher industry profits via the upstream input price. The joint venture can replicate the outcome of a horizontal merger by raising the input price sufficiently above cost. But it can yield even higher profit by using the input price strategically to soften competition with the outside rival.

Softening competition entails setting an input price above one that would replicate a merger if downstream competition is in strategic complements and below it if downstream competition is in strategic substitutes, which leads to higher prices (and hence lower consumer and total welfare) when competition is differentiated Bertrand, but lower prices (and potentially higher welfare) when competition is differentiated Cournot. The mechanism that leads a joint venture to soften competition is reminiscent of the influence

that delegation or vertical separation has on rival firms (see Fershtman and Judd, 1987; Bonanno and Vickers, 1988). Vertical separation allows owners to act like Stackelberg leaders vis-à-vis an opposing firm's franchise by using the input price to induce the competing franchise to raise its retail price or lower its quantity. The joint venture attains a similar leadership position relative to the outside competitor. However, crucially, vertical separation is absent in our model—the input pricing decision is made directly by the joint venture partners, not delegated to an upstream input producer.

In light of the results in Section 2, one might ask why firms would merge at all when a joint venture could lead to more profit. We contemplate a number of potential answers in Section 3. First, as suggested by the literature on delegation through unobservable contracts (Coughlan and Wernerfelt, 1989; Katz, 1991), if the input price is unobservable to an outside rival, it cannot be used to soften competition between the collaborators and the outsider. Second, a horizontal merger might be able to achieve greater cost synergies than a joint venture, which could ultimately prove more profitable. Finally, when the joint venture is asymmetric, the joint venture partners can have opposing incentives with regard to downstream actions, which could lead to lower than merger profits. This leads us to make some fairly straightforward policy recommendations to competition authorities.

2 Baseline model and equilibrium

Three firms indexed 1, 2, and 3 produce imperfectly substitutable goods. In a baseline scenario without collaboration, every firm is vertically integrated, consisting of a separate upstream and downstream division. Each upstream division can produce a unit of an intermediate good at constant marginal cost c with no constraints on capacity. Downstream divisions require a unit of the intermediate good as an input for each unit of output sold

and have no other input requirements.[7] Let w_i denote the input price charged by each upstream division to its downstream division. As in Chen and Ross (2003), who study a symmetric industry wide input joint venture, our mathematical exposition focuses on downstream competition in prices. We provide intuition for the case of downstream quantity competition below and derive general results in a supplemental appendix.

Demand for firm i's product is given by $x_i = h_i(\mathbf{p})$ where $\mathbf{p} = (p_1, p_2, p_3)$. When positive, demands are downward sloping ($\partial h_i/\partial p_i < 0$ for all i) and yield positive cross effects ($\partial h_i/\partial p_j > 0$ for $i \neq j$). Additionally, we assume that own effects are larger than cross effects: that is, for $i \neq j$, $|\partial h_i/\partial p_i| > \partial h_i/\partial p_j$.

Firms 1 and 2 may be assumed to be parties to a horizontal agreement: either a merger or a symmetric input joint venture (JV). The merger preserves both downstream products, but consolidates all decisions. A JV produces and prices the requisite input to be used by its owners, who evenly split the profits of the collaboration, but continue to compete downstream. It is assumed that the firm outside the JV is aware of the ownership and financial division between the JV partners.[8] Within the JV, the input is presumed homogenous, it is bought from the JV if and only if a firm is a party to the JV, parties to the JV are obligated to procure the input from the collaboration, and buying from or selling to outside parties is ruled out by the collaboration contract (e.g., see Morasch, 2000). Referring back to our earlier example of the joint venture between the two Alaskan-based mobile wireless providers competing against AT&T, the collaborating firms stated that their JV would operate the wireless network and charge the partner firms, who would price competing wireless plans on a wholesale basis. The bulk of our other assumptions likewise conforms to the details of that motivating example (see ACS, 2012).

[7] We note that even if other inputs are required for downstream production, as long as the intermediate good produced by upstream divisions cannot be substituted, our setup is without loss of generality.

[8] Firms frequently announce the details of joint ventures and other collaborations to the public.

To aid exposition, in this section, we assume that there is no efficiency gain from making a horizontal agreement—thus, c remains the same following the agreement. Likewise, we abstract from fixed costs by supposing that additional entry into the market is not permitted. Let $\pi_i(\mathbf{p})$ denote the profit of firm i and let $\mathbf{J_p}$ be the matrix of second-order price partial derivatives of profits. We assume that downstream prices are strategic complements ($\partial^2\pi_i/(\partial p_i \partial p_j) > 0$, $i \neq j$) and that $\mathbf{J_p}$ is negative definite.[9]

We solve for a subgame perfect Nash equilibrium of the following two-stage game: In stage one, firms choose input prices. In the event that firms 1 and 2 are parties to an input JV, the JV chooses a price w that meets the approval of both owners. In the symmetric context discussed here, this is a price that maximizes each owner's total profit.[10] Because absent capacity constraints, the optimal downstream price of a firm with complete ownership and control over its upstream production facility is invariant to the input price set by that facility, we suppose that a firm that is not party to a JV sets $w = c$. At stage two, after learning the input prices, firms simultaneously set downstream prices.

2.1 Downstream competition

We first analyze the stage two equilibrium when firms 1 and 2 form a JV. Given input price w, firms choose prices to maximize profits. The profits of firm $i = 1, 2$ are:

$$\pi_i(\mathbf{p}) = (p_i - w)\, h_i(\mathbf{p}) + \frac{w - c}{2}\left[h_1(\mathbf{p}) + h_2(\mathbf{p})\right] \tag{1}$$

Firm i derives profits from selling its output downstream as well as from its share of the JV (though we do not assume that $w \geq c$). Firm 3's profit equation is $\pi_3(\mathbf{p}) = (p_3 - c)h_3(\mathbf{p})$.

The first-order condition for the profit maximization problem of firm $i \neq j \in \{1, 2\}$ is:

[9]Thus, profits are concave in downstream prices and there is a locally strictly stable equilibrium (even absent firm 3).

[10]This is in contrast to upstream profit only, which the JV would maximize if the collaborators delegated the input pricing decision to it a la Bonanno and Vickers (1988).

$$h_i + (p_i - w)\frac{\partial h_i}{\partial p_i} + \frac{w - c}{2}\left(\frac{\partial h_i}{\partial p_i} + \frac{\partial h_j}{\partial p_i}\right) = 0 \tag{2}$$

The first-order condition for firm 3 is $h_3 + (p_3 - c)\partial h_3/\partial p_3 = 0$. Going forward, we restrict w to an open, bounded set, $W_p \in \mathbb{R}$, such that our assumptions on $\pi_i(\mathbf{p})$ and $\mathbf{J_p}$ apply. Thus, simultaneous solutions to firms' first-order conditions lead to a strictly stable equilibrium in prices. For a given $w \in W_p$, we denote the equilibrium price of firm i as a function of w, $p_i(w)$. Under our profit assumptions, comparative statics show that $\mathrm{d}p_i(w)/\mathrm{d}w > 0$. Higher input prices make it more costly to produce downstream. When downstream competition is Bertrand, this causes the JV partners' equilibrium prices to rise and because prices are strategic complements, the outside firm responds in kind.

Next, consider the downstream game in the event of a horizontal merger between firms 1 and 2. The merged firm's profit equation is $\pi_M(\mathbf{p}) = (p_1 - c)h_1(\mathbf{p}) + (p_2 - c)h_2(\mathbf{p})$ whereas the profit function for firm 3 remains the same as in the joint venture scenario. The first-order condition for product $i \neq j \in \{1, 2\}$ becomes:

$$h_i + (p_i - c)\frac{\partial h_i}{\partial p_i} + (p_j - c)\frac{\partial h_j}{\partial p_i} = 0 \tag{3}$$

Observe that as is always the case for firm 3, the merged firm's input prices cancel out of the profit equation such that this scenario could properly be analyzed as a single-stage game with marginal cost input pricing. The two-stage setup preserves the timing of the game across the joint venture and horizontal merger scenarios.[11]

Assuming that $c \in W_p$, our profit assumptions apply, such that solutions to firms' first-order conditions lead to a strictly stable equilibrium. We denote the equilibrium price with regard to product i (where the merged firm controls products 1 and 2), p_i^M.

[11] In principal, our two-stage setup in the horizontal merger and baseline scenarios result in a multiplicity of equilibria with respect to the input prices across which all firms are indifferent. As a tie-breaking rule, we assume marginal cost input pricing, which is implicit in the single-stage game.

2.2 Setting the input price

In the joint venture scenario, substituting $\mathbf{p}(w)$ into Equation (1) yields firm i's ($i = 1, 2$) stage one profit functions, denoted $\pi_i(\mathbf{p}(w))$. Our symmetry assumptions imply that were the JV under the complete operational control of one of the firms (with profits split equally), assuming price discrimination across downstream divisions is not allowed, that firm's profit function would be the same as that of its silent JV partner. Thus, both firms would agree to the same input price and either first-order condition $\mathrm{d}\pi_i(\mathbf{p}(w))/\mathrm{d}w = 0$, $i = 1, 2$, could be used to determine equilibrium input price w^*.

Because our objective is to assess the competitive effects of a production JV relative to those of a horizontal merger, before examining the solution for w^*, to aid exposition we consider the JV's best response when firm 3 fixes its price to one that would prevail in a merger. Define the equilibrium input price that prevails in this situation as $\bar{w}$. When firm 3's price is constant at p_3^M, so that $\mathrm{d}p_3/\mathrm{d}w = 0$, we can rely on symmetry (namely $h_1 = h_2$, $\mathrm{d}p_1/\mathrm{d}w = \mathrm{d}p_2/\mathrm{d}w$, $\partial h_1/\partial p_1 = \partial h_2/\partial p_2$, and $\partial h_2/\partial p_1 = \partial h_1/\partial p_2$) to reduce firm i's, $i \neq j = 1, 2$, first-order condition to:

$$\left[h_i + (p_i - c)\left(\frac{\partial h_i}{\partial p_i} + \frac{\partial h_j}{\partial p_i}\right)\right]\frac{\mathrm{d}p_i}{\mathrm{d}w} = 0 \tag{4}$$

Referring back to Expression (3) and noting that symmetry also implies that $p_1^M = p_2^M$, we see that the term in square brackets in Equation (4) is equivalent to the first-order condition for product i in the horizontal merger scenario. Because firm 3's price is p_3^M by assumption, it follows that $p_i(\bar{w}) = p_i^M$ for $i = 1, 2$ as well. Furthermore, because $p_i(\bar{w}) = p_i^M$ for $i = 1, 2$, p_3^M turns out to be firm 3's best response when the JV sets input price $\bar{w}$, so that we may write $p_3(\bar{w}) = p_3^M$. In summary:

Proposition 1. *Suppose that firms 1 and 2 collaborate in a symmetric input joint venture and suppose that firm 3's price is fixed at p_3^M. Then, the equilibrium input price, $\bar{w}$, is*

such that $p_i(\bar{w}) = p_i^M$ *for* $i = 1, 2, 3$ *and* $\pi_1(\boldsymbol{p}(\bar{w})) + \pi_2(\boldsymbol{p}(\bar{w})) = \pi_M(\boldsymbol{p}^{\mathbf{M}})$.

Proposition 1 states that when firm 3's action is fixed as if it were in the horizontal merger scenario, the JV optimally prices the input to replicate the merger outcome. This resembles the result obtained by Chen and Ross (2003), who show that an industry wide input JV achieves the monopoly outcome by committing to an input price above c. As can be seen when substituting $\mathbf{p}(w)$ into Equation (1), the commitment is facilitated by each collaborator's ability to directly profit from increases in their JV partner's input prices, coupled with the need to pay a higher w. As Chen and Ross point out, when w is increased above c, the optimal prices charged by both firms rise. Even accounting for the fact that half the JV profit will be returned to it, firm i still pays more for its inputs when w increases, and so it buys less. As Equation (4) shows, when the impact of w on an outside rival is not a concern, it is possible for the JV to achieve the same outcome that a merger attains by internalizing downstream competition. However, in contrast to Chen and Ross (2003), the monopoly outcome is not obtained in Proposition 1. Even though firm 3 does not behave "strategically," it remains outside of the horizontal agreement. Hence, there is room for improvement.

When firm 3 acts like a standard oligopoly competitor, the input price paid by the JV partners influences its action. Firms 1 and 2 recognize this effect and consider it when setting w. The derivative of firm i's, $i \neq j = 1, 2$, profit with respect to w is:

$$\frac{\mathrm{d}\pi_i(\mathbf{p}(w))}{\mathrm{d}w} = \left[h_i + (p_i - c)\left(\frac{\partial h_i}{\partial p_i} + \frac{\partial h_j}{\partial p_i}\right)\right]\frac{\mathrm{d}p_i}{\mathrm{d}w} + (p_i - c)\frac{\partial h_i}{\partial p_3}\frac{\mathrm{d}p_3}{\mathrm{d}w} \tag{5}$$

From Equation (4) together with $\partial h_i/\partial p_3 > 0$ and $\mathrm{d}p_3/\mathrm{d}w > 0$, we know that $\mathrm{d}\pi_i(\mathbf{p}(w))/\mathrm{d}w > 0$ at $\bar{w}$, so that the JV can outperform a merger. As the following proposition states, this occurs at a w above $\bar{w}$ and leaves all firms better off than a merger. The logic, which is laid out more precisely in a supplemental appendix, is that the first term on the right-hand

side of Equation (5) is positive below $\bar{w}$ and negative above it and because the second term is always positive, the first-order condition can only be satisfied at $w^* > \bar{w}$.

Proposition 2. *Suppose that firms 1 and 2 collaborate in a symmetric input joint venture and firms compete in prices downstream. In equilibrium,* $w^* > \bar{w}$ *and* $p_i(w^*) > p_i^M$, $i = 1, 2, 3$. *Additionally,* $\pi_1(\mathbf{p}(w^*)) + \pi_2(\mathbf{p}(w^*)) > \pi_M(\mathbf{p^M})$ *and* $\pi_3(\mathbf{p}(w^*)) > \pi_3(\mathbf{p^M})$.

From Proposition 1, we know that collaborators can exploit the commitment power inherent in a higher input price to achieve the same effect attained by complete consolidation. Moreover, partners to a JV also understand that the input price matters to an outside oligopolist via its effect on JV partners' downstream prices. Because downstream prices are strategic complements, the JV partners realize that firm 3 responds to a higher input price (which leads the collaborators to set higher downstream prices) with a higher downstream price. Therefore, although setting the input price above one that causes the JV to replicate a horizontal merger would lead to an unprofitable decline in the quantities of products 1 and 2 demanded absent firm 3, the effect that an increase in firm 3's price has on the demand for products 1 and 2 makes an input price higher than $\bar{w}$ worthwhile.

As mentioned in Section 1, the effect that a change in w has on firm 3 is tantamount to a Stackelberg leadership position for the JV relative to firm 3. Thus far, we have compared the JV to a horizontal merger that continues to behave like a standard differentiated Bertrand competitor vis-à-vis its rival post-merger. Suppose that instead, because of its newfound size, the merger attains a Stackelberg leadership position in downstream prices relative to firm 3 (as in Daughety, 1990; Levin, 1990). As we show by comparing first-order conditions in the supplemental appendix, the Stackelberg leadership advantage that the JV attains via the rightmost term in Equation (5) is equivalent to the downstream pricing advantage attained by a merger that becomes a Stackelberg leader: thus, prices

and profits in both scenarios turn out to be the same.[12]

We next briefly consider differentiated downstream quantity competition. As in the Bertrand case, equilibrium quantities for JV partners decrease in w. However, because quantities are strategic substitutes, firm 3, whose production costs are unchanged by the JV, responds to lower quantities caused by a higher w by producing more. As a result, in equilibrium, the JV profitably sets its input price below $\bar{w}$ (defined in this case as the w that prevails when firm 3 fixes its quantity to that which would prevail following a merger between firms 1 and 2) in order to induce firm 3 to produce less.

In contrast to the Bertrand outcome, where higher prices lead to diminished consumer and total welfare in the joint venture scenario relative to the horizontal merger, the welfare consequences are ambiguous under Cournot competition downstream. Because the JV increases its own output relative to the horizontal merger while decreasing that of its rival, total welfare depends on the curvature of demand. As can be shown under linear demand, the combined profits and quantities of firms 1 and 2, as well as total and consumer welfare, are higher following a Cournot JV than following a horizontal merger. In contrast, all prices, as well as the profit and quantity of firm 3 are lower.

3 Why firms might still prefer to merge

Our results thus far indicate that ex-ante symmetric firms are better off as equal partners in an input JV than they would be by merging. However, although symmetric JVs are not uncommon, our results raise the question of why firms might nevertheless prefer to merge even though mergers have historically faced more antitrust scrutiny than JVs. We contemplate a number of potential reasons below.

[12]We thank an anonymous referee for pointing this out.

Imperfect Information. Unless the JV reports the price of its input—as it might if it stands ready to supply outside rivals[13]—the assumption that the outside firm learns the input price set by the JV prior to downstream competition may not be reasonable. However, if firm 3 does not observe w, then the JV sets w taking firm 3's price as fixed. Although in Proposition 1, we have shown that the JV retains an incentive to price the input above marginal cost (and high enough to replicate a horizontal merger) even without eliciting a response from firm 3, as we show in the appendix, when the input price is unobservable, there may be no additional benefit from raising the input price above $\bar{w}$. In fact, when demand is linear, in the unique sequential equilibrium of the game of imperfect information, the JV sets an input price of $\bar{w}$ and all firms set downstream prices as if firms 1 and 2 had merged. This result is consistent with the literature on delegation through unobservable contracts (Coughlan and Wernerfelt, 1989; Katz, 1991), which stipulates that firms cannot generally use unobservable contracts to induce beneficial strategic responses from their rivals. Moreover, this result suggests that the JV cannot outperform a horizontal merger and that if the merger can procure Stackelberg leadership, the JV underperforms.

Cost Reduction. For concision, our analysis assumed no scale economies or cost synergies, but in reality, these are major drivers of any JV or horizontal merger agreement that hopes to pass antitrust scrutiny. If because of its greater level of consolidation and control a merger is able to reduce costs more than the JV, even if the JV is able to command higher downstream prices, the merger may turn out to be more profitable. Consider for instance our motivating Alaskan JV example. According to the applicants, one partner would focus on expanding its GSM-based wireless network, whereas the other would maintain a CDMA-based network (ACS, 2012). By way of comparison, when AT&T acquired rival

[13]Note that this would not cause the JV input price to plummet to zero a la homogenous Bertrand competition as long as JV partners are prohibited from buying the input from outside rivals.

Leap while continuing to maintain its separate Cricket brand in 2014, it forced customers to transition from Leap's CDMA-based network to AT&T's GSM-based one (Baker et al., 2014). Such a cost reducing transition would not have been feasible in the Alaskan JV because the partners continued to serve their own downstream wireless customers.

Asymmetric Ownership. In reality, the ownership of an input JV is not necessarily equally distributed and this has important implications for firm profits and prices. As a simple example, consider a partnership in which firm 1 keeps $s_1 \in (1/2, 1]$ of the profits from the JV and firm 2 keeps $s_2 = 1 - s_1$. Suppose further that as a result of its majority ownership, firm 1 attains full control over w and in exchange pays a lump sum transfer to firm 2 that would leave both firms with equal expected profits.[14] It turns out that the resulting misalignment in pricing incentives brought about by such a setup leads to lower cumulative JV partner profits than a symmetric ownership arrangement.

The intuition above depends in part on the timing of the lump sum transfer and on how this impacts firm 1's optimization problem when setting w, a full discussion of which is beyond the scope of this manuscript. Suppose that firm 1 sets w to maximize joint profits. Because of its higher ownership, as s_1 rises, firm 1 is induced to lower its downstream price (and w) relative to the symmetric case to raise demand for the input. Due to its lower ownership, firm 2 is induced to focus more on downstream profit and possibly to raise its downstream price, though the extent of that increase is constrained by firm 1's lower price (as is the price of firm 3). The culmination of this incentive misalignment can lead to lower average prices than following a symmetric JV and can result in lower cumulative profits than following a merger. The price implications of such a misalignment may have contributed to agency approval of the Alaskan JV, whose ownership was split 2/3 and 1/3.

[14] We are grateful to an anonymous referee for suggesting this arrangement. Such an arrangement might result if one partner to a JV is debt constrained at the time that the transaction is consummated.

Our findings lead us to make a number of straightforward recommendations to antitrust agencies. First, in contrast to the takeaway from previous literature on production collaboration (Shapiro and Willig, 1990; Chen and Ross, 2003) it should not be taken for granted that were a merger to be approved that a joint venture should be likewise approved. In contrast to prior literature, we find that the JV can result in higher than merger prices when downstream competition is differentiated Bertrand. However, even if competition is Cournot, because an outside rival ends up with lower profits following a JV than following a merger, agencies should be wary to the extent that its solvency is threatened more by the JV. Additionally, agencies should take into account that a joint venture might not be able to reduce costs as much as a merger, which could lead the latter to be preferable to firms and consumers.[15] Perhaps more subtly, this manuscript suggests that agencies should consider the organization and transparency of the JV. A more symmetric JV is better able to align on higher prices. Moreover, greater transparency regarding the JV's price setting is more likely to soften competition with outside rivals, potentially leading to higher than merger pricing.

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[15] A related concern that is outside the scope of our model is that a joint venture might forestall investment. This issue was raised recently by French regulator ARCEP with regard to the type of wireless network joint ventures described in this manuscript (ARCEP, 2016).

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