A Bargaining Perspective on Strategic Outsourcing and Supply Competition[*]

by

Catherine C. de Fontenay *and* Joshua S. Gans[**]

First Draft: 15th June, 2004
This Version: 13th February, 2007

This paper considers the outsourcing choice of a downstream firm with its own upstream production resources or assets. The novelty of the approach is to consider the outsourced function as involving resources consistent with the resource-based view of the firm. From a bargaining perspective, we characterise a downstream firm's decision as to whether to outsource to an independent or established upstream firm. In so doing, that firm faces a trade-off between lower input costs afforded by independent competition and higher resource value associated to those who can consolidate upstream capabilities. We show that this trade-off is resolved in favour of outsourcing is to an established firm. *Journal of Economic Literature* Classification Number: L42

Keywords. outsourcing, resource-based view, property rights, bargaining, Shapley value.

[*] This paper was previously circulated under the title "Supply Competition and Outsourcing." We thank Marianne Broadbent, Ken Corts, Michael Ryall, participants at the CRES Foundations of Business Strategy Conference (St Louis, 2005) and two anonymous referees for helpful comments. Responsibility for all errors lies with the authors.

[**] Melbourne Business School, University of Melbourne. All correspondence to J.Gans@unimelb.edu.au. The latest version of this paper will be available at www.mbs.edu/jgans.

1. Introduction

Recent work in strategic management has advocated the use of formal models of bargaining to understand the strategic impacts of firm decisions (Brandenburger and Stuart, 1996; Lippman and Rumelt, 2003). The idea is to consider the resources that firms control and to use this to model how this translates into bargaining power – as a means of modeling value appropriation.[1]

This paper takes this new agenda seriously and applies it to a consideration of the outsourcing decision of the firm.[2] Outsourcing is generally conceived of as a decision by the firm to make a service/product internally or to purchase them externally. In so doing, however, it is often taken as a starting point that the function to be outsourced or not is not yet being conducted or, at the very least, is not being performed using an existing resource base including physical assets and human capital whose expenditures (in investment or development) have already been sunk.[3] While considering outsourcing as if no key resources already exist allows one to highlight many of the advantages and disadvantages of outsourcing, it also may disguise other important strategic issues. In particular, *firms must consider the value of existing resources that may be part of the bundle of property rights to be outsourced*.

We take an alternative approach that is more naturally consistent with a situation where resources are given and firms are evaluating what property rights they should hold over them. It begins with a status quo whereby firms have already invested in physical assets and resources that perform certain functions and are considering outsourcing those functions. In this setting, outsourcing represents an important strategic issue as it will involve the transfer of the ownership of those assets and resources to another firm.

[1] Foss and Foss (2005) argue that this leads naturally to a relationship between the resourced-based view (RBV) and the economics of property rights (EPR); the latter being a way of modeling control over resources or assets in a bargaining context. They present a strong case for viewing resources as bundles of property rights; property rights that can be re-allocated in a restructuring of a firm or organisation. However, they emphasise the importance of modeling transaction costs something not done in this paper. As such, their approach would appear to be complementary to our own.

[2] Other applications of the new agenda include Gans, McDonald and Ryall (2005) and Adner and Zemsky (2006).

[3] Cachon and Harker (2002) are a good representative example of this where firms negotiate over outsourcing contracts which may result in outsourcing or not and then all costs associated with production are incurred.

Moreover, given the longer-term nature of such a divestiture, this decision has a time frame longer than the length of any particular outsourcing contract. While those contracts may be longer-term, as Domberger (1998) (among others) has pointed out, outsourcing contracts – particularly, specification and pricing – tend to be renegotiated over time. Consequently, in considering outsourcing as a divestiture, a firm must have regard to the amount it will appropriate ex post. Of course, that appropriation will determine the value a purchaser of those assets places upon them. Therefore, we model a firm's outsourcing decision taking into account both the value a firm expects to appropriate in an on-going way and the value of the resources or assets under the control of another owner.

This approach allows us to consider an important strategic issue associated with outsourcing: who to outsource to. Some major firms have outsourced by spinning off separate, independent corporations who supply them with outsourced functions but the firm is also free to access the market for those services. This is seen as a way of bringing competitive pressure to bear on the efficiency to which those functions are performed. Others wish to tap into the competencies of established operators and outsource to them. To date, however, we are not aware of any work that considers this decision: whom to outsource to?[4]

Consider the case of GE and the production of microwave ovens. Having entered that market in the 1970s it faced competitive pressure and a reduction of market share. In 1983, it considered outsourcing that production entirely while maintain branding and distribution. One option was to turn to an existing competitor – Matsushita – to perform its production. The other – and the one GE ended up pursuing – was to outsource to Samsung who did not have a strong position in microwave oven production. GE had been concerned about the risks associated with dealing with a competitor and so chose an independent entity. Today, Samsung is the market leader.[5] Motorola had a similar experience more recently with the Taiwanese mobile phone maker BenQ. Motorola farmed out design and manufacture to them only to find BenQ entering the large Chinese market under their own brand.[6] In both cases, these firms were criticized for allowing outsourcing to provide a source of competition. Our analysis addresses these issues and

[4] For a review of recent work in strategy on outsourcing see Espino-Rodriguez and Padron-Robaina (2006).
[5] For an account of this see Jarillo (1993).
[6] "Outsourcing Innovation," *Business Week*, 21st March, 2005, p.53.

finds the criticisms to have some foundation. In particular, managers need to consider some important trade-offs when deciding how to outsource.

The key trade-off we identify is as follows: If firms outsource to an independent entity, they create additional competition for the supply of inputs to them. However, the value of the productive assets to an independent firm is simply what they earn in competition. In contrast, when outsourcing to an established firm, additional competition is not created but there is implicit consolidation as more assets are controlled by a single firm. That consolidation is valuable to the established firm – akin to the difference between monopoly and competitive profits – and so will increase amount paid for the assets in the resulting acquisition.[7] However, it also represents a longer-term issue for the outsourcing firm who will likely pay more to procure inputs.

In this paper, we show how a proper consideration of a bargaining approach to value appropriation can resolve the trade off between asset value versus competitive input supply terms. In doing this, we consider a situation where bargaining dictates the supply terms arising between upstream and downstream firms. Following de Fontenay and Gans (2005), the natural bargaining solution for this is the Shapley value. They demonstrate that when upstream and downstream firms bargain bilaterally in a non-cooperative fashion outcomes are value maximising and each firm appropriates its Shapley value as would arise in the underlying coalitional game. Such bargaining naturally describes situations when supply agreements are formed from face to face negotiations rather than anonymous wholesale markets. It is for this reason that we will not model the non-cooperative game here and simply consider its bargaining analogue.[8]

We use this approach to consider the set of negotiated supply terms that would arise under alternative ownership structures. As just noted, there is no double marginalization problem and, indeed, supply chain management is efficient. Hence, whether functions are outsourced or not and who they are outsourced to does not matter for the overall production of value.

---

[7] It is typically the case that the sum of profits of two competitors working together exceed the sum of them in competition with one another (see Gilbert and Newbery, 1982).

[8] Use of the Shapley value for this type of bargaining was advocated by Lippman and Rumelt (2003) and has been employed in the analysis of firm boundaries in the EPR approach by Hart and Moore (1990). While we do not model it here, similar results would arise if the coalitional approach of MacDonald and Ryall (2004) and Brandenberger and Stuart (2007) were used.

Our main finding is somewhat counterintuitive. In this situation, we show that a firm will want to outsource to an established firm – creating a monopoly – rather than to an independent player. While a monopoly does raise input costs for the firm, those higher costs are partly borne by other downstream firms. So when we consider the value of the asset to established upstream firm relative to an independent one, it is sufficiently greater that it compensates the outsourcing downstream firm for those higher inputs costs.

While the research question of this paper is novel, the use of this type of bargaining environment to describe strategic integration or outsourcing has important antecedents in the literature. Inderst and Wey (2003) and de Fontenay and Gans (2005) provide models of bilateral oligopoly (again with two upstream and two downstream firms) to analyze horizontal and vertical integration respectively. Each of these papers, however, concentrates on the social welfare implications of alternative market structures and does not consider the decision of a firm, currently holding upstream assets, to outsource. Here, our focus is on the purely strategic aspects of a private outsourcing decision when outsourcing changes asset ownership and bargaining terms.

The paper proceeds as follows. The next section sets up our 2x2 model and discusses our approach to outsourcing. The restriction to two upstream and downstream firms is for analytical ease and expanding their numbers would leave our main qualitative results unchanged. Section 3 then derives results for the bargaining approach and constructs baseline results. Sections 4 and 5 then examine the robustness of our baseline results to changes in the model including allowing for internal bargaining, competition amongst downstream firms, competition with integrated entities and double marginalization. A final section concludes.

2. Model Set-Up

Our approach here is to consider an industry with distinct upstream and downstream functions. The simplest example would be of manufacturing versus retailing (or distribution). To perform productively either function requires resources. The downstream resources or assets may be retail outlets and distribution networks while the upstream resources or assets may be production facilities.

While our analysis here could apply to functions that require many assets (physical, human and other) and also permit many collections of assets in the industry (corresponding to arbitrary numbers of upstream and downstream firms), for simplicity, our paper here will focus on the case where each function requires a single asset and there are only two such assets available for each function. Thus, there are two downstream assets – denoted D_i for $i \in \{1,2\}$ – and two upstream assets – denoted U_j for $j \in \{A,B\}$.

Another simplifying assumption that we make initially is to assume that the downstream assets are located in separate geographic market. Thus, downstream assets compete for inputs from upstream firms and upstream firms compete to supply them but downstream firms do not compete directly with one another. Clearly, this assumption does not correspond to some of our motivating examples. As such, having built intuition and analysis based on an independent final good market assumption, we will (in Section 4) amend our analysis to include head-to-head competition between downstream firms.

It is assumed that inputs produced from either upstream assets can be used by downstream firms in producing final goods for consumers. Our analysis here does not specify whether the inputs are perfectly substitutable or not or whether one set of inputs is more specialized to one downstream asset or not. The model can flexibly accommodate all these possibilities with homogeneous and non-homogeneous products alike. What is key is that each downstream firm can potential procure inputs from either upstream firm or indeed both simultaneously. Thus, we need impose no artificial constraints on whom trades with whom.

As a baseline case, we also allow for asymmetries between firms at the same functional level. So, say, U_A may have substantially lower costs than U_B or D_1 may have a significantly larger market than D_2. However, to obtain some cleaner results, we may at times assume that functional assets are symmetric with the same costs, capabilities and market potential.

Each independent firm bargains with each other firm on the other side of the market. Thus, we do not allow independently owned upstream or downstream firms to collude. However, integrated firms that own one or more assets, simply set internal supply conditions efficiently.

Denote by q_{ij} the quantity of inputs sold by U_j to D_i. Payments from downstream firm i to upstream firm j are a function, $p_{ij}(q_{ij})$. We consider a general form where supply contracts are a pair (p_{ij}, q_{ij}); that is, a lump sum payment of p_{ij} in return for the quantity, q_{ij}. Notice that this is a distinct assumption from the literature on vertical relationships in the absence of bargaining. In those models, upstream firms set simple per unit (or linear) prices to downstream firms. This results in familiar issues of double marginalization. In contrast, when firms negotiate over price and quantity pairs, the resulting supply contracts are efficient in the sense of avoiding the double marginalization distortion. This is an appropriate outcome given that we allow firms to engage in direct negotiations over supply terms rather than anonymous wholesale market trading.

By avoiding double marginalization, we remove a cost of outsourcing; that is, relative to vertical integration, outsourcing creates the double marginalization distortion and reduces profits. Instead, to consider the non-bargaining benefits to outsourcing, we adopt a 'black box' approach to the net benefits of outsourcing. We assume that if an upstream asset, U_j, is not owned by a downstream firm there is an additional benefit, Δ_j, for that asset that is earned by its owner. This benefit may arise from the additional competencies of independent ownership or some private or other benefits of control of that asset.[9] We will assume, however, that the benefits are only realised if the asset is utilized in production. This captures the notion that the resources of the firm are more valuable being productively utilized by an outsourcing partner. It will turn out that, in general, a downstream firm will suffer a pricing disadvantage if it outsources production. In this case, the benefit of placing resources elsewhere, Δ_j, will compensate for it. Of course, if $\Delta_j < 0$ it may not be profitable to outsource at all.[10] The main purpose of this assumption is to focus not on the decision of whether to outsource or not but the strategic decision of whom to outsource to.

[9] These might be incentives for independent owners to undertake non-contractible actions; something that would not occur if these managers were employees of a larger vertically integrated structure (Grossman and Hart, 1986). It may also account for a reduction in transaction costs (Foss and Foss, 2005).

[10] Here Δ_j is a fixed benefit. The results of this paper will be unchanged if Δ_j is a marginal benefit (depending on quantity produced by the upstream firm) or a specialised benefit impacting favorably on trade with one downstream firm more than another.

Timeline

We begin with the status quo where D_1 owns an upstream asset, say U_A. The other downstream firm (D_2) may own the other upstream asset or not. We explain what asset ownership means below.

The timeline for our model is as follows:

DATE 0 (**Outsourcing**): D_1 decides whether to outsource or not. Outsourcing means selling its upstream asset to either (i) an independent owner; or (ii) the owner of the other upstream asset, U_B.

DATE 1 (**Price Formation/Bargaining**): Each downstream firm engages in bargaining with each upstream firm over the procurement of inputs. If a downstream firm owns an upstream asset, it need not pay for or bargain over that asset's input supply. Bargaining outcomes are based on the Shapley value.

DATE 2 (**Production**): Production takes places, downstream output is sold and all payments are made.

This timeline reflects the basic premise of this paper – that the determination of asset ownership is a longer-term decision than the determination of input prices. Outsourcing contracts are rarely set in stone and have many elements that are renegotiated over time. In contrast, it is more difficult to move assets in and out of a firm. As asset ownership is more 'sticky' as a decision it has the greater strategic importance. As such outsourcing decisions (at Date 0) will have regard to the expected prices that will be negotiated ex post (at Date 1) as well as the value of the assets to the outsourcing firm. Given its importance, we comment in detail on the relationship between outsourcing and asset ownership.

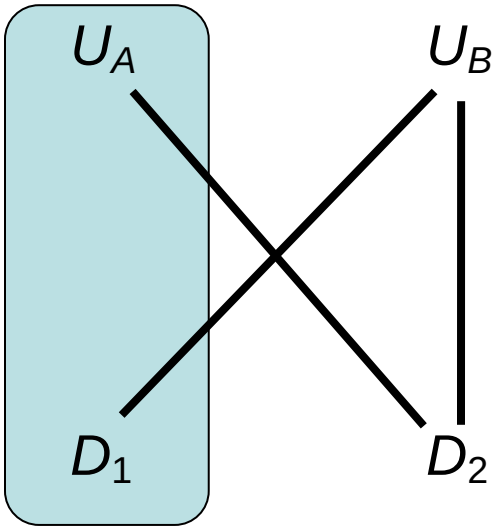
Integration and Asset Ownership

D_1 currently produces a service in-house; requiring the use of one upstream asset – assumed here to be U_A. Notice that, just because D_1 provides this service, it is not precluded from providing that service to others (namely, D_2). As D_1 and D_2 do not directly compete, such provision can, at times, be efficient.[11] Nonetheless, the decisions over inputs supplied from U_A, (q_{1A}, q_{2A}), lie with D_1. Thus, D_2 will have to negotiate with

[11] Indeed, it can be desired even if D_1 and D_2 do directly compete (de Fontenay and Gans, 2005).

it over input supply; a negotiation that will take into account D_1's expected use of that asset. In this case, D_1 and D_2 will still, of course, negotiate with U_B. Figure 1 depicts that graph of bargaining relationships that corresponds to this status quo (the black lines representing lines of negotiation rather than flows of inputs per se).

Figure 1: Status Quo



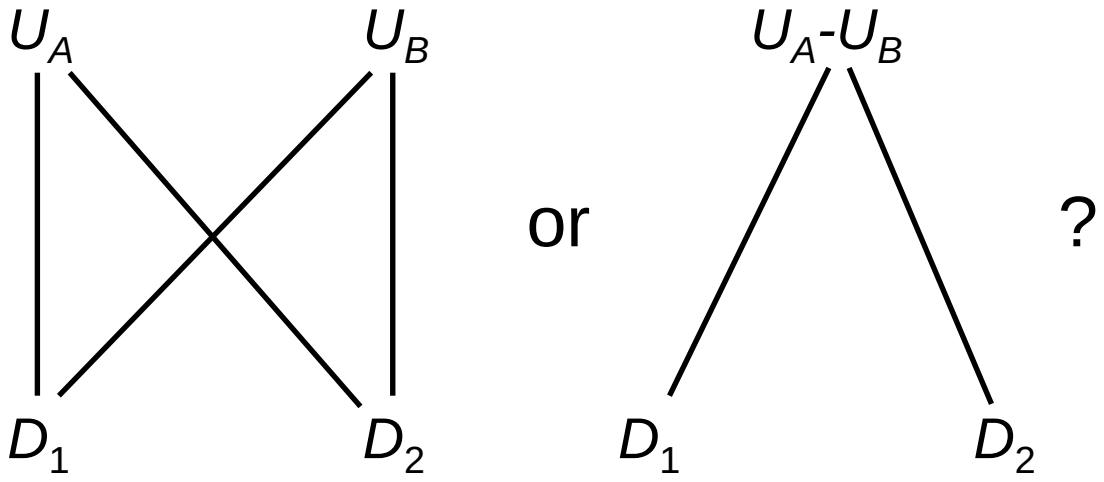
If D_1 sells the asset, it could choose to sell it to an *independent owner* (let's call that firm U_A).[12] D_1 and D_2 will then negotiate with U_A on equal terms; specifically, U_A will have regard to the price and supply it expects to make to D_2 when dealing with D_1. This corresponds to the left-hand side of Figure 2. However, each downstream firm will also consider their position with U_B when agreeing to supply terms. As will be seen, U_A and U_B will compete with one another in this regard. From D_1's perspective, selling the asset to an independent owner generates a competitive value for the asset but also a lower expected costs for future input supplies driven by additional upstream competition.

In contrast, if D_1 sells the asset to U_B, the two upstream assets are *commonly owned*. In this situation, both D_1 and D_2 will negotiate with a single entity for all of their

[12] Note that there is a difference between an independent outsourced firm and an upstream market entrant. An entrant, while independent, also brings resources into the industry. An independent outsourced firm does not and, in this paper, acquires ownership over existing resources. Market entry could be accommodated in this framework but it would add complexity in attempting to account for the additional resources and separate that out from bargaining effects.

input supply. Not surprisingly, this gives the upstream firm a stronger position. That will be reflected in its asset value, but the higher expected input prices will be something D_1 takes into account in its outsourcing decision. Figure 2 depicts the outsourcing choice for D_1.

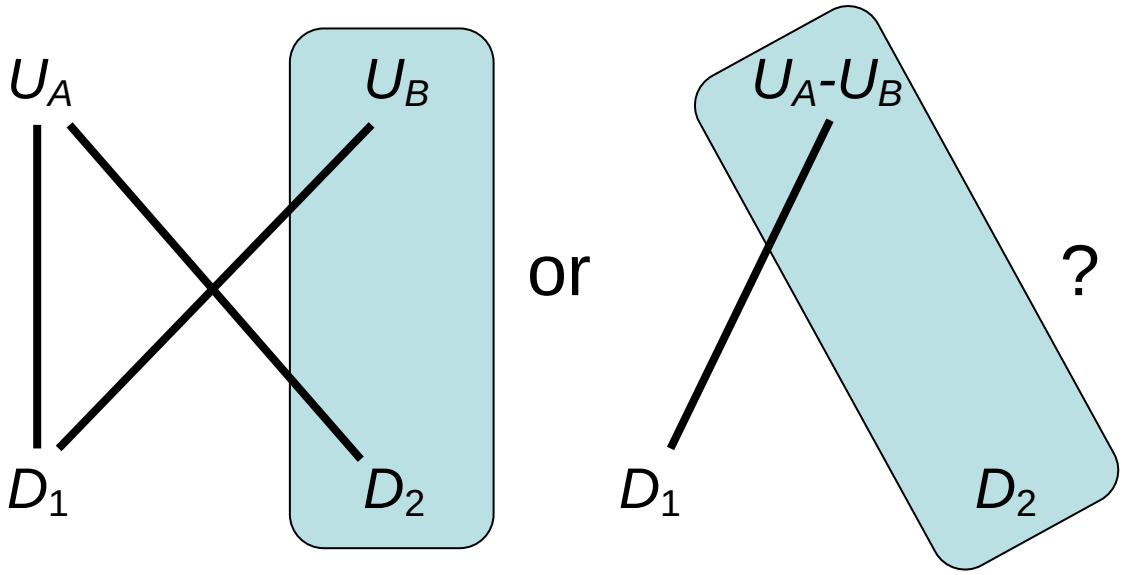
Figure 2: D_1's Outsourcing Choice



Finally, we will also consider situations where D_2 operates U_B in-house. This means that when D_1 considers outsourcing to an established firm, it will give D_2 control over an upstream monopoly (see Figure 3). Moreover, because it is integrated, that decision will not create the additional benefits (Δ_A and Δ_B).

In each case, there will be a potential gain from trade for D_1 and a respective potential purchaser of its upstream asset (U_A). Below we model the asset acquisition game as a (discriminatory) auction and evaluate the choices that D_1 makes in this context.

Figure 3: D_1's Outsourcing Decision (D_2 Integrated)



Coalitional notation

As already noted, the bargaining solution that we employ here is the Shapley value. In its direct application or as derived from more primitive game-theoretic assumptions (de Fontenay and Gans, 2006), the Shapley value says that each firm receives a weight sum of coalitional values as its profits. For that reason, it is useful to define here a notation for those coalitional values.

A coalition in a strategic setting such as that employed here is a collection of agents who are able to trade with one another. The coalitional value is the maximum surplus they can achieve through that trade. However, since the real primitives in determining surplus here are the resources or assets involved in trade, we will denote coalitional values based on those assets as a notational convention and trade the net benefits to outsourcing (should it occur) as an additional variable.

For example, the grand coalition where all agents and their assets participate in trade can generate value denoted by $\Pi(D_1D_2U_AU_B)$. $\Pi(D_1D_2U_AU_B)$ is literally the maximal level of industry profits that can be generated by efficiently employing both upstream and both downstream assets. For example, if $\pi_i(q_{iA}, q_{iB})$ are D_i's profits net of

payments for inputs and $C_j(q_{1j}, q_{2j})$ are U_j's costs of input supply (where $C_j(.)$ is assumed to be convex),[13] then:

$$\Pi(D_1D_2U_AU_B) \equiv \max_{\substack{\{q_{ij}\}_{i=1,2} \\ j=A,B}} \pi_1(q_{1A}, q_{1B}) + \pi_2(q_{2A}, q_{2B}) - C_A(q_{1A}, q_{2A}) - C_B(q_{1B}, q_{2B}) \quad (1)$$

Notice that this value can be achieved regardless of whether D_1 and U_A are integrated or U_A is outsourced and owned by U_B or is independently operated. However, in the latter two cases, the grand coalition surplus is, in fact, $\Pi(D_1D_2U_AU_B) + \Delta_A + \Delta_B$, while in the former case it is $\Pi(D_1D_2U_AU_B) + \Delta_B$.

The bargaining outcome also depends upon value that would arise should agreements between firms breakdown resulting in some firms being exclude from selling or being sold to by others. In this situation, alternative 'coalitions' or supply structures form. These might involve, a single upstream asset supplying both downstream assets (monopoly):

$$\Pi(D_1D_2U_j) \equiv \max_{\{q_{ij}\}_{i=1,2}} \pi_1(q_{1j}) + \pi_2(q_{2j}) - C_j(q_{1j}, q_{2j}) \quad (2)$$

a single downstream asset supplied by both upstream assets (monopsony):

$$\Pi(D_iU_AU_B) \equiv \max_{\{q_{ij}\}_{j=A,B}} \pi_i(q_{iA}, q_{iB}) - C_A(q_{iA}) - C_B(q_{iB}) \quad (3)$$

or alternatively a situation where there is only a single upstream and downstream asset (bilateral monopoly):

$$\Pi(D_iU_j) \equiv \max_{q_{ij}} \pi_i(q_{ij}) - C_j(q_{ij}) \quad (4)$$

It is worthwhile noting here some important properties of these coalitional values. First, adding assets into the potential trade pool, increases coalitional value. That is, $\Pi(D_1D_2U_AU_B) \geq \Pi(D_iU_AU_B)$ for all *i*; $\Pi(D_1D_2U_AU_B) \geq \Pi(D_1D_2U_j)$ for all *j*, and $\Pi(D_1D_2U_j) \geq \Pi(D_iU_j)$ and $\Pi(D_iU_AU_B) \geq \Pi(D_iU_j)$ for all *i* and *j*. Second, if an assets at the same functional level can be removed without reducing coalitional value (that is, the previous inequalities hold with equality), we will say that that asset and its functional

[13] Note that this assumption rules out scale economies. This assumption is made for simplicity only and to avoid some technical issues associated with non-interior solutions (de Fontenay and Gans, 2005). All of the conclusions of the model would continue to hold if upstream production technologies exhibited scale economies. This would mean that it was optimal to have a single upstream supplier – thereby adding to the bargaining reasons for this that we derive below.

neighbor are *perfectly substitutable*. For instance, this might arise for upstream assets that have unlimited capacity and the same costs.

Ownership notation

We will rely heavily on a notation for the payoffs each firm receives under various ownership structures. In this regard, we will group commonly owned assets together. For instance, say that D_1 owned U_A but D_2 and U_B were independent. This would be described by the state (D_1U_A, D_2, U_B). If D_1 sold U_A to an independent owner the state would become (D_1, U_A, D_2, U_B) while if those asset were sold to U_B the state would be (D_1, D_2, U_AU_B).

Given this, the expected payoff to firm *i*, is given by $v_i(.)$. So if the ownership structure was (D_1U_A, D_2, U_B), then D_2's expected payoff would be $v_{D_2}(D_1U_A, D_2, U_B)$ while the integrated D_1 and U_A's payoff would be $v_{D_1U_A}(D_1U_A, D_2, U_B)$.

3. Baseline Results

We are now in a position to derive our results regarding the strategic outsourcing decision of D_1. We begin first with the status quo: (a) whereby D_1 performs upstream operations itself; owning U_A. In deciding whether to outsource and to whom, D_1 will compare their profits from the status quo with their profits and the profits of other firms in various scenarios: (b) outsourcing to an independent firm and (c) outsourcing to an established firm. In this regard, we will, initially, assume that D_2 and U_B are independently owned firms; exploring the implications of this assumption below.

The outsourcing decision

The focus of this paper is how bargaining considerations impact on outsourcing and, in particular, how outsourcing is achieved. We begin, therefore, by considering D_1's decision to outsource in the first place and what might drive it. Thus, we will assume here that it does not have a choice as to who to outsource to. We will endogenize that choice below.

To consider D_1's outsourcing decision, we consider what payoffs each firm gets in the status quo (as represented by Figure 1). If D_1 owns and controls the assets of U_A, this means that in negotiations with U_B, D_1 is assured of supply from U_A while in negotiations with D_2, D_1 can effectively exclude the use of U_A. This impacts upon the possible outcomes that can arise if a full set of supply agreements is not reached: namely, there cannot be a situation where D_2 is supplied by U_A without D_1 also being supplied. Similarly, there cannot be a situation where U_B supplies D_1 without U_A also supplying D_1. Thus, D_1 is never at risk of facing an upstream monopolist that it does not own. Table 1 lists the (Shapley value) payoffs to the three firms in this scenario.

Outsourcing means two things. First, the outsourced firm can realize the benefit Δ_A. Second, D_1 is no longer assured of supply in certain circumstances; namely, if bargaining between it and a supplier breaks down, it may face a monopoly or no supply at all. This latter effect may mean that D_1 is in a diminished bargaining position and may face higher on-going costs.

Given this, we can state the following proposition:

Proposition 1. *Regardless of whether it outsources to an independent or an established firm, D_1's on-going costs of input supply will only fall if Δ_A is sufficiently large.*

The proofs of all propositions are in the appendix. This result says that just because Δ_A is positive (which means that outsourcing is efficient from an industry perspective) does not mean that a decision to outsource will result in those costs being passed through to D_1. Instead, U_A captures some of these in negotiations with D_1. But, more interestingly, D_2 is a beneficiary of those gains (see Table 1). This is because when D_1 outsources (whether it be to an independent or an established firm), D_2 now negotiates with that firm and so can capture some of the productive benefits flowing from D_1's outsourcing decision. Consequently, D_1 does not fully internalize the benefits of outsourcing in terms of on-going reductions in its supply costs.

That said, D_1's outsourcing decision does not purely rest on its on-going returns (that is, $v_{D_1}(D_1,D_2,U_A,U_B)-v_{D_1U_A}(D_1U_A,D_2,U_B)$). Instead, another firm (independent or established as the case may be) benefits from the acquisition of the assets, U_A, and from the on-going ability this gives them to earn rents through bargaining. If an independent

firm purchases these assets they receive $v_{U_A}(D_1, D_2, U_A, U_B)$ and would be willing to pay this full value as there were many such firms. Thus, D_1, by outsourcing, could earn:

$$\underbrace{v_{U_A}(D_1, D_2, U_A, U_B)}_{\text{Asset Acquisition Payment}} - \underbrace{\left(v_{D_1U_A}(D_1U_A, D_2, U_B) - v_{D_1}(D_1, D_2, U_A, U_B)\right)}_{\text{On-going cost increase}} \quad (5)$$

That is, D_1's on-going cost increase (if any) must be weighed against the payment it could receive for its outsourced division.

Similarly, were D_1 to outsource to an established firm, its total return could be as high as:

$$\underbrace{v_{U_AU_B}(D_1, D_2, U_AU_B) - v_{U_B}(D_1U_A, D_2, U_B)}_{\text{Asset Acquisition Payment}} - \underbrace{\left(v_{D_1U_A}(D_1U_A, D_2, U_B) - v_{D_1}(D_1, D_2, U_AU_B)\right)}_{\text{On-going cost increase}} \quad (6)$$

Notice that, in this case, the maximum payment that U_B could make for the assets, U_A, would be its on-going profits post-acquisition less its profits pre-acquisition. We say maximum here because U_B may not have to pay that much for outsourcing to it to still be attractive relative to the status quo. The actual asset acquisition payment would be the subject of a negotiation between them.

When we take into account the full potential benefits of outsourcing (acquisition price plus on-going impacts), we find the following:

Proposition 2. *$\Delta_A > 0$ is not a sufficient condition for outsourcing to be profitable for D_1. $\Delta_A > 0$ is a necessary condition for D_1 to find it profitable to outsource to an independent firm.*

The first part of the proposition says that just because outsourcing is efficient does not mean that D_1 will find it profitable. Given Proposition 1, clearly, this will be the case if D_1 cannot appropriate U_A's full asset value in spinning off or selling the division. However, the proposition makes no assumption and that and so even when D_1 can appropriate U_A's full value to its acquirer. This result is not surprising given our earlier observation that some of the efficiency benefits from outsourcing by D_1 will be passed through to D_2 through bargaining.

The second part of the proposition looks at the converse. When D_1 outsources to an independent firm, unless $\Delta_A > 0$, it will not find this profitable. The same cannot be said of outsourcing to an established firm. There it is possible that outsourcing could be

profitable even if it is productively inefficient (that is $\Delta_A < 0$). The reasons why this is the case will become clearer below when we compare the two types of outsourcing.

For the moment, it is interesting to note the empirical implications of this. First, in examining outsourcing by spin-off, if this is observed it is efficient. Thus, measures of industry productivity will increase as a result of observed outsourcing. Second, the same cannot be said of outsourcing to other established firms. In this case, industry productivity might well decline as a result of this. However, if the assets, U_A, held little market value, and D_1 procured from an established firm, this would only occur if Δ_A were sufficiently large (Proposition 1). In this case, outsourcing would be associated with rises in industry productivity.

Finally, it is instructive to examine how the overall scarcity of supply, might impact on the returns to outsourcing. Supply scarcity could be modeled by consideration of the convexity of upstream costs. If these were not convex and firms had unlimited capacity, then, for example, $\Pi(D_1D_2U_AU_B) = \Pi(D_1D_2U_j)$ and $\Pi(D_iU_AU_B) = \Pi(D_iU_j)$; i.e., adding an upstream asset would add little to industry profits. On the other hand, with highly convex costs and limited upstream capacity, $\Pi(D_1D_2U_AU_B) = \Pi(D_iU_AU_B)$ and $\Pi(D_1D_2U_j) = \Pi(D_iU_j)$; that is, additional demand could not be fulfilled so that additional downstream markets would add little to industry profits.

In our general set-up we can prove the following:

Proposition 3. *The returns to outsourcing to an established firm fall as upstream capacity becomes scarce. The returns to outsourcing to an independent firm rise as upstream capacity becomes scarce.*

Thus, the scarcity of upstream capacity has markedly different impacts on the returns to established and independent firm outsourcing. Prior to outsourcing, D_1 has the option of procuring internally or externally. It can negotiate favorable external returns when it has its own internal supply. This option is more valuable when capacity is scarce. However, when it outsources to an established firm, that capacity is concentrated in the hands of a single firm who even in the absence of such consolidation would earn scarcity rents. Hence, the value of outsourcing is reduced. In contrast, an independent firm will value a scarce upstream resource highly relative to not owning any upstream assets at all. Thus, it will increase its bid for those assets accordingly. Thus, it is the fact that the value of

being able to earn scarcity rents is greater for independent than established operators that changes their relative returns.

Independent versus established firm outsourcing

We now turn to consider D_1's choice, if it were to outsource, would it outsource to an independent firm (say, by spinning off its division) or to an established firm (by selling off its upstream division)? In considering this decision there are two forces at work. First, by creating an independent upstream supplier, competition is created which lowers the cost of procuring inputs. Second, in so doing, the value of upstream assets are diminished relative to a situation whereby they are consolidated in a single upstream entity.

It turns out that the latter (asset value) effect dominates the former (on-going cost) effect. To demonstrate this, we suppose that D_1 puts its U_A asset up for auction. To model this, we assume that there is a continuum of independent owners who might purchase the asset (so that each bids up to their willingness to pay) while there is a single owner of U_B who might also bid. As D_1's future surplus depends upon the owner, it will not treat such bids as equally; thus, the auction is discriminatory. Moreover, as U_B has regard to the different implications associated with it not becoming the owner, it will take this into account in its bidding. Thus, the auction possesses external effects which means that care must be taken in specifying what each firm will bid and how this impacts upon the seller.[14]

To begin, note that, from D_1's perspective it earns more net of any payments for assets by selling to an independent firm. That is,

$$\begin{aligned} & v_{D_1}(D_1,D_2,U_A,U_B) - v_{D_1}(D_1,D_2,U_A U_B) \\ & = \tfrac{1}{12}\begin{pmatrix} \Pi(D_1D_2U_AU_B) + \Pi(D_1U_AU_B) - \Pi(D_2U_AU_B) \\ +\Pi(D_1D_2U_A) + \Pi(D_1D_2U_B) \\ +\Pi(D_1U_A) + \Pi(D_1U_B) - \Pi(D_2U_A) - \Pi(D_2U_B) \end{pmatrix} > 0 \end{aligned} \tag{7}$$

where the inequality follows as $\Pi(D_1D_2U_AU_B) \geq \Pi(D_2U_AU_B)$ and $\Pi(D_1D_2U_j) \geq \Pi(D_2U_j)$ for each j. Thus, D_1 will earn lower on-going profits by selling its asset to U_B. For this reason, it will not simply want to accept the highest bid in this

[14] Gans (2005) provides a comprehensive analysis of such auctions in the context of ownership.

auction. Instead, it will expect U_B to bid a certain amount above the bids of an independent purchaser in order to award the asset to U_B.

In this situation, that maximum amount an independent firm would bid for the assets would be $v_{U_A}(D_1, D_2, U_A, U_B)$. Thus, in order to beat an independent bid for the assets and assuming complete information regarding these values, U_B would have to bid an amount, b, so that:

$$\underbrace{b + v_{D_1}(D_1, D_2, U_A U_B)}_{D_1\text{'s Returns from Established Outsourcing}} > \underbrace{v_{U_A}(D_1, D_2, U_A, U_B) + v_{D_1}(D_1, D_2, U_A, U_B)}_{D_1\text{'s Returns from Independent Outsourcing}} \quad (8)$$

Will U_B bid this amount? If it does, knowing that the alternative is independent outsourcing, its bid must satisfy:

$$\underbrace{v_{U_A U_B}(D_1, D_2, U_A U_B) - b}_{U_B\text{'s Returns from Winning}} \geq \underbrace{v_{U_B}(D_1, D_2, U_A, U_B)}_{U_B\text{'s Returns from Losing}} \quad (9)$$

The following proposition demonstrates that (8) and (9) will both hold and so D_1 will receive strictly more than the value of the outsourced assets to an independent firm as U_B bids enough to compensate it for on-going losses from a lack of competition.

Proposition 4. *Suppose that Δ_A is sufficiently high so that D_1 always wants to outsource. Under a discriminatory asset auction, D_1 will always prefer to outsource to an established rather than an independent upstream firm.*

In this situation, U_B will be willing to set b just above $v_{U_A}(D_1, D_2, U_A, U_B) + v_{D_1}(D_1, D_2, U_A, U_B) - v_{D_1}(D_1, D_2, U_A U_B)$; which is the bid of the independent firm. Thus, while considering just the cost implications, D_1 would choose to set up an independent U_A rather than outsource to an established U_B, the value of A's assets in U_B's hands is greater than their value with an independent owner. This is because the higher costs D_1 faces also flows on to D_2 with a consequent increase in asset value that more than compensates D_1 for on-going losses.

Having options of whom to outsource to, raises the returns to outsourcing. Established firms bid more because of competition in the auction from independents. Thus, the overall incentive to outsource is higher than if only one type of firm was being considered. In addition, what is driving established firm outsourcing is that the auction process takes into account the 'before and after' profits of D_1, U_B and the independents. However, it ignores D_2. Because D_2 is harmed more by established firm outsourcing than

independent outsourcing, it is this that drives the incentives of others to extract those rents. Specifically, D_1 and U_B are able to share in the rents accruing from U_B's improved bargaining position with respect to D_2.

4. Robustness

Our baseline model provides a clear prediction that in its outsourcing decisions, based on bargaining position considerations, firms should outsource to established upstream suppliers rather than create competition for them. The baseline model has some inbuilt assumptions that simplify exposition. Consequently, in this section and the next, we consider alternatives. This section looks at alternatives that reinforce the baseline result while the next looks for explanations of when independent outsourcing might be profitable.

Internal bargaining

de Fontenay and Gans (2005) assumed that associated with each physical asset was a manager who was somewhat irreplaceable. What this meant was that if that asset was owned and operated by another firm, the manager concerned would have to be an employee of that firm. That manager would have some bargaining power over their wage as the asset would be less or unproductive without them.

Allowing for internal bargaining of this kind changes the returns to outsourcing. Specifically, if D_1 were to outsource U_A to an independent company, it would not have to negotiate with U_A's manager directly but instead as a combination. Not surprisingly, U_A's manager will have more bargaining power if it more closely controls the physical asset (as it would under outsourcing) than if they are just an employee of D_1. It is not clear that this increases the cost of outsourcing per se because integration carries its own cost (paying for employment) but its presence changes the potential return. This is especially the case if we follow de Fontenay and Gans (2005) and assume that, under outsourcing, the manager becomes the owner of the independent firm.

In contrast, with outsourcing to an established firm, the manager of U_A remains an employee regardless. It is just that their employment transfers from D_1 to U_B. This may change their wage.

de Fontenay and Gans (2005) did not examine outsourcing per se. Their focus was on vertical integration and so they did not consider D_1's choice between independent and established firm outsourcing. Doing so with internal bargaining yields the following result:

Proposition 5. *Suppose that Δ_A is sufficiently high so that D_1 always wants to outsource and that there is internal bargaining. Under a discriminatory asset auction, D_1 will always prefer to outsource to an established rather than an independent upstream firm.*

Thus, internal bargaining considerations – while placing a cost of an established upstream firm in terms of creating a powerful employee – do not overturn the baseline result. This is because outsourcing to an established firm still consolidates competitive outcomes; the returns to which are shared between D_1 and U_B, and otherwise merely transfer the powerful employment relationship and its bargaining costs between them. Moreover, as the manager of U_A has some bargaining power in either case, their incentive to bid for the upstream assets, U_A, are themselves diminished.[15]

Forward versus backward integration

While outsourcing considered here is outsourcing of supply, the considerations here would apply equally to outsourcing demand; that is, where U_A chooses to divest D_1. In this case, the choice would be between an independent D_1 or selling D_1 to D_2. As D_1 and D_2 do not directly compete, the choice between the two options is similar and consolidation of demand is attractive because it raises the value of U_A's downstream assets. Consequently, the bargaining implications would be isomorphic to the outsourced supply case.

Where these might differ is when there is internal bargaining. As de Fontenay and Gans (2005) show, internal bargaining means that the status quo point without outsourcing involves differing profits for the integrated firm (D_1-U_A). This is because depending upon who owns whom (i.e., whether we consider this backward or forward integration from the viewpoint of the economic property rights view of the firm) the implications for firm profits are different. Hence, in comparing those with outsourcing,

[15] This type of force is explored in more detail in Gans (2005). There, outsourcing to an established firm may bring about an additional cost in terms of the incentives for the manager of U_A to undertake certain productive actions. Such potential inefficiency would, of course, mitigate the incentive towards established firm outsourcing but not necessarily eliminate it.

the returns to outsourcing may themselves be different. However, even in this case, the choice between independent and established firm outsourcing will be driven by similar considerations to Proposition 5.

Competing downstream firms

Thus far, we have assumed that downstream firms compete in separate markets (geographic or otherwise). However, in the case of GE with microwaves and Motorola with mobile phones, they could be regarded as competing directly with established firms they considered outsourcing to. In each case, the anecdotal reports listed this as a reason for outsourcing to an independent firm (at least one that was independent at the time). For this reason, it is natural to explore downstream competition as a motivation for independent outsourcing.

It turns out, however, that downstream competition only reinforces the rationale for established firm outsourcing. To see this, we cannot rely on a simply application of the Shapley value as a model of bargaining between upstream and downstream firms. This is because that model allows competing downstream firms to reach agreements that collusively lead to monopoly outcomes in the industry – that is, it assumes away the very competitive forces we are trying to take into account. Instead, the bilateral bargaining approached developed by de Fontenay and Gans (2005, 2006) provides a non-cooperative game theoretic approach to bargaining that allows for competitive externalities to be present and to matter. This means that the bargaining outcome – while being Shapley value like in terms of what firms appropriate – has value determined in a non-cooperative fashion. Specifically, industry profits are not maximised and may potentially change with outsourcing.

For our purposes here, it is useful to consider a simple version of the de Fontenay and Gans (2005) set-up to illustrate why downstream competition will drive established firm outsourcing. Suppose that when both downstream firms are present, they compete and industry profits are reduced to $\hat{\Pi}(D_1 D_2 U_A U_B) < \Pi(D_1 D_2 U_A U_B)$ and $\hat{\Pi}(D_1 D_2 U_j) < \Pi(D_1 D_2 U_j)$, respectively. The idea here is that the presence of competing downstream firms leads to rent dissipation to final consumers but the magnitude of this depends on the cohort of upstream resources present in the industry.

With this set-up, we can demonstrate the following.

Proposition 6. *Suppose that Δ_A is sufficiently high so that D_1 always wants to outsource and that downstream firms directly compete. Under a discriminatory asset auction, D_1 will always prefer to outsource to an established rather than an independent upstream firm.*

The intuition is as follows. When both downstream firms outsource their production, industry profits are driven by competition between them. Even when there is an upstream monopoly, industry rents are dissipated by downstream competition. Indeed, a key result of de Fontenay and Gans (2005) is that this rent dissipation is the same, regardless of whether upstream assets are independently held or consolidated.[16] Thus, the choice between outsourcing to an independent or established firm rests on pure bargaining effects; precisely the same as those derived in Proposition 4. As such, allowing for downstream competition does not change this choice.[17]

Similarly, suppose that in outsourcing to an independent firm, D_1 creates a platform for future downstream entry by that firm. This is arguably what happened with GE and Samsung in microwave ovens. In this situation, future industry profits will be dissipated further by independent firm outsourcing as all downstream firms face future competition. Now while this will raise the independent firm's bid for D_1's upstream assets, this possibility also raises U_B's bid price as it recognizes that its successful bid would prevent entry and industry profit dissipation. D_1 will also favor that outcome. Hence, the possibility that outsourcing encourages future competition, is another reason to favor established firm rather than independent outsourcing. It suggests that in GE's case and perhaps Motorola too[18] their choice of independent outsourcing may have been poorly considered or at least based on factors other than bargaining position and potential competition.

[16] This is a general outcome in economic models of vertical contracting (McAfee and Schwartz, 1994; Rey and Tirole, 2003).

[17] de Fontenay and Gans (2005) do demonstrate that an integrated upstream monopolist can achieve higher industry profits. This will change the returns to that particular structure.

[18] In that case, BenQ's entry was arguably into a separate geographic market and so less of a direct competition issue. However, it did involve BenQ becoming integrated which is something we consider in the next section.

Outsource and Break Up

In addition, we are also able to consider outsourcing by a 'large' firm with many productive assets. Such outsourcing may involve creating a separate entity or alternatively breaking up production between different partners. British Petroleum did the latter when it outsourced its information technology services in the 1990s (Cross, 1995).

Given this, as a final exercise, we consider D_1's outsourcing decision if it is the owner of all upstream assets. The Shapley values of each firm in this status quo are:

$$v_{D_1U_AU_B}(D_1U_AU_B, D_2) = \tfrac{1}{2}\left(\Pi(D_1D_2U_AU_B) + \Pi(D_1U_AU_B)\right) \tag{10}$$

$$v_{D_2}(D_1U_AU_B, D_2) = \tfrac{1}{2}\left(\Pi(D_1D_2U_AU_B) - \Pi(D_1U_AU_B)\right) \tag{11}$$

In this situation, the decision is not to whom to outsource but whether to outsource as a consolidated supplier or to break up the upstream assets into competing entities.

D_1's incentive to outsource and break-up versus continue as an integrated entity depends on the sign of the following inequality:

$$\begin{aligned} &v_{D_1}(D_1, D_2, U_A, U_B) + v_{U_A}(D_1, D_2, U_A, U_B) + v_{U_B}(D_1, D_2, U_A, U_B) \geq v_{D_1U_AU_B}(D_1U_AU_B, D_2) \\ &\Rightarrow \tfrac{1}{12}\begin{pmatrix} 3\Pi(\overline{D_1D_2U_AU_B}) - \Pi(\overline{D_1D_2U_A}) - \Pi(\overline{D_1D_2U_B}) \\ +\Pi(\overline{D_1U_A}) + \Pi(\overline{D_1U_B}) - \Pi(\overline{D_2U_A}) - \Pi(\overline{D_2U_B}) \\ -3\Pi(\overline{D_1U_AU_B}) - \Pi(\overline{D_2U_AU_B}) \end{pmatrix} + \tfrac{5}{6}(\Delta_A + \Delta_B) \geq 0 \end{aligned} \tag{12}$$

However, it could also choose to outsource but keep the upstream assets as a single entity. Its incentive to do this is given by the following:

$$\begin{aligned} &v_{D_1}(D_1, D_2, U_AU_B) + v_{U_AU_B}(D_1, D_2, U_AU_B) \geq v_{D_1U_AU_B}(D_1U_AU_B, D_2) \\ &\Rightarrow \tfrac{1}{6}\left(\Pi(D_1D_2U_AU_B) - \Pi(D_1U_AU_B) - \Pi(D_2U_AU_B)\right) + \tfrac{5}{6}(\Delta_A + \Delta_B) \geq 0 \end{aligned} \tag{13}$$

Comparing (12) and (13) it is readily apparent that the incentive to outsource and keep the upstream assets together is greater than the breakup strategy. This is because as their initial owner, D_1 gains more by selling an upstream monopolist than upstream competitors with D_2 being harmed as a result of this decision.

Thus, BP's choice to break-up its outsourcing arrangements stands alongside GE and Motorola as a puzzle from a purely bargaining perspective. This suggests that either other, non-bargaining factors were at work in those cases, or alternatively, the set-up here is restrictive on an important dimension. We consider such dimensions next.

5. Explaining Independent Outsourcing

Our baseline results give a clear prediction that – faced with a choice between outsourcing to an independent firm or an established firm – a downstream firm will choose the established firm. While the on-going costs of so doing are higher, the downstream firm will appropriate enough asset value in the sale to completely offset these.

This prediction from the bargaining perspective stands in contrast to observations that spin-offs and independent outsourcing does occur. Indeed, this was the case with our motivating examples in the introduction. Consequently, given the clarity of our prediction on this, it is worthwhile to consider here some amendments to the baseline model that might generate an opposite conclusion.

Clearly, if it were the case that independent outsourcing was more productively efficient than established firm outsourcing (we had assumed they were symmetric in this regard), then we might observe independent outsourcing. In addition, if D_1's upstream assets had no value in of themselves, then D_1 would prefer to outsource to an independent rather than an established firm. However, our model was flexible enough to consider a range of environments. In each case, this outcome did not arise.

What we consider here, therefore, are explanations that rely on bargaining outcomes rather than other environmental factors. That is the focus of this paper and is appropriate given that it was the relative changes in bargaining position that drove Proposition 4.

Outsourcing to an integrated supplier

The first alternative specification – and one we anticipated in setting up the model – arose if D_2-U_B were themselves integrated with U_B is already owned by D_2. Table 2 states the Shapley value outcomes for this situation.

In this situation, we obtain the following result:

Proposition 7. *Suppose that Δ_A is sufficiently high so that D_1 always wants to outsource and that D_2 and U_B are integrated. Under a discriminatory asset auction, D_1 will always prefer to outsource to an independent rather than an established upstream firm.*

Outsourcing to an integrated supplier is less profitable than outsourcing to an independent one; a reversal of the prediction of Proposition 4.

The intuition is as follows. First, note that there are no advantages from outsourcing to the existing upstream player. Specifically, the sum of payoffs to the two integrated chains prior to the merger is $\Pi(D_1D_2U_AU_B)$ and if U_A moves from D_1 to D_2 both affected parties are part of the transaction and so there are no external effects; it is a pure transfer of value. Hence, the two structures involve different ways of splitting $\Pi(D_1D_2U_AU_B)$ between D_1 and D_2 and hence, there are no gains from this type of asset exchange.

In contrast, if D_1 sells U_A to an independent owner, there may be gains from trade as this impacts on D_2.

$$\begin{aligned} & v_{D_1}(D_1,U_A,D_2U_B)+v_{U_A}(D_1,U_A,D_2U_B)\geq v_{D_1U_A}(D_1U_A,D_2U_B) \\ & \Rightarrow \tfrac{1}{6}\Big(\Pi(\overline{D_1D_2U_AU_B})-\Pi(\overline{D_1D_2U_B})-\Pi(\overline{D_2U_AU_B})+\Pi(\overline{D_2U_B})-\Pi(\overline{D_1U_A})\Big)+\tfrac{5}{6}\Delta_A\geq 0 \end{aligned} \quad (14)$$

As can be seen from the above inequality, the impact on D_2 is, in fact, a positive one and their bargaining position is enhanced. Thus, D_1 will only choose to outsource if the benefits from so doing are sufficiently high. Nonetheless, if it were going to outsource, D_1 would outsource to an independent firm in this instance.[19]

Thus, if the starting position in an industry were that other downstream firms owned their own suppliers, then D_1 would prefer to outsource and create an independent firm rather than to rely on supply from one of these others. Notice that this occurs even though downstream firms do not compete in the final product market. It is a pure effect arising from the change in bargaining position that outsourcing will bring as well as the potential to realize any productive benefits from outsourcing.

[19] Interestingly, if D_1 were to outsource but then chose to auction off the assets, D_2's highest bid would match that of an independent owner. That is, taking into account D_2's highest bid, D_1 would receive $v_{D_1}(D_1,D_2U_AU_B)+v_{D_2U_AU_B}(D_1,D_2U_AU_B)-v_{D_2U_B}(D_1,U_A,D_2U_B)$ in this instance and $_{D_1}(D_1,U_A,D_2U_B)+v_{U_A}(D_1,U_A,D_2U_B)$ if it sold to an independent firm. It is easy to show these values are identical. In this case, other factors would determine who the owner is.

Double marginalization

Our bargaining approach here models upstream and downstream firms negotiating supply agreements that are efficient. In particular, when downstream firms make their decisions as to input volumes to purchase their marginal decision reflects the marginal costs faced by upstream firms in producing those inputs. This is reasonable when upstream and downstream firms negotiate directly with one another. Indeed, supply agreements contain rebates, discounts, volume bonuses that are all designed to ensure efficient procurement.

In contrast, when supply agreements are determined at arms-length, it is sometimes argued that efficient pricing does not result. Instead, supply arrangements involve downstream firms being offered a simple linear price (i.e., price per unit) and then choosing the quantity they would like to purchase at that price. In this situation, outsourcing results in the well-known double marginalization problem whereby supply prices are above marginal costs and downstream firms themselves procure and price on the basis of this inflated price. The end result is less production and, indeed, profits in the industry.

Upstream competition is a force that mitigates the double marginalization problem. Hence, it is useful here to consider that alternative model rather than our bargaining model and what it implies for the established firm versus independent firm choice. Recall that the two considerations driving our baseline result – that established firm outsourcing raises on-going procurement costs but affords higher value from the sale of assets – still occur in the double marginalization environment. The issue is how the trade-off between them plays out.

Analyzing linear pricing models in a vertical contracting situation can become very complex. However, in a simple setting we can demonstrate the following:

Proposition 8. *Suppose that Δ_A is sufficiently high so that D_1 always wants to outsource and (a) downstream demand is linear; (b) upstream and downstream outputs are perfect substitutes; and (c) upstream and downstream firms are symmetric. Under a discriminatory asset auction, D_1 will always prefer to outsource to an independent rather than an established upstream firm.*

This proposition demonstrates that it is possible to find cases where, under linear pricing, outsourcing imposes a cost on the entire industry – greater double marginalization. This

problem is less pronounced when there is upstream competition than when there is an upstream monopoly. For this reason, if outsourcing were to occur, a downstream firm would prefer it to occur in a competitive way rather than a monopolistic one; even if it could appropriate the rents from this.

Double marginalization is a mechanism by which consolidating upstream assets reduces over industry profits. As a result, that effect can counteract the bargaining position advantages that D_1 can achieve with U_B by established firm outsourcing. However, the issue empirically is whether this type of pricing is an on-going restriction of a sufficiently on-going nature to impact upon long-term value creation in the industry. It suggests that in investigating the nature of outsourcing, empirical researchers need to closely examine the overall form of contracting that is present in the industry.

6. Bandwagon Effects

The above analysis has demonstrated that (i) when U_B is independently owned, D_1 prefers to outsource to it rather than to an independent firm; and (ii) when U_B is integrated, D_1 prefers to outsource to an independent firm rather than it. Given this, it is a natural question to ask whether D_1's incentives to outsource are higher if U_B is independently owned or not? That is, will outsourcing by D_2 raise incentives for D_1 to outsource?

To analyze this, let's consider a situation where both D_1 and D_2 own an upstream asset and D_2 moves to outsource first. Observing this, then D_1 decides whether to outsource. Working backwards, if D_2 has outsourced (creating an independent U_B[20]), then D_1's incentives to outsource are driven by the same considerations as Proposition 4; that is, it will prefer to outsource to an established rather than an independent firm. If D_2 does not outsource, D_1's incentives are given by Proposition 7. Comparing these two, it is easy to see that D_1's incentives to outsource at all are greater when U_B is independently owned. Thus, *outsourcing elsewhere tends to raise incentives for outsourcing by* D_1.

But given this, will D_2 choose to outsource? After all, it will recognize that by outsourcing, it will not face an independently owned U_B but a commonly owned

[20] This is its only option in this game as there is no established firm to outsource to.

upstream monopolist. This may be an acceptable situation, if D_2 can appropriate sufficient value from the assets outsourced to compensate for on-going costs associated with outsourcing. However, we have not specified in sufficient detail the 'asset trading game' that might arise in this situation. In many respects, that is a topic well beyond the scope of this paper. Nonetheless, in its outsourcing decision, should D_1 choose to outsource regardless, D_2 will be comparing a situation where it stays integrated to one where there is a non-integrated upstream monopolist. It may choose, therefore, to outsource for the same reason as D_1 did in Proposition 1.

This discussion highlights some of the interdependencies between outsourcing decisions but also the complexity that arises as a result of those interdependencies. This suggests that extensions to the model to capture those complexities are a fruitful area for future research.

7. Conclusion

Applications of bargaining theory to strategy and supply chain management are in their infancy. Models based on bargaining have only been recently developed. This paper uses one such approach to evaluate the type of outsourcing choices that might be made by firms; specifically, whether a firm wants to create an independent competitor or to outsource to an established firm. In the absence of any other motive for choosing between them (say, based on already developed competencies), a downstream firm must tradeoff lower expected input prices against lower asset value when choosing between an independent and established firm.

Utilizing a bargaining perspective, we demonstrate here that industry value is not impacted by these choices. Based on pure bargaining effects, a downstream firm earns more by outsourcing, or even better, by auctioning off its assets to an established firm. Basically, upstream monopoly is more valuable to an asset owner and hence, that owner will have an incentive to create that outcome.

The analysis here is admittedly specialized to focus in on the bargaining aspects of outsourcing. As such, we do not explicitly take into account other explanations for outsourcing and also imperfections in capital markets that might play a role in observed

ownership structures. Our approach does not rule these alternative factors out and indeed is complementary to them but, in their absence, we do not claim to have provided a complete set of conditions that might drive one form of outsourcing or another.

There is a sense in which establishing independent upstream ownership as a long-term outcome relies upon the operation of anti-trust laws. Having divested its upstream assets to an independent owner, that owner and the other upstream firms will still have an incentive to merge ex post. Antitrust protection may limit this at this stage in a way it cannot achieve at the earlier outsourcing stage. A more comprehensive model of the dynamics of asset ownership is something for further work.

Finally, it is useful to note that our results here also shed light on the role of upstream competition per se. Outsourcing is often prescribed as a valuable outcome where upstream markets are more competitive (Domberger, 1998; Spulber, 1998). While the standard approach supports this intuition, when efficient bilateral contracts can be written, the reverse is true. The incentives to outsource (as opposed to retain production in-house) are *stronger* when an upstream monopoly is possible than when there is upstream competition.

8. Appendix: Proofs of Propositions

Proof of Proposition 1

Using the values in Table 1, note that the potential 'cost' of outsourcing for the independent and established firm cases respectively are:

$$\begin{aligned} & v_{D_1U_A}(D_1U_A, D_2, U_B) - v_{D_1}(D_1, D_2, U_A, U_B) \\ & = \tfrac{1}{12}\begin{pmatrix} \Pi(D_1D_2U_AU_B) + \Pi(D_1D_2U_A) - \Pi(D_1D_2U_B) + \Pi(D_1U_AU_B) + 3\Pi(D_2U_AU_B) \\ +3\Pi(D_1U_A) - \Pi(D_1U_B) + \Pi(D_2U_A) - 3\Pi(D_2U_B) \end{pmatrix} - \tfrac{1}{6}\Delta_A \end{aligned} \tag{15}$$

$$\begin{aligned} & v_{D_1U_A}(D_1U_A, D_2, U_B) - v_{D_1}(D_1, D_2, U_AU_B) \\ & = \tfrac{1}{12}\left(2\Pi(D_1D_2U_A) + 4\Pi(D_2U_AU_B) + 4\Pi(D_1U_A) - 4\Pi(D_2U_B)\right) - \tfrac{1}{6}\Delta_A \end{aligned} \tag{16}$$

It is easy to see that the first (bracketed) term in each of these equations is positive. Hence, outsourcing will only result in cost reductions (these equations being negative) if Δ_A is sufficiently large.

Proof of Proposition 2

Using the values in Table 1, the total return for independent outsourcing is:

$$\begin{aligned} & v_{U_A}(D_1, D_2, U_A, U_B) + v_{D_1}(D_1, D_2, U_A, U_B) - v_{D_1U_A}(D_1U_A, D_2, U_B) \\ & = \tfrac{1}{12}\left(2\Pi(D_1D_2U_AU_B) - 2\Pi(D_1D_2U_B) - 2\Pi(D_1U_A) + 2\Pi(D_2U_B) - 2\Pi(D_2U_AU_B)\right) + \tfrac{5}{6}\Delta_A \end{aligned} \tag{17}$$

Note that the first (bracketed term) is negative. Hence, outsourcing will only be profitable to an independent firm if Δ_A is positive. However, this is not sufficient for this to be the case. In contrast, for established firm outsourcing, the return is potentially:

$$\begin{aligned} & v_{U_AU_B}(D_1, D_2, U_AU_B) - v_{U_B}(D_1U_A, D_2, U_B) - \left(v_{D_1U_A}(D_1U_A, D_2, U_B) - v_{D_1}(D_1, D_2, U_AU_B)\right) \\ & = \tfrac{1}{12}\left(2\Pi(D_1D_2U_A) - 2\Pi(D_2U_AU_B) - 2\Pi(D_1U_A) + 2\Pi(D_2U_B)\right) + \tfrac{5}{6}\Delta_A \end{aligned} \tag{18}$$

Here the bracketed term may be positive or negative. Hence, Δ_A being positive is neither necessary nor sufficient for such outsourcing to be profitable.

Proof of Proposition 3

From (17), note that as capacity becomes less scarce, $2\Pi(D_1D_2U_AU_B) \to 2\Pi(D_1D_2U_B)$ and $2\Pi(D_2U_B) \to 2\Pi(D_2U_AU_B)$ eliminating a negative term and so increasing the returns to outsourcing to an independent firm.

From (18), when capacity becomes limited, the returns to outsourcing become $\tfrac{1}{12}\left(-2\Pi(D_2U_AU_B) + 2\Pi(D_2U_B)\right) + \tfrac{5}{6}\Delta_A$ while with unlimited capacity they are: $\tfrac{1}{12}\left(2\Pi(D_1D_2U_A) - 2\Pi(D_1U_A)\right) + \tfrac{5}{6}\Delta_A$. It is clear that the limited capacity return is higher. Thus, the returns to outsourcing to an established firm rise as capacity becomes more scarce.

Proof of Proposition 4

Because a discriminatory auction is being used, the choice between independent and established firm outsourcing will depend upon the bilateral gains from trade given that outsourcing will occur. The gain from trade of an asset to an independent U_A is:

$$\begin{aligned}&\underbrace{v_{U_A}(D_1,D_2,U_A,U_B)}_{U_A\text{'s Gain}}-\underbrace{\left(v_{D_1U_A}(D_1U_A,D_2,U_B)-v_{D_1}(D_1,D_2,U_A,U_B)\right)}_{D_1\text{'s Loss}}\\&=\tfrac{1}{12}\left(2\Pi(D_1D_2U_AU_B)-2\Pi(D_1D_2U_B)-2\Pi(D_1U_A)+2\Pi(D_2U_B)-2\Pi(D_2U_AU_B)\right)+\tfrac{5}{6}\Delta_A\end{aligned}\tag{19}$$

The gain from trade of selling A to an established U_B is:

$$\begin{aligned}&\underbrace{v_{U_AU_B}(D_1,D_2,U_AU_B)-v_{U_B}(D_1U_A,D_2,U_B)}_{U_B\text{'s Gain}}-\underbrace{\left(v_{D_1U_A}(D_1U_A,D_2,U_B)-v_{D_1}(D_1,D_2,U_AU_B)\right)}_{D_1\text{'s Loss}}\\&=\tfrac{1}{12}\left(2\Pi(D_1D_2U_A)-2\Pi(D_1U_A)+2\Pi(D_2U_B)-2\Pi(D_2U_AU_B)\right)+\tfrac{5}{6}\Delta_A\end{aligned}\tag{20}$$

Comparing (19) and (20) we have:

$$\begin{aligned}&\tfrac{1}{12}\left(2\Pi(D_1D_2U_AU_B)-2\Pi(D_1D_2U_B)-2\Pi(D_1U_A)+2\Pi(D_2U_B)-2\Pi(D_2U_AU_B)\right)+\tfrac{5}{6}\Delta_A\\&\le\tfrac{1}{12}\left(2\Pi(D_1D_2U_A)-2\Pi(D_2U_AU_B)-2\Pi(D_1U_A)+2\Pi(D_2U_B)\right)+\tfrac{5}{6}\Delta_A\\&\Rightarrow\Pi(D_1D_2U_AU_B)-\Pi(D_1D_2U_A)\le\Pi(D_1D_2U_B)\end{aligned}\tag{21}$$

where the last inequality follows because the marginal return of U_B in coalition value is highest when U_A is not present.

Proof of Proposition 5

Using the payoffs in de Fontenay and Gans (2005; Table 1, p.551); independent outsourcing will win an auction over established firm outsourcing if:

$$\begin{aligned}&v_{D_1}(D_1,D_2,U_A,U_B)+v_{U_A}(D_1,D_2,U_A,U_B)-v_{U_A}(D_1,D_2,U_AU_B)\\&>v_{D_1}(D_1,D_2,U_AU_B)+v_{U_B}(D_1,D_2,U_AU_B)-v_{U_B}(D_1,D_2,U_A,U_B)\end{aligned}\tag{22}$$

This is equivalent to:

$$\tfrac{1}{12}\left(\Pi(D_1U_B)-\Pi(D_1D_2U_B)-2\Pi(D_1U_A)-5\Pi(D_2U_B)\right)-\tfrac{1}{6}\Delta_A>0\tag{23}$$

which can never hold.

Proof of Proposition 6

For expositional purposes we assume that each upstream and each downstream firm are symmetric. In this situation, we can use the payoffs of Table 1 amended for the value reductions from downstream competition. Given this, an established firm will outbid an independent firm if:

$$\hat{\Pi}(D_1D_2U_AU_B)\le 2\hat{\Pi}(D_1D_2U_j)\tag{24}$$

Where this inequality continues to hold as in the Proof of Proposition 4.

Proof of Proposition 7

Proposition 4 establishes that D_1 would prefer to outsource to an established rather than an independent upstream supplier. However, what if the established supplier was integrated: that is, what happens if U_B is already owned by D_2? In this case, the analogue of (21) becomes:

$$\begin{aligned}&\underbrace{v_{D_2U_AU_B}(D_1, D_2U_AU_B) - v_{D_2U_B}(D_1, U_A, D_2U_B) - v_{U_A}(D_1, U_A, D_2U_B)}_{\text{Marginal Gain Asset Value for } A \text{ from } U_B \text{ Ownership}}\\ &\geq \underbrace{v_{D_1}(D_1, U_A, D_2U_B) - v_{D_1}(D_1, D_2U_AU_B)}_{\text{Marginal Cost Increase for } D_1 \text{ Outsourcing to } U_B}\end{aligned} \tag{25}$$

Re-arranging and using values from Table 2, notice that:

$$\begin{aligned}&\underbrace{v_{D_2U_AU_B}(D_1, D_2U_AU_B) + v_{D_1}(D_1, D_2U_AU_B)}_{=\Pi(D_1D_2U_AU_B)}\\ &\geq \underbrace{v_{D_1}(D_1, U_A, D_2U_B) + v_{U_A}(D_1, U_A, D_2U_B) + v_{D_2U_B}(D_1, U_A, D_2U_B)}_{=\Pi(D_1D_2U_AU_B)+\Delta_A}\end{aligned} \tag{26}$$

which cannot hold if $\Delta_A > 0$. Thus, it is preferable to outsource to an independent firm in this instance.

Proof of Proposition 8

Let downstream demand for D_i be $p_i = a - b(q_{iA} + q_{iB})$ and its costs be linear with marginal cost, $\alpha < a$. Finally, suppose that $C_j = \beta \frac{1}{2}(q_{1j} + q_{2j})^2$.

The marginal value of an additional unit of q_{ij} supplied by *j* to downstream firm *i* is $a - 2b(q_{iA} + q_{iB})$. Given the homogeneity of upstream inputs, this means that *i*'s (inverse) demand for external inputs is $p_i = a - 2b(q_{iA} + q_{iB})$. If it has an integrated upstream asset, *i*'s demand will take into account the cost of input supply.

If D_1 currently produces inputs in-house (owning U_A), it may also sell those inputs externally to D_2. In this situation, under the assumption of Cournot quantity competition, equilibrium input supplies $(\hat{q}_{1A}, \hat{q}_{1B}, \hat{q}_{2A}, \hat{q}_{2B})$ are determined by the following two problems:

$$\begin{aligned}\max_{q_{1A}, q_{2A}} \; &(a - b(q_{1A} + \hat{q}_{1B}))(q_{1A} + \hat{q}_{1B}) - (a - 2b(q_{1A} + \hat{q}_{1B}))\hat{q}_{1B}\\ &+(a - 2b(q_{2A} + \hat{q}_{2B}))q_{2A} - \alpha(q_{1A} + q_{2A}) - \beta \tfrac{1}{2}(q_{1A} + q_{2A})^2\end{aligned} \tag{27}$$

$$\begin{aligned}\max_{q_{1B}, q_{2B}} \; &(a - 2b(\hat{q}_{1A} + q_{1B}))q_{1B} + (a - 2b(\hat{q}_{2A} + q_{2B}))q_{2B}\\ &-\alpha(q_{1B} + q_{2B}) - \beta \tfrac{1}{2}(q_{1B} + q_{2B})^2\end{aligned} \tag{28}$$

In this situation, it is easy to show that:

$$\hat{q}_{1A} = 3(4b + 3\beta)\Gamma,\ \hat{q}_{2A} = (4b + \beta)\Gamma,\ \hat{q}_{1B} = 3\beta\Gamma,\ \hat{q}_{2B} = (4b + 7\beta)\Gamma$$

where $\Gamma = \frac{a-\alpha}{24b^2 + 34b\beta + 10\beta^2}$. In this case, the payoffs to each firm are:

$$v_{D_1U_A}(D_1U_A, D_2, U_B) = \frac{88b^3 + 180b^2\beta + 126b\beta^2 + 25\beta^2}{2(b+\beta)^2}\Lambda$$

$$v_{D_2}(D_1U_A, D_2, U_B) = 16b\Lambda$$

$$v_{U_B}(D_1U_A, D_2, U_B) = \frac{16b^3 + 60b^2\beta + 78b\beta^2 + 25\beta^2}{2(b+\beta)^2}\Lambda + \Delta$$

where $\Lambda = \left(\frac{a-\alpha}{12b+5\beta}\right)^2$. It is useful to note that, in this case, D_1's output exceeds D_2 by 50 percent.

it has two options. First, it could sell its assets to an independent firm in which case we would have a completely non-integrated industry. Alternatively, it could sell the

assets to U_B, in which case we would have a non-integrated upstream monopolist. We examine the equilibrium outcomes of each of these in turn.

If D_1 chooses to outsource to an independent firm, the two upstream firms solve:

$$\max_{q_{1A},q_{2A}} \begin{array}{c}(a-2b(q_{1A}+\hat{q}_{1B}))q_{1A}+(a-2b(q_{2A}+\hat{q}_{2B}))q_{2A}\\ -\alpha(q_{1A}+q_{2A})-\beta\tfrac{1}{2}(q_{1A}+q_{2A})^2\end{array} \tag{29}$$

$$\max_{q_{1B},q_{2B}} \begin{array}{c}(a-2b(\hat{q}_{1A}+q_{1B}))q_{1B}+(a-2b(\hat{q}_{2A}+q_{2B}))q_{2B}\\ -\alpha(q_{1B}+q_{2B})-\beta\tfrac{1}{2}(q_{1B}+q_{2B})^2\end{array} \tag{30}$$

which gives equilibrium outcomes $\hat{q}_{ij}=\frac{a-\alpha}{6b+2\beta}$ for all ij. In this case,

$$v_{D_i}(D_1,D_2,U_A,U_B)=\frac{b(a-\alpha)^2}{(3b+\beta)^2}$$

$$v_{U_j}(D_1,D_2,U_A,U_B)=\frac{(2b+\beta)(a-\alpha)^2}{2(3b+\beta)^2}+\Delta$$

Note that, in this case, D_1 will choose to outsource to an independent firm if:

$$\begin{array}{l}v_{D_1}(D_1,D_2,U_A,U_B)+v_{U_A}(D_1,D_2,U_A,U_B)\geq v_{D_1U_A}(D_1U_A,D_2,U_B)\\ \Rightarrow \Delta\geq\frac{(a-\alpha)^2 3b(36b^4+62b^3\beta+43b^2\beta^2+12b\beta^3+\beta^4)}{(b+\beta)^2(3b+\beta)^2(12b+5\beta)^2}\end{array} \tag{31}$$

which collapses to $\Delta\geq\frac{(a-\alpha)^2}{12b}$ if $\beta=0$. Outsourcing leads to a direct advantage, Δ, but at the cost of the emergence of a double marginalization problem reflected in the right hand side of the above inequality.

On the other hand, if it outsources to an established firm, that upstream monopolist will solve:

$$\max_{\{q_{ij}\}_{\substack{i=1,2\\ j=A,B}}} \begin{array}{c}(a-2b(q_{1A}+q_{1B}))(q_{1A}+q_{1B})+(a-2b(q_{2A}+q_{2B}))(q_{2A}+q_{2B})\\ -\alpha(q_{1A}+q_{1B}+q_{2A}+q_{2B})-\beta\tfrac{1}{2}\left((q_{1A}+q_{2A})^2+(q_{1B}+q_{2B})^2\right)\end{array} \tag{32}$$

which gives equilibrium outcomes $\hat{q}_{ij}=\frac{a-\alpha}{2(8b+\beta)}$ for all ij. In this case,

$$v_{D_i}(D_1,D_2,U_AU_B)=\frac{3b(a-\alpha)^2}{(8b+\beta)^2}$$

$$v_{U_AU_B}(D_1,D_2,U_AU_B)=\frac{(a-\alpha)^2}{8b+\beta}+2\Delta$$

Note that, in this case, D_1 will choose to outsource to U_B if:

$$\begin{array}{l}v_{D_1}(D_1,D_2,U_AU_B)+v_{U_AU_B}(D_1,D_2,U_AU_B)\geq v_{D_1U_A}(D_1U_A,D_2,U_B)+v_{U_B}(D_1U_A,D_2,U_B)\\ \Rightarrow \Delta\geq\frac{(a-\alpha)^2 b(1744b^4+3880b^3\beta+3593b^2\beta^2+1073b\beta^3+57\beta^4)}{(b+\beta)^2(8b+\beta)^2(12b+5\beta)^2}\end{array} \tag{33}$$

which collapses to $\Delta\geq\frac{109(a-\alpha)^2}{576b}$ if $\beta=0$.

Comparing (31) and (33) it is apparent that if D_1 were to outsource, it would earn more by outsourcing to an independent firm than to U_B. This is because the latter case results in an upstream monopoly with a more pronounced double marginalization problem than the more competitive upstream case.

This presumes, however, that D_1 is choosing between alternative bilateral transactions. Suppose instead that it was to auction its upstream assets to an independent firm or U_B. Recall our assumption that there are a continuum of independent firms who

might purchase those assets and that (31) holds. In this case, an independent firm will be willing to pay $v_{U_A}(D_1, D_2, U_A, U_B)$ for the assets. On the other hand, U_B will be willing to pay $v_{U_A U_B}(D_1, D_2, U_A U_B) - v_{U_B}(D_1, D_2, U_A, U_B)$ as it realises that D_1 will find it worthwhile to sell to an independent firm as (31) holds. In this case, D_1 will only sell to U_B if:

$$\begin{aligned} & v_{D_1}(D_1, D_2, U_A U_B) + v_{U_A U_B}(D_1, D_2, U_A U_B) - v_{U_B}(D_1, D_2, U_A, U_B) \\ & \geq v_{D_1}(D_1, D_2, U_A, U_B) + v_{U_A}(D_1, D_2, U_A, U_B) \qquad (34) \\ & \Rightarrow -\frac{(a-\alpha)^2 b(31b+2\beta)}{(3b+\beta)(8b+\beta)^2} \geq 0 \end{aligned}$$

which can never hold. Thus, even an auction that would allow D_1 to extract the monopoly rent that would accrue to U_B, it would still prefer to sell to an independent firm.

Table 1: Shapley Value Outcomes

Ownership Structure	Payoffs (Shapley values)
U_B Independently Held	
D_1 owns U_A	$v_{D_1U_A} = \frac{1}{12}\begin{pmatrix} 4\Pi(D_1D_2U_AU_B) + 2\Pi(D_1D_2U_A) \\ +2\Pi(D_1U_AU_B) + 4\Pi(D_1U_A) - 4\Pi(D_2U_B) \end{pmatrix} + \frac{1}{6}\Delta_B$, $v_{D_2} = \frac{1}{12}\begin{pmatrix} 4\Pi(D_1D_2U_AU_B) + 2\Pi(D_1D_2U_A) \\ -4\Pi(D_1U_AU_B) - 2\Pi(D_1U_A) + 2\Pi(D_2U_B) \end{pmatrix} + \frac{1}{6}\Delta_B$ $v_{U_B} = \frac{1}{12}\begin{pmatrix} 4\Pi(D_1D_2U_AU_B) - 4\Pi(D_1D_2U_A) \\ +2\Pi(D_1U_AU_B) - 2\Pi(D_1U_A) + 2\Pi(D_2U_B) \end{pmatrix} + \frac{2}{3}\Delta_B$
Complete Non-Integration	$v_{D_1} = \frac{1}{12}\begin{pmatrix} 3\Pi(D_1D_2U_AU_B) + \Pi(D_1D_2U_A) + \Pi(D_1D_2U_B) \\ +\Pi(D_1U_A) + \Pi(D_1U_B) - \Pi(D_2U_A) - \Pi(D_2U_B) \\ +\Pi(D_1U_AU_B) - 3\Pi(D_2U_AU_B) \end{pmatrix} + \frac{1}{6}(\Delta_A + \Delta_B)$ $v_{D_2} = \frac{1}{12}\begin{pmatrix} 3\Pi(D_1D_2U_AU_B) + \Pi(D_1D_2U_A) + \Pi(D_1D_2U_B) \\ -\Pi(D_1U_A) - \Pi(D_1U_B) + \Pi(D_2U_A) + \Pi(D_2U_B) \\ +\Pi(D_2U_AU_B) - 3\Pi(D_1U_AU_B) \end{pmatrix} + \frac{1}{6}(\Delta_A + \Delta_B)$ $v_{U_A} = \frac{1}{12}\begin{pmatrix} 3\Pi(D_1D_2U_AU_B) + \Pi(D_1D_2U_A) - 3\Pi(D_1D_2U_B) \\ +\Pi(D_1U_A) - \Pi(D_1U_B) + \Pi(D_2U_A) - \Pi(D_2U_B) \\ +\Pi(D_1U_AU_B) + \Pi(D_2U_AU_B) \end{pmatrix} + \frac{2}{3}\Delta_A$ $v_{U_B} = \frac{1}{12}\begin{pmatrix} 3\Pi(D_1D_2U_AU_B) + \Pi(D_1D_2U_B) - 3\Pi(D_1D_2U_A) \\ -\Pi(D_1U_A) + \Pi(D_1U_B) - \Pi(D_2U_A) + \Pi(D_2U_B) \\ +\Pi(D_1U_AU_B) + \Pi(D_2U_AU_B) \end{pmatrix} + \frac{2}{3}\Delta_B$
Non-integrated upstream monopoly	$v_{D_1} = \frac{1}{6}\left(2\Pi(D_1D_2U_AU_B) + \Pi(D_1U_AU_B) - 2\Pi(D_2U_AU_B)\right) + \frac{1}{6}(\Delta_A + \Delta_B)$ $v_{D_2} = \frac{1}{6}\left(2\Pi(D_1D_2U_AU_B) - 2\Pi(D_1U_AU_B) + \Pi(D_2U_AU_B)\right) + \frac{1}{6}(\Delta_A + \Delta_B)$ $v_{U_AU_B} = \frac{1}{6}\left(2\Pi(D_1D_2U_AU_B) + \Pi(D_1U_AU_B) + \Pi(D_2U_AU_B)\right) + \frac{2}{3}(\Delta_A + \Delta_B)$

Table 2: Shapley Value Outcomes

U_B owned by D_2	
D_1 owns U_A	$v_{D_1U_A} = \frac{1}{2}\left(\Pi(D_1D_2U_AU_B) + \Pi(D_1U_A) - \Pi(D_2U_B)\right)$, $v_{D_2U_B} = \frac{1}{2}\left(\Pi(D_1D_2U_AU_B) - \Pi(D_1U_A) + \Pi(D_2U_B)\right)$
U_A non-integrated	$v_{D_1} = \frac{1}{12}\begin{pmatrix} 4\Pi(D_1D_2U_AU_B) + 2\Pi(D_1D_2U_B) \\ -4\Pi(D_2U_AU_B) - 2\Pi(D_2U_B) + 2\Pi(D_1U_A) \end{pmatrix}$ $v_{U_A} = \frac{1}{12}\begin{pmatrix} 4\Pi(D_1D_2U_AU_B) - 4\Pi(D_1D_2U_B) \\ +2\Pi(D_2U_AU_B) - 2\Pi(D_2U_B) + 2\Pi(D_1U_A) \end{pmatrix} + \Delta$ $v_{D_2U_B} = \frac{1}{12}\begin{pmatrix} 4\Pi(D_1D_2U_AU_B) + 2\Pi(D_1D_2U_B) \\ +2\Pi(D_2U_AU_B) - 4\Pi(D_1U_A) + 4\Pi(D_2U_B) \end{pmatrix}$
D_2 owns U_A and U_B	$v_{D_1} = \frac{1}{2}\left(\Pi(D_1D_2U_AU_B) - \Pi(D_2U_AU_B)\right)$ $v_{D_2U_AU_B} = \frac{1}{2}\left(\Pi(D_1D_2U_AU_B) + \Pi(D_2U_AU_B)\right)$
D_1 owns U_A and U_B	$v_{D_1U_AU_B} = \frac{1}{2}\left(\Pi(D_1D_2U_AU_B) + \Pi(D_1U_AU_B)\right)$ $v_{D_2} = \frac{1}{2}\left(\Pi(D_1D_2U_AU_B) - \Pi(D_1U_AU_B)\right)$

References

Adner, R. and P. Zemsky (2006), "A Demand-Based Perspective on Sustainable Competitive Advantage," *Strategic Management Journal*, 27 (3), pp.215-239.

Binmore, K., A. Rubinstein and A. Wolinsky (1986), "The Nash Bargaining Solution in Economic Modelling," *RAND Journal of Economics*, 17, 176-188.

Brandenburger, A. and H. Stuart (1996), "Value-Based Business Strategy," *Journal of Economics and Management Strategy*, 5, pp.5-24.

Brandenburger, A. and H. Stuart (2007), "Biform Games," *Management Science*, forthcoming.

Cachon, G. and P. Harker (2002), "Competition and Outsourcing with Scale Economies," *Management Science*, 48 (10), pp.1314-1333.

Cross, J. (1995), "IT Outsourcing: British Petroleum's Competitive Approach," *Harvard Business Review*, May-June, pp.94-102.

de Fontenay, C.C. and J.S Gans (2005), "Vertical Integration in the Presence of Upstream Competition," *RAND Journal of Economics*, 36 (3), pp.544-572.

de Fontenay, C.C. and J.S Gans (2006), "Bilateral Bargaining with Externalities," *mimeo.*, Melbourne Business School.

Domberger, S. (1998), *The Contracting Organization: A Strategic Guide to Outsourcing*, Oxford University Press: Oxford.

Economides, N. and S.C. Salop (1992), "Competition and Integration among Complements, and Network Market Structure," *Journal of Industrial Economics*, 40 (1), pp.105-123.

Espino-Rodriguez, T.F. and V. Padron-Robaina (2006), "A review of the outsourcing from the resource-based view of the firm," *International Journal of Management Reviews*, 8 (1), pp.49-70.

Foss, K. and N.J. Foss (2005), "Resources and Transaction Costs: How Property Rights Economics Furthers the Resourced-Based View," *Strategic Management Journal*, 26 (6), pp.541-554.

Gans, J.S. (2005), "Markets for Ownership," *RAND Journal of Economics*, 36 (2), pp.433-455.

Gans, J.S., G. MacDonald and M. Ryall (2005), "Operationalizing Value-Based Business Strategy," *Working Paper*, Melbourne Business School.

Gilbert, R.J. and D.M. Newbery (1982), "Preemptive Patenting and the Persistence of Monopoly," *American Economic Review*, 72 (3), pp.514-526.

Grossman, S. and O. Hart (1986), "The Costs and Benefits of Ownership: A Theory of Vertical and Lateral Integration," *Journal of Political Economy*, 94, 691-719.

Hart, O. and J. Moore (1990), "Property Rights and the Theory of the Firm," *Journal of Political Economy*, 98 (6), pp.1119-1158.

Inderst, R. and C. Wey (2003), "Bargaining, Mergers and Technology Choice in Bilaterally Oligopolistic Industries," *RAND Journal of Economics*, 34 (1), pp.1-19.

Jarillo, J.C. (1993), *Strategic Networks: Creating the Borderless Organization*, Butterworth-Heinemann: Oxford.

Lippman, S.A. and R.P. Rumelt (2003), "A Bargaining Perspective on Resource Advantage," *Strategic Management Journa*l, 24, pp.1069-1086.

McAfee, R.P. and Schwartz, M. "Opportunism in Multilateral Vertical Contracting: Nondiscrimination, Exclusivity and Uniformity." *American Economic Review*, Vol.84 (1994), pp.210-230.

MacDonald, G. and M. Ryall (2004), "How do value creation and competition determine whether a firm appropriates value?," *Management Science*, 50 (10), pp.1319-1333.

Rey, P. and Tirole, J. "A Primer on Foreclosure." *Handbook of Industrial Organization*, Vol.III, North Holland: Amsterdam, 2003, (forthcoming).

Spulber, D.F. (1998), *The Market Markers: How Leading Companies Create and Win Markets*, McGraw-Hill: New York.