Vertical integration in the presence of upstream competition

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We analyze vertical integration to compare outcomes under upstream competition and monopoly. This is done in a model based on the property rights approach to firm boundaries and where multilateral negotiations are modeled using a fully specified, non-cooperative bargaining game. We demonstrate that vertical integration can alter the joint payoff of integrating parties in ex post bargaining; however, this bargaining effect *is stronger for firms integrating under upstream competition than upstream monopoly. In contrast, where integration internalizes competitive externalities,* ex post monopolization *is more likely to occur under upstream monopoly than upstream competition.*

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1 Introduction

There are long-standing antitrust concerns about potential social detriment from vertical integration, centering on integration by an upstream monopoly into a downstream segment. The monopolist may restrict supply after integration, foreclose on downstream rivals, or it may appropriate more rents at the expense of downstream firms. Moreover, there is a general belief that improving competition in the bottleneck segment would alleviate these concerns (DOJ, 1984; Williamson, 1987).

There are two ways that competition might serve to discourage socially harmful vertical integration. First, upstream competitors will respond to attempts by a firm to foreclose on non-integrated downstream firms by expanding their supply to them. This undermines the ability of an upstream firm to use vertical integration to raise prices in the industry by restricting supply to some downstream firms. Second, it is claimed that competition reduces any bargaining power conferred on the monopolist by integration and any foreclosure threats.

To date, there has been no unified theoretical analysis of the role that competition plays on the incentives for vertical integration and its social desirability. This paper provides such an analysis. In so doing, our primary task is to provide a model capable of studying the pure effect of an increase in competition; where competition does not otherwise change total resources, technical productivity or the nature of bargaining in the industry in an ad hoc way. To this end, we consider an environment where there are two downstream and two upstream assets. Upstream competition is modeled as a situation where the two upstream assets are separately owned, whereas under upstream monopoly they are commonly owned.

Our main modeling contribution, however, lies in the game we use to model bargaining between upstream and downstream firms over input supply. We consider an environment, common in the property rights approach to firm boundaries (Grossman and Hart, 1986; Hart and

Moore, 1990), where the manager of each asset has asset-specific skills, and integration decisions – i.e., the ownership of assets – are made prior to bargaining over the supply of inputs. This set-up allows us to consider the bargaining effects of vertical integration in a similar manner to the standard property rights literature. Importantly, in our environment, integration does not remove the potential for the manager of an acquired firm to earn rents. This is true both for a firm integrating vertically but also for an upstream monopoly where one upstream asset is owned by the manager of the other. Thus, we can capture the full effects of integration on bargaining relations in the industry. Moreover, in so doing, we are able to investigate new issues in strategic vertical integration; namely, the potential differences between forward and backwards integration.[1]

Bargaining takes a non-cooperative form with each upstream-downstream pair negotiating sequentially over the quantity supplied and a price between them. We demonstrate that this type of bargaining leads naturally to some of the inefficiencies emphasized in the contracting externalities literature: an upstream supplier with more than one buyer downstream oversupplies the market, because they cannot commit not to impose negative externalities on one buyer by selling large quantities to the other buyer.[2] A key feature of our bargaining game is that changes in market structure can change supply arrangements, either because such arrangements can be renegotiated (as in Stole and Zwiebel, 1996) or because they are made contingent on changes in market structure (as in Inderst and Wey, 2003). This enables us to characterize surplus

[1] Most analyses of the competitive impacts of vertical integration make no distinction between the type of integration (e.g., Riordan and Salop, 1995; Klass and Salinger, 1995; and Hovenkamp, 2001). The reason for this is that both parties have to agree to merge and so it is generally held to be in their joint interest. However, when there are many firms, as is well known, changes in asset ownership have differential impacts on different types of agents (Hart and Moore, 1990). We demonstrate that this is the case for vertical integration, in general, as forward and backward integration has different returns to the merging parties and different effects on outsiders.

[2] The seminal work on this comes from Hart and Tirole (1990) in terms of its relationship to vertical integration. However, McAfee and Schwartz (1994), O'Brien and Shaffer (1992) and Segal (1999) provide comprehensive treatments of the contracting problem when there are externalities amongst firms. See Rey and Tirole (2003) for a survey.

division; relating the realized payoffs of upstream and downstream firms to their relative power if sets of supply relationships were to be severed. Indeed, the payoffs resemble a 'coalition structure' similar to those derived in cooperative game theory, albeit over a reduced industry surplus.

We demonstrate that vertical integration has two potential effects. First, the bargaining position of all agents changes. Second, some contracting externalities are internalized. To demonstrate the first, we initially consider an environment where downstream assets are in different markets so that there are no competitive externalities between them (Section 3). There, vertical integration changes only the distribution of bargaining power and not the surplus generated. We show that vertical integration can increase the sum of payoffs for the integrating parties because it improves their bargaining position in negotiations with independent firms; specifically, it eliminates the possibility of market structures that may be favourable to independents.

Importantly, we demonstrate that there is a *greater* incentive for vertical integration under upstream competition than under monopoly. This is because the bargaining benefits come from the redistribution of rents from non-integrating parties; and in a monopoly, the non-integrating parties already have low rents. Thus, competition enhances rather than reduces the potential for purely strategic vertical integration. Moreover, we find that integration occurs from the *more* competitive segment into the *less* competitive segment: for example, forward integration is chosen over backward integration only when upstream firms are closer substitutes (in terms of generating overall industry profits) than downstream firms.

When downstream competitive externalities are taken into account, there is an additional incentive for vertical integration: integration can internalize those externalities and lead to some degree of monopolization in the industry. The integrated upstream firm, when dealing with the non-integrated downstream firm, will internalize the effect of its supply on its own downstream firm. Vertical integration of an upstream monopolist leads to higher industry profits than are possible under upstream competition, raising the returns to integration under upstream monopoly relative to upstream competition and mitigating the returns identified earlier that were based purely on bargaining. Indeed, we demonstrate that, in some situations, industry profits may fall (along with consumer surplus) as a result of vertical integration under upstream competition.

In this environment, we identify product differentiation as a key parameter driving incentives to vertically integrate. In particular, we find that when product differentiation is low (high), backward integration is more (less) privately profitable than forward integration. Importantly, while the conventional concern about vertical integration is confirmed when downstream products are relatively homogeneous, the incentive for such integration will be higher under upstream competition than upstream monopoly if products are relatively differentiated. Both these results suggest that the conventional approach of examining the market power of the acquiring firm will not necessarily allow one to draw a conclusion as to whether vertical integration is anti-competitive or not.

The paper that is closest to our own is that of Hart and Tirole (1990) – hereafter, HT. That paper identified bargaining and monopolisation effects that arise from vertical integration (see also Bolton and Whinston, 1993). This is done using three separate variants – each with extreme assumptions regarding downstream demand and upstream costs. In contrast, our model nests all of those variants within a single model that allows for more general downstream and upstream environments. In particular, we move beyond HT's homogeneous product assumptions to allow for downstream product differentiation; identifying it as an important driver of incentives for integration.[3] Thus, one contribution of our paper is to demonstrate the robustness of HT's

[3] A recent paper by Chemla (2003) also nests a bargaining and monopolization effect. He demonstrates that an upstream monopolist may expend resources to encourage entry by downstream firms so as to limit their bargaining power. Thus, vertical integration will have the dual effect of reducing the monopolist's need to expend those resources and also lead to higher industry profits. de Fontenay and Gans (2004a, 2004b) similarly demonstrate that vertical integration can lead to reduced entry and higher industry profits.

results.[4] Nonetheless, we identify subtle differences between our conclusions and theirs throughout. For instance, as in HT, we demonstrate that in some cases vertical integration may lead to a situation where there is foreclosure in input supply to the non-integrated downstream firm. However, in our model, this does not necessarily imply there is foreclosure in payments to that firm, as the integrated firm is interested in preserving the option to supply to that firm if bargaining with its internal manager were to break down.

Significantly, however, HT's model is not equipped to properly examine the questions that motivate us here. First, they assume that upstream and downstream firms simply share the surplus arising from a negotiation according to a fixed parameter, rather than model the drivers of bargaining power—in particular, the asset-specific skills that confer bargaining power in the property rights literature. Consequently, there is no distinction between forward and backward integration. In contrast, in our model, the bargaining position of each firm is driven by their roles in possible market structures that arise following breakdowns in individual negotiations. As forward and backwards integration have different implications as to what market structures are feasible, there will be a difference in the incentives and impact of each.

Second, their analysis of the impact of upstream competition is limited to an analysis of the efficiency of the weaker upstream firm. That is, they consider what happens to the incentives to vertically integrate as the weaker upstream firm becomes more efficient, confounding the effects of market power and superior productivity. Our analysis of the impact of upstream competition models monopoly as the horizontal integration of both upstream assets. As such, it explicitly considers the impact of vertical integration on internal arrangements within the upstream monopoly.

[4] Klass and Salinger (1995) argued that HT's results were highly specific and may not carry over to more general environments. Indeed, as they note, many of HT's results rely on integration precipitating exit of an upstream or downstream firm. We demonstrate similar bargaining and monopolization effects to HT but without the use of the exit device that drove many of their results (in addition, to our more general technology and demand assumptions).

In terms of its bargaining game, the paper has several antecedents. Grossman and Hart (1986) and Hart and Moore (1990) were the first to focus on Shapley values as likely outcomes of the bargaining game between firms. Variants of the bargaining game developed by Stole and Zwiebel (1996) have been applied to bargaining between firms over variable quantities by de Fontenay and Gans (2004a, 2004b), Inderst and Wey (2003) and Björnerstedt and Stennek (2001). Note that, unlike the present paper, contracting externalities are ruled out in all of the above game structures. Each considers environments in which either downstream players impose no externalities on each other or where capacity constraints preclude such behavior.

The remainder of the paper proceeds as follows: Section 2 sets up our basic model and, in particular, the non-cooperative bargaining game that is capable of assessing the impact of upstream competition on the incentives for vertical integration. Sections 3 and 4 then provide analyses of the 'no externalities' and 'competitive externalities' cases when one vertical merger is possible. Section 5 considers incentives for a counter merger and the question of whether the possibility of such mergers may alter incentives for the initial merger. A final section concludes.

2 Model Set-Up

We examine an industry that has two upstream and two downstream assets. The upstream assets produce inputs that are used by downstream assets to make final goods. Inputs from at least one upstream asset are necessary for valuable production downstream. In addition, associated with each asset is a manager endowed with asset-specific human capital that is in turn necessary to generate valuable goods and services from that asset.[5] We denote the respective managers of upstream firms *A* and *B* by U_A and U_B, and downstream managers by D_1 and D_2. Integration changes the ownership of these assets; however, the manager associated with an asset will not

[5] This is a common set-up in the incomplete contracts literature (see, for example, Bolton and Whinston, 1993 and Hart, 1995).

change, as each remains necessary for its use.

An upstream asset, U_j, can produce input quantities q_{1j} and q_{2j} for D_1 and D_2, respectively. Its costs are given by $c_j(q_{1j}, q_{2j})$, assumed to be weakly convex in (q_{1j}, q_{2j}).

Using input quantities, q_{iA} and q_{iB} from U_A and U_B, respectively, D_i makes a downstream profit (gross of payments to upstream suppliers) of $\pi_i(q_{iA}, q_{iB}, q_{-iA}, q_{-iB})$ where *-i* denotes the index of *i*'s potential downstream rival. We assume that $\pi_i(.)$ is concave in (q_{iA}, q_{iB}), non-increasing in (q_{-iA}, q_{-iB}).

Finally, it will often be convenient to express outcomes in terms of industry profits that can be generated for alternative configurations of supply relationships. Let

$$\Pi(\overline{D_1 D_2 U_A U_B}) \equiv \max_{\substack{q_{1A}, q_{1B} \\ q_{2A}, q_{2B}}} \pi_1(q_{1A}, q_{1B}, q_{2A}, q_{2B}) + \pi_2(q_{2A}, q_{2B}, q_{1A}, q_{1B}) - c_A(q_{1A}, q_{2A}) - c_B(q_{1B}, q_{2B})$$

be maximized industry profits when both upstream assets can potentially provide inputs that can be used by both downstream assets. Industry profits for other supply possibilities are similarly defined. For example,

$$\Pi(\overline{D_1 U_A U_B}) \equiv \max_{q_{1A}, q_{1B}} \pi_1(q_{1A}, q_{1B}, 0, 0) - c_A(q_{1A}, 0) - c_B(q_{1B}, 0)$$

$$\Pi(\overline{D_1 U_A}) \equiv \max_{q_{1A}} \pi_1(q_{1A}, 0, 0, 0) - c_A(q_{1A}, 0)$$

Note that maximized industry profits are higher whenever an additional asset and its associated manager are used. For example, $\Pi(\overline{D_1 D_2 U_A}) \geq \Pi(\overline{D_2 U_A})$ and $\Pi(\overline{D_1 D_2 U_A U_B}) \geq \Pi(\overline{D_1 D_2 U_A})$.

It is possible that a particular market structure may involve a 'partitioned' set of supply arrangements. For instance, D_1 may only negotiate with U_A and D_2 may only negotiate with U_B. For this situation, let $(\hat{q}_{1A}, \hat{q}_{2B})$ be the equilibrium input supply quantities. Then,

$$\Pi(\overline{D_1 U_A}, \overline{D_2 U_B}) \equiv \pi_1(\hat{q}_{1A}, 0, 0, \hat{q}_{2B}) - c_A(\hat{q}_{1A}, 0)$$

$$\Pi(\overline{D_2 U_B}, \overline{D_1 U_A}) \equiv \pi_2(0, \hat{q}_{2B}, \hat{q}_{1A}, 0) - c_B(0, \hat{q}_{2B})$$

denotes the (equilibrium) profits to each buyer/supplier pair, respectively. Below we demonstrate that this equilibrium is Cournot, i.e., that $\hat{q}_{1A} = \arg\max_{q_{1A}} \pi_1(q_{1A},0,0,\hat{q}_{2B}) - c_A(q_{1A},0)$ and $\hat{q}_{2B} = \arg\max_{q_{2B}} \pi_2(0,q_{2B},\hat{q}_{1A},0) - c_B(0,q_{2B})$.

Timeline. The timeline for our model is as follows:

STAGE 0 (*Asset Allocation*): Ownership of assets is determined among all four managers.
STAGE 1 (*Bargaining*): Bargaining over input supply terms takes place.
STAGE 2 (*Production*): Production takes place and payoffs are realized.

Initially, the asset allocation process is not modeled as a fully specified endogenous process. That is, we focus on more limited, partial incentives, including whether integration is jointly profitable for the merging parties. Nonetheless, in Section 5, we consider the possibility of counter-mergers and possible equilibria in Stage 0 to check (and, in general, confirm) the robustness of this partial approach.

Note that we do not explicitly model any efficiency cost to integration. This could involve a straight resource costs (as in HT) or alternatively investment incentive effects (as in Hart and Moore, 1990; Bolton and Whinston, 1993). It would be straightforward to incorporate both upstream and downstream investment into the model here, however, they are omitted so as to focus on the main effects as they relate to competition. Essentially, the impact of integration on such investment will involve a similar set of effects as those considered by Segal and Whinston (2000) for the exclusive dealing case. For the remainder of this paper, we simply compare the profitability of integration under different market structures, supposing that the most profitable opportunities for integration are the least likely to be outweighed by the cost of lost resources or investment.

Bargaining. Bargaining is bilateral (involving alternating offers), vertical (occurring between managers of individual upstream and downstream assets), and sequential (only one pair of agents bargain at a time). Each upstream-downstream pair negotiates over price and quantity supply terms. For example, U_j and D_i bargain over terms specifying a quantity of inputs purchased, q_{ij}, and a lump-sum transfer, $\tilde{p}_{ij}$ paid by i to j. When bargaining takes place internally, quantity is not relevant and the focus of negotiations is over the size of any transfer payment, $\tilde{t}_{ij}$ paid by j to manager i for i's participation in the production process.

Our bargaining game takes a particular extensive form.[6] The game is as follows: fix an order of pairs to negotiate in sequence. This order is common knowledge and, as will be demonstrated, irrelevant for the equilibrium outcome. Each pair negotiates bilaterally in a manner specified by Binmore, Rubinstein and Wolinsky (1986); i.e., they alternate making offers to one another until they reach an agreement, and after an offer is rejected there is an infinitesimal probability of an irrevocable breakdown in their negotiations. Once an agreement is reached, the next pair begins bargaining.[7] If a breakdown occurs before an agreement is reached, the entire sequence of negotiations takes place again (in the same order as before), but without any pair whose negotiations have broken down previously. Once all pairs have either agreed or suffered a breakdown, the game ends.

There are two key assumptions of this bargaining game that are worth emphasizing: incomplete information and renegotiation. First, as is commonly assumed in the literature on vertical contracting, our bargaining game is one of incomplete information (Rey and Tirole, 2003). In particular, agents do not know the prices and quantities agreed upon in earlier negotiations that they did not participate in. These cannot be observed ex post; eliminating the

[6] Our non-cooperative bargaining game is an extension of the extensive form game underlying the wage bargaining model of Stole and Zwiebel (1996) to the case of vertical supply agreements. The key difference between our environment and theirs is that input supply quantities are potentially variable and there is competition on both sides of the market. Their model had a single firm bargaining with many workers, each of whom supplied an indivisible unit of labor.

[7] As is well-known, holding the outcomes of other negotiations as fixed, as the probability of a breakdown becomes arbitrarily small, a pair bargaining in this fashion will immediately agree on the Nash bargaining solution.

ability to agree to contracts contingent upon the particular pricing outcomes of other negotiations. Thus, a negotiating pair can engage in secret discounting that enhances the future competitive position of the downstream party at the expense of their rivals. Other negotiating pairs anticipate such effects impacting on their own equilibrium agreements.

Given this, agents will form beliefs about the outcomes of negotiations they do not participate in. To refine the set of possible equilibrium outcomes, we adopt the commonly used assumption that agents hold *passive beliefs* regarding the prices agreed upon in earlier negotiations.[8] Under passive beliefs, an agent's beliefs about the outcomes of other negotiations are not revised by an unexpected price offer.

Second, in our bargaining game, once negotiations have commenced, a supply agreement will only take place in equilibrium if the joint payoff to the upstream and downstream pair exceeds what each might receive if an agreement never takes place. This is reasonable as a non-agreement is possible and the parties should, given the lump-sum transfer, be able to jointly earn more from agreement than not.

But what payoffs will the parties expect to receive if an agreement never takes place? Answering this requires specifying what occurs in remaining negotiations and to past agreements in the event of such a breakdown. First, given that the breakdown is permanent, it is reasonable to assume that such events are common knowledge. Second, it is plausible that, in reality, remaining supply agreements might be impacted upon by such an event. For example, if a downstream firm was supplied by both upstream firms, but the relationship with one broke down irrevocably, the remaining upstream firm might eventually be able to negotiate a more favourable agreement. We take this into account by assuming that in the event of a breakdown all other supply agreements

[8] The assumption of passive beliefs arises naturally when supply negotiations occur simultaneously or downstream firms are not able to observe the precise sequence of negotiations. While we assume here that agents know the negotiation order, our model and environment could easily accommodate a situation where this was unverifiable. See McAfee and Schwartz (1994), Rey and Tirole (2003) and Rey and Verge (2002) for detailed discussions.

can be renegotiated.

This has two interpretations, both of which turn out to have equivalent implications. First, the renegotiation option may arise because, say, an upstream firm can hold up its downstream customer by refusing to honor the past agreement. If that agreement is too costly to enforce, it will be renegotiated. Operationally, this amounts to an assumption that parties cannot jointly commit to refrain from renegotiations following a breakdown in supply relationships by others. This lack of commitment is a common assumption in the literature on incomplete contracts and the property rights theory of the firm (Hart, 1995). It is generally applied in environments in which price contracts are renegotiated more frequently than the market or ownership structure changes.

Because agreements are renegotiated following breakdowns, subgame perfection implies that *all players take disagreement payoffs as given in their current negotiations*. The irrevocability of breakdowns means that following this, the game will never return to the current "node of the game," the set of negotiations currently underway. Therefore, agents cannot credibly choose a post-breakdown strategy that will improve their payoff in the current negotiations. Instead, after a breakdown they will follow the strategy that maximizes payoffs in post-breakdown negotiations.

The second interpretation is that parties may negotiate contracts that take into account contingencies relating to the breakdown of other supply agreements. Such contracts will specify price and quantity terms if no breakdown were to occur elsewhere but also how those terms would be adjusted if supply relationships involving other pairs were to dissolve. Below we demonstrate that there is an equilibrium where the contingent supply terms are the same as the terms that would be renegotiation-proof in the event that contingent contracts were not binding.[9]

[9] The disagreement payoffs governed by the contingencies negotiated by others are not observed across negotiating pairs. Hence, given passive beliefs, they cannot be impacted upon by the negotiating pair and so players act as if disagreement payoffs are taken as given in current negotiations.

However, as in the contingent contract case of Inderst and Wey (2003), and in contrast to equilibria arising in the incomplete contracts case, this equilibrium may not be unique. For this reason, the specific extensive form game reflects the first interpretation but we will demonstrate equivalence to the latter interpretation for key results below.

The combination of our assumptions regarding passive beliefs and what happens following breakdowns elsewhere serves to simplify the multi-person bargaining game dramatically. In particular, we can analyze each bilateral negotiation, taking the outcomes of other negotiations as given. This allows us to derive explicit closed form solutions in an otherwise general economic environment (in terms of demand and production technologies); making the analysis of bilateral oligopoly quite tractable. In addition, as will be demonstrated below, our solution concept replicates cooperative bargaining concepts (such as the Shapley value and its extensions by Myerson) only in certain circumstances. When there are competitive externalities, our solution is novel in that it does not arise in cooperative game theory (see de Fontenay and Gans, 2004c, for a complete analysis).

3 Bargaining and Integration with No Externalities

We begin by assuming, in this section, that there are *no competitive externalities* downstream.[10] That is, for each D_i, $\pi_i(q_{iA}, q_{iB}, q_{-iA}, q_{-iB}) = \pi_i(q_{iA}, q_{iB}, 0, 0) \equiv \pi_i(q_{iA}, q_{iB})$ for all (q_{-iA}, q_{-iB}). This may arise if downstream firms sell distinct products using a similar set of inputs, sell products in different geographical markets, or sell highly differentiated products. As will be demonstrated, this case allows us to isolate the impact of vertical integration on each agent's bargaining position – holding efficiency considerations fixed.

[10] To clarify, there are still externalities between negotiations in that an agreement by one pair impacts upon upstream costs faced in another. However, we demonstrate that such externalities are internalized.

Non-Integration. Under non-integration with upstream competition, all four assets are separately owned by their respective managers, who can potentially negotiate with any vertically related manager. Given the assumption of passive beliefs we can solve for the equilibrium payoffs of each agent. Moreover, we can demonstrate that the outcome is efficient in that industry profits are maximized.

Proposition 1. In any perfect Bayesian equilibrium with passive beliefs, $(q_{1A}, q_{2A}, q_{1B}, q_{2B})$ are such that $\pi_1(q_{1A}, q_{1B}) + \pi_2(q_{2A}, q_{2B}) - c_A(q_{1A}, q_{2A}) - c_B(q_{1B}, q_{2B})$ is maximized. Each agent receives their payoff as given in Table 1.

Proof. See the Appendix.[11]

The intuition for efficiency is subtle, given the interactions between the negotiations of each pair of agents. As depicted in Figure 1(a), under non-integration, there are potentially four pairs of negotiations. Each negotiation involves Nash bargaining where the pair chooses their respective supply quantity to maximize their bilateral payoff. For example, U_A and D_1 would choose q_{1A} to maximize:

$$\pi_1(q_{1A}, q_{1B}) - \tilde{p}_{1B} - \Phi_{1A} + \tilde{p}_{2A} - c_A(q_{1A}, q_{2A}) - \Phi_{A1} \quad (1)$$

while $\tilde{p}_{1A}$ would satisfy:

$$\pi_1(q_{1A}, q_{1B}) - \tilde{p}_{1A} - \tilde{p}_{1B} - \Phi_{1A} = \tilde{p}_{1A} + \tilde{p}_{2A} - c_A(q_{1A}, q_{2A}) - \Phi_{A1} \quad (2)$$

where Φ_{ij} and Φ_{ji} represent the payoffs D_i and U_j expect to receive in the renegotiation subgame triggered by a breakdown in their negotiations; by subgame perfection, these are taken

[11] Notice that this result is independent of the precise ordering of pairs in sequential negotiations. We could weaken that passive beliefs requirement and consider 'wary beliefs' (Rey and Verge, 2002). In this case, parties anticipate that later negotiation behavior will be adjusted according to deviations in earlier negotiations. (see McAfee and Schwartz, 1994). This weaker assumption, however, does not result in the same outcome as passive beliefs when there are competitive externalities. In that case, the order of negotiations does matter, complicating considerably the notational complexity of the paper but without any change in the qualitative results regarding vertical integration.

as given. The remaining pricing terms either form the subject of a previous agreement earlier in the bargaining sequence (in which case their terms are given by the assumption of passive beliefs) or anticipate the negotiations of pairs further in the sequence. In that case, we can demonstrate that when anticipated outcomes are substituted into (1), the only term involving q_{1A}, taking into account the envelope theorem, is a linear function of $\pi_1(q_{1A}, q_{1B}) - c_A(q_{1A}, q_{2A})$. Thus, q_{1A} is always chosen to maximize industry profits.

In terms of distribution, the equilibrium payoffs in Table 1 are obtained by resolving the equivalent of (2) for all pairs and all subgames. They represent the Shapley values of each respective agent given the allocation of assets among them (mirroring the result of Stole and Zwiebel, 1996). While other analyses of bilateral oligopoly have derived Shapley value outcomes using axiomatic bargaining treatments ours is based on an explicit extensive form.

What is most significant about this distribution is its coalitional form; where each agent's payoff depends on industry profits generated under various alternative supply configurations. Thus, if, say, there is a breakdown between U_A and D_1, bargaining proceeds between the remaining pairs on the basis that no supply can occur between them. Interestingly, as was noted by Jackson and Wolinsky (1996) for the cooperative game context, only certain types of supply configurations actually enter into the resulting payoff. Specifically, supply configurations where one supply relationship has been severed but otherwise all firms remain connected (in a graph-theoretic sense) do not appear in payoffs; those terms are relevant in bargaining off the equilibrium path but cancel out in the equilibrium payoffs because of the game's recursive structure. This simplifies the form of the payoffs and eliminates the need to make strong assumptions about outcomes where links between groups of agents are only partially severed.

Vertical Integration. Vertical integration involves a change in asset ownership between an upstream and a downstream manager. We will focus here on vertical integration between U_A and

D_1. This may involve forward integration (FI) whereby U_A acquires D_1's assets or backward integration (BI) where U_A's assets are acquired by D_1. In each case, as in the property rights literature, the acquirer becomes the residual claimant to the earnings of an asset and has residual control rights as to what it is used for (Hart and Moore, 1990). However, each manager continues to be essential for the productive use of the asset.[12]

To illustrate what changes in ownership mean in the present context, suppose U_A integrates forward by purchasing D_1's assets. The manager of the acquired D_1 receives a transfer payment, $\tilde{t}_{1A}$, while the profits from its asset, $\pi_1(q_{1A}, q_{1B}) - \tilde{t}_{1A} - \tilde{p}_{1B}$, accrue to the new owner, U_A.[13] Importantly, as depicted in Figure 1(b), U_A rather than D_1 negotiates a supply agreement with U_B for the supply of inputs to D_1. This is because the residual control rights of the downstream asset have been transferred to U_A. Thus, in the event of a breakdown in negotiations between U_A and the manager of D_1, no supply will occur between U_B and D_1.

What this means is that a breakdown between U_A and the manager of D_1 has a deeper impact upon U_B and D_2. While, under non-integration, such a breakdown would still mean that D_1 could continue to receive inputs from U_B, under FI, this would no longer occur. In this case, U_B would be left with D_2 as its sole source of demand. FI thus eliminates the possibility of U_B being the only supplier of D_1, thereby weakening its bargaining power. For the same reason, FI

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[12] It is conceivable that managers who are not asset-owners could be replaced following a merger (especially when large firms are considered). de Fontenay and Gans (2004d) explore this issue in detail showing that such replaceability might enhance or reduce the incentives for vertical integration.

[13] A reasonable question to ask here is if U_A purchased D_1's assets, for example, why could not U_A give D_1 an equity stake in the merged firm; as often occurs with actual mergers? The standard finding in the property rights literature is that this equity exchange could occur but that it would be irrelevant for any outcome; hence, it is appropriate to confine attention to acquisitions based purely on cash (Hart, 1995). To see this, suppose that there is a single upstream and a single downstream firm. Suppose that U acquires D and offers D a lump-sum payment plus an equity share, α, of the new firm. Imagine that this is less than 50% so that U effectively controls the firm's decisions. In subsequent negotiations over the manager of D's wage, t, Nash bargaining implies that t equals $(1\text{-}2\alpha)(\pi(.)–c(.))/2$. Thus, both U and D each earn a payoff of $(\pi(.)–c(.))/2$; the same payoffs that would arise if D did not have any equity in the merged firm. So, even if in actual practice, shares are exchanged, this does not impact upon eventual payoffs as ex post negotiations will take this into account.

improves the bargaining position of D_2 as it increases the chances it will not have to compete with D_1 for U_B's input.

In this environment, it can be demonstrated – along the same lines as in the proof of Proposition 1 – that integration (BI or FI) will only affect the distribution of surplus between agents and not the overall surplus generated. As in non-integration, this occurs because, under passive beliefs, each negotiating pair chooses their price and quantity in a way that does not impact on the pricing and quantity terms of other negotiations.

The payoffs contained in Table 1 show how distribution changes following integration. The critical feature to note about the effect of integration is that it rules out the participation of an asset's manager in a coalition that does not include the owner. When U_A owns D_1 (that is, forward integration FI), the payoff $\Pi(\overline{D_1D_2U_B})$ becomes $\Pi(\overline{D_2U_B})$, and the payoff $\Pi(\overline{D_1U_B})$ becomes 0. When D_1 owns U_A (that is, backward integration BI), the payoff $\Pi(\overline{D_2U_AU_B})$ becomes $\Pi(\overline{D_2U_B})$, and the payoff $\Pi(\overline{D_2U_A})$ becomes 0. In each case, integration diminishes the bargaining position of one or both of the non-integrated firms and, as is depicted in the last two rows of Table 1, this raises U_A and D_1's joint payoff from integration over non-integration by $\frac{1}{6}\left(\Pi(\overline{D_1D_2U_B})-\Pi(\overline{D_2U_B})\right)$ for FI and $\frac{1}{6}\left(\Pi(\overline{D_2U_AU_B})-\Pi(\overline{D_2U_B})\right)$ for BI.

Comparing these two changes in payoffs, notice that FI will be chosen over BI if and only if $\Pi(\overline{D_1D_2U_B})>\Pi(\overline{D_2U_AU_B})$. That is, FI is favored as an instrument for improving joint bargaining power precisely when upstream firms are closer substitutes (in producing industry profits) than downstream firms. In other words, the acquiring firm comes from the *more* competitive vertical segment. This is because integration eliminates an option for the acquirer's competitor, an option that is valuable precisely because firms in the other vertical segment are not close substitutes from their perspective (and therefore that segment is less competitive). For example, forward integration means that U_B loses an option to supply both downstream firms and this loss is costly when supplying both is relatively valuable. Consequently, the non-integrating firm that suffers the greatest harm from integration is the firm that is in the same segment as the acquiring firm (i.e., D_2 under BI and U_B under FI).

Our results here generalize HT's 'scarce needs' and 'scarce supplies' motives for vertical integration, by allowing for upstream costs to lie between the extremes of constant and backwards L-shaped marginal costs. To see this, observe that when upstream marginal costs are constant and symmetric (that is, there are 'scarce needs' as industry supply is perfectly elastic and products are identical), D_1 and U_A have no incentive for BI but a positive incentive for FI. In this case, D_2's payoff is unchanged and rents shift entirely from U_B. In contrast, when upstream firms are capacity constrained and downstream firms are perfectly substitutable (that is, there are 'scarce supplies'), there is no incentive for FI but a positive incentive for BI. In that case, it is U_B's payoff that is unchanged by integration with the impact being borne entirely by D_2. This accords with the general findings of HT.[14] However, we have derived these motives for vertical integration in a model where bargaining position is determined by the characteristics of possible breakdown market structures rather than an exogenous parameter. We demonstrate below that these motives are preserved when competitive externalities are considered.

Upstream Monopoly. As the focus of this paper is the change in the effect of vertical integration as upstream competition is introduced, we need to take care in specifying the upstream monopoly case.[15] In particular, we require the set of productive assets in the industry to be the same between the two cases as well as the characteristics of any human capital. This means that we cannot

[14] Strictly speaking, while HT find that only D_2 is harmed under 'scarce supplies,' in their 'scarce needs' model both non-integrated firms were harmed by integration. In our model, when upstream costs lie between these two extremes, we also find that both D_2 and U_B are harmed by integration.

[15] All of the results regarding vertical integration in this sub-section would similarly hold if we had a downstream monopsony rather than upstream monopoly. There would, however, be a difference in results when we include competitive externalities downstream.

simply take the two upstream assets and combine them under a single owner, as one of the assets will be managed by an individual with important human capital. As with vertical integration, that agent cannot be replaced and so will have some bargaining power in negotiations with the owner of upstream assets.

The only difference between the outcomes under upstream monopoly as compared with upstream competition is in the distribution of the surplus between agents. Industry profits are maximized under the same logic as Proposition 1 and these profits are the same as under upstream competition, as the characteristics of resources in the industry are unchanged. In contrast, the payoffs of individual agents – listed in Table 1 – are different under upstream monopoly.

The negotiating relationships for upstream monopoly are depicted in Figure 2(a). In comparison with the upstream competition case, there are only three relevant negotiations as there is only a single firm negotiating the supply of inputs to downstream firms. What this means is that if negotiations between the upstream monopolist (chosen to be U_A) and a downstream firm break down, the downstream firm exits the industry.

As before, we consider vertical integration between U_A and D_1. The changed bargaining relationships are depicted in Figures 2(b) and 2(c) for the cases of forward and backwards integration, respectively. Notice that, under forward integration, the change in residual control rights implies no change in the bargaining relationships. This means that forward integration will yield *exactly* the same payoffs as non-integration.

In contrast, the changes in bargaining relationships under backwards integration are quite extensive (see Figure 2(c)). In this situation, D_1 purchases U_A's assets. This makes D_1 the owner of its assets and those of U_A and U_B. It will negotiate with *both* of those managers. Hence, backwards integration allows some market structures to be possible relative to the non-integration case. In particular, it is now possible for D_1 to rely solely on supply from U_B, because U_B's manager can still supply D_1 if negotiations break down between D_1 and U_A's manager. The implication is that BI may improve U_B's bargaining position.[16]

Backward integration is preferred to the status quo — or, equivalently, FI — if $\Pi(\overline{D_2U_AU_B}) > \Pi(\overline{D_1D_2U_B})$; this is the same condition as under upstream competition. In other words, BI is preferable if upstream assets are relatively less substitutable than downstream assets. Otherwise, BI may not be privately desirable as it improves the bargaining power of U_B whose productive role is otherwise similar to U_A. Thus, as in the upstream competition case, the acquiring firm comes from the segment that is relatively competitive and not from the monopoly segment as is the presumption of conventional wisdom.

Comparison of Upstream Competition and Upstream Monopoly. We are now in a position to compare the incentives for vertical integration in upstream monopoly with those for upstream competition, based on pure bargaining effects (using Table 1).

For FI, the comparison is clear: there is no incentive for FI under upstream monopoly, but a positive incentive for FI under upstream competition. FI confers additional market power on the upstream firm, by ruling out options for the other upstream firm; but under upstream monopoly, this has already been achieved.

For BI, it is easy to see that it too will improve the joint payoff to U_A and D_1 by more under upstream competition than under upstream monopoly, as $\Pi(\overline{D_1D_2U_B}) \geq \Pi(\overline{D_2U_B})$. Under upstream competition, BI also increases the chance of a bilateral monopoly between U_B and D_2, whereas under upstream monopoly the possibility of a U_B monopoly is reintroduced.

Thus, from a pure bargaining perspective, *integration has a higher private return under upstream competition than under upstream monopoly*. The reason for this is that the benefits of integration flow from harming agents outside of the proposed merger, thereby redistributing rents

[16] For example, when U_A and U_B are perfect substitutes (i.e., symmetric with linear costs), U_B obtains no rents under non-integration and positive rents under backwards integration.

in favour of the insiders. Under upstream monopoly, outsiders either do not have their bargaining position change, or in some cases can potentially improve their negotiating relationships with insiders. For upstream competition, integration always removes possible market structures that may have been of benefit to outsiders. Hence, the incentive for integration is stronger under upstream competition. If vertical integration involved a fixed cost (in terms of foregone investment, or transactions costs), integration would be more likely under upstream competition.[17]

4 Competitive Externalities

The previous section demonstrates that incentives for strategic vertical integration can be higher under upstream competition than upstream monopoly. In the no externalities case, however, production is unchanged following integration so industry profits are always maximized. Integration served only to change distribution in ways that were different, depending upon the degree of upstream competition. When there are competitive externalities, the distributional (or bargaining) consequences of vertical integration are largely identical. What differs is the level of production, meaning that integration has welfare consequences. As demonstrated here, vertical integration can lead to higher downstream prices and increased deadweight losses, as in the contracting externalities literature. Critically, however, the industry profits generated by vertical integration differ between upstream competition and monopoly leading to distinct welfare consequences.

Total Surplus. The contracting externalities literature typically considers a monopolist selling to

[17] Given that the payoff of at least one non-integrated firm is reduced by integration, there is also a possibility that integration may induce exit. In this case, there will be a direct welfare consequence of integration. In HT, exit is the only way in which distribution effects can occur. Instead, here we have provided a context in which exit does not occur (i.e., there are no fixed costs) but distributional effects from vertical integration still arise.

downstream firms producing identical goods (McAfee and Schwartz, 1994). The monopolist makes take-it-or-leave-it offers to each firm in turn. If it were to sell the profit-maximizing quantity to the first, it would have an incentive to “secretly discount” (i.e., sell more than the profit-maximizing quantity, at a discount) to other downstream firms, as those later offers would not internalize any externality imposed on contracts already signed. For this reason, firms will not accept a contract consistent with industry profit maximization. If prices and quantities are unobservable, and if agents hold *passive beliefs*, implying that they do not revise their beliefs about prices and quantities in other contracts when they observe behavior that is off the equilibrium path, the only perfect Bayesian equilibrium is for the monopolist to offer Cournot quantities to all firms. In other words, each negotiating pair maximizes their profits, taking the negotiated quantity in the other agreement as given.

A similar set of outcomes arises in our bargaining environment. Bilateral Nash bargaining implies that each q_{ij} is chosen to maximize $\pi_i(.) - c_j(.)$, taking as given quantities chosen in other negotiations (by passive beliefs). When there were no competitive externalities, this choice did not impact upon the outcome of other negotiations; therefore each choice maximized industry profits. Similarly, in market structures where only one downstream firm is present, industry profits will still be maximized, as there are no competitive externalities. However, total industry profits will not be maximized overall when both downstream firms are present, as each negotiation imposes externalities on others. Let $\hat{\Pi}(.)$ represent equilibrium industry profits in that case. The following proposition summarises the equilibrium outcome:

Proposition 2. There exists a unique perfect Bayesian equilibrium with passive beliefs, under non-integration, regardless of whether there is upstream competition or monopoly, in which $\hat{\Pi}(\overline{D_1 D_2 U_A U_B})$, $\hat{\Pi}(\overline{D_1 D_2 U_A})$ and $\hat{\Pi}(\overline{D_1 D_2 U_B})$ are at their Cournot duopoly levels when upstream inputs are supplied on the basis of industry upstream marginal cost. For all other industry configurations, $\hat{\Pi}(.) = \Pi(.)$.

Proof. See the Appendix.

Our model yields the same conclusion reached in the contracting externalities literature, that under passive beliefs, Cournot outcomes will result. What is interesting here is that the outcome under an upstream monopoly where both assets are commonly owned is the same as that achieved when the upstream assets are independently held. Interestingly, this implies that an upstream (horizontal) merger does not change retail prices and welfare downstream in this setting. Because there is no negotiation involving residual claimants on the returns of both downstream assets, there is no negotiation in which the impact of a supply choice on both downstream firms is considered. Instead, in each negotiation the quantity supplied to one downstream firm is chosen holding supply to the other constant – yielding a Cournot equilibrium.

EXAMPLE: *Suppose that both downstream firms face linear demand,* $p_i = 1-(q_{iA}+q_{iB})-\gamma(q_{-iA}+q_{-iB})$ $(1\geq\gamma)$ *and have cost functions* $c_i(q_{iA},q_{iB})=\theta(q_{iA}-q_{iB})^2$ *(with* $1\geq\theta\geq 0$ *)*[18] *while upstream firms have symmetric cost functions,* $c_j(q_{1j}+q_{2j})=(q_{1j}+q_{2j})^2$. *The unique equilibrium under both upstream competition and monopoly involves both downstream firms being supplied* $\hat{q}_{ij}=\frac{1}{8+2\gamma}$ *by both upstream firms, generating profits of* $\hat{\Pi}(\overline{D_1D_2U_AU_B})=\frac{4}{(4+\gamma)^2}$ *; in contrast with the fully integrated monopoly outcome of* $q_{ij}^*=\frac{1}{8+4\gamma}$ *with* $\Pi(\overline{D_1D_2U_AU_B})=\frac{1}{4+2\gamma}$.

What happens when D_1 and U_A integrate? First, as in the no externality case, this eliminates certain market structures depending upon whether there has been FI or BI. Second, for those market structures that remain possible, equilibrium industry profits are unchanged for all market structures where one or more of D_1, D_2 and U_A are not present. That is, a change in equilibrium profits following integration requires the presence of both D_1 and U_A, and it is only where D_2 is also present that industry profits are not maximized under non-integration and integration alike.

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[18] This cost function is assumed as a very simple way to make upstream inputs imperfect substitutes in the eyes of downstream firms. It captures a notion of 'balance' and that to receive more inputs from one source than another would lead to some efficiency losses.

Third, the impact on equilibrium outcomes from integration is the same under both BI and FI. In each case, integration implies that the residual claimant on the profits of D_1 is the one negotiating the supply from U_A to D_2. Under both FI and BI, in negotiations over q_{2A}, the negotiated supply quantity maximizes $\pi_1(.) + \pi_2(.) - c_A(.)$. This is because the residual claimant on D_1's profits negotiates with D_2 over the supply from U_A to D_2. Nonetheless, negotiations that are internal to the integrated firm will still involve supply quantities chosen to maximize $\pi_i(.) - c_j(.)$. D_2 does not participate in those negotiations and hence, the impact on its profits is not considered.

Fourth, there is a difference between the impact of integration in the upstream competition and monopoly cases. Under upstream competition, negotiations over q_{2B} will still maximize $\pi_2(.) - c_B(.)$ whereas, under upstream monopoly, $\hat{q}_{2B} \in \arg\max_{q_{2B}} \pi_1(.) + \pi_2(.) - c_B(.)$. The fact that competitive externalities are internalized in two negotiations rather than one suggests that integration will allow an upstream monopolist to more easily restrict output and raise prices downstream. Given the general nature of profit and cost functions (and potential asymmetries between firms) assumed thus far, it is not possible to provide a simple proof of this.

Nonetheless, by imposing further restrictions, we can characterize the effects of integration on industry profits explicitly.

Proposition 3. Let $\hat{\hat{\Pi}}_{UC}(.)$ and $\hat{\hat{\Pi}}_{UM}(.)$ denote industry profits in any perfect Bayesian equilibrium with passive beliefs under integration by D_1 and U_A, for upstream competition and monopoly respectively. Assume that (1) D_1 and D_2 are symmetric and are indifferent to the source of supply; (2) each c_j has symmetric and weakly concave isoquants (for given total cost) in (q_{1j}, q_{2j}). Then,

(i) Industry profits are unchanged following integration under upstream competition; i.e., $\hat{\hat{\Pi}}_{UC}(\overline{D_1 D_2 U_A U_B}) = \hat{\Pi}(\overline{D_1 D_2 U_A U_B})$;

(ii) If D_1 and D_2 sell products that are perfect substitutes, then all externalities are internalized under market structures with an upstream monopoly; i.e.,

$$\hat{\hat{\Pi}}_{UM}(\overline{D_1 D_2 U_A U_B}) = \Pi(\overline{D_1 D_2 U_A U_B}) \text{ and } \hat{\hat{\Pi}}_{UM}(\overline{D_1 D_2 U_A}) = \hat{\hat{\Pi}}_{UC}(\overline{D_1 D_2 U_A}) = \Pi(\overline{D_1 D_2 U_A}).$$

Proof. See the Appendix.

Proposition 3 provides a sharp characterization of the outcomes in an environment where upstream competition is very strong (as upstream inputs are perfectly substitutable from the point of view of downstream firms). The concavity of upstream cost isoquants means that it is (weakly) cost minimizing for each upstream firm to supply a single downstream firm, under non-integration as well as integration. In the presence of upstream competition, therefore, all integration does is change supply relations, without changing the actual production or surplus generated. This leads to the interesting result that if a dedicated supply flow is optimal, there is no change in industry profits following integration (Result (i)).[19]

When downstream firms are perfect substitutes, we can further characterize the results. When there is an upstream monopolist– either U_A and U_B are owned by the same manager, or U_B has exited the market following breakdowns in negotiation, leaving U_A alone in the market – integration leads to *foreclosure* of the non-integrated firm, D_2. The monopoly quantity is supplied to D_1, and profits are thereby maximized.[20] It is important to note, however, that while it appears that foreclosure occurs here – as the independent downstream firm receives no inputs from its integrated rival – this does not necessarily mean that it receives no payment from the integrated firm (see below).

When D_1 and D_2 are not perfect substitutes, upstream firms reduce their supply to D_2 but do not necessarily foreclose. This is precisely the monopolization effect from integration first identified by HT that arises because the integrated firm internalizes its own competitive externality when negotiating with outside parties. Industry profits are not perfectly maximized, in

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[19] This also assists in comparing our results to those of other models in the literature. For instance, Chen (2001) assumes that there are switching costs associated with changing from dedicated suppliers. This means that inputs are not perfect substitutes for downstream firms; hence, integration has an impact on industry profits in Chen's model.

[20] In this respect, Proposition 3 is stated more strongly than necessary: no assumptions on upstream firms are necessary. It is only necessary for downstream firms to be perfect substitutes.

general, because the integrated firm does not take into account the externality it imposes on D_2.

More generally, when it comes to integration under upstream competition, the impact of integration on overall profits is often ambiguous. The main reason for this is that, while an upstream monopolist will necessarily take actions that realize productive efficiency for upstream supply, there is no similar control in upstream competition. While this did not matter under non-integration, by creating incentives for U_A to reduce its supply to D_2, integration creates the opposite incentives for U_B, who wants to expand supply to D_2. If downstream firms care about the source of input supply (i.e., do not view outputs from U_A and U_B as perfect substitutes), then these changes can increase industry costs and lead to a reduction in profits; a possibility we demonstrate in our running example below.

EXAMPLE (Continued): *When $\theta = 0$ (downstream firms are indifferent as to the source of input supply), vertical integration does not change the equilibrium outcome under upstream competition (as this involved each upstream firm supplying a single downstream firm); although U_A will be the sole supplier of D_1 (thus, $\hat{\hat{\Pi}}_{UC}(\overline{D_1 D_2 U_A U_B}) = \hat{\Pi}(\overline{D_1 D_2 U_A U_B})$). For upstream monopoly, as all supply is controlled by the owner of D_1, the impact of any supply to D_2 on D_1's profits will be internalised for that decision. In addition, it is easy to confirm that both downstream firms will continue to be supplied (each from one downstream asset); although there will be a contraction of supply to D_2 relative to the non-integrated case (thus, $\hat{\hat{\Pi}}_{UM}(\overline{D_1 D_2 U_A U_B}) = \frac{32-40\gamma+7\gamma^2+4\gamma^3}{2(2\gamma^2+3\gamma-8)^2}$).*

When $\theta > 0$, integration changes industry profits under both upstream monopoly and upstream competition. In each case, there is an overall reduction in output with D_1 having a higher output than D_2. Figure 3(a) shows what happens to industry profits when $\theta = \frac{1}{2}$ and Figure 3(b) shows what happens to consumer surplus (as defined as the unweighted sum of consumer surpluses from both markets). Note that $\hat{\hat{\Pi}}_{UM}(\overline{D_1 D_2 U_A U_B}) > \hat{\Pi}(\overline{D_1 D_2 U_A U_B}) > \hat{\hat{\Pi}}_{UC}(\overline{D_1 D_2 U_A U_B})$ (for θ high enough) while for consumer surplus non-integration provides the best outcome and integration by an upstream monopolist is the worst. Overall total welfare follows the consumer surplus ranking. Nonetheless, consumers in D_1's (D_2's) market are better (worse) off under integration with an upstream monopoly than the upstream competition case.

Distribution. In solving for the equilibrium payoffs under competitive externalities, there arises the important issue of what SZ term '*feasibility*.' An equilibrium is feasible if there is no incentive for an individual party to precipitate a breakdown in any negotiating pair at any stage (i.e., in any market structure that might have emerged). Under competitive externalities feasibility cannot be guaranteed.

To see this, consider a situation where a single upstream firm, U_A, is negotiating with two non-integrated downstream firms. If both negotiating pairs agree, then they divide up $\hat{\Pi}(D_1D_2U_A)$ with:

$$v_{U_A} = \tfrac{1}{6}\left(2\hat{\Pi}(D_1D_2U_A) + \Pi(D_1U_A) + \Pi(D_2U_A)\right),\ v_{D_1} = \tfrac{1}{6}\left(2\hat{\Pi}(D_1D_2U_A) + \Pi(D_1U_A) - 2\Pi(D_2U_A)\right),$$
$$v_{D_2} = \tfrac{1}{6}\left(2\hat{\Pi}(D_1D_2U_A) - 2\Pi(D_1U_A) + \Pi(D_2U_A)\right).$$

However, suppose that U_A negotiated with D_1 followed by D_2, then by refusing to negotiate with D_1 and causing an eventual breakdown, U_A would receive $\tfrac{1}{2}\Pi(D_2U_A)$ from an agreement with D_2 alone. If $\Pi(D_2U_A) - \tfrac{1}{2}\Pi(D_1U_A) > \hat{\Pi}(D_1D_2U_A)$, both U_A and D_1 would prefer a breakdown to an agreement and hence, an equilibrium involving both downstream firms being active would not be possible. Observe that this preference would not occur in the absence of externalities.[21]

For the remainder of this paper, we will assume that the feasibility conditions hold regardless of the level of integration. Nonetheless, we can show that there exist reasonable conditions on market outcomes that generate feasible outcomes (including our running example; see de Fontenay and Gans, 2003b).

Given feasibility, we can demonstrate the following:

Proposition 4. In a perfect Bayesian equilibrium with passive beliefs, each firm receives the payoffs listed in Table 2.

Proof. See the Appendix.

The payoffs in Table 2 are particularly interesting: they are not classical Shapley values. First,

[21] Note that, in contrast to other papers on competitive externalities such as Hart and Tirole (1990), Rey and Tirole (2003) and Chemla (2003), we allow the upstream firm to exclude one downstream firm or the other. What constrains the incentive to exclude, however, is that after triggering a breakdown the upstream firm would face only a single downstream firm, with greater bargaining power as a result. The upstream firm trades off competitive externalities against the loss in bargaining power.

surplus is not maximized because payoffs reflect the presence of externalities. Second, the distribution of the surplus generated does not take a Shapley form. For example, payoffs are a function of $\hat{\Pi}(\overline{D_1U_A}, \overline{D_2U_B})$, the profit earned by U_A and D_1 jointly when U_A supplies D_1, and they face competing supply in the downstream market from D_2, supplied by U_B. In contrast, Shapley values do not allow one's payoff to depend on the configuration of players that one is not cooperating with.[22] In effect these payoffs are allowing for the effect of competitive externalities. Notice that when there are no externalities, the payoffs in Table 2 collapse to Shapley values (as in Table 1); that is, profits are maximized under all market structures and, say, $\hat{\Pi}(\overline{D_1U_B}, \overline{D_2U_A}) = \Pi(\overline{D_1U_B})$.

Notice, however, that the Shapley value-type solution arises naturally in the upstream monopoly case. In that situation, U_B can never produce independently of U_A, so the types of partitions that arise for the upstream competition case are ruled out. Thus, competitive externalities do not change the payoffs of each agent under upstream monopoly; save for the fact that industry profits are not maximized where both downstream firms are present.

Comparing Incentives for FI and BI. In Section 3, we asked whether the acquiring firm in vertical integration would come from the more or less competitive vertical segment. From Table 2, we can see that FI will be preferred to BI, under either upstream competition or monopoly, if and only if $\hat{\Pi}(\overline{D_1D_2U_B}) \geq \Pi(\overline{D_2U_AU_B})$. This corresponds to the comparison made for the no externalities case except that here the left hand side takes into account the fact that when downstream outputs are substitutes in the eyes of consumers, industry profits will be lower as a result of their competition. Indeed, the more substitutable are downstream outputs in the eyes of consumers (intensifying Cournot competition under non-integration), the more likely it is that a

[22] The payoffs here are related to cooperative games in partition function form (see Myerson (1980) for a discussion). The precise relationship of the payoffs here with cooperative game theory is derived in de Fontenay and Gans (2004c).

downstream firm will acquire upstream assets. Hence, our conclusion that the acquirer will come from the more competitive vertical segment is strengthened when there are competitive externalities.

At this stage it is also instructive to consider the relative impacts of FI and BI on outsiders. Recall that, in general, research on the anticompetitive effects of vertical integration have not distinguished between the type of integration. While our analysis demonstrates that FI and BI have the same impact on total surplus, it also highlights their differential impact on bargaining positions; especially for outsiders.

Table 3 lists the benefits to outsiders from integration by D_1 and U_A for a situation where upstream and downstream firms are symmetric and the conditions of Proposition 3 hold. In that case, FI always improves D_2's payoff, whether the acquirer of D_1 is an upstream competitor or monopolist. Essentially, any reduction in bargaining position is outweighed by the potential increase in industry profits. Thus, it is BI that would raise concerns for exit by D_2; indeed, when there are no competitive externalities, D_2's payoff is reduced by BI. In contrast, from upstream competition, FI reduces U_B's payoff; causing more concern regarding its potential exit than would be the case for BI. Thus, the FI-BI distinction can matter for antitrust analysis if potential exit of an outsider is an issue for evaluation.

Comparing Upstream Competition and Monopoly. The central question being considered in this paper is whether it is indeed the case that there is more incentive for vertical integration when there is upstream monopoly rather than upstream competition. When there are no competitive externalities, we concluded that due to pure bargaining effects, the greatest potential for purely strategic vertical integration arose under upstream competition rather than upstream monopoly.

When there are competitive externalities, vertical integration involves a monopolization effect and consequent welfare harm. In the special case of Proposition 3, this effect was stronger when there was a vertically integrated upstream monopolist rather than an upstream competitor.

Nonetheless, using Table 2, we can compare the incentives for welfare-reducing vertical integration in each case.

Proposition 5. The increase in the joint payoff of D_1 and U_A from both FI and BI under upstream competition will exceed that achieved under upstream monopoly if and only if $\frac{1}{3}\left(\hat{\Pi}(\overline{D_1 D_2 U_B}) - \Pi(\overline{D_2 U_B})\right) \geq \hat{\hat{\Pi}}_{UM}(\overline{D_1 D_2 U_A U_B}) - \hat{\hat{\Pi}}_{UC}(\overline{D_1 D_2 U_A U_B})$.

The left hand side of the inequality in the proposition comes from the fact that the bargaining effect from vertical integration is stronger under upstream competition than monopoly. On the other hand, an upstream monopoly is able to use vertical integration more effectively to increase industry profits; thus, the monopolization effect weakens the relative incentives of an upstream competitor to vertically integrate.

Propositions 3 and 5 demonstrate that if downstream firms sell perfectly substitutable products, the conventional wisdom regarding the impact of upstream competition on the incentive to integrate is likely (although not guaranteed) to hold. In that case, the left hand side of the inequality in Proposition 5 is at its lowest while the right hand-side is at its highest possible level; as the upstream monopolist can achieve an industry monopoly outcome when it integrates while under upstream competition, integration leaves industry profits unchanged.

Nonetheless, as downstream products become less substitutable, it is likely that the reverse will be the case. Indeed, we know (from Section 3) that in the extreme – where downstream firms operate in separate markets – there is a greater incentive to integrate under upstream competition. This suggests that as the degree of downstream product differentiation becomes sufficiently high, the conventional wisdom will be overturned (something that can easily be verified for our earlier example, de Fontenay and Gans, 2003b).

Integration and Foreclosure. It is worth emphasizing that the foreclosure effects of integration on non-integrated firms differ in a subtle but important way from previous studies. An interesting feature of the upstream monopoly case is that, under the assumption of perfect symmetry and substitutability upstream and downstream, vertical integration leads to the monopoly output industry-wide. In that case, D_2 is not supplied any inputs and hence, does not produce, leaving D_1 to supply the monopoly quantity downstream. However, under FI, D_2 does receive a payoff of:

$$v_{D_2}(FI) = \tfrac{1}{12}\left(\Pi(\overline{D_1 D_2 U_A U_B}) - \Pi(\overline{D_i U_j})\right).$$

The reason for this is that even though D_2 plays no actual productive role, it does provide the integrated firm owner (in its internal negotiations under FI) an outside option in case of a bargaining breakdown with D_1.[23] Thus, while there is *technical* foreclosure in terms of the elimination of downstream competition, U_A still cedes rents to D_2 so as to improve its bargaining position with respect to D_1's manager.[24]

5 Counter-Mergers

To date, our analysis has focused on consideration of the incentives and effects of a single vertical merger between U_A and D_1. While this might be appropriate in situations where merger opportunities are limited (for instance, due to a need for technological or organizational compatibility or some other legal restraint), in other situations the possibility of a counter-merger

[23] A lump sum payment from upstream firms to D_2, without any corresponding input supply, might be seen as strange. The solution here can be approximated, however, by some arbitrarily small input supply to D_2.

[24] When upstream firms have constant costs (as in HT's 'Ex Post Monopolization' variant) but, say, U_A's costs are lower than U_B's, then U_B does not supply either downstream firm under non-integration or integration. However, while in HT, this implies that U_B receives no payoff, here that is only the case under upstream monopoly. Under upstream competition, so long as U_B is not too inefficient, U_B receives a payment from D_1 (or the integrated firm) so as to improve its bargaining position in the event of an internal breakdown. However, it always receives a payment from D_2. Hence, even with FI, U_B may not wish to exit the industry. This result is very similar to Stole and Zwiebel (1996) who find that a firm will employ more workers than would be efficient in order to reduce the bargaining position of all its workers. Here, however, while an essentially inactive firm might receive a payment, it is not in the payer's interest to require that firm produce. In the Stole and Zwiebel case, it remains in the interests of the firm to utilize all employed workers in production (implicitly assuming that inactive workers lose their skills). If a pool of inactive, skilled replacement workers was always available this would change that result (de Fontenay and Gans, 2003a).

remains and such mergers are observed (Scherer and Ross, 1990).

Two related issues arise in this regard. First, are participants to a counter-merger reacting to the initial merger or would they have chosen this course independently? That is, is there a *bandwagon effect* associated with vertical integration? Second, does the possibility of a counter-merger alter the incentives for the initial merger? We analyze each of these questions in turn. As the possibility of a counter-merger is most salient when rival firms are similarly placed to the initial merging parties, we will assume throughout this section that upstream and downstream firms are *symmetric*.[25]

Are there bandwagon effects from vertical integration? Here we explore whether an initial merger may encourage or discourage further mergers. One measure of this type of interrelationship is to compare the follow-on incentive for a merger (that is, the increase in joint payoff for, say, U_B and D_2 if their merger follows that of U_A and D_1) with their incentive for a stand-alone merger (presuming that U_A and D_1 remain vertically separated). As will be demonstrated when we look at the full equilibrium below, if the follow-on incentive for a merger is greater than the stand-alone incentive, we can conclude that positive bandwagon effects exist; that is, an initial merger may precipitate further mergers in the industry.[26]

Suppose that following forward or backwards integration by U_A and D_1, U_B and D_2 integrate in the *same* fashion. The impact of counter-mergers is only relevant in the upstream competition case. The payoffs following a counter-merger are as in Table 3 where NI, PI and CI

[25] This assumption is made for simplicity of exposition and can easily be relaxed (de Fontenay and Gans, 2003b).

[26] The past literature is divided on whether bandwagon effects arise. Some researchers examining the possibility of vertical foreclosure have constructed models whereby vertical integration reduces incentives for further integration (Ordover, Saloner and Salop, 1990; Choi and Yi, 2000; and Chen, 2001). They demonstrate that potential negative externalities motivating initial integration are not present for later integration as such integration may 're-symmetrize' competition and trigger a strong competitive response. In contrast, HT and McLaren (2000) provide models whereby initial integration by exacerbating 'hold-up' problems for non-integrated firms raises the incentives for further vertical integration.

are the states of non-integration, partial integration by either pair and 'complete' integration by both pairs, respectively.[27] The stand-alone incentives for U_B and D_2 to integrate (absent a similar merger by U_A and D_1) are:

$$S_{B2} \equiv \tfrac{1}{2}\left(\hat{\hat{\Pi}}_{PI}(\overline{D_1 D_2 U_A U_B}) - \hat{\Pi}_{NI}(\overline{D_1 D_2 U_A U_B})\right) + \tfrac{1}{6}\omega(s) \qquad (3)$$

where

$$\omega(BI) = \hat{\hat{\Pi}}_{PI}(\overline{D_1 D_2 U_j}) - \hat{\Pi}_{NI}(\overline{D_1 D_2 U_j}) + \Pi(\overline{D_i U_A U_B}) - \Pi(\overline{D_i U_j})$$

$$\text{and } \omega(FI) = \hat{\hat{\Pi}}_{PI}(\overline{D_1 D_2 U_j}) - \Pi(\overline{D_i U_j}) .$$

In contrast, the incentive for a counter-merger (that is, the increase in the joint payoff to U_B and D_2 from CI over PI by U_A and D_1) is:

$$F_{B2} \equiv \tfrac{1}{2}\left(\hat{\hat{\Pi}}_{CI}(\overline{D_1 D_2 U_A U_B}) - \hat{\hat{\Pi}}_{PI}(\overline{D_1 D_2 U_A U_B})\right) + \tfrac{1}{6}\omega(s) \qquad (4).$$

There is a positive bandwagon effect if $F_{B2} > S_{B2}$. Regardless of whether there is BI or FI, this will occur if:

$$\hat{\Pi}_{CI}(D_1 D_2 U_A U_B) - \hat{\Pi}_{PI}(D_1 D_2 U_A U_B) > \hat{\Pi}_{PI}(D_1 D_2 U_A U_B) - \hat{\Pi}_{NI}(D_1 D_2 U_A U_B) \qquad (5).$$

That is, if the marginal increase in industry profits from moving to CI from PI is higher than that to PI from NI. If the inequality in (5) is reversed, then there is a negative bandwagon effect and the incentives for a counter-merger are reduced by the occurrence of an initial merger.

Observe that this bandwagon effect collapses to 0 when there are no competitive externalities or the conditions of Proposition 3 hold. In these cases, U_B and D_2's incentives to merge are unchanged by what U_A and D_1 may have done. The reason is that, in this case, the only impact from vertical integration comes from bargaining effects. In particular, integration by U_B and D_2 only rules out possible market structures that involve profits that are the same regardless

[27] The payoffs in Table 3 are calculated using the same procedure as in Table 2 (as documented in the proof of Proposition 4). As before, we need to make an assumption as to what would happen if negotiations broke down between the downstream unit of one firm and the other integrated firm. Analogous to our earlier assumption, we assume that in this case, no negotiations between the two firms would be possible – that is, the downstream unit of the other firm would not be able to purchase inputs outside their firm.

of whether U_A and D_1 are integrated or not. Thus, the return to integration does not depend on prior integration.

When there is an impact on total profits from integration, bandwagon effects are possible. However, it is possible that integration could reduce industry profits. In this case, an initial merger may reduce the incentives for a second merger.

EXAMPLE (Continued): *In our running example, Figure 4 illustrates the size of the bandwagon effect. The graph assumes that downstream firms care about the source of inputs ($\theta = 1$). The bandwagon effect becomes negative as product differentiation is reduced so that a first merger reduces incentives for a second parallel one.*

How does the possibility of a counter-merger impact on initial merger incentives? Our analysis in Sections 3 and 4 has demonstrated that a merger between U_A and D_1 can harm one or both of the remaining firms (at least insofar as bargaining effects are concerned). It is conceivable that U_B and D_2 will have an opportunity to respond to the merger by themselves integrating; perhaps mitigating any bargaining advantage U_A and D_1 were expecting to receive.

The effect of counter-mergers on any resulting 'asset market equilibrium' has received some attention in the literature on vertical foreclosure. Here we consider the 'reduced form' game of HT and use it to evaluate whether an initial merger will still proceed if a counter-merger is possible.[28]

HT assume that (i) U_A can only merge with D_1 and U_B with D_2; (ii) integration is irreversible; and (iii) if one merger occurs the other pair can also follow suit prior to any bargaining or production. This last assumption is a critical one, allowing rival firms to respond quickly to a merger by others; thereby, raising the incentives for and potential deterrent effect of a counter-merger. Effectively, it corresponds to an extensive form game where each pair

[28] A comparison with Ordover, Saloner and Salop (1990)'s reduced form game is contained in de Fontenay and Gans (2003b). Bolton and Whinston (1993) and Gans (2004) also consider market-based allocations of asset ownership. Those papers highlight the difficulties of providing general solutions given the nature of ownership externalities. For this reason we focus here to more specific merger games; illustrating the possible effects of counter-mergers rather than general asset market equilibrium.

simultaneously chooses whether to merge or not. If one pair does but the other does not, the latter has a further opportunity to merge but if neither chooses to merge, no further merger is possible.

To see how this applies to our model, suppose that U_A and D_1 always have a stand-alone incentive to integrate ($S_{A1} > 0$). In this case, if $F_{B2} \leq 0$, then there will be a subgame perfect equilibrium involving partial integration by U_A and D_1. Notice that, by symmetry, a necessary condition for this to be the case is that there are negative bandwagon effects (i.e., (5) does not hold). For this equilibrium, all of the analysis in Sections 3 and 4 holds even when a counter-merger is possible. Nonetheless, this equilibrium involving partial integration is ruled out if either there are no externalities or the conditions of Proposition 3 hold as $F_{B2} = S_{B2} > 0$ in this case. In the no externality case, for example, integration results in pure rent distribution so that whenever there is a gain from an initial stand-alone merger, there must also be a similar offsetting gain from a counter-merger.

Both non-integration and complete integration (with two vertical mergers) are also possible equilibrium outcomes if $F_{A1}, F_{B2} > 0$. In the CI equilibrium, both pairs merge initially and neither gains an advantage from (nor can commit to) not merging at all given the merger of their rivals. An NI equilibrium can co-exist with this one if pairs prefer NI to CI; that is, neither pair merges initially (and so there is no second period merger possibility) and each knows that if it does merge the other will counter-merge, resulting in CI.

Looking at the CI equilibrium, if $F_{B2} > 0$ (and by symmetry, $F_{A1} > 0$) then these become the relevant incentives for integration under upstream competition. Comparing this with the incentives for the integration of a single downstream firm under upstream monopoly, both BI and FI are more likely to occur under upstream competition if:

$$\begin{aligned} &\tfrac{1}{6}\left(\hat{\Pi}(\overline{D_1 D_2 U_j}) - \Pi(\overline{D_i U_j})\right) \\ &> \tfrac{1}{2}\left(\hat{\hat{\Pi}}_{UM}(\overline{D_1 D_2 U_A U_B}) - \hat{\Pi}(\overline{D_1 D_2 U_A U_B}) - \hat{\hat{\Pi}}_{CI}(\overline{D_1 D_2 U_A U_B}) + \hat{\hat{\Pi}}_{PI}(\overline{D_1 D_2 U_A U_B})\right) \end{aligned} \tag{6}$$

The LHS differs from the condition in Proposition 5. It is easy to see that the LHS of (6) is lower if (5) holds; that is, if there are positive bandwagon effects. In this case, the incentives to integrate under upstream competition continue to be greater than those under upstream monopoly. Notice that under the conditions of Proposition 3 or if there are no competitive externalities, then both conditions are equivalent and the incentive for BI and FI under a scenario leading to complete integration is no different from the stand-alone merger incentives.

In summary, our previous analysis of the relative incentives for integration from upstream competition as opposed to monopoly are generally robust to the inclusion of the possibility of a counter-merger. In terms of welfare effects, CI tends to lead to higher prices and lower consumer surplus than (and potentially lower profits) PI or NI, although higher consumer surplus than integration in upstream monopoly. Again this can be easily verified using our earlier example.

6 Conclusions

This paper has sorted out alternative claims regarding the impact of upstream competition on the incentives and consequences for vertical integration. While vertical integration that occurs when there is an upstream monopoly has the greatest potential to cause higher prices and lower consumer welfare, this need not translate into greater incentives for purely strategic vertical integration. Specifically, those incentives may be higher when there is upstream competition (especially if downstream competition is not too intense) and may be higher for backward integration (from the competitive into the monopolistic segment) than for forward integration (akin to the more conventional picture of an acquiring monopolistic firm).

In terms of competition and anti-trust analysis, our results support the notion that proposed vertical mergers involving a monopoly bottleneck are of greater concern than where there is upstream competition. Nonetheless, in terms of policies designed to restructure industries and encourage upstream competition (such as those that have occurred in cable television and telecommunications), the potential gains associated with these moves may be mitigated as it could encourage greater strategic vertical integration.

Nonetheless, while our model has synthesized and generalized existing models in the strategic vertical integration literature – as well as providing a framework linking these to models in the property rights literature – there are many possible extensions such as considering investment effects. Moving beyond the simple 2 by 2 case would be useful. This could be done by expanding the number of upstream and downstream assets as well as deepening the vertical chain of production. This would allow a mapping between our work and the work of Hendricks and McAfee (2000) who provide (based on a mechanism design approach) a means of linking concentration measures and integration in vertical segments with the potential for anticompetitive harm from a merger.

Appendix

Proof of Propositions 1, 2 and 4. The key to the proof lies in several steps. First, we demonstrate that the solution to our extensive form game are equations of the form specified by the bilateral Nash bargaining solution, for each pair, in each subgame of a given supply configuration. Second, we demonstrate that, given this, the surplus generated in each subgame is to maximize industry profits (if there are no competitive externalities in that subgame) or the Cournot outcome (if there are competitive externalities). Finally, we demonstrate that the realized payoffs are as listed in Tables 1 and 2.

Step 1 (Bilateral Bargaining Outcomes): We wish to demonstrate that, say, $(\tilde{p}_{1A}, \tilde{q}_{1A})$ satisfy:

$$\tilde{q}_{1A} \in \arg\max_{q_{1A}} \pi_1(q_{1A}, q_{1B}, q_{2A}, q_{2B}) - c_A(q_{1A}, q_{2A}) \tag{A7}$$

and $\tilde{p}_{1A} \in \left\{ p_{1A} \middle| \pi_1(\tilde{q}_{1A}, q_{1B}, q_{2A}, q_{2B}) - p_{1A} - p_{1B} - \Phi_{1A} = p_{1A} + p_{2A} - c_A(\tilde{q}_{1A}, q_{2A}) - \Phi_{A1} \right\}$

where Φ_{1A} and Φ_{A1} represent the payoffs D_1 and U_A expect to receive in the renegotiation subgame triggered by a breakdown in their negotiations. Pairwise bargaining takes an alternating offer format. To fix ideas, suppose that D_i makes the first offer that U_j chooses to accept or reject. If the offer is accepted, the negotiation ends on the basis of that offer and the game moves on to the next negotiating pair or ends as the case may be. If it is rejected, then with probability (1-σ) the negotiation ends with no supply taking place between the pair and the game moves on to the next negotiating pair. With probability σ, however, U_j is able to make a counter-offer that may be accepted or rejected on the same basis as D_i's original offer. Offers alternate until one is accepted or there is an exogenous breakdown in negotiations. This format is the same as Binmore, Rubinstein and Wolinsky (1986) for bilateral negotiations. The subtlety here comes from the potential interrelationships between negotiations in a given sequence.

Let $(\tilde{p}_{ij}, \tilde{q}_{ij})$ be the actual outcomes of negotiations between D_i and U_j and $(\hat{p}_{ij}, \hat{q}_{ij})$ be the beliefs of downstream firms other than *i* and upstream firms other than *j* about the outcomes of those negotiations. Clearly for firms that were part of a particular negotiation, $(\hat{p}_{ij}, \hat{q}_{ij}) = (\tilde{p}_{ij}, \tilde{q}_{ij})$. Otherwise, we assume that the agents hold passive beliefs.

Rey and Verge (2002) provide a definition of passive beliefs that we rely upon here. Here is a definition in relation to a given downstream firm, *i*. The converse definition for beliefs of upstream firms is analogous.

Definition (Passive Beliefs). Let $(\hat{p}_{ij}, \hat{q}_{ij})$ be *i* and *j*'s beliefs about the offer it expects to receive from j and let $(\hat{p}_{kj}, \hat{q}_{kj})$ be *i*'s beliefs about the agreements *j* will make with any other firm, $k \neq i$. When i receives an offer from *j* of $(p_{ij}, q_{ij}) \neq (\hat{p}_{ij}, \hat{q}_{ij})$, it believes that:

1. *j* expects it to accept this offer,
2. $(\hat{p}_{kj}, \hat{q}_{kj})$ will not change,
3. k reasons the same way.

Suppose first that U_A and D_1 are the last pair negotiating. One possible equilibrium outcome has U_A and D_1 accepting offers made to them. This requires that when D_1 makes an offer it solves:

$$\begin{aligned}&\max_{(p_{1A},q_{1A})} \pi_1(q_{1A},\tilde{q}_{1B},\hat{q}_{2A},\hat{q}_{2B}) - p_{1A} - \tilde{p}_{1B}\\ &\text{s.t. } p_{1A} + \hat{p}_{2A} - c_A(q_{1A},\hat{q}_{2A}) \geq \sigma\hat{V}_{U_A} + (1-\sigma)\Phi_{A1}\end{aligned} \qquad \text{(D1)}$$

where $\hat{V}_{U_A}$ is D_1's beliefs about U_A's expected payoff from an agreement (i.e., the solution to (UA) below). That is, it maximizes its payoffs subject to U_A accepting its offer. D_1 will choose p_{1A} so that U_A's participation constraint binds. Notice that U_A will only accept this offer if:

$$\tilde{p}_{2A} - c_A(q_{1A},\tilde{q}_{2A}) - \sigma\tilde{V}_{U_A} \geq \hat{p}_{2A} - c_A(q_{1A},\hat{q}_{2A}) - \sigma\hat{V}_{U_A} \qquad \text{(PC-UA)}$$

being U_A's equilibrium participation constraint where $\tilde{V}_{U_A}$ is U_A's expected payoff from an agreement.

In contrast, if U_A makes an offer it solves (where it knows that D_1 holds passive beliefs):

$$\begin{aligned}&\max_{(p_{1A},q_{1A})} p_{1A} + \tilde{p}_{2A} - c_A(q_{1A},\tilde{q}_{2A})\\ &\text{s.t. } \pi_1(q_{1A},\hat{q}_{1B},\hat{q}_{2A},\hat{q}_{2B}) - p_{1A} - \hat{p}_{1B} \geq \sigma\hat{V}_{D_1} + (1-\sigma)\Phi_{1A}\end{aligned} \qquad \text{(UA)}$$

However, D_1 will only accept this offer if:

$$\pi_1(q_{1A},\tilde{q}_{1B},\hat{q}_{2A},\hat{q}_{2B}) - \tilde{p}_{1B} - \sigma\tilde{V}_{D_1} \geq \pi_1(q_{1A},\hat{q}_{1B},\hat{q}_{2A},\hat{q}_{2B}) - \hat{p}_{1B} - \sigma\hat{V}_{D_1} \qquad \text{(PC-D1)}$$

Notice that the maximisation problems – (D1) and (UA) – imply that:

$$\begin{aligned}\tilde{V}_{D_1} &= \max_{q_{1A}} \pi_1(q_{1A},\tilde{q}_{1B},\hat{q}_{2A},\hat{q}_{2B}) - \tilde{p}_{1B} + \hat{p}_{2A} - c_A(q_{1A},\hat{q}_{2A}) - \sigma\hat{V}_{U_A} - (1-\sigma)\Phi_{A1}\\ \tilde{V}_{U_A} &= \max_{q_{1A}} \pi_1(q_{1A},\hat{q}_{1B},\hat{q}_{2A},\hat{q}_{2B}) - \hat{p}_{1B} + \tilde{p}_{2A} - c_A(q_{1A},\tilde{q}_{2A}) - \sigma\hat{V}_{D_1} - (1-\sigma)\Phi_{1A}\\ \hat{V}_{D_1} &= \max_{q_{1A}} \pi_1(q_{1A},\hat{q}_{1B},\hat{q}_{2A},\hat{q}_{2B}) - \hat{p}_{1B} + \hat{p}_{2A} - c_A(q_{1A},\hat{q}_{2A}) - \sigma\hat{V}_{U_A} - (1-\sigma)\Phi_{A1}\\ \hat{V}_{U_A} &= \max_{q_{1A}} \pi_1(q_{1A},\hat{q}_{1B},\hat{q}_{2A},\hat{q}_{2B}) - \hat{p}_{1B} + \hat{p}_{2A} - c_A(q_{1A},\hat{q}_{2A}) - \sigma\hat{V}_{D_1} - (1-\sigma)\Phi_{1A}\end{aligned}$$

There are four equations and four unknowns. Notice that the last two involve the same quantity choice (let this be $\hat{q}_{1A}$) while we denote the quantity choice in the first and second as $\tilde{q}_{1A}^1$ and $\tilde{q}_{1A}^A$, respectively. Solving the last two yields:

$$\begin{aligned}\hat{V}_{D_1} &= \tfrac{1}{1+\sigma}\left(\pi_1(\hat{q}_{1A},\hat{q}_{1B},\hat{q}_{2A},\hat{q}_{2B}) - \hat{p}_{1B} + \hat{p}_{2A} - c_A(\hat{q}_{1A},\hat{q}_{2A}) + \sigma\Phi_{1A} - \Phi_{A1}\right)\\ \hat{V}_{U_A} &= \tfrac{1}{1+\sigma}\left(\pi_1(\hat{q}_{1A},\hat{q}_{1B},\hat{q}_{2A},\hat{q}_{2B}) - \hat{p}_{1B} + \hat{p}_{2A} - c_A(\hat{q}_{1A},\hat{q}_{2A}) - \Phi_{1A} + \sigma\Phi_{A1}\right).\end{aligned}$$

Notice that these correspond to the payoff outcomes that would result from the conjectured bilateral bargaining outcome.

Given this (PC-UA) becomes:

$$\begin{aligned}&(1-\sigma)\tilde{p}_{2A} - c_A(\tilde{q}_{1A}^1,\tilde{q}_{2A}) - \sigma\left(\pi_1(\tilde{q}_{1A}^A,\hat{q}_{1B},\hat{q}_{2A},\hat{q}_{2B}) - c_A(\tilde{q}_{1A}^A,\tilde{q}_{2A})\right)\\ &\geq (1-\sigma)\hat{p}_{2A} - c_A(\tilde{q}_{1A}^1,\hat{q}_{2A}) - \sigma\left(\pi_1(\hat{q}_{1A},\hat{q}_{1B},\hat{q}_{2A},\hat{q}_{2B}) - c_A(\hat{q}_{1A},\hat{q}_{2A})\right)\end{aligned} \qquad \text{(PC-UAa)}$$

and (PC-D1) becomes:

$$\begin{aligned}&\pi_1(\tilde{q}_{1A}^A,\tilde{q}_{1B},\hat{q}_{2A},\hat{q}_{2B}) - \tilde{p}_{1B}(1-\sigma) - \sigma\left(\pi_1(\tilde{q}_{1A}^1,\tilde{q}_{1B},\hat{q}_{2A},\hat{q}_{2B}) - c_A(\tilde{q}_{1A}^1,\hat{q}_{2A})\right)\\ &\geq \pi_1(\tilde{q}_{1A}^A,\hat{q}_{1B},\hat{q}_{2A},\hat{q}_{2B}) - \hat{p}_{1B}(1-\sigma) - \sigma\left(\pi_1(\hat{q}_{1A},\hat{q}_{1B},\hat{q}_{2A},\hat{q}_{2B}) - c_A(\hat{q}_{1A},\hat{q}_{2A})\right)\end{aligned} \qquad \text{(PC-D1a)}$$

Re-arranging these constraints and taking the limit as σ approaches 1, it is easy to see that both inequalities will hold only if:

$$\begin{aligned}&\max[c_A(\tilde{q}_{1A}^1,\tilde{q}_{2A}) - c_A(\tilde{q}_{1A}^A,\tilde{q}_{2A}), \pi_1(\tilde{q}_{1A}^1,\tilde{q}_{1B},\hat{q}_{2A},\hat{q}_{2B}) - \pi_1(\tilde{q}_{1A}^A,\tilde{q}_{1B},\hat{q}_{2A},\hat{q}_{2B})]\\ &\leq \pi_1(\hat{q}_{1A},\hat{q}_{1B},\hat{q}_{2A},\hat{q}_{2B}) - c_A(\hat{q}_{1A},\hat{q}_{2A}) - \pi_1(\tilde{q}_{1A}^A,\hat{q}_{1B},\hat{q}_{2A},\hat{q}_{2B}) + c_A(\tilde{q}_{1A}^1,\hat{q}_{2A})\end{aligned}$$

Notice that if $\tilde{q}_{1A}^{1} = \tilde{q}_{1A}^{A} = \hat{q}_{1A}$ this holds with equality. This will occur if $\tilde{q}_{2A} = \hat{q}_{2A}$ and $\tilde{q}_{1B} = \hat{q}_{1B}$. Thus, the conjectured equilibrium for this negotiation is, in fact, an equilibrium outcome where any offer by any party is immediately accepted; that is, the parties receive $\hat{V}_{D_1}$ and $\hat{V}_{U_A}$, respectively. In this situation, the above bilateral bargaining outcomes will emerge, so long as the conjectured equilibrium outcomes result from all other bilateral negotiations.

We now consider whether there might be a deviation in an earlier negotiation. If there is such a deviation what does the equilibrium of the bilateral bargaining subgame become? Recall that:

$$\tilde{q}_{1A}^{1} = \arg\max_{q_{1A}} \pi_1(q_{1A}, \tilde{q}_{1B}, \hat{q}_{2A}, \hat{q}_{2B}) - c_A(q_{1A}, \hat{q}_{2A})$$

$$\tilde{q}_{1A}^{A} = \arg\max_{q_{1A}} \pi_1(q_{1A}, \hat{q}_{1B}, \hat{q}_{2A}, \hat{q}_{2B}) - c_A(q_{1A}, \tilde{q}_{2A})$$

Thus, if $\tilde{q}_{2A} = \hat{q}_{2A}$ but $\tilde{q}_{1B} \neq \hat{q}_{1B}$, then $\tilde{q}_{1A}^{A} = \hat{q}_{1A}$ and (PC-UAa) holds with equality (as σ goes to 1); so U_A will accept D_1's offer. However, (PC-D1a) becomes:

$$\pi_1(\hat{q}_{1A}, \tilde{q}_{1B}, \hat{q}_{2A}, \hat{q}_{2B}) - c_A(\hat{q}_{1A}, \hat{q}_{2A}) \geq \pi_1(\tilde{q}_{1A}^{1}, \tilde{q}_{1B}, \hat{q}_{2A}, \hat{q}_{2B}) - c_A(\tilde{q}_{1A}^{1}, \hat{q}_{2A})$$

which cannot be true by the definition of $\tilde{q}_{1A}^{1}$. Similarly, if $\tilde{q}_{1B} = \hat{q}_{1B}$ but $\tilde{q}_{2A} \neq \hat{q}_{2A}$, then $\tilde{q}_{1A}^{1} = \hat{q}_{1A}$ and (PC-D1a) holds with equality; so D_1 will accept U_A's offer. However, (PC-UAa) cannot hold by the definition of $\tilde{q}_{1A}^{A}$, so U_A will reject D_1's offer. Thus, an earlier deviation by a negotiating pair leads to an equilibrium in the bargaining game whereby one party accepts an offer while the other rejects and waits to make a counter-offer. The rejecting party is the party that was a party to an earlier deviation.

The question now becomes: anticipating this equilibrium outcome will an earlier deviation occur? Consider a deviation by D_1 and U_B. This results in D_1's offer of $\tilde{p}_{1A} = -\hat{p}_{2A} + c_A(\tilde{q}_{1A}^{1}, \hat{q}_{2A}) + \sigma\hat{V}_{U_A} + (1-\sigma)\Phi_{A1}$ being accepted by U_A. Because of passive beliefs, U_B will not deviate in its offers to D_1 as it perceives that this will not impact on the later negotiation between D_1 and U_A. In contrast, when D_1 makes an offer it anticipates the impact on the later negotiation when it solves:

$$\max_{q_{1B}} \pi_1(\tilde{q}_{1A}^{1}(q_{1B}), q_{1B}, \hat{q}_{2A}, \hat{q}_{2B}) - \underbrace{(-\hat{p}_{2A} + c_A(\tilde{q}_{1A}^{1}(q_{1B}), \hat{q}_{2A}) + \sigma\hat{V}_{U_A} + (1-\sigma)\Phi_{A1})}_{=\tilde{p}_{1A}} + \hat{p}_{2B} - c_B(q_{1B}, \hat{q}_{2B}) .$$

Notice that the impact on $\tilde{q}_{1A}^{1}$ is of second order, by the envelope theorem, and so the solution to this problem is $\hat{q}_{1B}$ (that is, there is no deviation from the conjectured equilibrium).

Now consider a deviation by D_2 and U_A. Substituting in U_A's offer to D_1, U_A will make an offer to D_2 that solves (assuming downstream firms make the first offer in any negotiation and D_2 continues to holds passive beliefs, $\hat{q}_{1A}$):

$$\max_{q_{2A}} \pi_2(\hat{q}_{1A}, \hat{q}_{1B}, q_{2A}, \hat{q}_{2B}) - \hat{p}_{2B} + \sigma(\underbrace{\pi_1(\tilde{q}_{1A}^{A}(q_{2A}), \hat{q}_{1B}, \hat{q}_{2A}, \hat{q}_{2B}) - \hat{p}_{1B} - \sigma\hat{V}_{D_1} - (1-\sigma)\Phi_{1A}}_{=\tilde{p}_{1A}}) - c_A(\tilde{q}_{1A}^{A}(q_{2A}), q_{2A})$$

Note that it is not necessary to consider the offer from D_2 as its beliefs have not changed. The first order condition involves:

$$\frac{\partial \pi_2(\hat{q}_{1A}, \hat{q}_{1B}, q_{2A}, \hat{q}_{2B})}{\partial q_{2A}} - \frac{\partial c_A(\tilde{q}_{1A}^{A}(q_{2A}), q_{2A})}{\partial q_{2A}} + \underbrace{\frac{d\tilde{q}_{1A}^{A}(q_{2A})}{dq_{2A}}}_{<0}\left(\frac{\partial \pi_1(\tilde{q}_{1A}^{A}(q_{2A}), \hat{q}_{1B}, \hat{q}_{2A}, \hat{q}_{2B})}{\partial q_{1A}} - \frac{\partial c_A(\tilde{q}_{1A}^{A}(q_{2A}), q_{2A})}{\partial q_{1A}}\right) = 0 \cdot$$

Evaluate this at $q_{2A} = \hat{q}_{2A}$ (as defined by the equivalent condition to (A7)) gives:

$$\underbrace{\frac{\partial \pi_2(\hat{q}_{1A},\hat{q}_{1B},\hat{q}_{2A},\hat{q}_{2B})}{\partial q_{2A}} - \frac{\partial c_A(\tilde{q}^A_{1A}(q_{2A}),\hat{q}_{2A})}{\partial q_{2A}}}_{=0} + \underbrace{\frac{d\tilde{q}^A_{1A}(q_{2A})}{dq_{2A}}}_{<0}\left(\underbrace{\frac{\partial \pi_1(\hat{q}_{1A},\hat{q}_{1B},\hat{q}_{2A},\hat{q}_{2B})}{\partial q_{1A}} - \frac{\partial c_A(\hat{q}_{1A},\hat{q}_{2A})}{\partial q_{1A}}}_{=0}\right) = 0.$$

Thus, even anticipating the outcomes from a deviation, U_A does not find it profitable to deviate from the proposed equilibrium.

It is easy to see that the logic used here did not rely on U_A and D_1's actual place in the sequence of negotiations. Hence, under passive beliefs, the Binmore, Rubinstein, Wolinsky (1986) outcomes for bilateral negotiations continues to hold in this case. Moreover, the situation where there are four supply negotiations can be readily derived for the three and two negotiation case.

Step 2 (Surplus): The above analysis demonstrates that in an individual bilateral negotiation, quantity will be chosen to maximize the joint profits of each negotiating pair, taking the outcomes of other negotiations as given. That is, $q^*_{ij} \in \arg\max_{q_{ij}} \pi_i(q_{iA},q_{iB},q_{-iA},q_{-iB}) - c_j(q_{1j},q_{2j})$. If there are no competitive externalities downstream and quantities can be renegotiated in any breakdown subgame, under passive beliefs, these are the only terms in industry profits containing q_{ij}; hence, if all negotiating pairs choose their respective quantities to maximize joint profits, by our concavity assumptions, industry profits will be maximized. This establishes efficiency for the no externality case (Proposition 1).

When there are competitive externalities, each pair chooses a quantity that maximizes joint profits taking the quantities chosen in other pairs as given. However, these quantities are chosen in a manner that equates marginal downstream profit to marginal upstream cost. Note that if instead downstream firms chose their quantities based on a per unit upstream price, say ρ_{ij}, they would choose their quantities to satisfy $\frac{\partial \pi_i}{\partial q_{ij}} = \rho_{ij}$. If $\rho_{ij} = \frac{\partial c_j}{\partial q_{ij}}$, then this will yield the same outcome as in each negotiation (establishing Proposition 2).

Under integration the quantities change for negotiations between D_2 and U_A. In this case, maximizing bilateral surplus is equivalent to: $\max_{q_{2B}} \pi_2(q_{1A},q_{1B},q_{2A},q_{2B}) + \pi_1(q_{1A},q_{1B},q_{2A},q_{2B}) - c_A(q_{1A},q_{2A})$. The form of the quantity choice problems in the other negotiations will be unchanged. However, the change in one negotiation may lead to different quantities in equilibrium.

Step 3 (Distribution): For distribution, given passive beliefs, in the initial subgame, there are four bargaining pairs, the pricing outcomes of which are described by the following equations (as σ goes to 1).

$$\pi_1(q_{1A},q_{1B},q_{2A},q_{2B}) - \tilde{p}_{1A} - \tilde{p}_{1B} - \Phi_{1A} = \tilde{p}_{1A} + \tilde{p}_{2A} - c_A(q_{1A},q_{2A}) - \Phi_{A1} \quad \text{(A8)}$$

$$\pi_1(q_{1A},q_{1B},q_{2A},q_{2B}) - \tilde{p}_{1A} - \tilde{p}_{1B} - \Phi_{1B} = \tilde{p}_{1B} + \tilde{p}_{2B} - c_B(q_{1B},q_{2B}) - \Phi_{B1} \quad \text{(A9)}$$

$$\pi_2(q_{1A},q_{1B},q_{2A},q_{2B}) - \tilde{p}_{2A} - \tilde{p}_{2B} - \Phi_{2A} = \tilde{p}_{1A} + \tilde{p}_{2A} - c_A(q_{1A},q_{2A}) - \Phi_{A2} \quad \text{(A10)}$$

$$\pi_2(q_{1A},q_{1B},q_{2A},q_{2B}) - \tilde{p}_{2A} - \tilde{p}_{2B} - \Phi_{2B} = \tilde{p}_{1B} + \tilde{p}_{2B} - c_B(q_{1B},q_{2B}) - \Phi_{B2} \quad \text{(A11)}$$

where Φ_{ij} and Φ_{ji} represent the payoffs D_i and U_j expect to receive in the renegotiation subgame triggered by a breakdown in their negotiations. Solving these equations recursively, including the payoffs of each renegotiation subgame, allows us to derive the equilibrium payoffs of each firm as in Table 2 (Proposition 4).

Under integration, the equations change. For example, for FI, the resulting (Nash) bargaining equations for price become:

$$\tilde{t}_{1A} - \Phi_{1A} = \pi_1(q_{1A}, q_{1B}, q_{2A}, q_{2B}) - \tilde{t}_{1A} - \tilde{p}_{1B} + \tilde{p}_{2A} - c_A(q_{1A}, q_{2A}) - \Phi_{A1} \quad \text{(A12)}$$

$$\pi_1(q_{1A}, q_{1B}, q_{2A}, q_{2B}) - \tilde{t}_{1A} - \tilde{p}_{1B} + \tilde{p}_{2A} - c_A(q_{1A}, q_{2A}) - \Phi_{AB} = \tilde{p}_{1B} + \tilde{p}_{2B} - c_B(q_{1B}, q_{2B}) - \Phi_{BA} \quad \text{(A13)}$$

$$\pi_2(q_{1A}, q_{1B}, q_{2A}, q_{2B}) - \tilde{p}_{2A} - \tilde{p}_{2B} - \Phi_{2A} = \pi_1(q_{1A}, q_{1B}, q_{2A}, q_{2B}) - \tilde{t}_{1A} - \tilde{p}_{1B} + \tilde{p}_{2A} - c_A(q_{1A}, q_{2A}) - \Phi_{A2} \quad \text{(A14)}$$

$$\pi_2(q_{1A}, q_{1B}, q_{2A}, q_{2B}) - \tilde{p}_{2A} - \tilde{p}_{2B} - \Phi_{2B} = \tilde{p}_{1B} + \tilde{p}_{2B} - c_B(q_{1B}, q_{2B}) - \Phi_{B2} \quad \text{(A15)}$$

Notice that there is a change in negotiating pairs relative to the non-integrated case. U_A negotiates a supply agreement with U_B for the supply of inputs to D_1. This is because the residual control rights of the downstream asset have been transferred to U_A. Again, solving these equations recursively, including the payoffs of each renegotiation subgame, allows us to derive the equilibrium payoffs of each firm as in Table 2 (Proposition 4).

Contingent Contracts: Finally, we demonstrate that the above equilibrium is also an equilibrium when pairs can negotiate contracts contingent upon the breakdown of others. Suppose that U_A and D_1 were the first pair to negotiate and consider a situation where they expect other pairs to reach agreement so long as they themselves continue to reach agreement. Let $\left(\tilde{p}_{1A}(m), \tilde{q}_{1A}(m)\right)$ be the price and quantity pairs between U_A and D_1 contingent upon market structure, m. In this case, U_A and D_1 will choose quantities to maximise their bilateral surplus when $m = D_1 D_2 U_A U_B$. Moreover, under passive beliefs, for other market structures, any deviation from the equilibrium where they maximise their bilateral surplus given m will not improve their bilateral surplus in any other market structure. This is because a deviation on a contingency will not be observed by the other party on subsequent negotiations and will lead to the either the rejection equilibrium posited earlier or no agreement in that negotiation. Given feasibility, in either case, a deviation will reduce bilateral surplus. Hence, U_A and D_1 will not deviate from the conjectured equilibrium. Applying this logic to all four negotiations demonstrates that the equilibrium outcomes in Propositions 1, 2 and 4 are also equilibrium outcomes where pairs can negotiate binding breakdown contingent contracts.

Proof of Proposition 3. Suppose that $\pi_i(q_{iA}, q_{iB}, q_{-iA}, q_{-iB}) = P(q_{1A} + q_{1B}, q_{2A} + q_{2B})(q_{iA} + q_{iB})$. Then, under both upstream monopoly and competition, with non-integration, equilibrium quantities are determined by:

$$q_{1A} : \tfrac{\partial P}{\partial q_{1A}}(q_{1A} + q_{1B}) + P(.) \le \tfrac{\partial c_A}{\partial q_{1A}} \quad \text{(A16)}$$

$$q_{1B} : \tfrac{\partial P}{\partial q_{1B}}(q_{1A} + q_{1B}) + P(.) \le \tfrac{\partial c_B}{\partial q_{1B}} \quad \text{(A17)}$$

$$q_{2A} : \tfrac{\partial P}{\partial q_{2A}}(q_{2A} + q_{2B}) + P(.) \le \tfrac{\partial c_A}{\partial q_{2A}} \quad \text{(A18)}$$

$$q_{2B} : \tfrac{\partial P}{\partial q_{2B}}(q_{2A} + q_{2B}) + P(.) \le \tfrac{\partial c_B}{\partial q_{2B}} \quad \text{(A19)}$$

Suppose that each downstream firm was supplied positive input quantities from each upstream firm and each of the above conditions held with equality. Then, $q_{1A} + q_{1B}$ must equal $q_{2A} + q_{2B}$. Note that if, say, both q_{1A} and q_{1B} are strictly positive, both (A16) and (A17) hold with equality implying that $\tfrac{\partial c_A}{\partial q_{1A}} = \tfrac{\partial c_A}{\partial q_{2A}}$. This can only be true if isoquants are linear (in which case any combination of q_{1A} and q_{1B} satisfying $q_{1A} + q_{1B}$ is an equilibrium. If isoquants are strictly concave, then $\tfrac{\partial c_A}{\partial q_{1A}} \ne \tfrac{\partial c_A}{\partial q_{2A}}$ implying that either one of (A16) and (A17) hold with equality with the other being a strict inequality. Applying the same logic to D_2's inputs, an equilibrium outcome exists that involves $q_{2A} = q_{1B} = 0$ and $q_{1A} = q_{2B}$ at their Cournot equilibrium quantities with (A16) and (A19) holding with equality but (A17) and (A18) have a strict inequality if isoquants are strictly concave (as $\frac{\partial c_A}{\partial q_{1A}} < \frac{\partial c_A}{\partial q_{2A}}$ and $\frac{\partial c_B}{\partial q_{1B}} < \frac{\partial c_B}{\partial q_{2B}}$) and having an equality if isoquants are linear (as $\frac{\partial c_A}{\partial q_{1A}} = \frac{\partial c_A}{\partial q_{2A}}$ and $\frac{\partial c_B}{\partial q_{1B}} = \frac{\partial c_B}{\partial q_{2B}}$).

Under upstream monopoly (ii), with vertical integration, equilibrium quantities are determined by:

$$q_{1A} : \frac{\partial P}{\partial q_{1A}}(q_{1A} + q_{1B}) + P(.) \leq \frac{\partial c_A}{\partial q_{1A}} \tag{A20}$$

$$q_{1B} : \frac{\partial P}{\partial q_{1B}}(q_{1A} + q_{1B}) + P(.) \leq \frac{\partial c_B}{\partial q_{1B}} \tag{A21}$$

$$q_{2A} : \frac{\partial P}{\partial q_{2A}}(q_{1A} + q_{1B} + q_{2A} + q_{2B}) + P(.) \leq \frac{\partial c_A}{\partial q_{2A}} \tag{A22}$$

$$q_{2B} : \frac{\partial P}{\partial q_{2B}}(q_{1A} + q_{1B} + q_{2A} + q_{2B}) + P(.) \leq \frac{\partial c_B}{\partial q_{2B}} \tag{A23}$$

If (A20) and (A21) hold with equality, because $\frac{\partial P}{\partial q_{1j}} < 0$, (A22) and (A23) are only satisfied if $q_{2A} + q_{2B} = 0$ while (A20) and (A21) cannot hold if $q_{2A} + q_{2B} > 0$ and (A22) and (A23) hold. As $q_{2A} + q_{2B} = 0$, given the perfect substitutes assumption, industry profits are maximized under upstream monopoly. Moreover when $q_{1B} + q_{2B} = 0$, the only way (A20) and (A22) can simultaneously hold is if $q_{2A} = 0$. Hence, $\hat{\hat{\Pi}}(\overline{D_1 D_2 U_A U_B}) = \Pi(\overline{D_1 D_2 U_A U_B})$. The case for $\hat{\hat{\Pi}}(\overline{D_1 D_2 U_A}) = \Pi(\overline{D_1 D_2 U_A})$ follows analogously.

Under upstream competition (i), (A23) is still as in (A19). In this case, the only way all four inequalities can be satisfied is if $q_{1B} = q_{2A} = 0$; in which case, given the homogeneity of upstream costs, equilibrium downstream outputs are at their Cournot levels and so total industry profits remains the same as under non-integration. Note that the perfect substitutes assumption is not required in this case.

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TABLE 1
Payoffs in No Externality Case
(where (*x*,*y*) = (1,1) for NI, (0,1) for FI and (1,0) for BI)

Upstream Competition	Upstream Monopoly (U_A owns U_B)
$v_{D_1} = \frac{1}{12}\left(\begin{array}{l} 3\Pi(\overline{D_1 D_2 U_A U_B}) + \Pi(\overline{D_1 D_2 U_A}) \\ +\Pi(\overline{D_1 U_A U_B}) + \Pi(\overline{D_1 U_A}) - 3\Pi(\overline{D_2 U_B}) \\ +x\left(\Pi(\overline{D_1 D_2 U_B}) - \Pi(\overline{D_2 U_B}) + \Pi(\overline{D_1 U_B})\right) \\ +y\left(-3\left(\Pi(\overline{D_2 U_A U_B}) - \Pi(\overline{D_2 U_B})\right) - \Pi(\overline{D_2 U_A})\right) \end{array}\right)$	$v_{D_1} = \frac{1}{12}\left(\begin{array}{l} 3\Pi(\overline{D_1 D_2 U_A U_B}) + \Pi(\overline{D_1 D_2 U_A}) \\ +\Pi(\overline{D_1 U_A U_B}) + \Pi(\overline{D_1 U_A}) \\ +(1-y)\Pi(\overline{D_1 D_2 U_B}) - 3y\Pi(\overline{D_2 U_A U_B}) \\ -y\Pi(\overline{D_2 U_A}) + (1-y)\Pi(\overline{D_1 U_B}) \end{array}\right)$
$v_{D_2} = \frac{1}{12}\left(\begin{array}{l} 3\Pi(\overline{D_1 D_2 U_A U_B}) + \Pi(\overline{D_1 D_2 U_A}) \\ -3\Pi(\overline{D_1 U_A U_B}) - \Pi(\overline{D_1 U_A}) + 3\Pi(\overline{D_2 U_B}) \\ +x\left(\Pi(\overline{D_1 D_2 U_B}) - \Pi(\overline{D_2 U_B}) - \Pi(\overline{D_1 U_B})\right) \\ +y\left(\Pi(\overline{D_2 U_A U_B}) - \Pi(\overline{D_2 U_B}) + \Pi(\overline{D_2 U_A})\right) \end{array}\right)$	$v_{D_2} = \frac{1}{12}\left(\begin{array}{l} 3\Pi(\overline{D_1 D_2 U_A U_B}) + \Pi(\overline{D_1 D_2 U_A}) \\ -3\Pi(\overline{D_1 U_A U_B}) - \Pi(\overline{D_1 U_A}) \\ +(1-y)\Pi(\overline{D_1 D_2 U_B}) + y\Pi(\overline{D_2 U_A U_B}) \\ +y\Pi(\overline{D_2 U_A}) - (1-y)\Pi(\overline{D_1 U_B}) \end{array}\right)$
$v_{U_A} = \frac{1}{12}\left(\begin{array}{l} 3\Pi(\overline{D_1 D_2 U_A U_B}) + \Pi(\overline{D_1 D_2 U_A}) \\ +\Pi(\overline{D_1 U_A U_B}) + \Pi(\overline{D_1 U_A}) - 3\Pi(\overline{D_2 U_B}) \\ +x\left(-3\left(\Pi(\overline{D_1 D_2 U_B}) - \Pi(\overline{D_2 U_B})\right) - \Pi(\overline{D_1 U_B})\right) \\ +y\left(\Pi(\overline{D_2 U_A U_B}) - \Pi(\overline{D_2 U_B}) + \Pi(\overline{D_2 U_A})\right) \end{array}\right)$	$v_{U_A} = \frac{1}{12}\left(\begin{array}{l} 3\Pi(\overline{D_1 D_2 U_A U_B}) + \Pi(\overline{D_1 D_2 U_A}) \\ +\Pi(\overline{D_1 U_A U_B}) + \Pi(\overline{D_1 U_A}) \\ -3(1-y)\Pi(\overline{D_1 D_2 U_B}) + y\Pi(\overline{D_2 U_A U_B}) \\ +y\Pi(\overline{D_2 U_A}) - (1-y)\Pi(\overline{D_1 U_B}) \end{array}\right)$
$v_{U_B} = \frac{1}{12}\left(\begin{array}{l} 3\Pi(\overline{D_1 D_2 U_A U_B}) - 3\Pi(\overline{D_1 D_2 U_A}) \\ +\Pi(\overline{D_1 U_A U_B}) - \Pi(\overline{D_1 U_A}) + 3\Pi(\overline{D_2 U_B}) \\ +x\left(\Pi(\overline{D_1 D_2 U_B}) - \Pi(\overline{D_2 U_B}) + \Pi(\overline{D_1 U_B})\right) \\ +y\left(\Pi(\overline{D_2 U_A U_B}) - \Pi(\overline{D_2 U_B}) - \Pi(\overline{D_2 U_A})\right) \end{array}\right)$	$v_{U_B} = \frac{1}{12}\left(\begin{array}{l} 3\Pi(\overline{D_1 D_2 U_A U_B}) - 3\Pi(\overline{D_1 D_2 U_A}) \\ +\Pi(\overline{D_1 U_A U_B}) - \Pi(\overline{D_1 U_A}) \\ +(1-y)\Pi(\overline{D_1 D_2 U_B}) + y\Pi(\overline{D_2 U_A U_B}) \\ -y\Pi(\overline{D_2 U_A}) + (1-y)\Pi(\overline{D_1 U_B}) \end{array}\right)$
$\frac{\partial(v_{D_1}+v_{U_A})}{\partial(-x)} = \frac{1}{6}\left(\Pi(\overline{D_1 D_2 U_B}) - \Pi(\overline{D_2 U_B})\right)$	$\frac{\partial(v_{D_1}+v_{U_A})}{\partial(-x)} = 0$
$\frac{\partial(v_{D_1}+v_{U_A})}{\partial(-y)} = \frac{1}{6}\left(\Pi(\overline{D_2 U_A U_B}) - \Pi(\overline{D_2 U_B})\right)$	$\frac{\partial(v_{D_1}+v_{U_A})}{\partial(-y)} = \frac{1}{6}\left(\Pi(\overline{D_2 U_A U_B}) - \Pi(\overline{D_1 D_2 U_B})\right)$

TABLE 2
Payoffs in Competitive Externality Case
(where (*x*,*y*) = (1,1) for NI, (0,1) for FI and (1,0) for BI)

Upstream Competition	Upstream Monopoly (U_A owns U_B)
$v_{D_1} = \frac{1}{12}\left(\begin{array}{l} xy\left(3\hat{\Pi}(\overline{D_1D_2U_AU_B})+\hat{\Pi}(\overline{D_1D_2U_A})\right) \\ +(1-xy)\left(3\hat{\hat{\Pi}}_{UC}(\overline{D_1D_2U_AU_B})+\hat{\hat{\Pi}}(\overline{D_1D_2U_A})\right) \\ +\Pi(\overline{D_1U_AU_B})-2\Pi(\overline{D_1U_A})+3\Pi(\overline{D_1U_B})-3\Pi(\overline{D_2U_A}) \\ +3\Pi(\overline{D_1U_A},\overline{D_2U_B})-3\Pi(\overline{D_2U_B},\overline{D_1U_A}) \\ +x\left(\hat{\Pi}(\overline{D_1D_2U_B})-\Pi(\overline{D_2U_B})-2\Pi(\overline{D_1U_B})+3\Pi(\overline{D_2U_A})\right) \\ +y\left(-3\Pi(\overline{D_2U_AU_B})+3\Pi(\overline{D_2U_B})+2\Pi(\overline{D_2U_A})-3\Pi(\overline{D_1U_B})\right) \\ +xy\left(3\Pi(\overline{D_1U_B},\overline{D_2U_A})-3\Pi(\overline{D_2U_A},\overline{D_1U_B})\right) \end{array}\right)$	$v_{D_1} = \frac{1}{12}\left(\begin{array}{l} xy\left(3\hat{\Pi}(\overline{D_1D_2U_AU_B})+\hat{\Pi}(\overline{D_1D_2U_A})\right)+ \\ (1-xy)\left(3\hat{\hat{\Pi}}_{UM}(\overline{D_1D_2U_AU_B})+\hat{\hat{\Pi}}(\overline{D_1D_2U_A})\right) \\ +\Pi(\overline{D_1U_AU_B})+\Pi(\overline{D_1U_A}) \\ +(1-y)\hat{\Pi}(\overline{D_1D_2U_B})-3y\Pi(\overline{D_2U_AU_B}) \\ -y\Pi(\overline{D_2U_A})+(1-y)\Pi(\overline{D_1U_B}) \end{array}\right)$
$v_{D_2} = \frac{1}{12}\left(\begin{array}{l} xy\left(3\hat{\Pi}(\overline{D_1D_2U_AU_B})+\hat{\Pi}(\overline{D_1D_2U_A})\right) \\ +(1-xy)\left(3\hat{\hat{\Pi}}_{UC}(\overline{D_1D_2U_AU_B})+\hat{\hat{\Pi}}(\overline{D_1D_2U_A})\right) \\ -3\Pi(\overline{D_1U_AU_B})+2\Pi(\overline{D_1U_A})-3\Pi(\overline{D_1U_B})+3\Pi(\overline{D_2U_A}) \\ -3\Pi(\overline{D_1U_A},\overline{D_2U_B})+3\Pi(\overline{D_2U_B},\overline{D_1U_A}) \\ +x\left(\hat{\Pi}(\overline{D_1D_2U_B})-\Pi(\overline{D_2U_B})+2\Pi(\overline{D_1U_B})-3\Pi(\overline{D_2U_A})\right) \\ +y\left(\Pi(\overline{D_2U_AU_B})-\Pi(\overline{D_2U_B})-2\Pi(\overline{D_2U_A})+3\Pi(\overline{D_1U_B})\right) \\ +xy\left(-3\Pi(\overline{D_1U_B},\overline{D_2U_A})+3\Pi(\overline{D_2U_A},\overline{D_1U_B})\right) \end{array}\right)$	$v_{D_2} = \frac{1}{12}\left(\begin{array}{l} xy\left(3\hat{\Pi}(\overline{D_1D_2U_AU_B})+\hat{\Pi}(\overline{D_1D_2U_A})\right)+ \\ (1-xy)\left(3\hat{\hat{\Pi}}_{UM}(\overline{D_1D_2U_AU_B})+\hat{\hat{\Pi}}(\overline{D_1D_2U_A})\right) \\ -3\Pi(\overline{D_1U_AU_B})-\Pi(\overline{D_1U_A}) \\ +(1-y)\hat{\Pi}(\overline{D_1D_2U_B})+y\Pi(\overline{D_2U_AU_B}) \\ +y\Pi(\overline{D_2U_A})-(1-y)\Pi(\overline{D_1U_B}) \end{array}\right)$
$v_{U_A} = \frac{1}{12}\left(\begin{array}{l} xy\left(3\hat{\Pi}(\overline{D_1D_2U_AU_B})+\hat{\Pi}(\overline{D_1D_2U_A})\right) \\ +(1-xy)\left(3\hat{\hat{\Pi}}_{UC}(\overline{D_1D_2U_AU_B})+\hat{\hat{\Pi}}(\overline{D_1D_2U_A})\right) \\ +\Pi(\overline{D_1U_AU_B})-2\Pi(\overline{D_1U_A})-3\Pi(\overline{D_1U_B})+3\Pi(\overline{D_2U_A}) \\ +3\Pi(\overline{D_1U_A},\overline{D_2U_B})-3\Pi(\overline{D_2U_B},\overline{D_1U_A}) \\ +x\left(-3\hat{\Pi}(\overline{D_1D_2U_B})+3\Pi(\overline{D_2U_B})+2\Pi(\overline{D_1U_B})-3\Pi(\overline{D_2U_A})\right) \\ +y\left(\Pi(\overline{D_2U_AU_B})-\Pi(\overline{D_2U_B})-2\Pi(\overline{D_2U_A})+3\Pi(\overline{D_1U_B})\right) \\ +xy\left(-3\Pi(\overline{D_1U_B},\overline{D_2U_A})+3\Pi(\overline{D_2U_A},\overline{D_1U_B})\right) \end{array}\right)$	$v_{U_A} = \frac{1}{12}\left(\begin{array}{l} xy\left(3\hat{\Pi}(\overline{D_1D_2U_AU_B})+\hat{\Pi}(\overline{D_1D_2U_A})\right)+ \\ (1-xy)\left(3\hat{\hat{\Pi}}_{UM}(\overline{D_1D_2U_AU_B})+\hat{\hat{\Pi}}(\overline{D_1D_2U_A})\right) \\ +\Pi(\overline{D_1U_AU_B})+\Pi(\overline{D_1U_A}) \\ -3(1-y)\hat{\Pi}(\overline{D_1D_2U_B})+y\Pi(\overline{D_2U_AU_B}) \\ +y\Pi(\overline{D_2U_A})-(1-y)\Pi(\overline{D_1U_B}) \end{array}\right)$
$v_{U_B} = \frac{1}{12}\left(\begin{array}{l} xy\left(3\hat{\Pi}(\overline{D_1D_2U_AU_B})-3\hat{\Pi}(\overline{D_1D_2U_A})\right) \\ +(1-xy)\left(3\hat{\hat{\Pi}}_{UC}(\overline{D_1D_2U_AU_B})-3\hat{\hat{\Pi}}(\overline{D_1D_2U_A})\right) \\ +\Pi(\overline{D_1U_AU_B})+2\Pi(\overline{D_1U_A})+3\Pi(\overline{D_1U_B})-3\Pi(\overline{D_2U_A}) \\ -3\Pi(\overline{D_1U_A},\overline{D_2U_B})+3\Pi(\overline{D_2U_B},\overline{D_1U_A}) \\ +x\left(\hat{\Pi}(\overline{D_1D_2U_B})-\Pi(\overline{D_2U_B})-2\Pi(\overline{D_1U_B})+3\Pi(\overline{D_2U_A})\right) \\ +y\left(\Pi(\overline{D_2U_AU_B})-\Pi(\overline{D_2U_B})+2\Pi(\overline{D_2U_A})-3\Pi(\overline{D_1U_B})\right) \\ +xy\left(3\Pi(\overline{D_1U_B},\overline{D_2U_A})-3\Pi(\overline{D_2U_A},\overline{D_1U_B})\right) \end{array}\right)$	$v_{U_B} = \frac{1}{12}\left(\begin{array}{l} xy\left(3\hat{\Pi}(\overline{D_1D_2U_AU_B})-3\hat{\Pi}(\overline{D_1D_2U_A})\right)+ \\ (1-xy)\left(3\hat{\hat{\Pi}}_{UM}(\overline{D_1D_2U_AU_B})-3\hat{\hat{\Pi}}(\overline{D_1D_2U_A})\right) \\ +\Pi(\overline{D_1U_AU_B})-\Pi(\overline{D_1U_A}) \\ +(1-y)\hat{\Pi}(\overline{D_1D_2U_B})+y\Pi(\overline{D_2U_AU_B}) \\ -y\Pi(\overline{D_2U_A})+(1-y)\Pi(\overline{D_1U_B}) \end{array}\right)$
$\frac{\partial(v_{D_1}+v_{U_A})}{\partial(-x)} = \frac{1}{2}\left(\hat{\hat{\Pi}}_{UC}(\overline{D_1D_2U_AU_B})-\hat{\Pi}(\overline{D_1D_2U_AU_B})\right) + \frac{1}{6}\left(\begin{array}{l} \hat{\hat{\Pi}}(\overline{D_1D_2U_A})-\hat{\Pi}(\overline{D_1D_2U_A}) \\ +\hat{\Pi}(\overline{D_1D_2U_B})-\Pi(\overline{D_2U_B}) \end{array}\right)$	$\left.\frac{\partial(v_{D_1}+v_{U_A})}{\partial(-x)}\right\vert_{y=1} = \frac{1}{2}\left(\hat{\hat{\Pi}}_{UM}(\overline{D_1D_2U_AU_B})-\hat{\Pi}(\overline{D_1D_2U_AU_B})\right) + \frac{1}{6}\left(\hat{\hat{\Pi}}(\overline{D_1D_2U_A})-\hat{\Pi}(\overline{D_1D_2U_A})\right)$

$\frac{\partial(v_{D_1}+v_{U_A})}{\partial(-y)} = \frac{1}{2}\left(\hat{\hat{\Pi}}_{UC}(\overline{D_1 D_2 U_A U_B}) - \hat{\Pi}(\overline{D_1 D_2 U_A U_B})\right) + \frac{1}{6}\begin{pmatrix}\hat{\hat{\Pi}}(\overline{D_1 D_2 U_A}) - \hat{\Pi}(\overline{D_1 D_2 U_A}) \\ +\Pi(\overline{D_2 U_A U_B}) - \Pi(\overline{D_2 U_B})\end{pmatrix}$	$\left.\frac{\partial(v_{D_1}+v_{U_A})}{\partial(-y)}\right\|_{x=1} = \frac{1}{2}\left(\hat{\hat{\Pi}}_{UM}(\overline{D_1 D_2 U_A U_B}) - \hat{\Pi}(\overline{D_1 D_2 U_A U_B})\right) + \frac{1}{6}\begin{pmatrix}\hat{\hat{\Pi}}(\overline{D_1 D_2 U_A}) - \hat{\Pi}(\overline{D_1 D_2 U_A}) \\ +\Pi(\overline{D_2 U_A U_B}) - \hat{\Pi}(\overline{D_1 D_2 U_B})\end{pmatrix}$

TABLE 3
Impact of Integration on Outsiders

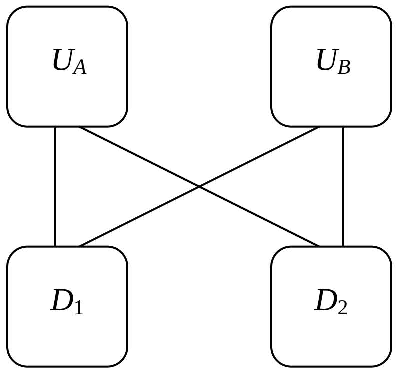
Integration Type	Benefit to D_2	Benefit to U_B
UC-FI	$\frac{1}{12}\begin{pmatrix}\Pi(\overline{D_1D_2U_j})-2\hat{\Pi}(\overline{D_1D_2U_j})\\ +2\Pi(\overline{D_iU_j})\end{pmatrix}>0$	$\frac{1}{12}\left(2\hat{\Pi}(\overline{D_1D_2U_j})-3\Pi(\overline{D_1D_2U_j})\right)<0$
UC-BI	$\frac{1}{12}\begin{pmatrix}\Pi(\overline{D_1D_2U_j})-\hat{\Pi}(\overline{D_1D_2U_j})\\ -\Pi(\overline{D_iU_AU_B})\end{pmatrix}$	$\frac{1}{12}\begin{pmatrix}3\hat{\Pi}(\overline{D_1D_2U_j})-3\Pi(\overline{D_1D_2U_j})\\ -\Pi(\overline{D_iU_AU_B})+2\Pi(\overline{D_iU_j})\end{pmatrix}$
UM-FI	$\frac{1}{12}\begin{pmatrix}3\Pi(\overline{D_1D_2U_AU_B})-3\hat{\Pi}(\overline{D_1D_2U_AU_B})\\ +\Pi(\overline{D_1D_2U_j})-\hat{\Pi}(\overline{D_1D_2U_j})\end{pmatrix}>0$	$\frac{1}{12}\begin{pmatrix}3\Pi(\overline{D_1D_2U_AU_B})-3\hat{\Pi}(\overline{D_1D_2U_AU_B})\\ -3\Pi(\overline{D_1D_2U_j})+3\hat{\Pi}(\overline{D_1D_2U_j})\end{pmatrix}$
UM-BI	$\frac{1}{12}\begin{pmatrix}3\Pi(\overline{D_1D_2U_AU_B})-3\hat{\Pi}(\overline{D_1D_2U_AU_B})\\ +\Pi(\overline{D_1D_2U_j})\\ -\Pi(\overline{D_iU_AU_B})-2\Pi(\overline{D_iU_j})\end{pmatrix}$	$\frac{1}{12}\begin{pmatrix}3\Pi(\overline{D_1D_2U_AU_B})-3\hat{\Pi}(\overline{D_1D_2U_AU_B})\\ -3\Pi(\overline{D_1D_2U_j})+4\hat{\Pi}(\overline{D_1D_2U_j})\\ -\Pi(\overline{D_iU_AU_B})+2\Pi(\overline{D_iU_j})\end{pmatrix}$

TABLE 4
Payoffs from Second Merger

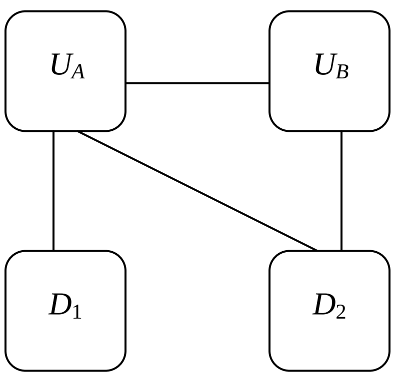
BI by D_1-U_A followed by BI by D_2-U_B	FI by D_1-U_A followed by FI by D_2-U_B
$v_{D_1}=\frac{1}{12}\begin{pmatrix}3\hat{\hat{\Pi}}_{CI}(\overline{D_1D_2U_AU_B})+\hat{\hat{\Pi}}_{A1}(\overline{D_1D_2U_A})\\ +\hat{\hat{\Pi}}_{B2}(\overline{D_1D_2U_B})\\ +3\Pi(\overline{D_1U_A},\overline{D_2U_B})-3\Pi(\overline{D_2U_B},\overline{D_1U_A})\\ -\Pi(\overline{D_1U_A})-\Pi(\overline{D_2U_B})\end{pmatrix}$	$v_{D_1}=\frac{1}{12}\begin{pmatrix}3\hat{\hat{\Pi}}_{CI}(\overline{D_1D_2U_AU_B})\\ +\Pi(\overline{D_1U_AU_B})-\Pi(\overline{D_1U_A})\\ +3\Pi(\overline{D_1U_A},\overline{D_2U_B})-3\Pi(\overline{D_2U_B},\overline{D_1U_A})\\ -3\Pi(\overline{D_2U_AU_B})+3\Pi(\overline{D_2U_B})\end{pmatrix}$
$v_{D_2}=\frac{1}{12}\begin{pmatrix}3\hat{\hat{\Pi}}_{CI}(\overline{D_1D_2U_AU_B})+\hat{\hat{\Pi}}_{A1}(\overline{D_1D_2U_A})\\ +\hat{\hat{\Pi}}_{B2}(\overline{D_1D_2U_B})\\ -3\Pi(\overline{D_1U_A},\overline{D_2U_B})+3\Pi(\overline{D_2U_B},\overline{D_1U_A})\\ -\Pi(\overline{D_1U_A})-\Pi(\overline{D_2U_B})\end{pmatrix}$	$v_{D_2}=\frac{1}{12}\begin{pmatrix}3\hat{\hat{\Pi}}_{CI}(\overline{D_1D_2U_AU_B})\\ -3\Pi(\overline{D_1U_AU_B})+3\Pi(\overline{D_1U_A})\\ -3\Pi(\overline{D_1U_A},\overline{D_2U_B})+3\Pi(\overline{D_2U_B},\overline{D_1U_A})\\ +\Pi(\overline{D_2U_AU_B})-\Pi(\overline{D_2U_B})\end{pmatrix}$
$v_{U_A}=\frac{1}{12}\begin{pmatrix}3\hat{\hat{\Pi}}_{CI}(\overline{D_1D_2U_AU_B})+\hat{\hat{\Pi}}_{A1}(\overline{D_1D_2U_A})\\ -3\hat{\hat{\Pi}}_{B2}(\overline{D_1D_2U_B})\\ +3\Pi(\overline{D_1U_A},\overline{D_2U_B})-3\Pi(\overline{D_2U_B},\overline{D_1U_A})\\ -\Pi(\overline{D_1U_A})+3\Pi(\overline{D_2U_B})\end{pmatrix}$	$v_{U_A}=\frac{1}{12}\begin{pmatrix}3\hat{\hat{\Pi}}_{CI}(\overline{D_1D_2U_AU_B})\\ +\Pi(\overline{D_1U_AU_B})-\Pi(\overline{D_1U_A})\\ +3\Pi(\overline{D_1U_A},\overline{D_2U_B})-3\Pi(\overline{D_2U_B},\overline{D_1U_A})\\ +\Pi(\overline{D_2U_AU_B})-\Pi(\overline{D_2U_B})\end{pmatrix}$
$v_{U_B}=\frac{1}{12}\begin{pmatrix}3\hat{\hat{\Pi}}_{CI}(\overline{D_1D_2U_AU_B})-3\hat{\hat{\Pi}}_{A1}(\overline{D_1D_2U_A})\\ +\hat{\hat{\Pi}}_{B2}(\overline{D_1D_2U_B})\\ -3\Pi(\overline{D_1U_A},\overline{D_2U_B})+3\Pi(\overline{D_2U_B},\overline{D_1U_A})\\ +3\Pi(\overline{D_1U_A})-\Pi(\overline{D_2U_B})\end{pmatrix}$	$v_{U_B}=\frac{1}{12}\begin{pmatrix}3\hat{\hat{\Pi}}_{CI}(\overline{D_1D_2U_AU_B})\\ +\Pi(\overline{D_1U_AU_B})-\Pi(\overline{D_1U_A})\\ -3\Pi(\overline{D_1U_A},\overline{D_2U_B})+3\Pi(\overline{D_2U_B},\overline{D_1U_A})\\ +\Pi(\overline{D_2U_AU_B})-\Pi(\overline{D_2U_B})\end{pmatrix}$

FIGURE 1
Upstream Competition – Patterns of Negotiation

(a) Non-Integration



(b) Forward Integration



(c) Backwards Integration

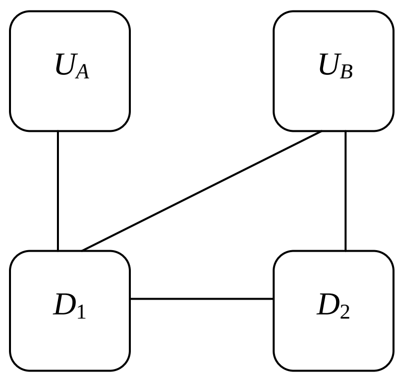
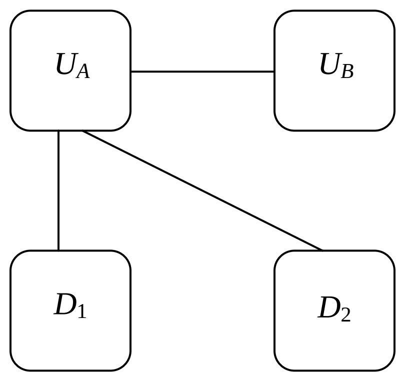
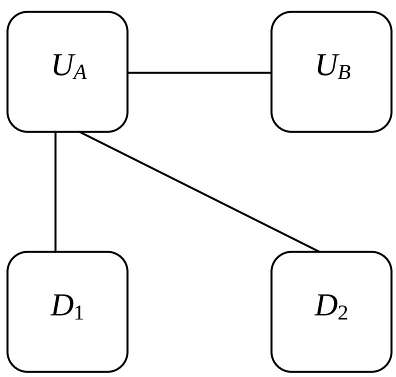


FIGURE 2
Upstream Monopoly – Patterns of Negotiation

(a) Non-Integration



(b) Forward Integration



(c) Backwards Integration

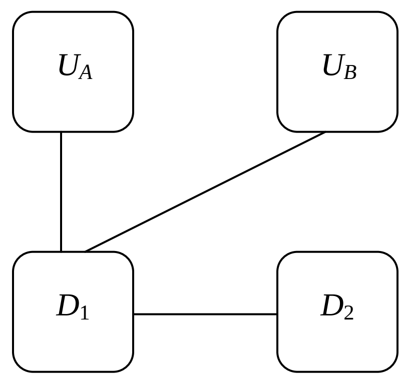


FIGURE 3
Profits and Welfare

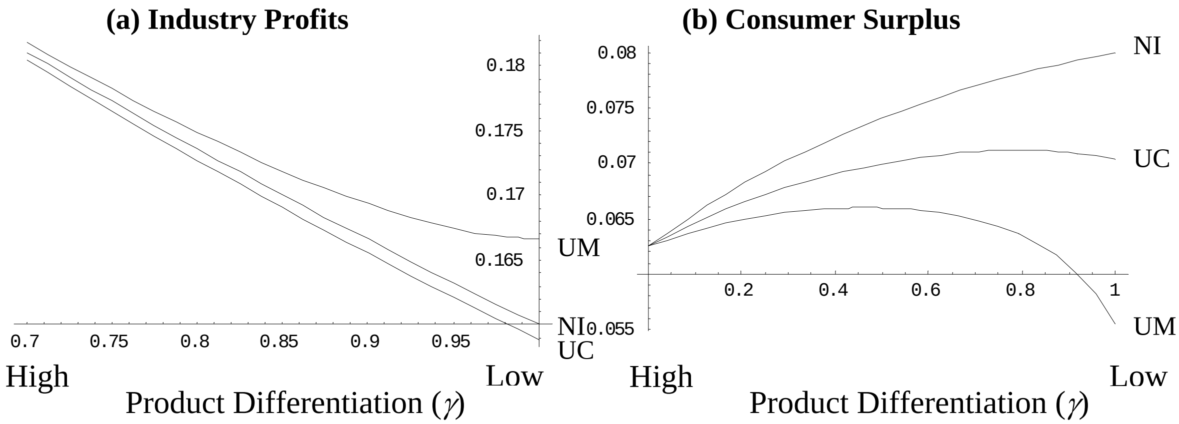


FIGURE 4
Bandwagon Effect ($F_{B2} - S_{B2}$)