# Markets for ownership

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*The prevailing theory of the firm demonstrates that ownership by dispensable, outside parties is inefficient relative to ownership by productive agents. To better understand observed patterns of ownership, this paper analyzes markets for ownership, demonstrating that outside parties will often become asset owners. Outside parties only earn rents from ownership whereas productive agents can earn rents even as non-owners. Given that their contribution is complementary with other productive agents this mutes their willingness to pay for ownership relative to outsiders. The main conclusion is that the nature of ownership markets stands alongside incentives as an important predictor of firm boundaries.*

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# 1. Introduction

In recent times, economic analyses of firm boundaries have focused on the incentive properties of ownership. Grossman and Hart (1986) and Hart and Moore (1990) – hereafter GHM – have demonstrated how the residual rights of control allow asset owners to potentially exclude others from profiting or using their assets, increasing their share of any surplus generated and hence, their incentives to maximize that surplus. In essence, ownership is a source of ex post bargaining power; impacting upon agents' ex ante choices over non-contractible actions and, consequently, on the surplus generated by different ownership arrangements.

GHM use this framework to generate a host of insights into what type of ownership structures will be efficient. This includes findings that important and indispensable agents should own assets, while joint ownership (where more than one agent has veto power over an asset's use) is less efficient than other structures. This paper focuses on their finding that dispensable, outside parties should not own assets. Basically, when an outside party owns an asset, this serves merely to reduce the surplus to those 'productive' agents who can undertake non-contractible actions. As a consequence, ownership changes that assign control rights to those productive agents can be efficiency enhancing.

The relative inefficiency of outside party ownership raises a host of empirical puzzles as such structures are commonly observed. Individual shareholders and mutual funds, who rarely take important actions, own firms. Moreover, much ownership is concentrated in the hands of a few individuals who are neither indispensable for value creation nor take important, but non-contractible, actions (Hansmann, 1996; Holmstrom and Roberts, 1998).

In this paper, it is suggested that a potential factor in explaining incidences of outside party ownership lies in the nature of ex ante markets for asset ownership. To explore this, I utilise the GHM model whereby the allocation of ownership determines bargaining and surplus generation but model that allocation as the outcome of non-cooperative, market interactions between agents. This stands in contrast to the cooperative approach employed by GHM that allows the coalition of all agents to allocate ownership efficiently.[1] Not surprisingly, a non-cooperative approach potentially generates inefficient allocations; however, the main goal is to explore how the introduction of a market for ownership can generate more precise predictions regarding asset ownership and firm boundaries.[2]

The key finding of the paper is as follows: while an agent's dispensability is a key criterion for ruling them out as owners under GHM, it is an important predictor of ownership patterns when assets are allocated in a market. To see this, suppose that ownership of an asset was allocated to the highest bidder in a simple auction. Each agent will bid up to their *private* value for ownership, that is, an agent's incremental return from being an asset owner as opposed to non-owner. For dispensable, outside parties, this amount would be all of the rents they would earn as asset owners. This is because, as non-owners, they are unable to command any surplus. In contrast, productive agents are able to earn rents even when they do not own the asset. This dampens their willingness to pay for ownership; reducing their bids for the asset.

Two factors drive whether the willingness to pay for ownership of an outside party actually *exceeds* that of a productive agent; making outside ownership the equilibrium outcome. First, the smaller are the incentive effects from ownership (i.e., the reduction in surplus generated by outside ownership), the higher are outside party's relative willingnesses to pay. Indeed, when those incentive effects are very small and the contributions of productive agents are complementary to one another (as is assumed by GHM), then outside ownership is always the equilibrium outcome in an asset market.

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[1] See Hart (1995, p.43) for a statement. The basic assumption there is that all agents can agree upon ex ante transfers and implement an efficient structure. In contrast, here it will be assumed that such ex ante transfers are limited to bilateral ones between agents.

[2] Bolton and Whinston (1993) also consider non-cooperative processes for the allocation of asset ownership. Their approach, while related to the one pursued here, is distinct in that it does not consider the

Second, a greater strength of complementarity between productive agents serves to diminish their relative willingnesses to pay for ownership. This is because complementarity gives a productive agent greater bargaining power as non-owners, reducing their private value of ownership and the level of their bids in the marketplace.

Thus, an equilibrium market outcome of outside ownership arises naturally in the commonly assumed environment that underlies the GHM approach. In particular, complementarity between the contributions of productive agents – that drives the difference between the private value of ownership of outside parties compared with productive ones – also drives the relative inefficiency of outside ownership. This means that market equilibria with outside ownership may become more likely precisely when such ownership is increasingly inefficient relative to other ownership structures.[3]

The paper also explores the robustness of the basic result that market equilibrium can involve outside ownership; specifically, that it can arise even when the initial asset owner is interested productive agent (Section 2). However, in Section 3, potential cooperative mechanisms that might block outside ownership are explored. It is demonstrated that to achieve an efficient ownership structure, a sufficient set of productive agents would have to form a joint bid for the asset. But, precisely because productive agents have preferences against outside ownership, there is a free riding issue in joint bid formation. This limits the possibility and efficiency of cooperative means of blocking outside ownership in ways well known in the literature on public good provision. For this reason, the results in this paper have greatest potential force when institutions are lacking to allow joint bidding coalitions to form.

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key role the outside parties play in such environments.

[3] The market force identified here that drives outside ownership is complementary to other explanations that have been developed in the literature including alternative bargaining impacts (de Meza and Lockwood, 1998; Rajan and Zingales, 1998; Chiu, 1998; and Baker, Gibbons and Murphy, 2002), wealth constraints (Aghion and Tirole, 1994) and substitute incentive instruments (Holmstrom, 1999). Each of these research streams could be integrated into the framework developed here.

## 2. Basic Result

This section outlines the basic driving result of the paper – that the private value of ownership is often highest for outside parties and, as a consequence, that they can become owners when assets are allocated by markets. This is done using a baseline model that captures the essence of the GHM approach to ownership. It is assumed that the asset is sold (using a simple English auction) to the highest bidder. This market-based allocation mechanism stands in direct contrast to the cooperative allocation mechanism considered by GHM, in that transfers between agents as part of the allocation mechanism (such as would be needed for joint bidding) are not permitted. The possibility of joint bids is explored in Section 3.

**Model set-up**

Suppose there is a set $\underline{S}$ of productive agents ( $i = 1,...,N$ where $N \geq 2$ ) and many outside parties (of type *O*). Outside parties are perfectly substitutable for one another in a productive sense. There is a single alienable asset that can be potentially owned by any agent – productive or otherwise.

Productive agents can make asset-specific investments (or take other actions), $x_i$ ( $\geq 0$ ), that generate value so long as the agent works in association with the asset. Let **x** denote the *N*-element vector of investments. Each individual investment is privately costly – incurring a cost of $x_i$ to agent *i* – and, so long as all productive agents are associated with (that is, work or utilize) the asset, gives rise to total value created from the asset of $v(\mathbf{x},\underline{S})$ . $v(\mathbf{x},\underline{S})$ is non-decreasing in each element of **x**. If only a subset of productive agents, *S*, is associated with the asset, value created is $v(\mathbf{x}(S),S)$ a non-decreasing function of each element of $\mathbf{x}(S)$ , where $\mathbf{x}(S) \equiv \{\mathbf{x} | x_i = 0, \forall i \notin S\}$ , with $v(.,\varnothing) = 0$ (i.e., at least one productive agent is necessary to create any value). Agents not associated with the asset generate no additional value. In this sense, the asset itself is necessary for any value to be created and so is *essential* (according the Hart and Moore's (1990) definition) to all agents.

On the other hand, an *O*'s association with the asset has no influence on the value of production from any coalition controlling the asset; for all *S*, $v(\mathbf{x}(S), S) = v(\mathbf{x}(S), S \cup O)$. Thus, following the definition of Hart and Moore (1990), *O* is a *dispensable*, *outside party*.

The following standard assumption is made with respect to this production environment:

$$\frac{\partial v(\mathbf{x}(S'), S')}{\partial x_i} > \frac{\partial v(\mathbf{x}(S), S)}{\partial x_i} \text{ for all } x_i \text{ and } S \subset S'.$$

This says that, for a given set of investments, the marginal return to any one investment is increasing in the participation of additional agents; that is, productive agents are *complementary* in creating value. Note that this implies (as in Hart and Moore, 1990, Assumption 6) that the coalition of *all* productive agents is socially desirable in that, for all *S*, $\max_{\mathbf{x}} v(\mathbf{x}, \underline{S}) - \sum_{i=1}^{N} x_i > \max_{\mathbf{x}(S)} v(\mathbf{x}(S), S) - \sum_{i \in S} x_i$.

The timing of the model is as follows:

DATE 0: Allocation of asset ownership.

DATE 1: Investments made and associated costs incurred by each productive agent.

DATE 2: Bargaining occurs and payoffs are realized.

This is the same model timing that arises in GHM where **x** is considered non-contractible; with each agent making its investment choice, $x_i$, (and incurring investment costs) prior to any bargaining. In what follows, the focus of attention will be to the form of the Date 0 allocation mechanism; the principal point of departure from GHM.

**Ownership-contingent bargaining outcomes**

Perhaps the key feature of the GHM approach is that changing the allocation of asset ownership changes the relative ex post bargaining power of agents (in Date 2). This, in turn, alters individual agents' choices of investments (which are based on their expected value share ex post) and hence, overall value created.

To see this, let $\pi_j^i$ be the payoff (including investment costs) realized by agent *j* under *i*-ownership. Similarly, if there is *i*-ownership, let $x_j^i$ be the investment choice made by agent *j* and $\mathbf{x}^i$ denote the corresponding vector of investments at Date 1. Hart and Moore (1990) assume that Date 2 bargaining is efficient with the precise division is based on the Shapley value. They demonstrate that $x_j^i > x_j^O$ for ownership by any productive agent, *i*, and hence, given the assumed complementarity, $\sum_{j=1}^{N} \pi_j^i > \sum_{j=1}^{N} \pi_j^O + \pi_O^O$. This is the standard result in GHM that ownership should not be allocated to outside parties (such as agent *O* in this model) as this leads to the lowest value created.[4]

**Equilibrium bids when an outside party is the initial owner**

The starting point for analysis is where the asset is initially owned by a disinterested party who cares only about achieving the highest value for the asset. In particular, suppose that a simple ascending bid or English auction is used to determine ownership at Date 0.

The interactions amongst the potential bidders make calculations of willingnesses to pay for ownership somewhat complex. Of key importance is the fact that, while an *O*-type's willingness to pay depends only on the rents they earn as an owner, this is not the case for productive agents. Productive agents earn rents under any ownership structure and hence, the value each places on ownership depends upon their conjectures as to what structure might alternatively arise.

Despite this potential complexity, the following can be demonstrated:

[4] See Hart and Moore (1990, footnote 20). Their Corollary (p.1137) states that outside parties should not receive any control rights if stochastic control is possible. However, their Propositions 11 and 12 have a stronger implication that even where stochastic control is not possible, an outside party should not be the sole owner of an essential asset.

*Proposition 1*. Suppose that $\pi_j^i > \pi_j^O$ for each $j \neq i$ and that the asset is initially owned by an *O*-type. Then,

(i) *O*-ownership is the unique Nash equilibrium outcome if and only if $\pi_O^O > \pi_i^i - \pi_i^O$ for all *i*. If $\pi_O^O < \pi_i^i - \pi_i^O$ for some *i*, then *O*-ownership is not a Nash equilibrium.

(ii) *i*-ownership is the unique Nash equilibrium outcome if $\pi_O^O < \pi_i^i - \pi_i^O$ while $\pi_O^O > \pi_j^j - \pi_j^O$ for all $j \neq i$.

*Proof*: See Appendix A.

The intuition for the result is as follows. In an English auction, each agent will bid up to their willingness to pay for asset-ownership. For the *O*-types, this is $\pi_O^O$; the rents they expect to earn from ownership. For a productive agent, asset ownership yields $\pi_i^i$. However, they also earn rents under non-ownership. If each productive agent expects *O*-ownership to arise if they do not win the auction, their willingness to pay is $\pi_i^i - \pi_i^O$. Thus, if $\pi_O^O > \pi_i^i - \pi_i^O$ for each *i*, then a bid by an *O*-type will always exceed that of a productive agent; confirming *O*-ownership as an equilibrium outcome.

Absent other restrictions, there are potentially alternative equilibria. However, if *O*-ownership is the worst outcome for each productive agent, then bids based on the expectation that another productive agent will be the next highest bid, say $\pi_i^i - \pi_i^j$ will not exceed *O*'s bid; leading to uniqueness.[5] Thus, $\pi_j^i > \pi_j^O$ is a critical condition as *any bargaining outcome that leads to this ranking will result in O-ownership being the unique Nash equilibrium outcome*. In particular, the Shapley value used by GHM (and resulting Date 1 investments) will generate this ranking.[6]

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[5] If, alternatively, $\pi_j^i < \pi_j^O$, then *O*-ownership can still be an equilibrium outcome if $\pi_O^O > \pi_i^i - \pi_i^O$ for all *i*. In this equilibrium, all productive agents form the expectation that *O*-ownership will result if they do not win the auction and so they bid based on this expectation. As *O*-ownership results, this expectation is confirmed. There are, however, other equilibria. Thus, the condition of the Proposition guarantees uniqueness of an *O*-ownership equilibrium. As discussed below, this condition arises naturally in the GHM model.

[6] The results here would hold for many cooperative bargaining models beyond the Shapley outcome commonly used in the property rights literature. In the model here, the asset owner is indispensable. Hence,

It is also important to recognize that even where *O*-ownership is not an equilibrium, this does not guarantee efficient ownership. A less efficient productive agent could emerge as the owner. This generic inefficiency arises when there are externalities amongst bidders who care about who owns an asset is well established in the literature (Jehiel and Moldovanu, 1996; Jehiel, Moldovanu and Stacchetti, 1996; and Caillaud and Jehiel, 1998). What is of most interest here is that the least efficient outcome (ownership by *O*) can be the unique equilibrium.[7] Thus, I turn next to a closer examination of the conditions that give rise to *O*-ownership: in particular, the roles of complementarity and investment incentives.

**Complementarity and investment incentives**

*O*-ownership is more likely to be an equilibrium outcome the more complementary are productive agents. It is easiest to illustrate this by focusing on the case where $N = 2$. Let $v(\mathbf{x},\{1,2\}) = v(x_1, x_2)$, $v(\mathbf{x}(\{1\}),\{1\}) = v(x_1, 0)$ and $v(\mathbf{x}(\{2\}),\{2\}) = v(0, x_2)$. In this case, under ownership by a productive agent, say 1, a Shapley value outcome gives:

$$\pi_1^1 = \tfrac{1}{2}\left(v(x_1^1, x_2^1) + v(x_1^1, 0)\right) - x_1^1,\ \pi_2^1 = \tfrac{1}{2}\left(v(x_1^1, x_2^1) - v(x_1^1, 0)\right) - x_2^1,\ \pi_O^i = 0$$

In contrast, under *O*-ownership,

$$\pi_1^O = \tfrac{1}{3}\left(v(x_1^O, x_2^O) - v(0, x_2^O) + \tfrac{1}{2}v(x_1^O, 0)\right) - x_1^O,\ \pi_2^O = \tfrac{1}{3}\left(v(x_1^O, x_2^O) - v(x_1^O, 0) + \tfrac{1}{2}v(0, x_2^O)\right) - x_2^O \text{ and}$$

$$\pi_O^O = \tfrac{1}{3}\left(v(x_1^O, x_2^O) + \tfrac{1}{2}\left(v(x_1^O, 0) + v(0, x_2^O)\right)\right).$$

when there is *O*-ownership, ex post collusion between productive agents would assist *O* as productive agents could not negotiate over their marginal contributions that exceed their average contribution under complementarity. This means that, under *O*-ownership, productive agent payoffs are sufficiently high, reducing their individual willingnesses-to-pay for ownership. Segal (2003) demonstrates that this property is common to most random-order bargaining games. It would also hold for bargaining concepts such as the core.

[7] The results here do not depend on an auction being used as the allocation mechanism as they rest on simple comparisons of gains from trade. Similarly, the ex post bargaining outcome could be restricted to a non-cooperative approach involving bilateral negotiations and payments so that the entire model is non-cooperative (see, for example, Stole and Zwiebel, 1996).

To see the effect of complementarity, suppose that each productive agent's investment choice does not vary with asset ownership (that is, $x_i^s = x_i$ for all $s = j$ or $O$). Then $\pi_O^O > \pi_1^1 - \pi_1^O$ and $\pi_O^O > \pi_2^2 - \pi_2^O$ are equivalent to $v(x_1, x_2) > v(x_1, 0) + v(0, x_2)$; a condition defining the strength of complementarity between productive agents. Intuitively, the complementarity between productive agents means that their payoff is higher when the other productive agent owns the asset compared with what they receive under *O*-ownership. Because of this, *O* cannot easily play each productive agent off against the other in Date 2 bargaining, making their payoff under *O*-ownership relatively high.[8] This, in turn, softens their bids, making *O*-ownership more likely.[9]

To illustrate the role of investment incentives, consider a situation where agent 1's investment is endogenous while agent 2's remains fixed at $x_2$. In this situation, the conditions for *O*-ownership as an equilibrium become:

$$\begin{aligned} &\tfrac{1}{3}\left(v(x_1^O, x_2) - v(x_1^O, 0) - v(0, x_2)\right) \\ &\quad > v(x_1^1, x_2) + v(x_1^1, 0) - 2x_1^1 - \left(v(x_1^O, x_2) + v(x_1^O, 0) - 2x_1^O\right) \end{aligned} \tag{1}$$

$$\tfrac{1}{3}\left(v(x_1^O, x_2) - v(x_1^O, 0) - v(0, x_2)\right) > v(x_1^2, x_2) - v(x_1^O, x_2) \tag{2}$$

Note that the left hand sides of (1) and (2) reflect the effect derived above that a stronger degree of complementarity makes *O*-ownership more likely.

Nonetheless, it is perhaps not surprising that, all other things being equal, as the impact of ownership on 1's investment incentives becomes greater, *O*-ownership is less likely to be an equilibrium outcome. This effect is captured by the right hand sides of (1) and (2) above. Note

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[8] If 1 and 2 were substitutes, then the condition would not hold and productive agent ownership could be an equilibrium outcome. This is because, under *O*-ownership, *O* is able to play 1 and 2 against one another reducing their payoff under that regime.

[9] The fixed investment case also provides another insight regarding ownership. A current viewpoint held by researchers on the theory of the firm is that, in an environment where all relevant investments are contractible, economic theory does not provide any prediction as to firm boundaries as all ownership structures are equally efficient (Hart, 1995). The result here demonstrates that, even when ownership does not matter for efficiency, economic theory still generates predictions regarding firm boundaries.

that as $x_1^1, x_1^2 \to x_1^O$, these inequalities always hold as the endogenous investment case approximates the fixed investment one.

These effects are most clearly demonstrated when each productive agents' contributions are so highly complementary that each is indispensable (that is, $v(x_1, 0) = v(0, x_2) = 0$). In this case the GHM framework offers a clear prediction: either productive agent should own the asset (Hart and Moore, 1990, Proposition 6). However, a sufficient condition for *O*-ownership to be the unique equilibrium is that:

$$\frac{v(x_1^1, x_2) - v(x_1^O, x_2)}{v(x_1^O, x_2)} < \frac{1}{3} \qquad (3)^{10}$$

That is, when the incentive effect of ownership on total surplus results in less than a 33.33 percent improvement, *O* will have the highest willingness-to-pay for the asset.

It is important to recognize that the incentive effects of ownership and the strength of complementarity are related to one another. Specifically, it is often the case that when complementarity is strong, the incentives effects of ownership are also high; increasing both the left and right hand sides of (1) and (2). Indeed, it is entirely possible that the conditions supporting *O*-ownership as the unique equilibrium outcome are more likely to be satisfied even as the incentive effects of ownership become more important.

EXAMPLE: *As an example of this, consider a simple functional form for value:* $v(x_1, x_2) = \sqrt[3]{x_1 x_2}$ *; so that both agents are indispensable. Note that* $x_2$ *parameterizes the marginal product of 1's investment (that is, the strength of complementarity). In this case, the socially optimal level of* $x_1$ *is* $x_1^* = \frac{1}{3\sqrt{3}}\sqrt{x_2}$ *whereas* $x_1^1 = x_1^2 = \frac{1}{6\sqrt{6}}\sqrt{x_2} \geq x_1^O = \frac{1}{27}\sqrt{x_2}$. *Note that* $x_1^* - x_1^1$ *is increasing in* $x_2$ *while* (1) *is equivalent to* $\frac{20-6\sqrt{6}}{54}\sqrt{x_2} \geq 0$ *while* (2) *becomes* $\frac{8-3\sqrt{6}}{18}\sqrt{x_2} \geq 0$*; both of which also increase with* $x_2$.

In summary, one cannot simply interpret Proposition 1 as showing that market-based outcomes differ from GHM ones precisely when GHM's incentive effects are least relevant. This

[10] This is found from (1) and (2), ignoring investment costs. Actually, in this case, $v(x_1^1, x_2) = v(x_1^2, x_2)$ because ownership does not actually change either agent's bargaining position (see Maskin and Tirole,

need not be the case. It is entirely possible that the same forces driving incentive effects also drive complementarity and hence, outside ownership may be observed in environments where incentive effects could be important.

**Equilibrium bids when a productive agent is the initial owner**

In the baseline model, the asset is simply sold to the highest bidder. While this may be reasonable where the asset is owned initially by an outside party, there are many situations where the initial owner of an asset may be a productive agent. Consider, for example, an entrepreneur who has developed a patentable innovation or a firm that is deciding whether to outsource some of its operations. In this situation, a productive agent is unlikely to sell the asset to the highest bidder as their payoff will vary with identity of the ultimate owner.

To consider this, here the baseline model is extended to consider a discriminatory auction whereby the initial owner accepts the bid of the party who gives it the highest payoff (as opposed to bid). In this case, we have:

*Proposition 2.* Suppose that $\pi_j^i > \pi_j^O$ for each $j \neq i$ and that the asset is initially owned by a productive agent, *i*. Then, *O*-ownership is the unique Nash equilibrium outcome if and only if $\pi_i^O + \pi_O^O > \pi_i^i$ and $\pi_i^O + \pi_j^O + \pi_O^O > \pi_j^j + \pi_i^j$ for all $j \neq i$. If $\pi_i^O + \pi_j^O + \pi_O^O < \pi_j^j + \pi_i^j$ for some *j*, then *O*-ownership is not a Nash equilibrium.[11]

*Proof*: See Appendix A.

While it is possible that the conditions supporting *O*-ownership here may be stronger than those in Proposition 1 if $\pi_O^O > \pi_i^j$ for all $j \neq i$, as will be demonstrated below it will usually be the case that *O*-ownership is relatively less likely to occur when a productive agent is the initial owner.

In general, the number of productive agents plays an important role in supporting *O*-ownership as an equilibrium outcome. As a simple comparison, consider the case where each

1999).

[11] The other potential equilibrium outcomes and conditions are similar to those provided for in Proposition 1 and are omitted.

productive agent is symmetric and *indispensable* (i.e., $v(\mathbf{x}(S), S) = 0$ for $S \subset \underline{S}$ ). In this case, a sufficient condition for *O*-ownership when an outside agent is the initial owner is:

$$\frac{v(\mathbf{x}^i) - v(\mathbf{x}^O)}{v(\mathbf{x}^O)} < \frac{N-1}{N+1} \text{ for all } i \tag{4}$$

In contrast, when *i* is the initial owner a sufficient set of conditions for *O*-ownership is (4) for *i* and the following condition for others:

$$\frac{v(\mathbf{x}^j) - v(\mathbf{x}^O)}{v(\mathbf{x}^O)} < \frac{N-2}{2(N+1)} \text{ for all } j \neq i \qquad (5).$$

Note that both of these conditions are more likely to be satisfied when there are more productive agents. Thus, as *N* grows large, it becomes increasingly likely that the unique equilibrium outcome of the auction model is outside ownership.

Indeed, when a productive agent is the initial owner, *O*-ownership cannot be an equilibrium when there are only two productive agents ((5) would never hold as $v(\mathbf{x}^j) > v(\mathbf{x}^O)$ ). To see this, note that if 1 owned the asset initially it would always sell to 2. If 1 receives *O*'s maximal bid of $\pi_O^O$ but $\pi_O^O > \pi_1^1 - \pi_1^O$ (so that 1 preferred to accept this bid rather than retain ownership) then, the minimum amount 2 would have to pay 1 to make 1 indifferent between selling to 2 or *O* would be: $\pi_O^O + \pi_1^O - \pi_1^2$. If 2 paid this amount, then it would receive a payoff of $\pi_2^2 + \pi_1^2 - \pi_O^O - \pi_1^O$ (exceeding its payoff under *O*-ownership) and 1 would receive $\pi_O^O + \pi_1^O$ (exceeding its payoff from retaining ownership).[12]

[12] Note, however, that the outcome is not necessarily efficient, as the presence of outside parties allows 1 to potentially extract more rents by threatening to impose a negative externality on 2. In this model, 2 can only prevent this by owning the asset even if it is not the efficient owner. This reflects the general result of Segal (1999) that when there are negative externalities between potential buyers of an indivisible object, more trade occurs than would be socially efficient. If 2 could pay 1 not to sell the asset to any party, then 1-ownership would be retained if such ownership were efficient. Some difficulties of restricting future asset trading are considered in Section 3. In contrast, if condition $\pi_O^O < \pi_1^1 - \pi_1^O$ did not hold, then 1 would still sell to 2 if it were efficient to do so as the presence of outside parties would not impact on their gains from trade.

## 3. The Possibility of Cooperative Bidding

The main contribution of this paper has been to demonstrate what type of ownership would arise if asset ownership were allocated by a simple English auction. Outside ownership arose precisely because productive agents, when forming their bids, did not take into account the positive externality a higher bid might have on other productive agents. This was a result of the assumption that bids would be submitted and paid for independently. In effect, the outcomes in Section 2 describe what will happen if ex ante cooperation between the productive agents was not possible. However, it also demonstrates that to internalize those externalities would require a mechanism that allowed payments for the asset to come from more than one productive agent. This section explores this possibility.

Before doing this, it is important to note that there may be 'technical' reasons why cooperative arrangements may be difficult to implement ex ante. First, there may be difficulties in identifying all the productive agents initially. The GHM framework envisages that changes in asset ownership occur over a longer time horizon than bargaining over value created. Indeed, the very notion of ex post efficient bargaining may embed contracted changes in ownership at Date 2.[13] Thus, it is entirely possible that agents who might be employed at some time after Date 1 have not yet been identified at Date 0. Second, as Hart and Moore (1990) note, an ownership structure that is agreed upon cooperatively at Date 0 must be capable of being enforced; ruling out secret transfers. If such transfers are possible, productive agents 1, 2 and 3 might agree that 1 should own the asset but 1 might secretly sell the asset to 2, unbeknownst to 3 when taking their non-contractible action at Date 1. Thus, it may be as difficult for agents to commit contractually to an ownership structure as it is for them to commit contractually to an ex post division of the surplus. Finally, there are a myriad of results in bargaining that suggest that achieving cooperative

[13] Hart and Moore (1990, p.1126) write that ex post allocations of surplus are efficient as a contract to that effect is feasible at Date 2. "Such an allocation may be complex; for example, agents *i* and *j* may have to

agreements becomes more difficult as the number of cooperating agents gets large (See, for example, Rob, 1989, and Mailath and Postlewaite, 1990). All of these generic issues might make cooperation difficult ex ante even if it is possible ex post.

**Joint bids**

In contrast to GHM, this paper supposes that the initial owner or creator of an asset may be different from who might own the asset through Dates 1 and 2. Moreover, that initial owner, by virtue of their ownership has discretion as to the precise auction rules and will be interested in choosing these to maximize their overall payoff.[14]

The key assumption in Section 2 was that agents bid for the asset independently. Would, however, the initial owner choose an auction process that required independent bidding (outlawing collusion or joint bids)? Normally, such collusion is not in the interests of a seller because it reduces competition. Indeed, for this reason, it is easy to see that the initial owner would wish to see outside parties bid independently. Furthermore, it is difficult to imagine how a continuum of *O*-types would be able to profitably collude in this environment.[15]

However, collusion between productive agents might benefit an initial owner; especially if *O*-ownership would otherwise be the likely outcome. This is because a joint bid will only be successful if it exceeds the bid of *O*-types; that is, exceeding $\pi_O^O$. This benefit is even more salient if the initial owner is a productive agent and it is efficient to transfer ownership to another productive agent.[16] For this reason, I suppose here that joint bids are permitted and that it will be

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work with asset $a_n$ and sell the item they produce to agent *k*, who works on it some more and sells it to agent *l*."

[14] Indeed, the initial owner would likely have discretion as to the allocation mechanism itself. However, to provide the closest comparison with Section 2, the focus here will be on an auction. The issues raised will also be issues for general mechanisms. However, a complete characterization is left for future work.

[15] Specifically, if they were to collude with one another, their joint willingness to pay for asset ownership would not exceed the willingness to pay of one individually. If they were collude with one or more productive agents, the same would be true by the definition of outside ownership. It is only if all *O*-types were to collude that there might be some difference.

[16] Such preferences for collusion in auctions with positive externalities have been analysed by Caillaud and

possible for groups of productive agents to cooperate ex ante to internalise any positive externalities that might exist between them.

A cooperative mechanism, such as a joint bid, could internalize positive externalities associated with independent bidding and block outside ownership (and perhaps ensure efficient ownership). Notice that a simple reduction in competition amongst productive agents in the bidding process would not be sufficient here. Under the conditions of Propositions 1 and 2, an outside party would still be the highest bidder. Instead some form of ex ante side payments must be made in support of a joint bid.[17]

There is, however, an important economic constraint on the ability of productive agents to form an ex ante coalition that would support a joint bid. As has been noted in a number of contexts, when there are positive externalities from forming cooperative arrangements, free riding can constrain them from being realized. Maskin (2003) demonstrates that grand coalitions in cooperative game theory are unlikely to form if, by opting out of a coalition, individual agents (or groups of agents) can still realize some of the benefits from cooperation while avoiding side payments needed to support it.[18]

There is the same potential for free-riding when productive agents consider whether to support a joint bid. Essentially, in supporting a joint bid with a payment, productive agents are contributing to a public good. There is a large literature on the difficulties of achieving cooperation in this type of situation. Perhaps the most relevant is the model of Dixit and Olson (2000) who consider a public good contribution game involving many agents where there are no

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Jehiel (1998).

[17] This is one key difference between the cooperation that would be required ex ante and the cooperative mechanism used ex post to divide surplus. Where there is an essential productive asset, ex post, there need only be payments from the asset owner. In contrast, ex ante cooperation necessarily requires payments to the eventual asset owner. If there were many wealth-constrained, productive agents this would be a barrier to a joint bid succeeding in blocking outside ownership (see also Aghion and Tirole, 1994).

[18] Note that there is no similar constraint on the formation of a grand coalition of productive agents in ex post bargaining. Because access to the asset is essential for value creation (and agent's outside opportunities are independent of value created using the asset), there are no externalities. Hence, as Maskin (2003) demonstrates, a grand coalition would form ex post and the Shapely value would be a plausible

issues of private information. To illustrate this, here I present a general overview of their main result as applied to joint bids for ownership leaving the formal details to Appendix B.

Consider a situation – as in Dixit and Olson (2000) – where all productive agents simultaneously choose whether to support a particular joint bid or not. Supporting the bid means agreeing to contribute to a fund that the potential asset owner can use to increase their bid. The agreed upon contributions could themselves be based on a cooperative bargaining outcome such as the Shapley value. Importantly, if a productive agent chooses not to support the joint bid, they still receive any benefits that might arise without having to incur an ex ante side payment.

Several types of equilibria are possible in this game. One has no productive agent supporting a joint bid; resulting in outside ownership. This is an equilibrium because no single agent, by choosing to support the bid, would change the outcome. Moreover, for the same reason, there is no symmetric pure strategy equilibrium where all agents choose to support the bid. If this were the case, except in special cases, it would pay a single agent to withdraw support (achieving productive agent ownership but without having to incur an ex ante side payment). Nonetheless, there are many equilibria where exactly the minimal number of productive agents that would allow a joint bid to defeat an *O*-type bid choose to support the bid. In this case, the equilibrium is sustained as each is pivotal in that context. However, this would require precise coordination; something difficult given the inherently voluntary nature of individual agent's decision to support the bid or not.

For this reason, Dixit and Olson (2000), who consider essentially the same game in relation to the generation of public goods, focus on mixed strategy equilibria, so that identical agents choose the same strategies.[19] In any mixed strategy equilibrium, where productive agents

guide to ex post surplus division.

[19] Dixit and Olson (2000) also justify this focus because all of the agents in their model are identical. That motivation could apply to a sub-class of agents here as well. Nonetheless, the main justification is to model the difficulties associated with achieving coordination; something that also motivates the mixed strategy focus in the general public goods literature (Palfrey and Rosenthal, 1984), corporate takeovers literature (Bagnoli and Lipman, 1988; Holmstrom and Nalebuff, 1992) and the notion of a war of attrition considered

support a bid with some probability, there exists some chance that the minimal coalition required to support a joint bid will not form. Importantly, under certain conditions, the free riding that undermines cooperation becomes more salient as *N* grows large. For larger numbers of productive agents, the chance that any given agent is pivotal in ensuring the success of a cooperative bid is small, and hence, each weighs the probability of their participation lower in their chosen mixed strategy.

**Joint ownership**

Nonetheless, even the above strategy of using a joint bid to block outside ownership and implement efficient ownership requires that ownership itself 'sticks.' If a single productive agent emerges as the asset owner, they may be able to re-sell or threaten to re-sell the asset to an outside party, imposing a negative effect on the other productive agent and potentially reducing overall surplus. Indeed, Proposition 2 demonstrates that absent other constraints this re-sale threat would be credible. Thus, supporters of a joint bid may face continual expropriation and, anticipating this, may choose not to participate ex ante cooperation.[20]

There are two possible ways this outcome could be avoided. First, the joint bidders could impose restrictions on re-sale. The owner would still retain the right to exclude the other productive agent from being associated with the asset. However, exclusion is not the only value from ownership and part of the rights underlying the Shapley value division of ex post surplus could arise from other factors – including the ability to re-sell the asset. In this situation, even if commitments against re-sale could be made, it may lead to an inefficient outcome.

The second mechanism would be for the joint bid to be for joint ownership. Such joint ownership allows the joint bidders to appropriate the entire surplus and hence, could block an *O*-

by Maskin (2003) when binding agreements are hard to enforce. A more theoretical basis for a focus on mixed strategy equilibria is developed by Crawford and Haller (1990).

[20] In earlier versions of this paper it was demonstrated that re-sale options assisted in supporting outside ownership as an equilibrium outcome (Gans, 2000). See also Jehiel and Moldovanu (1999) who

type bid. However, joint ownership (with each agent having veto power over the asset's use and re-sale) is never efficient in the GHM approach (Hart and Moore, 1990, Proposition 4). So while joint ownership might be a plausible equilibrium outcome if joint bids were possible, it would not be efficient; although it could itself provide an explanation for the prevalence of joint ownership arrangements in a number of industries (Hansmann, 1996).

## 4. Conclusion and Future Directions

This paper has demonstrated that markets for ownership can be important drivers of the location of firm boundaries. Such markets tend to allocate ownership on the basis of the relative private values different types of agent receive from ownership. While the relative private values from ownership can themselves be determined by the incentive effects arising from changes in bargaining position, such effects need not dominate in the face of complementarities that strengthen productive agents' bargaining positions with respect to outside parties. Consequently, while outside parties would never be allocated ownership on efficiency grounds, they remain significant in markets for ownership as such parties only receive rents through ownership. Hence, their existence is likely to be an important factor in explaining observed patterns of ownership.

The above analysis of markets for ownership also highlights the potential complexity of interactions in those markets. Changes in ownership impose externalities on other agents and this complicates our ability to generate precise predictions regarding equilibria in asset markets. In addition, predictions vary with opportunities for ex ante cooperation as well as constraints on the ability to make contractual commitments regarding trading opportunities and incentives to undertake non-contractible investments. The results in this paper identify these issues as an important area for future research in relation to the operations of markets where externalities are present and on the precise role that exchange options afford asset owners.

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demonstrate the difficult of ensuring efficient ownership when re-sale of assets can occur.

Ultimately, the true test of this paper is an empirical one. In this regard, the paper's results provide a testable set of conditions under which outside ownership is likely to arise as an equilibrium outcome in markets for ownership. The analysis suggests that if (1) there are substitute instruments for ownership in providing incentives to productive agents; (2) there are many 'small' productive agents and an absence of key agents; (3) there are legal restrictions against cooperative bidding in asset markets; and (4) it is difficult or otherwise costly to impose contractual restrictions on re-sale, then outside ownership is likely. However, these conditions would need to be nested with those of other models to explain observed patterns of outside ownership.

Nonetheless, instances where we have seen trade in asset ownership are suggestive of such forces at work. Take, for example, the processes involved in privatising the state-owned enterprises in the former-Communist economies of Eastern Europe. While different methods of privatisation were employed in these economies, the eventual owners of firm assets were often outside parties, rather than the managers of those establishments. This occurred even where employees and managers were initially vested with shares in those privatised firms. Some commentators have attempted to explain this as an efficient means of re-structuring and renewing those enterprises (Boycko, Shleifer and Vishny, 1995). However, it could also be the case that such patterns resulted from an inability of productive agents to form effective coalitions preventing sales to outside parties or legal restrictions banning collusion among those agents in asset auctions.

Consider also the role of venture capitalists in start-up firms. It has been argued that venture capitalists provide important resources to start-up firms such as networking and commercial pressure as well as capital such entrepreneurs might not otherwise have (Gompers and Lerner, 1999; Gans, Hsu and Stern, 2002). These resources overcome the potential reduction in efficiency that might otherwise be expected from a reduction in entrepreneurial equity (Aghion and Tirole, 1994). However, consider Jim Clark (formerly of Silicon Graphics) founding

Netscape or Steve Jobs (Apple’s co-founder) founding Pixar. Each of these entrepreneurs received outside venture capital finance despite the wealth and network connections of their founding entrepreneurs. This suggests that a possible reason why entrepreneurial firms relinquish equity and control may be the high value that outside parties place on having a claim on future rents of such firms relative to that of founding entrepreneurs who will always remain critical to value creation.

## Appendix A: Proofs of Propositions

*Proof of Proposition 1.* In a simple English auction where the asset is allocated to the agent with the highest bid, given the perfect information about values, the winning bid will be from the agent with the highest willingness to pay for ownership. Since there are many *O*-types, their bid will be $\pi_O^O$. Now suppose that all productive agents believe that if they are not the highest bidder, an *O*-type will be. In this case, each *i*'s willingness to pay will be $\pi_i^i - \pi_i^O$. If $\pi_O^O > \pi_i^i - \pi_i^O$, *O*'s bid will exceed this. Thus, *O*-ownership is an equilibrium.

That it is unique depends upon the productive agents' bids if they conjectured that another productive agent would be allocated the asset if they were not the highest bidder; that is, $\pi_i^i - \pi_i^j$. By the assumption of the proposition, however, $\pi_i^j > \pi_i^O$. Therefore, given that $\pi_O^O > \pi_i^i - \pi_i^O$ for all *i*, their bids would still not exceed those of *O*.

Finally, if $\pi_O^O > \pi_i^i - \pi_i^O$ holds for all but one *i*, then that productive agent would outbid *O*. Uniqueness follows because if say *i* where to believe that say *j* were the next highest bidder, it would bid $\pi_i^i - \pi_i^j$ and if it does not win the auction, *O* would surely be the winner; meaning that conjecture would not be confirmed. Hence, it would raise its equilibrium bid above $\pi_O^O$; winning the auction. *Q.E.D.*

*Proof of Proposition 2.* First, note that an initial owner, *i*, will prefer to sell to an *O*-type (for a payment of $\pi_O^O$) rather than retain ownership if $\pi_i^O + \pi_O^O > \pi_i^i$. Suppose that this condition held and that all other productive agents believed that if they were not the highest bidder, an *O*-type would be. In order to provide a better payoff to *i* from *j*-ownership than *O*-ownership, *j* would have to bid, $b_j$, so that $b_j + \pi_i^j \geq \pi_i^O + \pi_O^O$. The maximum $b_j$ that *j* could bid would be up to their willingness to pay of $\pi_j^j - \pi_j^O$. However, if $\pi_i^O + \pi_j^O + \pi_O^O > \pi_j^j + \pi_i^j$. That it is unique follows from the same logic as in Proposition 1. *Q.E.D.*

## Appendix B: Dixit and Olson (2000) and Joint Bids

Here I present a model of coalition formation for the purpose of joint bidding on assets. To simplify exposition, suppose that all productive agents are symmetric and that the only joint bid being considered is to support agent 1. Assume that in the absence of a joint bid, $\pi_O^O - \pi_1^1 + \pi_1^O > 0$; the left hand side being the independent bid shortfall. If 1 can receive contributions of at least $\pi_O^O - \pi_i^i + \pi_i^O$, its bid will be higher than that of an outside agent. Let $M \equiv \min_n \pi_1^1 - \pi_1^O + n(\pi_i^1 - \pi_i^O) \geq \pi_O^O$ or $M \geq \frac{\pi_O^O - \pi_1^1 + \pi_1^O}{\pi_i^1 - \pi_i^O} > M - 1$. $M$ is the minimum number of productive agents such that a joint bid for 1-ownership could block outside ownership. Notice that *M* is independent of the number of participating agents although a given productive agent's payoff from participation is not. Hence, this exhibits the same free riding property that characterises the Dixit and Olson (2000) results.

The game is as follows:

1. Each productive agent (other than 1) independently decides whether to support the 1's bid or not;
2. If *M* agents or more choose to support the bid, then the bid proceeds with each of the supporting agents contributing an amount that equalises their expected payoffs (taking into account their contributions). On the other hand, if less than *M* agents choose to support the bid, no bid takes place.

Working backwards, if *m* agents support a joint bid, equalisation of expected payoffs implies that 1's contribution ($b_1$) and that of another agent ($b_i$) satisfy: $\pi_1^1 - b_1 = \pi_i^1 - b_i$ (using symmetry) while $b_1 + mb_i = \pi_O^O$. This implies that $b_i = \frac{1}{m+1}\left(\pi_O^O - \pi_1^1 + \pi_i^1\right)$ and $b_1 = \frac{m}{m+1}(\pi_1^1 - \pi_i^1) + \frac{1}{m+1}\pi_O^O$.

Note that if $N = 2$, then there is a symmetric pure strategy equilibrium with both agents choosing to support the joint bid for, if one fails to do so, outside ownership prevails. When $N > 2$, it is easy to see that if $M \geq 2$, then there is a unique symmetric pure strategy equilibrium where all agents choose to 'not support' any joint bid. This is an equilibrium because no single agent, by choosing to 'support' the bid, would change the outcome of outside ownership. Moreover, for the same reason, for higher *N*, there is no symmetric pure strategy equilibrium where all agents choose to support the bid. If this were the case, it would pay a single agent to withdraw support (achieving productive agent ownership but without having to incur an ex ante side payment). As noted in the text, there are many equilibria where exactly *M* agents choose to support the bid.

Turning to the mixed strategy equilibrium, suppose that productive agents support the bid with probability *q*. Recall that it is assumed here that 1 does not have an option of whether to participate or not. Applying Dixit and Olson's result there is a single symmetric mixed strategy equilibrium with where the equilibrium probability of *O*-ownership is $1 - \sum_{n=M}^{N-1} \frac{(N-1)!}{n!(N-1-n)!} q^n (1-q)^{N-1-n}$.

Finally, note that as *N* grows large this outcome can become increasingly likely. The condition that supported this result for Dixit and Olson is the linearity of the total value created from cooperation in the number of agents. Here, however, because of complementary, an additional productive agent involves an increased marginal contribution to overall surplus. Thus, surplus is higher as the number of productive agents expands. The key question, however, is whether the minimum number of agents required to support a joint bid rises more slowly than the increase in the number of agents. This is a difficult question to analyse for the general case here. However, if we suppose that productive agents are indispensable and their investments are non-contractible it is easy to see that $M \cong N / v(\mathbf{x}, N)$. Given the complementarities, average product rises with *N*. In this case, as *N* grows, *M* falls. As Dixit and Olson show, this makes a cooperative outcome less likely.

## References


AGHION, P. AND TIROLE, J. "The Management of Innovation." *Quarterly Journal of Economics*, Vol.109 (1994), pp.1185-1210.

BAGNOLI, M. AND LIPMAN, B.L. "Successful Takeovers without Exclusion." *Review of Financial Studies*, Vol.1 (1988), pp.89-110.

BAKER, G., GIBBONS, R., AND MURPHY, K.J. "Relational Contracts and the Theory of the Firm." *Quarterly Journal of Economics*, Vol.117 (2002), pp.39-84.

BOLTON, P. AND WHINSTON, M.D. "Incomplete Contracts, Vertical Integration, and Supply Constraints." *Review of Economic Studies*, Vol.60 (1993), pp.121-148.

BOYCKO, N. SHLEIFER, A. AND VISHNY, R. *Privatizing Russia*. Cambridge (MA): MIT Press, 1995.

CAILLAUD, B. AND JEHIEL, P. "Collusion in Auctions with Externalities." *Rand Journal of Economics*, Vol.29 (1998), pp.680-702.

CHIU, Y.S. "Noncooperative Bargaining, Hostages, and Optimal Asset Ownership." *American Economic Review*, Vol.88 (1998), pp.882-901.

CRAWFORD, V.P. AND HALLER, J. "Leaning how to Cooperate: Optimal Play in Repeated Coordination Games." *Econometrica*, Vol.58 (1990), pp.571-595.

DE MEZA, D. AND LOCKWOOD, B. "Does Asset Ownership Always Motivate Managers? Outside Options and the Property Rights Theory of the Firm." *Quarterly Journal of Economics*, Vol.113 (1998), pp.361-386.

DIXIT, A. AND OLSON, M. "Does Voluntary Participation Undermine the Coase Theorem?" *Journal of Public Economics*, Vol.76 (2000), pp.309-335.

GANS, J.S. "Markets for Ownership." *Working Paper*, No.2000-15, Melbourne Business School, 2000.

--------, HSU, D. AND STERN, S. "When does Start-Up Innovation Spur the Gale of Creative Destruction?" *RAND Journal of Economics,* Vol.33 (2002), pp.571-586.

GOMPERS, P. AND LERNER, J. *The Venture Capital Cycle*. Cambridge (MA): MIT Press, 1999.

GROSSMAN, S.J. AND HART, O.D. "The Costs and Benefits of Ownership: A Theory of Vertical and Lateral Integration." *Journal of Political Economy*, Vol.94 (1986), pp.691-719.

HANSMANN, H. *The Ownership of Enterprise*. Cambridge (MA): Belknap-Harvard, 1996.

HART, O.D. *Firms, Contracts and Financial Structure*. Oxford: Oxford University Press, 1995.

——— AND MOORE, J. "Property Rights and the Theory of the Firm." *Journal of Political Economy*, Vol.98 (1990), pp.1119-1158.

HOLMSTROM, B. "The Firm as a Subeconomy." *Journal of Law, Economics and Organization*, Vol.15 (1999), pp.74-102.

——— AND NALEBUFF, B. "To the Raider Goes the Surplus? A Reexamination of the Free-Rider Problem." *Journal of Economics and Management Strategy*, Vol.1 (1992), pp.37-62.

——— AND ROBERTS, J. "The Boundaries of the Firm Revisited," *Journal of Economic Perspectives*, Vol.12 (1998), pp.73-94.

JEHIEL, P. AND MOLDOVANU, B. "Strategic Nonparticipation." *Rand Journal of Economics*, Vol.27 (1996), pp.84-98.

——— AND MOLDOVANU, B. "Resale Markets and the Assignment of Property Rights." *Review of Economic Studies*, Vol.66 (1999), pp.971-986.

———, MOLDOVANU, B., AND STACCHETTI, E. "How (not) to Sell Nuclear Weapons." *American Economic Review*, Vol.86 (1996), pp.814-829.

MAILATH, G. AND POSTLEWAITE, A. "Asymmetric Information Bargaining Problems with Many Agents." *Review of Economic Studies*, Vol.57 (1990), pp.351-367.

MASKIN, E. "Bargaining, Coalitions and Externalities." Presidential Address to the Econometric Society, *Econometrica* (forthcoming), (2003),.

——— AND TIROLE, J. "Two Remarks on the Property-Rights Literature." *Review of Economic Studies*, Vol.66 (1999), pp.139-150.

PALFREY, T.R. AND ROSENTHAL, H. "Participation and the Provision of Discrete Public Goods: A Strategic Analysis," *Journal of Public Economics*, Vol.24 (1984), pp.171-193.

RAJAN, R. AND ZINGALES, L. "Power in a Theory of the Firm." *Quarterly Journal of Economics*, Vol.113 (1998), pp.387-432.

ROB, R. "Pollution Claim Settlements under Private Information." *Journal of Economic Theory*, Vol.47 (1989), pp.307-333.

SEGAL, I. "Contracting with Externalities." *Quarterly Journal of Economics*, Vol.114 (1999), pp.337-388.

——— "Collusion, Exclusion, and Inclusion in Random-Order Bargaining." *Review of Economic Studies*, Vol.70 (2003), pp.439-460.

STOLE, L. AND ZWIEBEL, J. "Intra-firm Bargaining under Non-Binding Contracts." *Review of Economic Studies*, Vol.63 (1996), pp.375-410.