UNIVERSIDAD **TORCUATO DI TELLA**

DEPARTAMENTO de ECONOMIA

MAESTRIA EN ECONOMIA

EVALUACION DE TESIS

ALUMNO : RUZZIER, CHRISTIAN ALEJANDRO

DNI: 24.587.767

TITULO DE TESIS: "Levels of Asset Specificity in Relational Contracting"

JURADO: Lucia Quesada
Martín Besfamille
Jacques Crémer. Evaluador externo. Director de IDEI (Institut d'Economie Industrielle, Francia).

FECHA: 2 de agosto de 2007

Levels of Asset Specificity in Relational Contracting[*]

Christian A. Ruzzier[†]

January 24, 2006

Abstract

Standard property rights theory (whether static or dynamic) assumes assets are specific, but once this assumption is in place, the *level* of asset specificity has no bearing on the make-or-buy decision. While there are good reasons to doubt the universality of transaction cost economics' prediction that the more specific the asset, the more likely is vertical integration to be optimal, this is an issue that cannot be addressed within the existing property rights framework.

In this paper the level of asset specificity matters for the integration decision, even in the static version of the model, and this result emerges naturally once an equally reasonable bargaining protocol is considered. To show this, we take Baker, Gibbons, and Murphy's (2002) relational contracting model, and use it as the vehicle for the analysis. Changing the bargaining protocol assumed by those authors results in a model in which the integration choice is affected in a non-trivial way by realized asset specificity.

1 Introduction

The basic idea that contracts are incomplete, and that, for this reason, the ex post allocation of power (or control) matters has been pervasive in economic thought at least since Simon's (1951) model of the employment relationship. The allocation of residual control rights over assets, in particular, has received a great deal of attention since the seminal work of Grossman and Hart (1986) and Hart and Moore (1990). These authors pioneered what is now called the property rights approach, which is probably best presented in Hart's (1995) book. The first models in this literature were concerned with one-shot relationships, but subsequent work beginning in the late 90s (Garvey, 1995; Halonen, 2002; Bragelien, 2002; Baker, Gibbons, and Murphy, 2001, 2002) has brought dynamic concerns into the picture, thus enriching the predictions of the property rights framework.

Contractual incompleteness necessitates ex post bargaining to allocate the surplus generated by the relationship; standard property rights theory (whether static or dynamic) typically uses the Nash bargaining solution at this point, a solution that assigns each party her disagreement payoff plus half of the surplus created.[1] Models in this tradition assume assets are specific, although the meaning of this assumption is typically very different from that envisioned by transaction cost economics: Marginal, not total, returns determine investments in a property rights theory of the firm, and for this reason the *level* of asset specificity has no bearing on the make-or-buy decision.[2] This is unsatisfactory: Common sense suggests that such differences would matter for the comparison of optimal governance structures.[3] For instance, the level of specificity is a primary concern of transaction cost economics, and a point repeatedly stressed by this literature is that the more specific the asset, the more likely is vertical integration to be optimal.[4] Although there are good reasons to doubt the universal validity of this prediction, this is an issue that cannot be properly

---

[1]Exceptions are the static models of Chiu (1998) and de Meza and Lockwood (1998).

[2]As long as it does not affect marginal returns.

[3]Holmstrom (1999, p. 86) also made this point: "Another potential problem for property rights models is the interpretation of asset specificity. ... There can be arbitrary amounts of asset specificity without any effect on the optimal distribution of assets". See also Holmstrom and Roberts (1998).

[4]Williamson (1985) provides a thorough discussion of the role of asset specificity. Moreover, the empirical literature has almost exclusively focused on this (see the discussion in Whinston, 2003).

addressed within the existing property rights framework.

In this paper the level of asset specificity matters for the integration decision, even in the static version of the model, and this result emerges naturally once an equally reasonable bargaining protocol is considered. To show this, I will borrow the basic setup from Baker, Gibbons, and Murphy (2002; BGM hereinafter), and use it as the vehicle for the analysis. Changing the bargaining protocol assumed by those authors will result in a model in which the predictions regarding the boundaries of the firm are contingent on the level of asset specificity. As a by-product, I will provide a check on the robustness of their results on the theory of the firm.

BGM develop a model of relational contracts both between and within firms, and show how different governance structures affect the parties' temptations to renege on a given agreement. BGM follow the property rights theory in taking asset ownership to be the defining characteristic of integration,[5] but they make use of a multi-task environment akin to that of Holmstrom (1999). They thus add a new perspective to the literature dealing with the hold-up problem under relational contracting.[6]

In BGM's model, an upstream party uses an asset to produce a good that is both valuable to a downstream party (with value Q) and in an alternative use (P). The asset is specific in the sense that $Q > P$. Nothing in BGM's results, however, depends on the *level* of asset specificity,[7] i.e. all their results hold as soon as $Q - P > 0$, irrespective of how large the difference is.

Since $Q > P$, and given some noncontractibility assumptions, under non-integration there is bargaining over the ownership of the good. BGM use the axiomatic Nash bargaining solution. This is consistent with the limiting equilibrium outcome of Rubinstein's (1982) alternating offers game in a setting in which each party is receiving a per-period payoff (an

---

[5]The usual cautionary note with respect to this definition of ownership applies here. A discussion of this issue falls out of the scope of this paper. The interested reader can check, for instance, Holmstrom and Milgrom (1994), Holmstrom and Roberts (1998), Rajan and Zingales (1998) and Whinston (2003).

[6]The traditional reference list on the hold-up literature includes Williamson (1975, 1985), Klein, Crawford, and Alchian (1978), Grossman and Hart (1986), and Hart and Moore (1990). On the hold-up problem under relational contracting see Garvey (1995), Halonen (2002), and Bragelien (2002).

[7]Measured here by the difference $Q - P$.

"inside option") while bargaining continues; these payoffs are given up once agreement is reached. We can think of a situation where there is a spot market for the good in which the upstream party continues to trade at price P while bargaining with the downstream party.

I consider here an equally plausible situation in which the upstream party must quit bargaining with the other party in order to sell the good in the spot market (which then constitutes an "outside option"). The predicted outcome is now that each bargainer gets half of the "pie", unless this gives one of them strictly less than her outside option (in which case she must receive her outside option, the other party receiving what is left).[8] De Meza and Lockwood (1998) and Chiu (1998) use this bargaining environment and show that some of the basic lessons from property rights models can be reversed, but they consider only static relationships,[9] while here we will consider also repeated-game versions of the model. Garvey (1995) and Halonen (2002) also analyze the implications of dynamics for the predictions of traditional property rights models, although they do not investigate alternative bargaining environments, nor the role of the level of asset specificity. Moreover, there is no uncertainty over the value of the relationship in any of these models, whereas here Q and P will be random variables whose distributions will depend on actions taken by the upstream party. Blonski and Spagnolo (2004) show that some of the predictions of Garvey, Halonen, and BGM can be overturned, but they keep the usual Nash solution and focus instead on optimal strategies.

Here, I first get a model were *the level of asset specificity matters*, in that it determines the outcome of the bargaining process:[10] the upstream party's outside option will not bind as long as the degree of asset specificity is high enough. Then I derive some results about the issue of the boundaries of the firm; some of these cannot be deduced from BGM's framework, while others will either confirm or modify some predictions of their paper. That the level of

---

[8]Binmore, Shaked and Sutton (1989) provide experimental evidence that the outside-option solution actually predicts better than the inside-option solution.

[9]They also consider a different setting (that of Hart, 1995) where there are two assets, both parties involved in the relationship make non-contractible investments, and there is no multi-tasking.

[10]This is a point already raised informally in Holmstrom (1999, p. 87): the implication that the amount of asset specificity does not affect the optimal ownership structure is sensitive to the particular bargaining game being used.

asset specificity matters is true *even in the static model*, as shown below: vertical integration is always dominated by non-integration (meaning that the latter generates a larger joint surplus than the former) when relational contracts are not feasible and asset specificity is high.

Whichever the outcome of the bargaining process, it is still true that "asset ownership affects the parties' temptations to renege on a relational contract" (the main proposition in BGM). Therefore, relational contracts between firms and within firms *are different*. In analyzing the choice between integration and non-integration, attention must be paid to which of the alternatives allows for a relational contract (which is superior to spot governances). The corollary BGM derive from this continues to hold when the bargaining environment is changed: A firm cannot mimic the spot-market outcome (i.e. replicate its payoffs) after it brings a transaction inside the organization. The statement is true irrespective of the bargaining rule and of the degree of asset specificity. Some of the other implications they explore, however, need to be qualified.

For instance, I find that vertical integration is indeed the efficient response to widely varying supply prices (understood as a large difference between realizations of P) *as long as the level of asset specificity is low enough*. To interpret this, notice that a binding outside option is the case in which incentives of both parties are worst aligned: the downstream party would like the upstream party to take actions that maximize the (expected) value of Q, whereas the latter tries to maximize the (expected) value of P, in order to get a higher price at the bargaining stage. This conflict is eliminated by integration.

When asset specificity is high, on the other hand, P does not affect the reneging temptations of any party. Intuitively, in this case the incentives of the upstream party are best aligned with those of the downstream party (since the value of P is not relevant) and incentives may be best provided under outsourcing. Indeed, if relational contracts are not available, given that asset ownership is the only remaining means to provide incentives for costly actions on the part of the upstream agent, spot employment is never optimal when asset specificity is high. Hence, with the alternative bargaining protocol, *integration will be less favored when asset specificity is high, but it is more likely to be optimal when asset specificity is low.*

Although not considered in BGM, I show that in their setting, as well as under the alternative bargaining environment, vertical integration is an efficient response to highly uncertain project outcomes (interpreted as a large difference between realizations of Q) when the degree of asset specificity is high and the optimal contract calls for incentives based only on project outcomes that are not too strong.[11] The conditions for the result are quite demanding, and it follows logically that strong Q-based incentives make the optimality of non-integration more likely when project outcomes are volatile. Moreover, if relational contracts are not feasible (say, for instance, because the interest rate is too high) *a large variation in the possible values of Q favors non-integration over integration* in the static model. The theory could then be interpreted as telling us that, for example, a firm engaged in R&D would be better off hiring an independent external contractor than having its own internal R&D lab when the outcome of an R&D project is very uncertain.

As in BGM, non-integration is preferred to vertical integration when high-powered incentives are desirable, and the optimal integration decision may depend on the discount rate (in the sense that for some r only some relational contracts will be feasible). When working with outside options, nevertheless, some qualifications are in order, since *when asset specificity is high it is always easier to achieve the first best under relational outsourcing (non-integration) than under relational employment (integration).* The result is reversed when asset specificity is low. This is best understood if we recall that the goals of both parties are best aligned in the former case, while they are most conflictive in the latter.

The next section presents the model in detail. In the following sections I take up the discussion of the optimal governance structure and asset ownership under the alternative bargaining environment in which the parties have outside options. I begin with the static version of the model and then turn to relational contracts. As in BGM, we will refer to these two governance structures as "spot" and "relational", respectively. Following Grossman and Hart (1986), say that a transaction is *integrated* when the downstream party owns the asset, and *non-integrated* when it is the upstream party who owns it. Finally, to simplify comparisons, we will identify vertical integration with "employment" and non-integration with "outsourcing", as in BGM. Thus we will call *spot outsourcing* the case in which the

---

[11]And as long as the interest rate is not too high.

upstream party owns the asset and no relational contract is feasible, and so on.

2 The Basic Model

Consider the following setup, drawn from BGM. Two parties are engaged in a vertical relationship and can trade at dates $t = 0,1,2...$; for simplicity we will call them U (for upstream) and D (for downstream). Both parties live forever, are risk-neutral, share the same interest rate r per period, and have sufficient wealth (so that they are able to purchase ownership rights whenever this is required).[12] At each period t, U uses an (infinitely-lived) asset to produce a good that is both valuable to D (this value is Q) and in an alternative use (this value is P). The value of the good always falls to zero at the end of the period during which it was produced. The asset is specific in the sense that $Q > P$. Ownership of the asset conveys ownership of the good.

We will consider a multi-task environment: in each period the upstream party chooses a vector of actions $\mathbf{a} \in \Re^n_+$ that stochastically affects Q and P. More specifically, Q and P can take high values (indexed by H) or low values (indexed by L) satisfying $Q_H > Q_L > P_H > P_L > 0$, and the actions taken by the upstream party determine the probabilities of achieving either outcome: Q_H (P_H) is realized with probability $q(\mathbf{a})$ (respectively, $p(\mathbf{a})$).[13] These actions are of course costly to the agent: the cost of actions $\mathbf{a}$ is given by $c(\mathbf{a})$, which we will assume increasing and strictly convex. Assume further that $q(\mathbf{0}) = p(\mathbf{0}) = c(\mathbf{0}) = 0$ (taking no action is costless, but gives no chance of achieving high values).[14]

Actions are not observed by the downstream party (so there is a moral hazard component). Outcomes (the realized values of Q and P), on the other hand, are observable by both parties but nonverifiable (for instance, by a court). Therefore, contracts based on $\mathbf{a}$, Q or P cannot be enforced by a third party. Under integration, D can simply take the

---

[12] We thus abstract from financial considerations. On this, see Hansmann (1996). See also Aghion and Tirole (1994) for an application to R&D where one party is cash constrained.

[13] Note that the crucial assumption here is that the asset is specific *for every realization of Q and P*; hence the analysis can be generalized to any finite number of values, as in Baker, Gibbons, and Murphy (2001), or to any joint distribution function that assigns positive probability only to events involving $Q > P$.

[14] $\mathbf{a} = \mathbf{0}$ can be interpreted as a normalization for some minimum level of "effort" exerted by U.

good without any payment to U once production takes place. Under non-integration, since $Q > P$, there will be bargaining over the ownership of the good. This will involve D paying U a (bargained) price ρ for the good. As we will discuss shortly, results and predictions may depend on how ρ is determined.

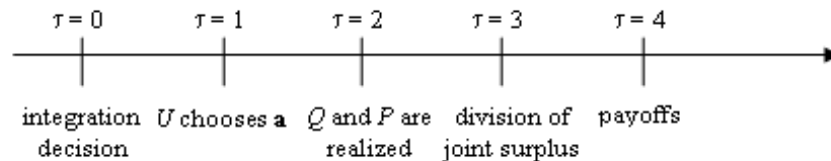The timing of the stage game (i.e. for each period t) is summarized in figure 1.

Figure 1: The timing of the game

3 Spot Governance Structures

In this section we want to characterize equilibrium actions and payoffs under both spot governance structures available: D-ownership or employment, and U-ownership or outsourcing.[15] In order to do so, we fix in turn the two choices in the first move of the game to integration (employment) and non-integration (outsourcing), and study the continuation games according to the timing laid out in Figure 1. Since under non-integration there is bargaining over the ownership of the good, we also introduce the alternative bargaining protocol at this point. Finally, we end the section by analyzing the optimal integration decision.

3.1 Spot employment

We begin by studying the case of integration under spot governance, what we have labeled spot employment. The outcome is very simple, almost embarrassingly so, when the downstream party owns the asset. Since no contract (formal or relational) is available, under

---

[15]We do not consider the case of joint ownership. Since under joint ownership the asset can be used only by consent, in our simple setting it would amount to assuming that outside options are zero for both parties, and results would be as in the case of high asset specificity (see below).

spot employment the downstream party can simply take the good and refuse to make any payment to the upstream party. In anticipation of this, the optimal choice for the upstream party is to take no costly action, i.e., to choose $\mathbf{a} = (0, 0, ..., 0)$.[16] Then the value of the good to the downstream party is Q_L with probability 1. Let the superscript SE denote spot outsourcing. Payoffs are then $U^{SE} = 0$ and $D^{SE} = Q_L$, and joint surplus is simply

$$S^{SE} = U^{SE} + D^{SE} = Q_L \tag{1}$$

Of course, these values do not depend on the bargaining protocol, nor on the realized asset specificity. When no contract is feasible, then the only means by which to provide incentives for U would be to give her the ownership of the asset.[17] Since under non-integration there would be bargaining over the price of the good, we turn to this matter before considering life under spot outsourcing.

3.2   Bargaining rules

Since $Q > P$, under non-integration there is bargaining over the ownership of the good after production takes place.[18] BGM use the Nash bargaining solution.[19] U's option to put the good to its alternative use is simply taken as shifting the status quo (or disagreement point, or threat point) from $(0, 0)$ to $(0, P)$, and the Nash solution is computed using this new

---

[16]This choice by the upstream party can be regarded as an illustration of an insight repeatedly emphasized in property rights theory: that the cost of control is the loss of initiative.

[17]We will find below that U's "investment" is monotonic in the number of assets held (just one here), as in Hart (1995), even with outside options. This has to be contrasted with de Meza and Lockwood (1998), who show that monotonicity does not necessarily hold with outside options. Their setup, however, is different (see fn. 9): in particular, given their assumptions, for any ownership structure equilibrium investment levels are less than their first-best levels (Proposition 6, p. 381), which implies that the optimal ownership structure is the one that maximizes the investment levels. This is not true in our model, where overinvestment is also possible (for instance, under spot outsourcing and low asset specificity).

[18]Since Q and P are observed by both parties, bargaining takes place under complete information and the outcome is ex post efficient. For a model with bargaining with private information and ex post inefficiencies, see Matouschek (2004).

[19]Binmore, Rubinstein and Wolinsky (1986) discuss extensively the application of the Nash bargaining solution in economic modelling. The following discussion draws heavily from their work and that of Sutton (1986).

status quo point in the Nash product. This solution assigns each party her disagreement payoff plus half of the surplus generated by the agreement, an outcome we will refer to as "split-the-difference", as is customary in the literature. Notice that shifting the status quo is but one possibility to incorporate U's alternative.

The Nash bargaining solution is rooted in the axiomatic (static) approach to bargaining, but can in fact be given sound non-cooperative foundations.[20] The advantage of working in terms of non-cooperative strategic models is that we can explicitly model the details of the bargaining situation (the set of possible agreements, the parties' preferences and attitudes toward risk and time, the bargaining procedure (i.e., the sequence of moves), and the environment within which the bargaining proceeds) and easily assess the impact of changes in these details on outcomes.

The bargaining outcome assumed in BGM is consistent, for instance, with the equilibrium outcome of Rubinstein's (1982) alternating offers game in a setting in which each party is receiving a per-period payoff (an "inside option"[21]) while bargaining continues; these payoffs are given up once agreement is reached. In the limit as discounting goes to zero, the outcome tends to split-the-difference. We might interpret this as a situation in which there exist other downstream parties to whom U can sell the good while bargaining with D, but only at price P since the good might be tailored to D's specifications.

It is also consistent with the limiting equilibrium outcome of a Rubinstein-like game in which after each proposal, should a random event occur, bargaining is automatically terminated and the parties receive the payoffs given by the breakdown point $(0, P)$. In the limit as the probability of such an exogenous breakdown of negotiations goes to one, once again we get the split-the-difference rule. This case may be interpreted as a situation where the two parties risk the chance of having their joint business opportunity snatched by someone else (thereby losing it), should they fail to agree. The existence of an exogenous risk of breakdown, outside the parties' control, would therefore lend support to the Nash

---

[20]This is actually the "Nash program" described in Binmore (1980, 1985). Notice that Nash (1953) himself tried to motivate his bargaining solution by means of a particular non-cooperative game (the simultaneous moves "Nash demand game").

[21]See de Meza and Lockwood (1998). In what follows we will use the mnemonic "inside options" whenever we will make reference to the bargaining situation or outcome used in BGM (the split-the-difference rule).

solution used in BGM.

Suppose now that when the random event occurs the respondent can *choose* to terminate bargaining after receiving a proposal, in which case the parties receive the payoffs given by $(0, P)$, as before. In other words, breakdown arises after one of the parties quits the negotiations in order to take up an opportunity elsewhere (when this opportunity is available), the other party following suit. How will the value of this outside option available to her affect the bargaining outcome? In the limit, when the outside option is always available to the respondent (i.e., when the probability of the random event goes to one), we get a very different outcome: each bargainer gets half of the "pie", unless this gives one of them strictly less than her outside option (in which case she must receive the latter, the other party receiving what is left). This is what Binmore, Shaked and Sutton (1989) termed the "deal-me-out" rule.

Think of a situation in which to sell the good to another downstream party (or in a spot market), the upstream party must quit bargaining with the downstream party.[22] P would then constitute an "outside option" in the sense of Binmore, Rubinstein, and Wolinsky (1986, p. 185).[23] In the static axiomatic approach, rather than shifting the status quo point in the Nash product, the outside options are in this case used only as constraints on the range of validity of the Nash solution. Under the deal-me-out rule, we have that the payoffs to D and U (s_D and s_U, respectively) from the bargaining process are given by:[24]

$$(s_D, s_U) = \begin{cases} (\frac{Q_i}{2}, \frac{Q_i}{2}) & \text{if } \frac{Q_i}{2} > P_j \\ (Q_i - P_j, P_j) & \text{if } \frac{Q_i}{2} \leq P_j \end{cases}$$

Notice that since the downstream party's outside option is 0, it can never bind. As is clear from the expressions above (see also Proposition 6 in Binmore, Rubinstein and Wolinsky, 1986), the outside options are relevant (they affect the equilibrium outcome) only if they

---

[22] For instance, looking for a new partner might be time-consuming, or require some (unmodelled) marketing costs. By the time this is done, it may be too late for D to wait further for another good to be produced.

[23] In what follows we will use the mnemonic "outside options" whenever we will make reference to the bargaining situation or outcome where the deal-me-out rule prevails.

[24] In what follows, Q and P will make reference to the random variables, whereas Q_i and P_j will denote realizations of these variables.

constitute a credible threat, i.e. if they are binding. This is the Outside Option Principle: only threats that are credible should have an effect on outcomes. As Sutton (1986) put it, "that bargaining agents will in practice fail to be influenced by their opponents' access to some relatively unattractive alternative is of course an empirical issue". The experimental evidence in Binmore, Shaked, and Sutton (1989) lends support to this conjecture. In the former case of an exogenous risk of breakdown (or when the parties are receiving some payoff while bargaining) even small threats are credible and, hence, the split-the-difference outcome emerges naturally. When this risk is endogenous, however, only a sufficiently large outside option makes a credible threat.

The outcome of the bargaining process can now take one of *two* forms, as shown in (2) below, *which depend on the realized asset specificity* $AS_{ij} \equiv Q_i - P_j$. The upstream party's outside option will not bind as long as $AS_{ij} > P_j$. Put differently, which outcome form arises depends on whether the level of asset specificity is greater or less than a threshold given by the alternative-use value of the good. The bargained price ρ of the good will then be

$$\rho = \begin{cases} \frac{Q_i}{2} & \text{if } AS_{ij} > P_j \\ P_j & \text{otherwise} \end{cases} \tag{2}$$

3.3 Spot outsourcing

We now consider matters under non-integration, i.e., when the upstream party owns the asset. Whatever the bargaining environment, U will take the expected outcome of the process into account when (optimally) choosing her actions. Denote $E[\rho]$ the expected price of the good. Let the superscript SO denote spot outsourcing. Then the payoff to the upstream party is given by

$$U^{SO} = \max_{\mathbf{a}} \quad E[\rho] - c(\mathbf{a}) = E[\rho \mid \mathbf{a} = \mathbf{a}^{SO}] - c(\mathbf{a}^{SO}),$$

whereas the downstream party's payoff is $D^{SO} = E[Q - \rho \mid \mathbf{a} = \mathbf{a}^{SO}]$, where $\mathbf{a}^{SO} \in \arg\max_{\mathbf{a}} E[\rho] - c(\mathbf{a})$. The total surplus of the relationship is then

$$S^{SO} = U^{SO} + D^{SO} = E[Q \mid \mathbf{a} = \mathbf{a}^{SO}] - c(\mathbf{a}^{SO}) \tag{3}$$

Note that when the bargaining protocol is changed as we did here, the expression for ρ depends on the realization of AS (and hence on those of Q and P). However, the upstream

party chooses **a** *before* Q and P are observed. Call the case in which $AS_{ij} > P_j$ a situation of "high" asset specificity, and the case $AS_{ij} < P_j$ a situation of "low" asset specificity. For U to know which bargaining environment will prevail (high or low specificity) when choosing **a**, we will assume that parameter values are such that we are always on one side of the threshold or the other, i.e. we will make two mutually exclusive assumptions, namely,

$$A^h : \quad Q_L > 2P_H \quad \text{("high" specificity)}$$

and

$$A^l : \quad Q_H < 2P_L \quad \text{("low" specificity)}$$

and perform the analysis under each of those alternatively to see how results are modified.[25] These assumptions[26] allow us to focus on the two extreme cases in the most simple setting, and to isolate the effects of the degree of asset specificity on the integration decision.

Under A^h, U's outside option will never bind, whatever the realizations of Q and P; i.e., we will always be in a situation of high specificity (hence we will index all variables by the superscript h). When the alternative assumption, A^l, holds, the upstream party's outside option will always bind, and therefore low asset specificity (superscript l) will prevail. The bargained price of the good in each case will be given by

$$\rho^h = \frac{Q_i}{2}, \tag{4}$$

and

$$\rho^l = P_j. \tag{5}$$

Take expectations over all possible values of Q and P in (4) and (5) to get the corresponding expected prices:

$$
\begin{aligned}
E\left[\rho^h \mid \mathbf{a}^{SO,h}\right] &= \frac{1}{2}E\left[Q \mid \mathbf{a}^{SO,h}\right] = \frac{1}{2}\left[q(\mathbf{a}^{SO,h})Q_H + (1 - q(\mathbf{a}^{SO,h}))Q_L\right] \\
E\left[\rho^l \mid \mathbf{a}^{SO,l}\right] &= E\left[P \mid \mathbf{a}^{SO,l}\right] = p(\mathbf{a}^{SO,l})P_H + (1 - p(\mathbf{a}^{SO,l}))P_L
\end{aligned}
$$

---

[25] We notice incidentally that these assumptions (A^h and A^l) are equivalent, broadly speaking, to de Meza and Lockwood's (1998) cases of relatively unproductive and relatively productive (in the outside option) investments, respectively.

[26] Given common knowledge of the distribution functions, the players know something like A^h or A^l; we are just picking the most "convenient" binomial distributions by making these assumptions.

where $\mathbf{a}^{SO,h}$ ($\mathbf{a}^{SO,l}$) denotes the optimal actions taken by U under spot outsourcing when asset specificity is high (low). Notice that here, contrary to BGM, even under non-integration P may play no role (i.e., in the case where asset specificity is high). This fact will drive many of the differences between our results.

Let $\Delta Q = Q_H - Q_L$ and $\Delta P = P_H - P_L$. The parties' payoffs and the total surplus in each situation can be written as:

$$
\begin{aligned}
U_h^{SO} &= \frac{1}{2}\left(Q_L + q\left(\mathbf{a}^{SO,h}\right)\Delta Q\right) - c(\mathbf{a}^{SO,h}) \\
D_h^{SO} &= \frac{1}{2}\left(Q_L + q\left(\mathbf{a}^{SO,h}\right)\Delta Q\right) \\
S_h^{SO} &= Q_L + q\left(\mathbf{a}^{SO,h}\right)\Delta Q - c(\mathbf{a}^{SO,h})
\end{aligned}
\tag{6}
$$

in a situation of high specificity (i.e., under A^h), and

$$
\begin{aligned}
U_l^{SO} &= P_L + p\left(\mathbf{a}^{SO,l}\right)\Delta P - c(\mathbf{a}^{SO,l}) \\
D_l^{SO} &= Q_L + q\left(\mathbf{a}^{SO,l}\right)\Delta Q - \left[P_L + p\left(\mathbf{a}^{SO,l}\right)\Delta P\right] \\
S_l^{SO} &= Q_L + q\left(\mathbf{a}^{SO,l}\right)\Delta Q - c(\mathbf{a}^{SO,l})
\end{aligned}
\tag{7}
$$

in the case of low specificity (i.e., under A^l).

3.4 The integration decision

The comparison between the two ownership structures is trivial under our assumptions. D will integrate with U as long as the joint surplus in (1) is higher than that in (3), i.e.:

$$
S^{SE} > S^{SO}
$$

$$
\iff q\left(\mathbf{a}^{SO}\right)\Delta Q < c(\mathbf{a}^{SO}).
\tag{8}
$$

Spot employment can only dominate spot outsourcing when providing incentives to the upstream party for taking costly actions reduces total surplus. This can easily be seen if we rewrite (8) as

$$
\left(q\left(\mathbf{a}^{SO}\right) - q\left(\mathbf{0}\right)\right)\Delta Q < c(\mathbf{a}^{SO}) - c(\mathbf{0}).
$$

Incentives will not be provided (by giving ownership to U) as long as the cost of extracting effort from the upstream party is larger than the benefit of doing so (i.e., achieving a higher

outcome with a higher probability). Direct comparison of the results under both types of spot governance highlights one of the two tools available in the model to influence the upstream party's choice of actions: asset ownership. The other one will be relational contracts, and will be addressed in the following section, where we analyze repeated-game versions of the model presented in section 2.

4 Governance under relational contracts

Regardless of the ownership arrangement, the downstream party would always like the upstream party to take actions that increase Q. Ongoing interaction may provide an instrument for providing effective incentives which is not available in the static framework of section 3: the downstream party may be able to make a self-enforcing promise to pay a bonus whenever a high value is achieved. This kind of implicit arrangement constitutes the essence of a relational contract. More formally, a relational contract is "a complete plan for the relationship... [that] for each date t and every history [of the relationship]... describes: (i) the compensation the principal should offer (and which should be paid); (ii) whether the agent should accept or reject the offer; and in the event of acceptance, (iii) the actions the agent should take" (Levin, 2003).

Note that, if a relational contract is feasible, it can never be worse than spot relationships. The parties can always play the static Nash equilibrium of the game, and this constitutes a subgame perfect Nash equilibrium in our supergame (see, for instance, Fudenberg and Tirole, 1991). In this section, we will thus see if and how asset ownership affects the feasibility of the superior relational contract. We will assume that the parties can trade at dates $t = 0$, 1, 2, ... according to the stage game depicted in figure 2 below.

In general terms, compensation in a relational contract consists of a fixed payment (salary) s_t and a contingent payment $b_t : \Phi \to \Re$, where Φ is the set of all possible realizations of the performance outcome observed by both parties, $\varphi_t = \{Q_t, P_t\}$. In principle, promised compensation can depend on the whole history of the relationship, and the relational contract can be quite messy. Fortunately, Levin (2003, Theorem 2, p. 840) has shown that in this context it suffices to look at *stationary contracts*, in which the downstream party
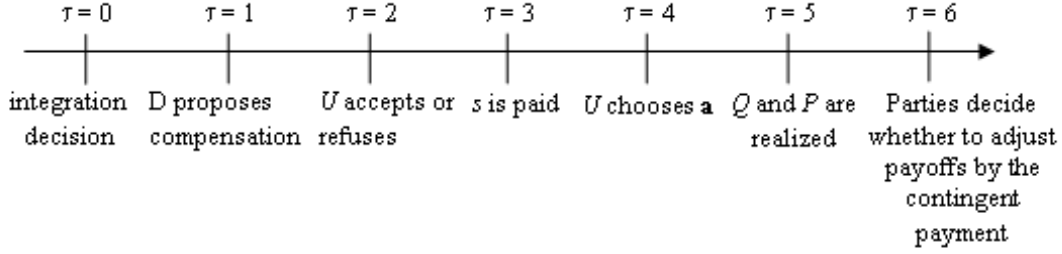
Figure 2: Timing with relational contracts

promises the same compensation scheme in every period, to characterize optimal relational contracts. Formally, total compensation in any period t is given by $W_t = s + b\left(\varphi_t\right)$, and the discretionary payments in each period only depend on the performance outcome in the same period.

Within our simple setting, the relational compensation contract can be best described as $(s, \{b_{ij}\}) = (s, b_{HH}, b_{HL}, b_{LH}, b_{LL})$, where the salary s is paid by the downstream party to the upstream party at the beginning of each period and b_{ij} is supposed to be paid when $Q = Q_i$ and $P = P_j$, respectively for $i, j =$ H, L.

Theorem 1 in Levin (2003, p. 840) tells us that, in analyzing self-enforcing relational contracts, we can concentrate on contracts that maximize the joint surplus of the relationship (subject to self-enforceability), since the fixed compensation in the initial period of the contract can be adjusted to redistribute surplus without affecting underlying incentives.[27]

If U accepts the relational contract offered by D,[28] her period payoff will be

$$U^R = \max_{\mathbf{a}} \quad s + b_{HH}q(\mathbf{a})p(\mathbf{a}) + b_{HL}q(\mathbf{a})(1 - p(\mathbf{a})) + b_{LH}(1 - q(\mathbf{a}))p(\mathbf{a}) +$$

$$+ b_{LL}(1 - q(\mathbf{a}))(1 - p(\mathbf{a})) - c(\mathbf{a}) = E\left[s + b \mid \mathbf{a} = \mathbf{a}^R\right] - c(\mathbf{a}^R),$$

where $\mathbf{a}^R \in \arg\max_{\mathbf{a}} E\left[s + b\right] - c(\mathbf{a})$. The downstream party's payoff is given by $D^R = E\left[Q - s - b \mid \mathbf{a} = \mathbf{a}^R\right]$. The total surplus of the relationship is then

---

[27]If a fixed compensation is not available, distribution matters, and the downstream party might as well prefer a "larger slice of a smaller cake". Hence, acting as a self-interested principal, she might choose an inefficient governance structure.

[28]Results would not change if U were to offer a contract to D.

16

$$S^R = U^R + D^R = E\left[Q \mid \mathbf{a} = \mathbf{a}^R\right] - c(\mathbf{a}^R). \tag{9}$$

A given relational contract will induce the same actions by the upstream party and thus produce the same surplus, irrespective of asset ownership, as long as the contract satisfies the corresponding feasibility constraint (which we analyze below).[29] Since changing the bargaining environment changes the outcome of the process (the bargained price), this change in outcome may also change the parties' temptations to renege on the relational contract, and hence affect the feasibility of a contract. Therefore, a crucial part in what follows will be to compute the payoffs after reneging, what we do in the next subsections.

Following BGM, we will analyze trigger-strategy equilibria (see Friedman, 1971), in which after a deviation from the relational compensation contract $(s, \{b_{ij}\})$ the parties revert to the static equilibrium of the game forever —i.e., the party who did not renege refuses to enter into any new relational contract with the other party, and the relationship goes on under spot governance. Although generally trigger strategies are suboptimal (in the sense of Abreu, 1986, 1988), and not robust to ex post renegotiation, trembles and mistakes, they are simple and not that unrealistic, and, more importantly, they allow direct comparison with the results in BGM. Since the main point of the paper is about bargaining rules, not strategies, we offer no further defense of this equilibrium concept here. The interested reader is referred to the paper by Blonski and Spagnolo (2004) for a discussion of strategies within the setting of BGM.

We will also allow parties to negotiate over asset ownership after reneging, so that the asset will end up in the "right" hands; for example, under relational employment we will have spot employment when it is more efficient for D to retain ownership of the asset ($S^{SE} > S^{SO}$), and we will have spot outsourcing when it is more efficient for U to buy it from D at some price π ($S^{SO} > S^{SE}$) —which she can always do given the sufficient wealth assumption.

4.1 Reneging temptations under relational employment

---

[29]We note that these are the same as in the case of inside options. The difference will be given by the reneging constraints that we discuss below.

Let us begin the analysis of the parties' temptations to renege on the relational contract by looking at the case in which the downstream party owns the asset. In this situation of relational employment, D can refuse to pay the promised bonus once Q_i and P_j are realized, and simply take the good without paying anything (which she can do since she owns the asset). After reneging, and given our former assumptions, she either retains ownership of the good and earns D^{SE} in perpetuity, or sells the asset to U at price π and receives D^{SO} in perpetuity. On the contrary, if the downstream party honors the contract, she pays b_{ij} and continues with the relationship, thus making profit D^{RE} each period in perpetuity. It follows that D will stick to the "terms" of the relational contract whenever

$$-b_{ij} + \frac{1}{r}D^{RE} \geq \frac{1}{r}D^{SE} \qquad \text{if } S^{SE} > S^{SO}, \text{ or} \tag{10}$$

$$-b_{ij} + \frac{1}{r}D^{RE} \geq \frac{1}{r}D^{SO} + \pi \quad \text{if } S^{SO} > S^{SE}. \tag{11}$$

The upstream party can renege on the relational contract by refusing to accept a promised payment b_{ij} (or to make a promised payment if $b_{ij} < 0$). After that, she earns U^{SE} for ever if she does not buy the asset, and $\frac{1}{r}U^{SO} - \pi$ if she buys it from D. On the other hand, if U honors the contract, she receives b_{ij} and continues with the relationship, thus making profit U^{RE} each period in perpetuity. It follows that the upstream party will honor the contract as long as

$$b_{ij} + \frac{1}{r}U^{RE} \geq \frac{1}{r}U^{SE} \qquad \text{if } S^{SE} > S^{SO}, \text{ or} \tag{12}$$

$$b_{ij} + \frac{1}{r}U^{RE} \geq \frac{1}{r}U^{SO} - \pi \quad \text{if } S^{SO} > S^{SE}. \tag{13}$$

The present value of honoring the contract for D (respectively, U) should exceed the present value of reneging for every value of b_{ij}, i.e., equations (10) and (11) [(12) and (13)] must hold for the maximum (minimum) value of the promised bonus. This is true both when $S^{SE} > S^{SO}$ and when $S^{SO} > S^{SE}$. We can combine these extreme versions of the reneging constraints into a single necessary and sufficient condition for a self-enforcing relational-employment contract (see BGM, p. 52, and Levin, 2003, Theorem 3, p. 842):

$$\max b_{ij} - \min b_{ij} \leq \frac{1}{r}\left[S^{RE} - \max\left(S^{SO}, S^{SE}\right)\right]. \tag{14}$$

The feasibility constraint (14) states that the variation in contingent compensation has a limit given by the net future gains from the relationship. This condition is what Levin

(2003) called the *dynamic enforcement* constraint.[30] The left-hand side of the inequality is the maximum total temptation to renege on the relational-employment contract (i.e. the sum of both parties' temptations), whereas the right-hand side is the present value of net total surplus (i.e. continuation surplus, S^{RE}, minus the best fallback if either party reneges, $\max\left(S^{SO}, S^{SE}\right)$). The efficient relational-employment contract maximizes the total surplus S^{RE} (equation (9)) subject to the dynamic enforcement constraint (14).

It is clear that it will be easier to maintain the relationship the lower the interest rate, and the higher the surplus generated. The model predicts that relationships will be more flexible (in terms of allowing a larger variation in contingent compensation), and will be able to provide better incentives, when interactions are more frequent, since this would translate into a decrease in r (see Tirole, 1988)

4.2   Reneging temptations under relational outsourcing

Let us now turn to the analysis of the feasibility of relational contracts under non-integration. When U owns the asset, the comparison between the promised payment and the price that would result from the bargaining process under spot outsourcing determines each party's temptations to renege on the relational-outsourcing contract. In particular, if the promised bonus b_{ij} exceeds the bargained price ρ [where $\rho = \rho^h$ or ρ^l depending on the level of asset specificity, as in equations (4) and (5)], the downstream party would be better off this period by reneging on the relational contract. Conversely, if b_{ij} falls short of ρ, it is the upstream party who would be better off by reneging. Proceeding as above we can show that a necessary and sufficient condition for the relational-outsourcing contract to be self-enforcing is

$$\max\left(b_{ij} - \rho\right) - \min\left(b_{ij} - \rho\right) \leq \frac{1}{r}\left[S^{RO} - \max\left(S^{SO}, S^{SE}\right)\right]. \tag{15}$$

As in (14), the left-hand side is the maximum total reneging temptation, and the right-hand side is the present value of the net total surplus. Once again, the efficient relational-outsourcing contract maximizes the total surplus S^{RO} in equation (9) subject to this dynamic

---

[30]Note that the value of S^{SO} will depend on the working assumption about the prevailing bargaining environment (i.e., A^h or A^l). We do not make this dependence explicit here in order to avoid additional subindices that would obscure the main point.

enforcement constraint. The interpretation is analogous to the case of relational employment, but note (see below) that now the reneging temptation *may* depend on P, the alternative-use value. More specifically, (15) takes the form

$$\max\left(b_{ij} - \frac{Q_i}{2}\right) - \min\left(b_{ij} - \frac{Q_i}{2}\right) \leq \frac{1}{r}\left[S^{RO} - \max\left(S_h^{SO}, S^{SE}\right)\right], \text{ under } A^h, \qquad (16)$$

or

$$\max\left(b_{ij} - P_j\right) - \min\left(b_{ij} - P_j\right) \leq \frac{1}{r}\left[S^{RO} - \max\left(S_l^{SO}, S^{SE}\right)\right], \text{ under } A^l, \qquad (17)$$

i.e., when asset specificity is high and low, respectively. In BGM, "a key difference between relational contracts under outsourcing versus under employment is that the good's value in its alternative use, P, affects the reneging decision under relational outsourcing but not under relational employment". As can readily be seen from (16), with deal-me-out bargaining this is not true for high enough asset specificity. We thus expect our results to differ the most from BGM's when outside options are not binding, an intuition that will be confirmed below.

4.3   Relational contracts between and within firms

Having now discussed the parties' temptations to renege on a relational contract under both governance structures, we can proceed to their comparison. By simple inspection of the feasibility constraints (14), (16), and (17), we can confirm the main proposition in BGM. Hence we can state (without additional proof)

Proposition 1 *(Baker, Gibbons, and Murphy, 2002, p. 56) Asset ownership affects the parties' temptations to renege on a relational contract, and hence affects whether a given relational contract is feasible.*

Therefore, relational contracts between firms and within firms *are different*. In analyzing the choice of integration versus non-integration, attention must be paid to which of the alternatives allows for a relational contract (which we know to be superior to spot governances). As we have shown, this result is robust to changes in the bargaining rules and holds irrespective of the level of asset specificity. It has also been shown elsewhere to be robust to more general strategies than those analyzed here (Blonski and Spagnolo, 2004, Proposition 4).

We conclude this section by extending correspondingly a corollary in BGM (p. 57).[31]

Corollary 1 *It is impossible for a firm to mimic the spot-market outcome (i.e., to replicate its payoffs) after it brings a transaction inside the organization, because the reneging temptation would be too great. The statement is true irrespective of the bargaining rule (split-the-difference or deal-me-out) and of the level of asset specificity.*

The proof of this corollary and all other proofs are in the Appendix. In the next section we will derive some implications of the model we have outlined, and we will contrast these with those presented in BGM.

5   The boundaries of the firm

To gain some insights about the optimality of each regime we will place some more structure on the model.[32] Following BGM, we will assume U takes two actions that affect linearly the probabilities of obtaining high values, and that impose quadratic costs on her. Formally,

$$
\begin{aligned}
\mathbf{a} &= (a_1, a_2) \\
q(\mathbf{a}) &= q_1 a_1 + q_2 a_2 \\
p(\mathbf{a}) &= p_1 a_1 + p_2 a_2 \\
c(\mathbf{a}) &= \frac{1}{2}a_1^2 + \frac{1}{2}a_2^2
\end{aligned}
$$

where $q_1, q_2, p_1, p_2 \geq 0$ and $q_1 p_2 \neq q_2 p_1$.

As in BGM, assume also that the bonus payments b_{ij} take the specific form $b_{ij} = b_i + \beta_j$ $(i, j = \text{H,L})$, where the first component has to do with the realization of Q and the second one is related to P.[33] For later reference, we will label the first component "Q-based incentives". Furthermore, let $\Delta b = b_H - b_L$ and $\Delta \beta = \beta_H - \beta_L$. The expected bonus can be written as $b_{LL} + q(\mathbf{a})\Delta b + p(\mathbf{a})\Delta \beta$, and thus we can interpret the assumed functional form as saying

---

[31]See also Proposition 1 in Baker, Gibbons and Murphy (2001, p. 216). Blonski and Spagnolo (2004, Proposition 5), however, find that patient firms may be able to mimic the market allocation when parties are free to choose optimally their strategies.

[32]At the cost of some loss of generality.

[33]Notice that this implies that $b_{HH} + b_{LL} = b_{HL} + b_{LH}$.

that the downstream party promises $b_L + \beta_L$ regardless of the outcomes and additional bonuses Δb if $Q = Q_H$ (which occurs with probability $q(\mathbf{a})$) and $\Delta \beta$ if $P = P_H$ (which happens with probability $p(\mathbf{a})$), without any further payment (for example, if *both* Q and P achieve their highest values).

Analyzing the special form taken now by the reneging constraints presented in section 4 will allow us to derive some additional results. Under relational employment, the self-enforcement constraint (14) writes as (see Appendix 1 in BGM)

$$|\Delta b| + |\Delta \beta| \leq \frac{1}{r} \left[S^{RE} - \max\left(S_k^{SO}, S^{SE} \right) \right], \tag{18}$$

where $k = h, l$ depending on the working assumption, A^h or A^l. Under relational outsourcing with outside options, we can show (see the Appendix) that the necessary and sufficient conditions (??) and (??) for the relational-outsourcing contract to be self-enforcing take the form

$$\left| \Delta b - \frac{1}{2} \Delta Q \right| + |\Delta \beta| \leq \frac{1}{r} \left[S^{RO} - \max\left(S_h^{SO}, S^{SE} \right) \right], \text{ under } A^h, \tag{19}$$

i.e., if asset specificity is high; and

$$|\Delta b| + |\Delta \beta - \Delta P| \leq \frac{1}{r} \left[S^{RO} - \max\left(S_l^{SO}, S^{SE} \right) \right], \text{ under } A^l, \tag{20}$$

i.e., if asset specificity is low.

Our first result concerns only spot governance structures, but will prove useful for what comes next. We state it as Lemma 1.

Lemma 1 *For given values of $q_1, p_1, q_2, p_2, \Delta Q$:*

(i) If A^l holds and $\Delta P \in (0, P_L)$, then there exists ΔP_l such that for all $\Delta P > \Delta P_l$ we have $S^{SE} > S_l^{SO}$.

(ii) If A^h holds and $\Delta P \in (0, Q_L - P_L)$, then $S^{SE} < S_h^{SO}$ for all ΔP.

To interpret this, notice that for sufficiently large[34] ΔP (interpreted as a very volatile supply price, for instance), spot employment dominates spot outsourcing when asset specificity is low, that is, when A^l holds. Furthermore, we show in the Appendix that the threshold

---

[34]The upper bound on ΔP guarantees that assumption A^l is not violated.

defined in Lemma 1 is lower than the corresponding threshold in BGM, i.e., $\Delta P_l < \Delta P_{BGM}$, meaning that the condition for the optimality of spot employment is less stringent under a binding outside option than under inside options.[35]

Result 1 in BGM (p. 76) says that vertical integration is the efficient governance structure when supply prices are very volatile. Lemma 1 tells us that this is not always the case with outside options, since when asset specificity is high (i.e., under A^h), spot employment is never optimal.[36] Intuitively, in this case the incentives of the upstream party are best aligned with those of the downstream party (the value of P is not relevant) and incentives are best provided under spot outsourcing, that is, by giving ownership to U.

The result, however, is verified for the case of low asset specificity, as Lemma 2 shows.

Lemma 2 *For given values of $q_1, p_1, q_2, p_2, r, \Delta Q$, if A^l holds and $\Delta P \in (0, P_L)$, then for ΔP large enough integration is optimal, i.e., either spot employment or relational employment generates the largest joint surplus. Formally, there exists ΔP_l^* such that for all $\Delta P > \Delta P_l^*$, D-ownership is more efficient than U-ownership.*

Lemma 2 states that, for sufficiently large ΔP, integration dominates non-integration when asset specificity is low, even in the case where relational contracts are feasible. To interpret this result, notice that integration eliminates the conflict of interests between the parties in the situation of a binding outside option, since the supply price no longer affects their reneging temptations [check inequalities (20) and (18) above]. A binding outside option is the case in which incentives of both parties are worst aligned: D would like U to take actions that maximize the (expected) value of Q, whereas the latter tries to maximize the (expected) value of P, in order to get a higher price at the bargaining stage.

To sum up, under the conditions of Lemmas 1 and 2 we can state the following proposition without further proof.

Proposition 2 *Vertical integration is the efficient response to widely varying supply prices —i.e., for large ΔP— **when the degree of asset specificity is low**.*

---

[35] This is consistent with the fact that BGM's framework allows for greater values of ΔP. There is however an upper bound (although not explicited) also in BGM since, given their assumptions, ΔP cannot be larger than $Q_L - P_L$.

[36] The upper bound on ΔP guarantees that assumption A^h is not violated.

Our next results focus on the variability of the value of the good to the downstream firm, Q. Under the alternative bargaining environment, a large variation in the possible values of Q favors non-integration over integration in the static model. Formally,

Lemma 3 *For given values of* $q_1, p_1, q_2, p_2, \Delta P$, *there exists* ΔQ_k *(k = h, l) such that if* $\Delta Q > \Delta Q_k$, *then* $S_k^{SO} > S^{SE}$.

Although not considered in BGM, it can be shown that the result holds also in their setting, as we show in the Appendix. Think of the downstream party as commanding an R&D project from the upstream party, where the ultimate outcome (the value of the project's results) is highly uncertain (as typical in R&D). What the theory is telling us is that the firm would be better off having an independent external contractor than having its own R&D department when relational contracts are not feasible. The result that vertical integration is an inefficient response to highly uncertain project outcomes in a static setting, is driven by the fact that the lack of a relational contract precludes the use of bonuses to provide incentives; asset ownership is then the only remaining means. Notice also that for ΔQ high enough, non-integration will be optimal irrespective of the level of specificity. As shown in the Appendix, however, the condition for the optimality of outsourcing is easier to fulfill under high asset specificity.

The picture can change dramatically when we allow for dynamic considerations. In a situation of high asset specificity, *and* if the optimal contract calls for incentives based on Q that are not too strong, *it is more efficient for the downstream party to own the asset* when relational contracts are feasible. To see why, notice first that equations (18) and (19) show that the feasibility constraint on relational-employment contracts does not depend on ΔQ, and suggest that too large a variation in the value of the good to D would render relational outsourcing infeasible, as the following lemma confirms.

Lemma 4 *For given* $q_1, p_1, q_2, p_2, \Delta P$, *if* A^h *holds, then there exists* ΔQ_h^* *such that for all* $\Delta Q > \Delta Q_h^*$, *relational outsourcing is impossible —i.e., condition (19) fails.*

The same holds for the case of inside options, as shown in the Appendix. If, in addition, optimal incentives based on Q are not too strong (in the sense that Δb is not larger than

a given threshold $\Delta b'$), so that some relational contracts remain feasible, the downstream party owns the asset in the efficient governance structure. We state this as Lemma 5.

Lemma 5 *For given $q_1, p_1, q_2, p_2, \Delta P$, assume A^h holds and that $\Delta b \leq \Delta b'$. Then, $\exists \, \Delta \widetilde{Q}_h$ such that $\forall \, \Delta Q > \Delta \widetilde{Q}_h$, D-ownership is more efficient than U-ownership.*

This is true also within BGM's environment, as shown in the Appendix. We summarize the result in the following proposition.

Proposition 3 *Vertical integration is an efficient response to highly uncertain project outcomes —i.e., for large ΔQ— when the level of asset specificity is high and the optimal contract calls for incentives based only on project outcomes that are not too strong.*

Given Lemma 3, Proposition 3 implicitly assumes that the interest rate r is not too high. Within our previous example of R&D, it would be optimal under the conditions of the proposition for the firm to have its own internal R&D lab.[37] Notice, however, that the conditions for the result are quite demanding, and thus it is likely that in many situations the result will not hold. In fact, we have the following corollary:

Corollary 2 *Strong Q-based incentives and high interest rates make the optimality of outsourcing more likely when project outcomes are highly uncertain.*

The proof is straightforward, and will thus be skipped here. Our following result concerns the power of incentives across governance structures, and confirms, under the alternative bargaining environment, a result already presented in BGM:

Proposition 4 *(Baker, Gibbons, and Murphy, 2002, Result 2, p. 65) High-powered incentives create bigger reneging temptations under integration than under non-integration, and performance payments will thus be smaller in firms than in (otherwise equivalent) markets.*

---

[37]Only few econometric studies have explored the factors determining a firm's choice between internal and external R&D. This paper suggests that the level of asset specificity is an important determinant that should be included in these studies. On the other hand, it also warns that this may not be enough: according to Proposition 3, incentives provided must also be taken into account.

Since under integration the upstream party cannot avoid total expropriation, whereas under separation she can obtain something through bargaining, the reneging temptation of the downstream party is lower in the latter case: only the amount of the promised bonus exceeding the bargained price of the good can be saved. Larger bonuses can be credibly promised under non-integration. This is consistent with Williamson's (1985) claim that incentives are higher-powered in markets than in firms. It is also consistent with Corollary 2, since it implies that when strong incentives are desirable,[38] relational employment is an inefficient governance mechanism compared to relational outsourcing (U-ownership); i.e., the total reneging temptation is smaller under the latter.[39]

Finally, we have the following proposition.

Proposition 5 *Under bargaining with outside options, and for given r, q_1, q_2, p_1, p_2, the first best is easier (harder) to achieve with a relational-outsourcing contract than with relational employment when the degree of asset specificity is high (low).*

This is best understood if we recall that the goals of both parties are best aligned in the former case, while they are most conflictive in the latter.

6   Concluding remarks

The insights of the property rights approach have proved very useful for improving our understanding of many economic institutions and arrangements, and for giving new answers to the long standing question of what determines the boundaries of the firm (Coase, 1937). Models in this tradition (whether static or dynamic) assume asset specificity from the outset but do not analyze the consequences of different levels of specificity for the integration decision.

This paper provides a simple and straightforward way of incorporating these different levels of asset specificity in relational contracting, and shows that they matter even in a static model. This simple idea has been pervasive in transaction cost economics (although

---

[38] In the sense that $\Delta b > \frac{1}{2}\Delta Q$ when asset specificity is high, and $\Delta \beta > \Delta P$ when it is low.

[39] Just compare equations (18), (19), and (20) above.

for very different reasons), but has been neglected in the property rights approach to the theory of the firm. As we have seen, the role of the level of specificity emerges naturally once one drops the standard Nash solution widely used in the latter approach.

By taking Baker, Gibbons, and Murphy's (2002) model of relational contracts both between and within firms, and considering an alternative situation in which to take up an outside option the upstream party must quit bargaining with the other party, we have been able to extend BGM's main insight that "asset ownership affects the parties' temptations to renege on a relational contract"[40] to an equally plausible and common bargaining setup. Therefore, we concluded that relational contracts between firms and within firms were different, and that an important consideration in deciding whether to integrate or not was which governance structure facilitated "the superior relational contract".

We have also seen that changing the bargaining protocol makes the predictions of the model regarding the boundaries of the firm contingent on the level of asset specificity, which allowed us to derive some results that could not be obtained from BGM's original framework. Most importantly we have shown that the integration choice is affected in a non-trivial way by realized asset specificity.

Traditional transaction cost economics has emphasized that the level of specificity matters for the integration decision, but its basic prediction that higher specificity makes integration more likely puts the theory in a difficult position to explain the pattern of new organizational forms that we are seeing, which are "characterized by high degrees of uncertainty, frequency and asset specificity, yet they do not lead to integration" (Holmstrom and Roberts, 1998). As we have shown, these new hybrid organizations can be easily accomodated in a model with the features discussed here.

Appendix

---

[40] Asset ownership is not the only means to affect reneging temptations. Multimarket contact (Bernheim and Whinston, 1990) and social relations (Spagnolo, 1999) may be relevant factors also, just to mention a couple.

A.1 Proof of Corollary 1

This proof parallels that in BGM. Recall expressions (4) and (5) for the bargained price of the good, ρ^h and ρ^l. Let $\rho^{BGM} = \frac{1}{2}(Q_i + P_j)$ denote the bargained price in BGM. The relational contract that would produce the same payoffs than spot outsourcing is given by $(s = 0, \{b_{ij} = \rho^m\})$ for $m = h, l, BGM$. It will induce the same actions[41] and produce the same surplus as spot outsourcing, but it cannot satisfy the feasibility constraints. To see this, notice that the maximum total temptation under relational employment in each bargaining scenario is given by

$\max b_{ij} - \min b_{ij} = \frac{1}{2}(Q_H + P_H) - \frac{1}{2}(Q_L + P_L) = \frac{1}{2}(\Delta Q + \Delta P) > 0$ under inside options;

$\max b_{ij} - \min b_{ij} = \frac{1}{2}Q_H - \frac{1}{2}Q_L = \frac{1}{2}\Delta Q > 0$ under nonbinding outside options; and

$\max b_{ij} - \min b_{ij} = P_H - P_L = \Delta P > 0$ under a binding outside option.

However, it is clear that the right-hand side of the corresponding feasibility constraint, $\frac{1}{r}\left[S^{RE} - \max\left(S_m^{SO}, S^{SE}\right)\right]$, cannot be greater than zero when $S^{RE} = S_m^{SO}$.

A.2 Proof of inequalities (19) and (20)

This proof parallels that in Appendix 1 in BGM. Let $Z = b_L + \beta_L - \frac{1}{2}Q_L$ and $W = b_L + \beta_L - P_L$. Under A^h, the left hand side of the dynamic enforcement constraint (15), i.e., the reneging temptation, is $\max\left(b_{ij} - \frac{Q_i}{2}\right) - \min\left(b_{ij} - \frac{Q_i}{2}\right)$. For every pair of realizations of Q and P, we have

(HH) $b_{HH} - \frac{1}{2}Q_H = b_H + \beta_H - \frac{1}{2}Q_H = \Delta b - \frac{1}{2}\Delta Q + \Delta\beta + Z$

(HL) $b_{HL} - \frac{1}{2}Q_H = b_H + \beta_L - \frac{1}{2}Q_H = \Delta b - \frac{1}{2}\Delta Q + Z$

(LH) $b_{LH} - \frac{1}{2}Q_L = b_L + \beta_H - \frac{1}{2}Q_L = \Delta\beta + Z$

(LL) $b_{LL} - \frac{1}{2}Q_L = b_L + \beta_L - \frac{1}{2}Q_L = Z$

Let $\max(\bullet)$ and $\min(\bullet)$ denote the maximum and minimum, respectively, of the expressions above. There are four cases to consider:

---

[41] Given our assumptions, there is a one-to-one correspondence between action vectors and bonuses; see BGM.

1. $\Delta b - \frac{1}{2}\Delta Q > 0$, $\Delta\beta > 0$. Then, $\max(\bullet) = $ (HH) and $\min(\bullet) = $ (LL), and the reneging temptation is $\Delta b - \frac{1}{2}\Delta Q + \Delta\beta$.

2. $\Delta b - \frac{1}{2}\Delta Q > 0$, $\Delta\beta < 0$. Then, $\max(\bullet) = $ (HL) and $\min(\bullet) = $ (LH), and the reneging temptation is $\Delta b - \frac{1}{2}\Delta Q - \Delta\beta$.

3. $\Delta b - \frac{1}{2}\Delta Q < 0$, $\Delta\beta < 0$. Then, $\max(\bullet) = $ (LL) and $\min(\bullet) = $ (HH), and the reneging temptation is $-\left(\Delta b - \frac{1}{2}\Delta Q\right) - \Delta\beta$.

4. $\Delta b - \frac{1}{2}\Delta Q < 0$, $\Delta\beta > 0$. Then, $\max(\bullet) = $ (LH) and $\min(\bullet) = $ (HL), and the reneging temptation is $-\left(\Delta b - \frac{1}{2}\Delta Q\right) + \Delta\beta$.

These four cases can be subsumed in a single expression for the reneging temptation, $\left|\Delta b - \frac{1}{2}\Delta Q\right| + |\Delta\beta|$, which yields (19). When A^l holds, the left hand side of (15) is $\max(b_{ij} - P_j) - \min(b_{ij} - P_j)$. For every pair of realizations of Q and P, we now have

(HH) $b_{HH} - P_H = b_H + \beta_H - P_H = \Delta b + \Delta\beta - \Delta P + W$

(HL) $b_{HL} - P_L = b_H + \beta_L - P_L = \Delta b + W$

(LH) $b_{LH} - P_H = b_L + \beta_H - P_H = \Delta\beta - \Delta P + W$

(LL) $b_{LL} - P_L = b_L + \beta_L - P_L = W$

We can now proceed as in the high specificity case by replacing $\Delta b - \frac{1}{2}\Delta Q$ by Δb and $\Delta\beta$ by $\Delta\beta - \Delta P$, to obtain a single expression for the reneging tempation, $|\Delta b| + |\Delta\beta - \Delta P|$, which yields (20) and completes the proof.

A.3   Proof of Lemma 1

The optimal actions taken by the upstream party under spot outsourcing and the associated surpluses are:

$$a_1^{SO} = \begin{cases} \frac{1}{2}q_1\Delta Q & \text{under } A^h \\ p_1\Delta P & \text{under } A^l \end{cases}$$

$$a_2^{SO} = \begin{cases} \frac{1}{2}q_2\Delta Q & \text{under } A^h \\ p_2\Delta P & \text{under } A^l \end{cases}$$

The joint surplus is given by expressions (6) and (7), and can be written as

$$S_h^{SO} = Q_L + q\left(\mathbf{a}_h^{SO}\right)\Delta Q - c(\mathbf{a}_h^{SO}) = Q_L + \frac{3}{8}\left(q_1^2 + q_2^2\right)\Delta Q^2 \tag{A1}$$

and

$$S_l^{SO} = Q_L + q\left(\mathbf{a}_l^{SO}\right)\Delta Q - c(\mathbf{a}_l^{SO})$$
$$= Q_L + (q_1 p_1 + q_2 p_2)\Delta Q \Delta P - \frac{1}{2}\left(p_1^2 + p_2^2\right)\Delta P^2 \tag{A2}$$

As in Section 3, $a_1^{SE} = a_2^{SE} = 0$ and $S^{SE} = Q_L$. If A^l holds and $\Delta P \in (0, P_L)$, by direct comparison of S^{SE} and S_l^{SO} in equation (A2), $S^{SE} > S_l^{SO}$ if and only if $\Delta P > \Delta P_l = 2\frac{q_1 p_1 + q_2 p_2}{p_1^2 + p_2^2}\Delta Q$, which proves the first part of the lemma. The second part follows trivially from inspection of equations (A1) and (1). Finally, the threshold ΔP_{BGM} defined in Section 5 for the case of inside options is the positive root of $S_{BGM}^{SO} - S^{SE} = -\frac{1}{8}\left(p_1^2 + p_2^2\right)\Delta P^2 + \frac{3}{8}\left(q_1^2 + q_2^2\right)\Delta Q^2 + \frac{1}{4}\left(q_1 p_1 + q_2 p_2\right)\Delta Q \Delta P = 0$, where S_{BGM}^{SO} is the joint surplus from spot outsourcing under the assumptions in BGM. Direct computation shows $\Delta P_l < \Delta P_{BGM}$ as claimed.

A.4   Proof of Lemma 2

We will proceed in several steps to prove the lemma.

Step 1. From Lemma 1 above we know that there exists ΔP_l such that if $\Delta P > \Delta P_l$ then $S^{SE} > S_l^{SO}$.

Step 2. From Lemma 2 in BGM (p. 76) we know that too strong an incentive based on the alternative-use value makes relational outsourcing inferior to spot employment, i.e., given $q_1, p_1, q_2, p_2, \Delta Q$ there exists $\Delta \beta'$ such that, for any Δb, if $\Delta \beta > \Delta \beta'$ then $S^{RO} - S^{SE} < 0$. This result does not depend on the assumed bargaining scenario (see BGM for a proof).

Step 3. Choose $\Delta P_l'$ such that $\Delta P_l' > \Delta \beta' + \frac{1}{r}\left[S^{FB} - S^{SE}\right]$, where $S^{FB} \equiv \max E\left[Q\right] - c\left(\mathbf{a}\right)$ stands for first-best surplus. If $\Delta \beta > \Delta \beta'$ we have $S^{RO} - S^{SE} < 0$ from step 2. Then $S^{RO} - \max\left(S_l^{SO}, S^{SE}\right) < 0$, and the necessary and sufficient condition for the relational-outsourcing contract to be self-enforcing, i.e., equation (17), fails. If $\Delta \beta \leq \Delta \beta'$, on the other hand, we have that $\Delta P_l' > \Delta \beta$, so the second term on the left-hand side of the feasibility constraint (17) is at least $\Delta P_l' - \Delta \beta \geq \Delta P_l' - \Delta \beta' > \frac{1}{r}\left[S^{FB} - S^{SE}\right] \geq \frac{1}{r}\left[S^{RO} - S^{SE}\right] \geq \frac{1}{r}\left[S^{RO} - \max\left(S_l^{SO}, S^{SE}\right)\right]$, so once again the necessary and sufficient condition fails. Therefore, we have that too large a variation in the alternative-use value makes relational out-

sourcing infeasible.

Step 4. To complete the proof, set $\Delta P_l^* = \max\{\Delta P_l, \Delta P_l'\}$; because $\Delta P > \Delta P_l$, spot outsourcing is not efficient, and because $\Delta P > \Delta P_l'$, relational outsourcing is not feasible.

A.5   Proof of Lemma 3

The result holds trivially for a situation of high asset specificity: any $\Delta Q > 0$ will do -see equation (A1). Next consider the case of outside options under A^l, i.e., a situation of low asset specificity. The difference $S_l^{SO} - S^{SE}$ is increasing and linear in ΔQ. Hence it will be positive for any $\Delta Q > \Delta Q_l = \frac{\left(p_1^2 + p_2^2\right)\Delta P}{2(q_1 p_1 + q_2 p_2)}$ (as long as $\Delta Q < 2P_L - Q_L$ to satisfy A^l). Finally, we can show that a similar result holds in the case of bargaining with inside options. Define ΔQ_{BGM} as the threshold for this case. From BGM we know that, in their setting, the joint surplus under spot outsourcing is $S_{BGM}^{SO} = Q_L + \frac{3}{8}\left(q_1^2 + q_2^2\right)\Delta Q^2 + \frac{1}{4}\left(q_1 p_1 + q_2 p_2\right)\Delta Q \Delta P - \frac{1}{8}\left(p_1^2 + p_2^2\right)\Delta P^2$. For the case of inside options the threshold ΔQ_{BGM} is the positive root of $S_{BGM}^{SO} - S^{SE} = \frac{3}{8}\left(q_1^2 + q_2^2\right)\Delta Q^2 + \frac{1}{4}\left(q_1 p_1 + q_2 p_2\right)\Delta Q \Delta P - \frac{1}{8}\left(p_1^2 + p_2^2\right)\Delta P^2 = 0$. Since S_{BGM}^{SO} is strictly convex in ΔQ and S^{SE} is a constant, for $\Delta Q > \Delta Q_{BGM}$ we have the result in the lemma.

A.6   Proof of Lemma 4

We will proceed in several steps to prove the lemma.

Step 1. Too strong an incentive based on the value of the good to the downstream party makes relational contracts inferior to spot outsourcing, i.e., given $q_1, p_1, q_2, p_2, \Delta P$, there exists $\Delta b'$ such that, for any $\Delta \beta$, if $\Delta b > \Delta b'$ then $S^R - S^{SO} < 0$. For the case of inside options, notice that the difference between S^R and $S_{BGM}^{SO} = Q_L + \frac{3}{8}\left(q_1^2 + q_2^2\right)\Delta Q^2 + \frac{1}{4}\left(q_1 p_1 + q_2 p_2\right)\Delta Q \Delta P - \frac{1}{8}\left(p_1^2 + p_2^2\right)\Delta P^2$, seen as a function of Δb, is a concave function (S_{BGM}^{SO} stands for the joint surplus under spot outsourcing in BGM's setting, and S^R for the surplus under relational contracting). Hence, it will be negative for sufficiently large Δb, i.e. for $\Delta b > \Delta b'$, where $\Delta b'$ is the largest root of $S^R - S_{BGM}^{SO} = \left(q_1^2 + q_2^2\right)\left[\left(\Delta Q - \frac{1}{2}\Delta b\right)\Delta b - \frac{3}{8}\Delta Q^2\right] + \left(q_1 p_1 + q_2 p_2\right) \times \left[\left(\Delta Q - \Delta b\right)\Delta \beta - \frac{1}{4}\Delta Q \Delta P\right] - \left(p_1^2 + p_2^2\right)\left(\frac{1}{2}\Delta \beta^2 - \frac{1}{8}\Delta P^2\right) = 0$. For the case

of outside options and high asset specificity (i.e., under A^h), we have the same reasoning for $\Delta b'$ equal to the largest root of $S^R - S_h^{SO} = (q_1^2 + q_2^2)\left[\left(\Delta Q - \frac{1}{2}\Delta b\right)\Delta b - \frac{3}{8}\Delta Q^2\right] + (q_1 p_1 + q_2 p_2)(\Delta Q - \Delta b)\Delta\beta - \frac{1}{2}(p_1^2 + p_2^2)\Delta\beta^2 = 0$.

Step 2. Choose ΔQ_n^* $(n = BGM, h)$ such that $\frac{1}{2}\Delta Q_n^* > \Delta b' + \frac{1}{r}\left[S^{FB} - S_n^{SO}\right]$, where $S^{FB} \equiv \max E[Q] - c(\mathbf{a})$ stands for first-best surplus. If $\Delta b > \Delta b'$ we have from step 2 that $S^R - S_n^{SO} < 0$. Hence $S^R - \max\left(S_n^{SO}, S^{SE}\right) < 0$, and the necessary and sufficient condition for any relational contract to be self-enforcing fails (since the left-hand side is always positive, and we have shown that the right-hand side is negative). Hence, no relational contract is feasible in this case, and when incentives based on Q are strong, the efficient governance structure is spot outsourcing for ΔQ large enough (as in Lemma 3). If incentives are not too strong, i.e. if $\Delta b \leq \Delta b'$, on the other hand, we have that $\frac{1}{2}\Delta Q_n^* > \Delta b$, so the first term on the left-hand side of the feasibility constraint (19) is at least $\frac{1}{2}\Delta Q_n^* - \Delta b \geq \frac{1}{2}\Delta Q_n^* - \Delta b' > \frac{1}{r}\left[S^{FB} - S_n^{SO}\right] \geq \frac{1}{r}\left[S^{RO} - S_n^{SO}\right] \geq \frac{1}{r}\left[S^{RO} - \max\left(S_n^{SO}, S^{SE}\right)\right]$, so once again the necessary and sufficient condition fails. Therefore, we have that too large a variation in the value to the downstream party makes relational outsourcing infeasible.

A.7   Proof of Lemma 5

From step 2 in the proof of Lemma 4, if the optimal contract calls for weak incentives on Q, set $\Delta\widetilde{Q}_h = \Delta Q_n^*$ $(n = BGM, h)$ to obtain the result. Because incentives are not too strong, relational employment is still feasible (although relational outsourcing is not) and more efficient than spot outsourcing. By Lemma 3, spot outsourcing yields higher surplus than spot employment.

A.8   Proof of Proposition 4

This proof will follow that of Result 2 in BGM (p. 76). Assume $a_1^{RE} < a_1^{FB}$ and $a_2^{RE} < a_2^{FB}$, so that relational employment yields actions below the first-best level. It must be the case then that the reneging constraint (18) is binding. Consider implementing the same incentives, Δb and $\Delta\beta$, through relational outsourcing instead. The same actions would obtain, but the

reneging constraints would differ. In the case of high asset specificity, if $\Delta b \geq \frac{1}{2}\Delta Q$ then the left-hand side of the relational-outsourcing reneging constraint (19) is smaller than that corresponding to relational employment, expression (18). Since the right-hand side is the same, the constraint is slack, and actions can be increased. On the other hand, if $\Delta b < \frac{1}{2}\Delta Q$, no relational-outsourcing contract may be feasible. But if feasible, then a small increase in Δb increases actions and reduces the left-hand side of the feasibility constraint.

Analogously, in the case of low asset specificity, if $\Delta\beta \geq \Delta P$ then again the-left hand side of the relational-outsourcing reneging constraint (20) is smaller than that of relational employment, and actions can be increased. But if $\Delta\beta < \Delta P$, no relational-outsourcing contract is feasible or, if one is feasible, a small increase in $\Delta\beta$ increases actions and reduces the left-hand side of the reneging constraint.

Hence, it would not be efficient for a relational-outsourcing contract to provide incentives as low-powered as those of a relational-employment contract.

A.9 Proof of Proposition 5

The first best actions are those which maximize the joint surplus $E[Q] - c(\mathbf{a})$. Under the assumed functional forms, these are the solution to

$$\max_{a_1, a_2} Q_L + (q_1 a_1 + q_2 a_2)\Delta Q - \frac{1}{2}a_1^2 - \frac{1}{2}a_2^2$$

Therefore,

$$
\begin{aligned}
a_1^{FB} &= q_1 \Delta Q \\
a_2^{FB} &= q_2 \Delta Q \\
S^{FB} &= Q_L + \frac{1}{2}\left(q_1^2 + q_2^2\right)\Delta Q^2.
\end{aligned}
$$

Under a relational contract, the upstream party chooses actions to maximize

$$(s + b_L + \beta_L) + (q_1 a_1 + q_2 a_2)\Delta b + (p_1 a_1 + p_2 a_2)\Delta\beta - \frac{1}{2}a_1^2 - \frac{1}{2}a_2^2.$$

Her optimal choices are given by

$$
\begin{aligned}
a_1^R &= q_1 \Delta b + p_1 \Delta\beta, \\
a_2^R &= q_2 \Delta b + p_2 \Delta\beta.
\end{aligned}
$$

Clearly, we can only have the first best outcome under a relational contract if $\Delta b = \Delta Q > 0$ and $\Delta \beta = 0$, as long as the relevant feasibility constraint is satisfied by this particular relational compensation contract, namely

- $\Delta Q \leq \frac{1}{r} \left[S^{FB} - \max \left(S_k^{SO}, S^{SE} \right) \right]$, $k = h, l$, under relational employment;

- $\frac{1}{2} \Delta Q \leq \frac{1}{r} \left[S^{FB} - \max \left(S_h^{SO}, S^{SE} \right) \right]$, under relational outsourcing and A^h; and

- $\Delta Q + \Delta P \leq \frac{1}{r} \left[S^{FB} - \max \left(S_l^{SO}, S^{SE} \right) \right]$, under relational outsourcing and A^l.

The proof follows from direct inspection of these inequalities above.

References

Abreu, Dilip (1986). "Extremal Equilibria of Oligopolistic Supergames", *Journal of Economic Theory* 39(1): 191-225.

_____ (1988). "On the Theory of Infinitely Repeated Games with Discounting", *Econometrica* 56: 383-396.

Aghion, Philippe, and Jean Tirole (1994). "The Management of Innovation", *The Quarterly Journal of Economics* 109(4): 1185-1209.

Baker, George, Robert Gibbons, and Kevin J. Murphy (2001). "Bringing the Market Inside the Firm?", *The American Economic Review* 91(2): 212-218.

_____, _____, and _____ (2002). "Relational Contracts and the Theory of the Firm", *The Quarterly Journal of Economics* 117(1): 39-84.

Bernheim, B. Douglas, and Michael D. Whinston (1990). "Multimarket Contact and Collusive Behavior", *Rand Journal of Economics* 21(1): 1-26.

Binmore, Ken (1980). "Nash Bargaining Theory I-III", in Ken Binmore and Partha Dasgupta, eds. (1987), *The Economics of Bargaining*, Basil Blackwell, Oxford, UK.

_____ (1985). "Bargaining and Coalitions", in Alvin Roth, ed. (1985), *Game-Theoretic Models of Bargaining*, Cambridge University Press, Cambridge, UK.

_____, Ariel Rubinstein, and Asher Wolinsky (1986). "The Nash Bargaining Solution in Economic Modelling", *Rand Journal of Economics* 17(2): 176-188.

_____, Avner Shaked, and John Sutton (1989). "An Outside Option Experiment", *The Quarterly Journal of Economics* 104(4): 753-770.

Blonski, Matthias, and Giancarlo Spagnolo (2004). "Relational Contracts and Property Rights", mimeo, University of Mannheim and Johann Wolfgang Goethe University.

Bragelien, Iver (2002). "Asset Ownership and Implicit Contracts", unpublished manuscript, Norwegian School of Business.

Chiu, Y. Stephen (1998). "Noncooperative Bargaining, Hostages, and Optimal Asset Ownership", *The American Economic Review* 88(4): 882-901.

Coase, Ronald (1937). "The Nature of the Firm", *Economica* 4: 386-405.

de Meza, David, and John Lockwood (1998). "Does Asset Ownership Always Motivate Managers? Outside Options and the Property Rights Theory of the Firm", *The Quarterly Journal of Economics* 113(2): 361-386.

Friedman, James (1971). "A Noncooperative Equilibrium for Supergames", *Review of Economic Studies* 38: 1-12.

Fudenberg, Drew, and Jean Tirole (1991). *Game Theory*, The MIT Press, Cambridge, MA.

Garvey, Gerald (1995). "Why Reputation Favors Joint Ventures over Vertical and Horizontal Integration: A Simple Model", *Journal of Economic Behavior and Organization* 28: 387-397.

Grossman, Sanford, and Oliver Hart (1986). "The Costs and Benefits of Ownership: A Theory of Vertical and Lateral Integration", *Journal of Political Economy* 94(4): 691-719.

Halonen, Maija (2002). "Reputation and the Allocation of Ownership", *The Economic Journal* 112: 539-558.

Hansmann, Henry (1996). *The Ownership of Enterprise*, Belknap Press of Harvard University Press, Cambridge, MA.

Hart, Oliver, and John Moore (1990). "Property Rights and the Nature of the Firm", *Journal of Political Economy* 98: 1119-1158.

Hart, Oliver (1995). *Firms, Contracts, and Financial Structure*, Clarendon Press, Oxford.

Holmstrom, Bengt (1999). "The Firm as a Subeconomy", *Journal of Law, Economics,*

and Organization 15(1): 74-102.

_____, and Paul Milgrom (1994). "The Firm as an Incentive System", *The American Economic Review* 84(4): 972-991.

_____, and John Roberts (1998). "The Boundaries of the Firm Revisited", *Journal of Economic Perspectives* 12(4): 73-94.

Klein, Benjamin, Robert Crawford, and Armen Alchian (1978). "Vertical Integration, Appropriable Rents, and the Competitive Contracting Process", *Journal of Law and Economics* 21: 297-326.

Levin, Jonathan (2003), "Relational Incentive Contracts", *The American Economic Review* 93(3): 835-857.

Matouschek, Niko (2004). "Ex Post Inefficiencies in a Property Rights Theory of the Firm", *Journal of Law, Economics, and Organization* 20(1): 125-147.

Nash, John (1953). "Two-Person Cooperative Games", *Econometrica* 21: 128-140.

Rajan, Raghuram, and Luigi Zingales (1998). "Power in a Theory of the Firm", *The Quarterly Journal of Economics* 113(2): 387-432.

Rubinstein, Ariel (1982). "Perfect Equilibrium in a Bargaining Model", *Econometrica* 50: 97-109.

Simon, Herbert (1951). "A Formal Theory of the Employment Relationship", *Econometrica* 19: 293-305.

Spagnolo, Giancarlo (1999). "Social Relations and Cooperation in Organizations", *Journal of Economic Behavior & Organization* 38: 1-25.

Sutton, John (1986). "Non-Cooperative Bargaining Theory: An Introduction", *Review of Economic Studies* 53: 709-724.

Tirole, Jean (1988). *The Theory of Industrial Organization*, The MIT Press, Cambridge, MA.

Whinston, Michael D. (2003). "On the Transaction Cost Determinants of Vertical Integration", *Journal of Law, Economics, and Organization* 19(1): 1-23.

Williamson, Oliver (1975). *Markets and Hierarchies: Analysis and Antitrust Implications*, Free Press, New York, NY.

Williamson, Oliver (1985). *The Economic Institutions of Capitalism*, Free Press, New

York, NY.