Strategic Alliances: Bridges Between "Islands of Conscious Power"☆

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Abstract

Strategic alliances range from unstructured collaborations, through consortia and joint ventures that superimpose new governance structures on existing firms, to transactions that restructure firm boundaries and asset ownership. In this paper, we draw on detailed discussions with practitioners to describe and analyze a rich collection of feasible governance structures. Our model focuses on two issues emphasized by practitioners: spillover effects (as opposed to hold-ups motivated by specific investments) and contracting problems ex post (as opposed to only ex ante). By considering the allocation of assets, decision rights, and payoffs, we generate a large number of potential governance structures, including strategic divestitures, total divestitures, licensing agreements, and royalty agreements. For the broad range of parameter values and payoff functions we consider, we show that each of these possible strategic alliances could be optimal. We expect that, given institutional knowledge about a particular setting, our broad theoretical framework can be specialized to deliver testable predictions for that setting (as has occurred in some analogous work on vertical integration, for example).

JEL classification: D2; L14; L22

Key Words: Strategic alliances; Theory of the Firm

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1. Introduction

Strategic alliances exist in a bewildering variety of forms, ranging from unstructured collaborations, through consortia and joint ventures that superimpose new governance structures on existing firms, to transactions that restructure firm boundaries and asset ownership. Even brief inspection of the existing governance structures in industries such as pharmaceuticals, biotechnology, medical devices, airlines, and telecommunications shows that firms have invented far more ways to work together than organizational economics has so far expressed (not to mention evaluated).

To investigate this plethora of observed attempts to coordinate activities across firms, we conducted a series of detailed interviews with practitioners who design, implement, consult to, and negotiate terms for these governance structures. Several important ideas arose during these discussions—some familiar from the organizational-economics literature, but others more novel. Two ideas emerged as especially important factors determining the form and performance of strategic alliances: spillovers (or externalities) from the joint project onto the parents; and the need for governance structures to induce efficient behavior ex post, since contracts often cannot. Standard ideas—such as inefficient hold-ups motivated by specific investments and inadequate investments motivated by bargaining over returns—played markedly smaller roles in what we heard from practitioners.

In this paper, we develop a model that incorporates the spillovers and ex post contracting problems emphasized to us by practitioners. We then consider the allocation of assets, decision rights, and payoffs in order to define and analyze a collection of governance structures, such as unstructured collaboration (where parties attempt to cooperate without any assets or decision rights changing hands), acquisitions (where one parent acquires and controls the joint project), total divestitures (where an autonomous entity is created to pursue the joint project without parental ownership or direct control), strategic divestitures (where an autonomous entity is create to own part of the project and to pursue it with the other parent), licenses (where some decision rights are extricated from their native assets and reallocated to new parties), and royalty contracts (where some payoffs are reallocated to new parties).

We see this paper as a contribution to the literature that seeks to describe and explain what Coase (1992) called the "institutional structure of production." For at least three-quarters of a century, the dominant view of this institutional structure has seen firms as "islands of conscious power … like lumps of butter coagulating in a pail of buttermilk" (Robertson, 1930: 85)—that is, firm boundaries are sharp, and within these boundaries the exchange transactions of markets are replaced by the authority transactions of firms. For example, Coase (1937: 388) quotes Robertson approvingly and then elaborates that, "Within a firm … market transactions are [replaced by] the entrepreneur–coordinator, who directs production." Simon's (1951) model of the employment relationship continues this tradition, as do Williamson's (1975, 1985) work on fiat within firms, Masten's (1988) "Legal Basis for the Firm," the property-rights model of Grossman-Hart-Moore, and the incentive-system model of Holmstrom-Milgrom-Tirole.[1]

While this "islands" view has been productive both theoretically and empirically, various dissenting and complementary views have occasionally surfaced. Even in 1937, Coase cautioned that "it is not possible to draw a hard and fast line which determines whether there is a firm or not "(p.392), and Alchian and Demsetz (1972) famously asserted that employers have no more authority over their employees than customers have over their

[1] See Grossman and Hart (1986), Hart and Moore (1990), and Hart (1995) on the property-rights model and Holmstrom and Milgrom (1991, 1994), Holmstrom and Tirole (1991), and Holmstrom (1999) on the incentive-system model.

grocers. In addition to theoretical discussions that have dissented from the focus on authority as the key to defining *what a firm is*, a complementary empirical strand of the literature has provided intriguing evidence about *what exists besides firms*. For example, in early papers, Richardson (1972) described "industrial activity that our simple story, based as it is on a dichotomy between firm and market, leaves out of account … the dense network of co-operation and affiliation by which firms are inter-related" and, in a similar spirit, Blois (1972) discussed "vertical quasi-integration." Much subsequent work (not always in economics) continues this tradition of empirically grounded criticism of the simple dichotomy between markets and firms: for example, see Cheung's (1983) description of contractual structures between firm and market, Eccles's (1981) work on quasi-firms, and Powell's (1990) discussion of networks ("Neither Market Nor Hierarchy").

The many governance structures between firms and markets are sometimes summarized as "hybrid" governance structures; see Williamson (1985; 1996) and Menard (2004; 2009). One particular strand of this hybrids literature is especially relevant to our purposes: the (largely empirical) work in which firms have fixed boundaries but pass decision rights across these boundaries by contract. In addition to Cheung (1983), early work along roughly these lines includes Goldberg and Erickson (1987), Joskow (1985), Masten and Crocker (1985), and Palay (1984). After something of a hiatus, this literature has recently been reinvigorated: Arruñada, Garicano, and Vazquez (2001), Bajari and Tadelis (2001), Elfenbein and Lerner (2003), Gil and Lafontaine (2007), Kaplan and Stromberg (2003), Klein (2000), Lafontaine and Masten (2002), Lerner and Merges (1998), Robinson and Stuart (2007a,b), and Ryall and Sampson (2007) can be seen as analyzing contractual movements of decision rights across fixed firm boundaries. These contracts are the "bridges" in our title: firms may be islands, and the boundaries of these islands sometimes shift (via changes in asset ownership), but a useful map of the industrial terrain must include the "dense network of [bridges] by which firms are inter-related."

In this paper, we offer additional evidence on the importance of contractual bridges linking firms. More importantly, we develop a flexible theoretical framework that allows us to define and analyze a wide range of governance structures beyond the simple dichotomy between markets and firms. Our theoretical framework includes not only assets, but also contractual allocations of decision rights and payoffs, thus incorporating some hybrid governance structures as well contractual "bridges."

We hope our theoretical framework will help empiricists study a wide range of strategic alliances—from changes in firms' boundaries, through contracts that move decision rights across fixed boundaries, to hybrid governance structures such as joint ventures. By considering the allocation of assets, decision rights, and payoffs, we are able to embed seemingly disparate governance structures within a single theoretical framework, and we are able to analyze, at least in broad terms, the costs and benefits of these different governance structures. We show that, under plausible parameters, any of almost a dozen possible governance structures could be second-best (while none can be first-best). Narrower, testable predictions about the efficient governance structure in any particular setting will require institutional knowledge and detailed data about the setting in question (in the spirit of what Ichniowski and Shaw (2003) call "insider econometrics"). We expect that (a) given such institutional knowledge about a particular setting, our theoretical framework can be specialized to deliver precise predictions for that setting and (b) given such detailed data, these predictions can then be tested (in the spirit of, say, Baker and Hubbard's (2003,2004) theory and evidence on vertical integration in the trucking industry).

The paper is organized as follows. We begin in Section 2 with an analysis of nearly 12,500 biotechnology alliances in the pharmaceutical and biotechnology industries. We document a dense network of contractual bridges among firms in the industry and confirm that a plethora of governance structures is used for a wide range of purposes.

Section 3 introduces our theoretical framework, which includes assets, decision rights and payoffs. We define a "governance structure" as an allocation of decision rights and payoffs to the parties, regardless of whether this allocation is achieved through contracts or asset ownership. We allow for a variety of observed governance structures for coordinating activities between firms, including acquisitions, unstructured collaborations, divestitures, licensing agreements, and royalty contracts. We then show in Section 4 that each of the governances structures can be second-best under some circumstances, but that (in general) none of them is first-best.

In Section 5, we sketch two extensions to our framework. First, our framework restricts attention to governance structures with "unique control" (*i.e.*, any given asset or decision right is owned or controlled by exactly one party). But joint ventures and some other governance structures involve shared rather than unique control. Because our model emphasizes contracting problems ex post, shared control raises theoretical issues that have gone unnoticed in the property-rights approach to joint ownership and are beyond the scope of this paper. Second, we consider how relationships (and self-enforcing relational contracts) can mitigate the *ex post* decision-making problem and achieve better adaptation to the state-of-the-world. See Baker, Gibbons, and Murphy (2008) for a richer analysis of such relational adaptation.

2. Bridges in Biotechnology

In this section, we offer suggestive evidence on the importance of contractual bridges in the pharmaceutical and biotechnology industries. Our evidence comes from data collected by Recombinant Capital (specialists on biotechnology alliances) on nearly 12,500 publicly disclosed contracts between pharmaceutical and biotechnology firms from 1973 to 2001.

Table 1 shows the number of contracts (and the number of partners) for the top 12 pharmaceuticals and top 12 biotechnology firms, where "top" is defined by the number of contracts reported in the Recombinant Capital database. These 24 firms (defined as the surviving parent as of year-end 2001 in the case of mergers and acquisitions) comprised less than 1% of the 4,231 surviving parents (after mergers and acquisitions) in the sample, but were involved in 32% of the 12,451 publicly disclosed contracts. In short, a few firms are doing lots of the alliances, raising the question: with whom?

Table 1 about here

Figure 1 shows the dense network of ties between these top pharmaceuticals and biotechs. On average, each firm among these 24 has at least one alliance with 15 of the other 23 firms. But far from all the alliances involving these 24 firms are with the remaining 23 firms. To the contrary, the 24 firms in Table 1 had contractual arrangements with 1,308 partners outside of the 24, and these 1,332 firms entered 11,303 alliances (91% of the universe identified by Recombinant). Including the partners of these 1,332 firms yields a total of 3,421 firms (81% of the firms) who were involved in 98% of the reported alliances.

Figure 1 about here

This evidence on indirect ties suggest that even the most peripheral firm was rarely more than "two phone calls" away from a "top 24" firm, who in turn was never more than two phone calls away from another peripheral firm. We sketch such an industrial structure in Figure 2; the figure is stylized but gives some of the actual summary statistics in its legend.

Figure 2 about here

The existence of this "dense network of [bridges] by which firms are inter-related" raises another question: what do these bridges do? The Recombinant data shed some light on this question, which we summarize in Table 2. The columns depict the prevalence of various observed governance structures used for coordinating activities across firms, including licensing agreements, investments, mergers, and acquisitions. The rows depict the activities that are being coordinated, including development, research, manufacturing, marketing, collaboration, or supply.

Table 2 about here

Overall, this evidence suggests that a plethora of governance structures are used for a wide range of purposes. Furthermore, the biotechnology industry is far from unique in this regard. For example, the indirect ties between partners in alliances, joint ventures, and the like are again extremely dense in the internet sector and the automotive industry.[2] Based on suggestive evidence of this kind, we turn next to our theoretical framework for describing and analyzing alternative governance structures.

3. Defining Governance Structures

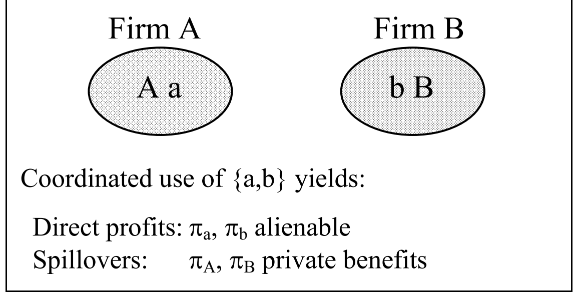
3a: Economic Environment

Suppose there are four assets, {A, a, B, b}, and (initially) two firms, A and B. Firm A owns {A, a} and Firm B {B, b}. Asset A represents the core activity of Firm A, and asset B the core activity of Firm B. Assets {a, b}, on the other hand, are valuable only if they are used together, in coordinated fashion. The decisions about how to use a and b are denoted $d_a \in D_a$ and $d_b \in D_b$ respectively. Coordinated use of the assets {a, b} produces profits π_a and π_b, both positive; any other uses of {a, b} produce profits of zero.[3] We assume, initially, that the profits π_a and π_b accrue to the owners of assets a and b.

2 For an example of networks in the internet sector, see http://www.orgnet.com/netindustry0104.gif.

3 More formally, one could imagine a state variable σ such that coordinated use of {a, b} in state σ means that the decisions $d_a*(\sigma)$ and $d_b*(\sigma)$ were chosen. We suppress the state σ for notational simplicity.

Figure 3
Economic Environment



In addition to producing profits π_a and π_b, coordinated use of {a, b} can also affect the profits from the core activities of Firms A and B. Let π_A and π_B denote the payoffs from these "spillover effects" on A and B. (That is, any profit from the core activity of Firm A that is independent of the use of assets {a, b} is excluded from π_A and ignored hereafter, and likewise for Firm B.) We assume that the payoffs π_A and π_B are private benefits, which are observable but not verifiable. All of this is summarized in Figure 3.

The coordinated use of {a, b} could either complement or compete with the core activities of one or both firms. To capture these possibilities, the spillover payoffs depend on a state variable, s, which also is observable but not verifiable. The spillover payoffs $\pi_A(s)$ and $\pi_B(s)$ have finite support of $\overline{\pi}_A$, $\underline{\pi}_A$, and $\overline{\pi}_B$, $\underline{\pi}_B$ respectively, and are drawn from the joint distribution $F(\pi_A,\pi_B)$.

For assets a and b, we define asset i to consist of the decision right d_i and the payoff π_i. (In a richer treatment, such as Baker, Gibbons, and Murphy (2008), there could be a vector of decision rights associated with an asset, but here we keep the exposition simple by considering a single decision right associated with each asset.) In Section 3c below, we assume that the decision right associated with an asset is inextricably linked to the payoff for that asset, so that decision rights and payoffs can be transferred only as a bundle, by transferring ownership of the asset. In Section 3d, we introduce the possibility that an asset's *decision rights* might be extricable and hence might be transferred separately by contract without transferring ownership of the asset. (Again, in a richer model, with a vector of decision rights associated with an asset, some might be extricable and others inextricable.) However, in Section 3d, we continue to envision the asset's *payoff* as being inextricably tied to the asset. Finally, in Section 3e, we introduce contracts over the assets' realized payoffs, such as royalty contracts, thus enriching our set of feasible governance structures beyond the possible allocations of payoffs through asset ownership.

In all of these subsections (namely, 3c, 3d, and 3e, with their respective focuses on assets, decision rights, and payoff contracts), the timing of the model is as follows. First, the parties choose a "governance structure," defined as an allocation of decision rights and payoffs, achieved through asset ownership and/or contracts. If this allocation differs from the initial setting in which Firm A owns {A, a} and Firm B {B, b}, then ex ante side payments may accompany the move to the new allocation. Second, the state of the world (s) is revealed. Third, the parties in control of d_a and/or d_b make decisions. Fourth, after decisions are made, payoffs accrue to the parties who own assets or hold royalty shares.

Two important assumptions are embedded in this timing. First, we assume that the opportunities presented by the revelation of s are fleeting, in the sense that decisions must be made soon after the state is revealed: there is not enough time to re-contract on either decision rights or payoffs between the time that s is revealed and decisions must be made. Second, we assume that *decisions* (as distinct from decision *rights*) are not contractible either before or after the state of the world is realized. As mentioned in the Introduction, this issue of contracting problems *ex post* was emphasized to us by practitioners.[4] This second assumption rules out the possibility of *ex post* renegotiation of decisions: whoever holds the decision right *ex ante* will make the decision that is in her best interest *ex post*; because decisions are not contractible, no Coasian bargaining can occur to achieve *ex post* efficiency.

To illustrate our ideas, consider the following example of our simple economic environment. Firm B is a biotech company that has patented a formulation for a drug. We will label this patent asset b. The decision for the biotech is whether and how to proceed with

[4] Hart and Holmstrom (2002) and others also build models on this assumption.

testing and marketing the drug. A pharmaceutical company, A, has a division (a) that develops (tests and markets) new drugs. Suppose that there is no other development organization that can do the job as well as a.

The biotech and pharma firms must decide whether to proceed with development, which requires the use of both assets (the patent and the development division). However, there are possible spillover effects from the development of the drug. For the pharma firm, the new drug could prove to be either synergistic or cannibalistic with the firm's existing line of products; for the biotech, developing the new drug could teach the firm how to test and market future drugs or could be an isolated exercise with no learning and perhaps even a high opportunity cost of time. The size of these spillovers will not be clear for either firm until the drug's precise indications have been determined, which will not occur until after development of the drug has begun.

Successful development of the drug requires the active cooperation of both the patent holder and whoever controls the development division. Enforcing this type of cooperation is not contractible: if either party chooses to withhold cooperation, the project will not proceed successfully, and no contract can force an unwilling partner to cooperate. Furthermore, we assume that once the drug's indications have been determined, the ownership of the assets and/or the control of decision rights cannot be renegotiated. So the question posed by our model is: what governance structure should the parties use to control the patent and the development division and to allocate the resulting payoffs?

3b: First-Best Implementation and Mergers

We begin our discussion of feasible governance structures by defining first-best decision making in this model. Under the first-best decision, the project will be implemented whenever the total payoffs are positive, that is whenever $\pi_A(s)+\pi_B(s)+\pi_a+\pi_b>0$. This result could be achieved by merging firms A and B, thereby internalizing the spillover effects.

In this paper, we restrict attention to governance structures that do not involve the transfer of ownership of either asset A or asset B. While we acknowledge that mergers are important empirically and are often used to internalize spillovers between firms, we believe that they are not efficient solutions in many of the situations that we attempt to model in this paper, where the assets a and b (and the profits and spillovers associated with their use) are small compared to assets A and B. We therefore assume that it is not worth combining A and B to solve the spillover problems associated with a and b (and that there is no need for coordinated use of assets A and B). Our argument rests on the assumption of (unmodeled) costs associated with combining assets. We assume that these costs—which might include the costs of integrating control systems and cultures, overcoming communications barriers, and moving decision-makers farther from the consequences of their actions—increase with the scale of the assets being combined. Therefore, while we assume that these costs can be ignored in choosing among governance structures that involve combining assets a and b, these costs would loom large if we considered integrating the parent firms A and B solely to achieve coordinated use of assets a and b.[5]

3c: Governance Structures Involving Ownership of Assets a and b

We now analyze governance structures that involve allocating ownership of assets a and b. There are four possible structures, which we label Unstructured Collaboration, an Acquisition, a Total Divestiture, and a Strategic Divestiture.

Unstructured Collaboration involves separate ownership of assets a and b by parties A and B: either A owns a and B owns b, or they swap a and b, possibly with a side payment. Under this governance structure, given the one-shot interaction between the parties that we assume here, the project will be implemented only when it is in each of the parties' interests to proceed. For example, if A owns a and B owns b, then the project will be implemented

[5] An alternative interpretation is that the payoffs $\pi_A(s)$ and $\pi_B(s)$ are inalienable private benefits flowing to parties A and B, so that it is impossible to integrate all decision rights and all payoffs under one party.

only in states of the world where $\pi_A(s) + \pi_a > 0$ and $\pi_B(s) + \pi_b > 0$.

In an *Acquisition*, party A (for instance) owns both a and b. In this case, the externalities imposed on party B will be irrelevant to the implementation decision regarding a and b. In a *Total Divestiture*, both A and B divest a and b to a third party, C. Since the project payoffs π_a and π_b are always positive, party C will always proceed with the project, ignoring the spillovers on A and B. In a *Strategic Divestiture*, one party (say, B) divests b to a third party. A strategic divestiture could be accompanied by an asset swap.

The four possible governance structures that involve the transfer of assets a and b are shown in the Figure 4 and Table 3 below. Recall that ownership of an asset confers both the decision right over that asset and the payoff flowing from that asset. Note that, even though we have restricted ourselves to a very simple environment with only two alienable assets, already there are nine possible governance structures, counting permutations of the four governance structures in Figure 4, as shown in Table 3. We next enrich the model by allowing decision rights to be allocated by contract, thus expanding the set of possible governance structures.

Figure 4: Examples of Governance Structures Involving Asset Ownership

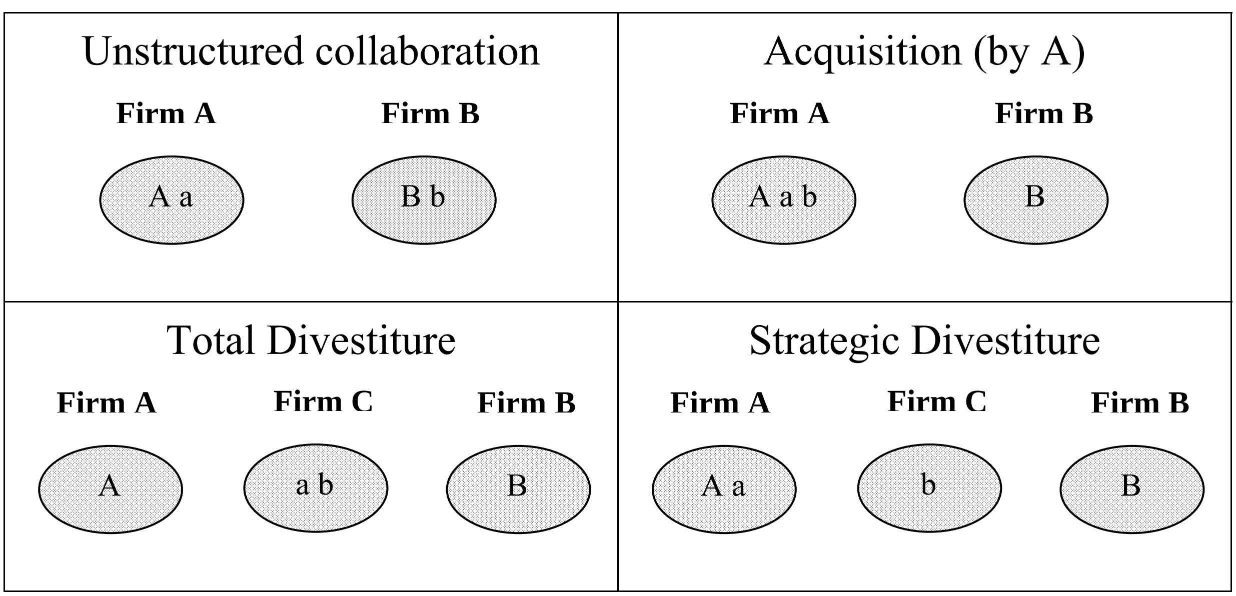


Table 3: Governance Structures Involving Asset Ownership

Governance Structure	Party A holds:	Party B holds:	Party C holds:
Unstructured Collaboration	a	b	-
	b	a	-
Acquisition	a,b	-	-
	-	a,b	-
Total Divestiture	-	-	a,b
Strategic Divestiture	a	-	b
	-	a	b
	b	-	a
	-	b	a

3d: Governance Structures Involving Contracting over Decision Rights

We now explore the possibility that certain decision rights can be allocated by contract rather than by asset ownership. We do this not only to examine the theoretical possibilities that such contracts introduce, but also because our discussions with practitioners and our reading of the empirical literature suggest that contracts that allocate decision rights across organizational boundaries are a common feature of strategic alliances.

We maintain the assumption throughout that *decisions* are not contractible, even ex post. In some cases, however the *decision right* over whether or not to use an asset could be allocated to another party, without transferring ownership. Consider, for instance, our biotech/pharma example above. The right to develop the drug need not be held by the owner of the patent; these rights could be held by another party, giving that party right to decide whether and how to market the product.

We define the transfer of a decision rights via contract (without the transfer of payoffs via changes in asset ownership) to be a *license* agreement. Such contractual arrangements offer many new governance structures, a few of which are pictured in Figure 5 below. In

Table 4, we consider only structures that give parties different incentives from those induced by governance structures shown in Table 3. (We also ignore license agreements that give only decision rights to party C, who would then have decision rights with no payoffs.) The first row shows an arrangement that allocates the decision over asset b to party A, while leaving the payoffs with party B. The third row shows the allocation of all of the decision rights over the project to party A, but none of the profits (other than the inalienable spillovers).

Figure 5: Examples of Licensing

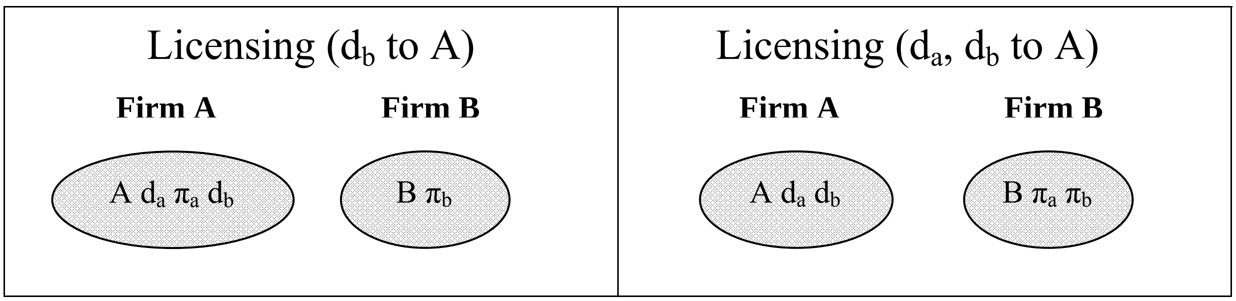


Table 4: Governance Structures Involving Contracting Over Decision Rights

Governance Structure	Party A holds:	Party B holds:	Party C holds:
License Agreement	d_a, π_a, d_b	π_b	-
	π_a	d_a, d_b, π_b	-
	d_a, d_b	π_a, π_b	-
	π_a, π_b	d_a, d_b	-
	d_a	-	$(d_b,\pi_b),\pi_a$
	-	d_b	$(d_a,\pi_a),\pi_b$

3e: Governance Structures Involving Contracting over Payoffs

The analysis of a contractual transfer of payoffs without the transfer of decision rights is more complex. We consider two possible assumptions. The first possibility, which parallels our assumption about decision rights, is that payoffs themselves are not contractible, but payoff rights are. This assumption would imply that payoffs are not divisible, but an asset's entire payoff stream could be allocated to a party other than the asset's owner, even though the owner retains the residual decision rights to the asset. However, we find this assumption implausible because the party to whom the non-contractible payoff stream is allocated runs the risk that these payoffs will be siphoned off by the party who retains the residual decision rights. As Holmstrom and Tirole (1989) argue:

> separating the return streams of the productive assets from the decision rights of these assets is not feasible, [when] return streams cannot be verified….[T]he owner of the asset can use the asset to generate returns for his own benefit, which cannot for reasons of verifiability be appropriated by the owner of the return stream. (p.70)

We follow Holmstrom and Tirole and do not model the situation in which payoff rights can be allocated separately from decision rights, when payoffs themselves are not contractible.

Rather, we model the situation in which the payoffs π_a and π_b (but not the payoffs $\pi_A(s)$ and $\pi_B(s)$) are contractible after decisions are made and results are observed. As described in Section 3a, the timing remains (1) the parties negotiate a governance structure, (2) the state is observed, (3) decisions are taken, and (4) payoffs are realized. Thus, the new feature in this section is that the payoffs π_a and π_b (but not the payoffs $\pi_A(s)$ and $\pi_B(s)$) can now be reallocated by contract. This assumption allows for "royalties" to be paid to any party when a project is implemented. Our discussions with practitioners, our reading of the empirical literature, and our examination of the data presented above suggest to us that such royalties are often a feature of strategic alliances.

A full analysis of how royalty rates could be added to the set of governance structures enumerated above is cumbersome; a couple of examples illustrate the main insights. One such royalty contract involves the asset ownership specified in the unstructured collaboration, combined with a royalty rate that allows all possible allocations of the total payoffs (π_a+π_b) between A and B. Alternatively, royalty contracts could be included with an acquisition. Both are shown in Table 5 below.

Table 5: Governance Structures Involving Contractible Payoffs

Governance Structure	Party A holds:	Party B holds:
Unstructured Collaboration with Royalty Contract	$d_a, \alpha(\pi_a+\pi_b)$	$d_b, (1-\alpha)(\pi_a+\pi_b)$
Acquisition with Royalty Contract	$(d_a, \alpha\pi_a), (d_b, \alpha\pi_b)$	$(1-\alpha)(\pi_a+\pi_b)$

4. Efficient Governance

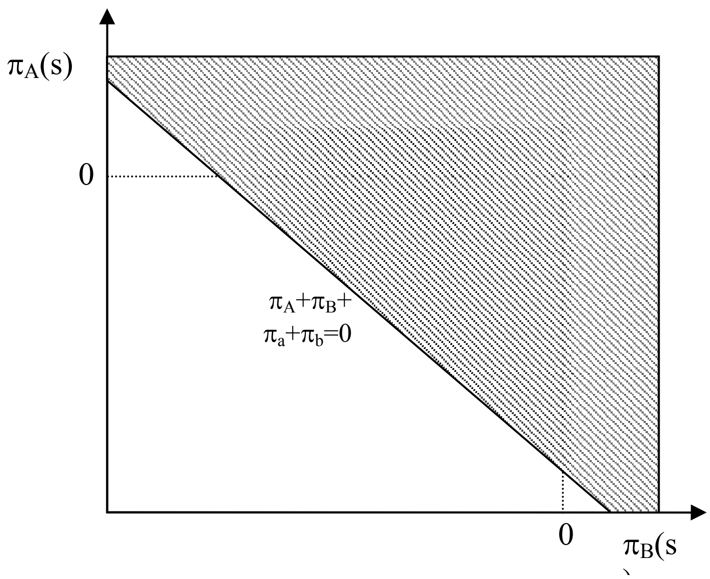
Having defined in Section 3 the feasible set of governance structures—that is, allocations of decision rights and payoffs to the parties—we now examine which of these structures will generate the highest surplus when the parties interact in a one-shot transaction. Determining efficient governance requires calculating the expected value of each governance structure. We will show that each of the governances structures identified in Section 3 can be optimal under some circumstances, but that (in general) none of them is first-best.

Much of the analysis in this section will be graphical: we show how each governance structure results in a different pattern of implementation across possible states of the world. This approach allows us to prove both that none of the structures is first-best and that each can be second-best.

Since the pair $(\pi_A(s), \pi_B(s))$ completely determines the possible profits in our model, we will represent each governance structure by shading region in the $(\pi_A(s), \pi_B(s))$ plane where the governance structure results in implementation. Figure 7 shows the region of first-best implementation, defined as all realizations of the state s such that $\pi_A(s) + \pi_B(s) + \pi_a + \pi_b > 0$.

Figure 7

First-best implementation



The vertical axis shows the private benefit to A, $\pi_A(s)$, and the horizontal axis shows the private benefit to B, $\pi_B(s)$. The first-best implementation region is defined as outcomes for which $\pi_A(s) + \pi_B(s) + \pi_a + \pi_b > 0$.

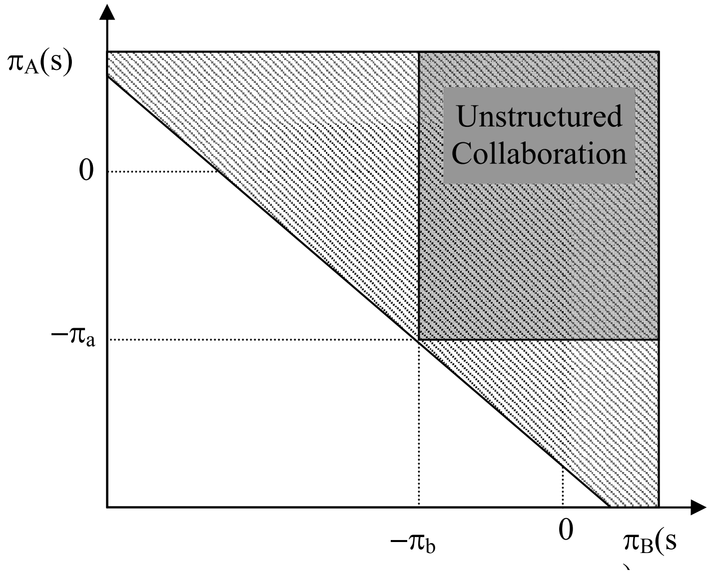
The probability distribution over s induces the distribution over $(\pi_A(s), \pi_B(s))$. To simplify notation, we will write x for $\pi_A(s)$, y for $\pi_B(s)$, and f(x, y) for their joint probability density. The expected surplus from first best implementation then equals:

$$V^{FB} = \int_{\underline{\pi}_A}^{-(\underline{\pi}_B+\pi_a+\pi_b)} \int_{-(x+\pi_a+\pi_b)}^{\bar{\pi}_B} (y + x + \pi_a + \pi_b) f(x,y) dxdy + \int_{-(\underline{\pi}_B+\pi_a+\pi_b)}^{\bar{\pi}_A} \int_{\underline{\pi}_B}^{\bar{\pi}_B} (y + x + \pi_a + \pi_b) f(x,y) dxdy$$

Under Unstructured Collaboration, each party will choose to implement only when the sum of his spillovers and his payoff from the project is positive. Thus party A will choose to implement whenever $\pi_A(s)+\pi_a > 0$ and Party B will only choose to implement when $\pi_B(s)+\pi_b > 0$, leading to the implementation pattern shown in Figure 8.

Figure 8

Implementation under Unstructured Collaboration



The axes and first-best implementation region are as in Figure 7. The Unstructured Collaboration implementation region is defined as outcomes where $\pi_A(s) + \pi_a > 0$ *and* $\pi_B(s) + \pi_b > 0$.

Surplus under Unstructured Collaboration is:

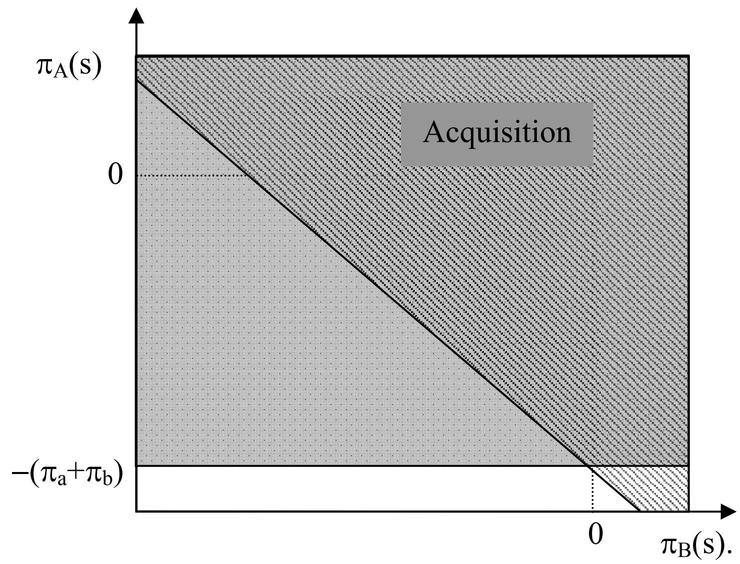
$$V^{UC} = \int_{-\pi_a}^{\bar{\pi}_A} \int_{-\pi_b}^{\bar{\pi}_B} (x + y + \pi_a + \pi_b) f(x,y) dx\, dy$$

As is clear from the shading in Figure 8, Unstructured Collaboration is not first-best because there are states in which the project should be implemented but is not. This inefficiency results from the inability of the parties to bargain *ex post* and devise a set of side payments that would lead to efficient implementation.

In an Acquisition (by party A), A has all of the decision rights and all of the project payoffs, but he ignores party B's spillovers. Thus Party A will choose to implement the project whenever $\pi_A(s) + \pi_a + \pi_b > 0$. This pattern of implementation is shown in Figure 9.

Figure 9

Implementation under Acquisition



The axes and first-best implementation region are as in Figure 7. The Acquisition implementation region is defined as outcomes where $\pi_A(s) + \pi_a + \pi_b > 0$.

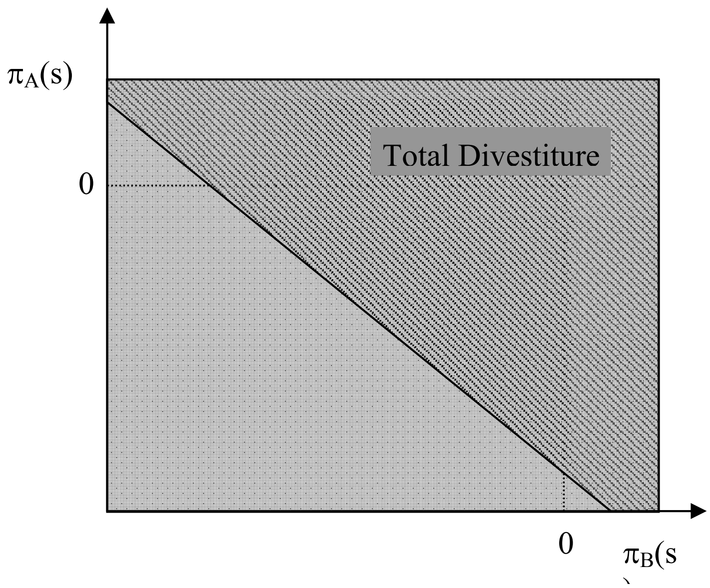
Surplus in an Acquisition by A is:

$$V^{ACQ(A)} = \int_{-(\pi_a+\pi_b)}^{\bar{\pi}_A} \int_{\underline{\pi}_B}^{\bar{\pi}_B} (y + x + \pi_a + \pi_b) f(x,y)dxdy$$

An Acquisition is also not first-best, as is clear from Figure 9: it leaves projects unimplemented in states where they should be, and it implements projects when they should not be. On the other hand, an Acquisition implements projects in states when Unstructured Collaboration does not, and vice versa. Whether an Acquisition or an Unstructured Collaboration is more efficient depends on the likelihood of these outcomes.

Figure 10

Implementation under Total Divestiture



The axes and first-best implementation region are as in Figure 7. The Total Divestiture area is defined as outcomes where $(\pi_a + \pi_b) > 0$ (which, given our assumptions, is always true).

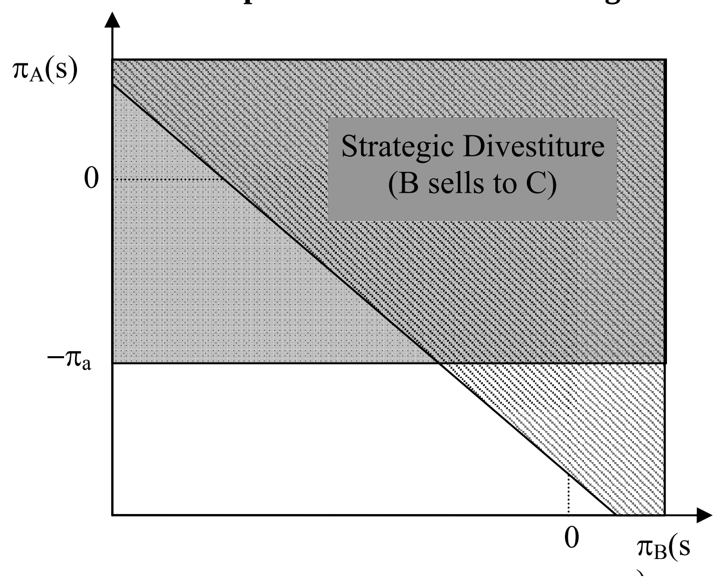
Since we have assumed that the payoffs π_a and π_b are always positive, a Total Divestiture implements in all states, and thus party C will always choose to go ahead with the project. This implementation pattern is shown in Figure 10 and results in surplus

$$V^{TD} = \int_{\underline{\pi}_A}^{\overline{\pi}_A} \int_{\underline{\pi}_B}^{\overline{\pi}_B} (y + x + \pi_a + \pi_b) f(x,y) dxdy$$

Once again, a Total Divestiture is not first-best, since (in comparison to the first-best implementation in Figure 7) it implements in many states where implementation is not optimal. However, if the probability of the states with inefficient implementation is sufficiently small, Total Divestiture could be more efficient than any of the governance structures analyzed previously.

Figure 11

Implementation under Strategic Divestiture



The axes and first-best implementation region are as in Figure 7. The figure depicts a strategic divestiture in which B sells b to C. The associated implementation region is defined as outcomes where (π_A + π_a) > 0.

A Strategic Divestiture can result in four possible implementation patterns, as shown in Table 3. Figure 11 shows only one: the divestiture by B of b to C. In this case, C will always choose to go ahead with the project (because $\pi_b > 0$) and A will go ahead with the project only if $\pi_A(s) + \pi_a > 0$. The surplus is:

$$V^{SD(B)} = \int_{-\pi_a}^{\bar{\pi}_A} \int_{\underline{\pi}_B}^{\bar{\pi}_B} (x + y + \pi_a + \pi_b) f(x,y) dx\, dy$$

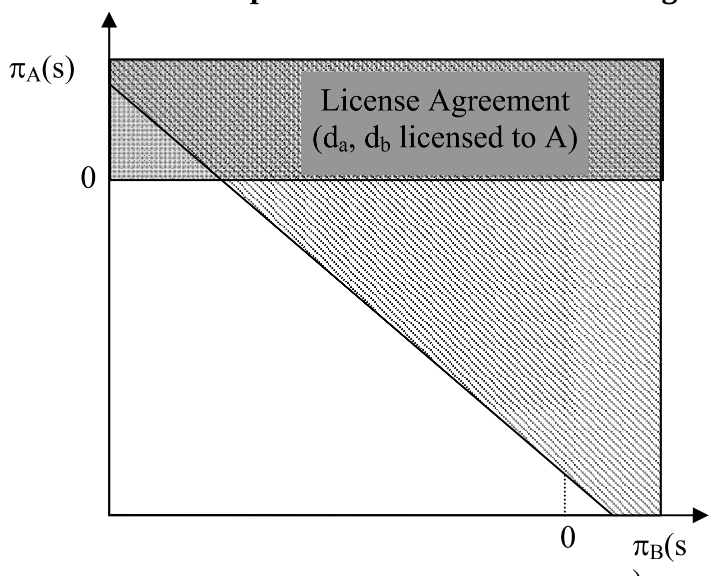
Similarly, the surplus associated with a divestiture by A of a to C is given by:

$$V^{SD(A)} = \int_{\underline{\pi}_A}^{\bar{\pi}_A} \int_{-\pi_b}^{\bar{\pi}_B} (x + y + \pi_a + \pi_b) f(x,y) dx\, dy$$

Clearly, these governance structures do not achieve the first-best, but each could be more efficient than any of the governance structures analyzed previously.

Figure 12

Implementation under License Agreement



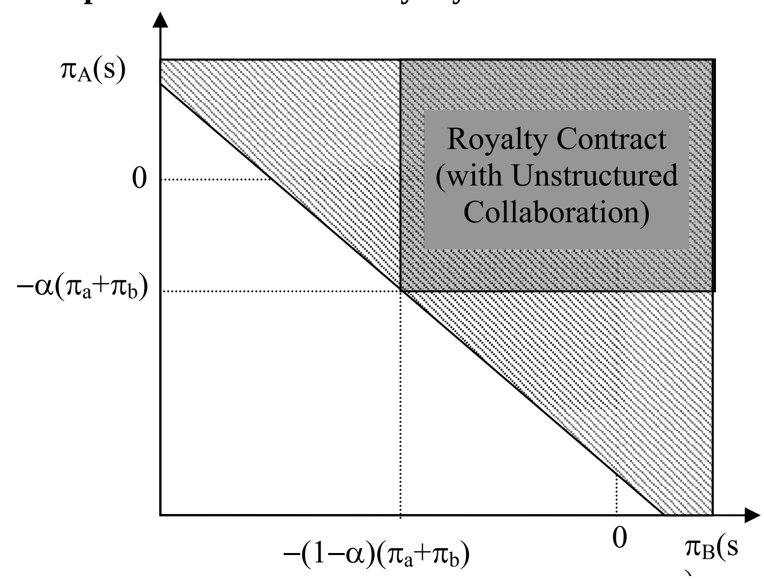
The axes and first-best implementation region are as in Figure 7. The figure depicts a Licensing agreement in which B receives the payoffs from both π_a and π_b but "licenses" the decision rights d_a and d_b to A. The associated implementation region is defined as outcomes where A's private benefit is positive, π_A > 0.

Figure 12 shows a License Agreement in which B receives the payoffs from both π_a and π_b but "licenses" the decision rights d_a and d_b to A,. In this case, A will implement the project whenever $\pi_A(s) > 0$, independent of B's payoffs. The surplus associated with this particular licensing agreement is given by

$$V^{L(A)} = \int_{0}^{\bar{\pi}_A} \int_{\underline{\pi}_B}^{\bar{\pi}_B} (x + y + \pi_a + \pi_b) f(x,y) dx\, dy$$

Figure 13

Implementation under Royalty Contract with Unstructured Collaboration



The axes and first-best implementation region are as in Figure 7. The figure depicts a Royalty Agreement in which A and B receives α and $(1 - \alpha)$ respective shares in the payoffs from implementation, $\pi_a + \pi_b$. The associated implementation region is defined as outcomes where $\pi_A + \alpha\ (\pi_a + \pi_b) > 0$ *and* $\pi_B + (1\text{-}\alpha)\ (\pi_a + \pi_b) > 0$.

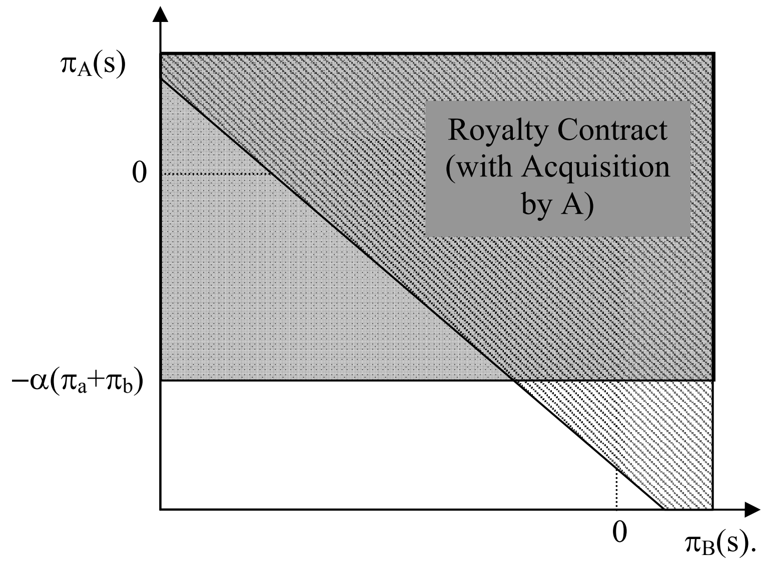
Figure 13 shows a Royalty Contract superimposed on Unstructured Collaboration, in which A makes decisions over d_a and receives a share α of the payoff from implementation $(\pi_a + \pi_b)$, and B makes decisions over d_b and receives a share $(1 - \alpha)$. Under this governance structure, A will wish to implement the project if $\pi_A(s) + \alpha(\pi_a + \pi_b) > 0$, while B will wish to implement if $\pi_B(s) + (1\text{-}\alpha)(\pi_a + \pi_b) > 0$. Since implementation occurs only when both parties agree to implement, the resulting surplus is:

$$V^{R:UC(\alpha)} = \int_{-\alpha(\pi_a+\pi_b)}^{\bar{\pi}_A} \int_{-(1-\alpha)(\pi_a+\pi_b)}^{\bar{\pi}_B} (x + y + \pi_a + \pi_b) f(x,y) dx\, dy$$

Note that, by varying the royalty payment α in Figure 13, implementation will occur in different states. The implementation will not be first-best for any α, but this structure can again be more efficient than any analyzed previously. Analysis of the Royalty Contract superimposed on Acquisition is very similar:

Figure 14

Implementation under Royalty Contract with Acquisition by A



The axes and first-best implementation region are as in Figure 7. The figure depicts a Royalty Agreement in which A receives α share in the payoffs from implementation, $\pi_a + \pi_b$. The associated implementation region is defined as outcomes where $\pi_A + \alpha(\pi_a + \pi_b) > 0$.

This governance structure yields surplus of:

$$V^{R:ACQ(A)} = \int_{-\alpha(\pi_a+\pi_b)}^{\bar{\pi}_A} \int_{\underline{\pi}_B}^{\bar{\pi}_B} (y + x + \pi_a + \pi_b) f(x,y) dxdy$$

As is evident from inspection of Figures 8-14, none of these governance structures dominates any other for all distributions f(x, y). To the contrary, each is a possible second-best structure. Even in a simple set-up like ours, many possible structures could be optimal and could be observed in the world. Thus the plethora of organizational forms that we identify in the data on strategic alliances is not surprising. Optimal governance requires choosing, from this plethora of possible structures, the one that maximizes total expected surplus.

This "result" on optimal governance structures does not generate any precise predictions about when different governance structures will be chosen: such a prediction would require a more detailed model of the particulars of a given situation. Thus, institutional knowledge of the (non-contractible) decisions that different parties could make, the consequences of these decisions, the effect of the state of the world on these consequences, and the probability distribution of states of the worlds would all be necessary to predict when, for instance, an Unstructured Collaboration would be preferred to an Acquisition, or to a Strategic Divestiture.

To see how more detailed information could refine the model and generate precise predictions about organizational forms, consider the biotech/pharmaceutical example from Section 3a. Suppose that in that particular case, the spillover effects of development on the biotech firm vary little with the state of the world: in all states, the development of the drug is good for the biotech. In this case, giving decision rights to the biotech (through, for instance, an acquisition by the biotech) will lead to implementation in all states. If the negative spillovers on the pharmaceutical firm are large and likely, implementing the project in all states could be quite inefficient. On the other hand, giving decision rights to the pharmaceutical firm will lead to under-implementation, because the pharmaceutical firm will not take the positive spillovers on the biotech into account. With an adequate understanding of the distribution of these spillovers, such a model can predict where the decision rights should reside.

It is important to recall that we have not examined a merger (combining A and B) as a possible solution. The fact that none of the governance structures we have examined is first-best suggests that mergers that internalize all the externalities between A and B will sometimes be optimal. Specifically, when assets a and b are large relative to A and B, so that the inefficiency of the second-best governance structure is large relative to the costs of integrating A and B, then it may be worth bearing these costs and merging the two firms.

5. Extensions

5a. Joint Control

All of the governance structures discussed above involve *unique control*: any given asset or decision right is owned or controlled by exactly one party. We observe, however, that the ownership of assets or decisions rights in actual strategic alliances are often more ambiguous. For instance, control over an asset might be vested in a joint venture owned by two or more parties. Such joint ownership requires a procedure by which the varied preferences of the owners are combined to produce a decision on any given matter. To give an example of one such procedure, suppose that a joint venture is created with ownership stakes of 49% each to A and B, and 2% to party C, and that party C captures some fraction of the payoffs from the project. Suppose further that the decision about whether or not to implement the project is determined by majority vote of the owners' shares. Since, by our assumptions in Section 3, party C always wants to proceed $(\pi_a+\pi_b) > 0$, this governance structure creates an implementation pattern that requires that both A and B vote "no" in order to stop the project. The implementation pattern from this voting process is different from any of those described in Section 4, and it could be optimal in some environments.

Notice, however, that the voting scheme described above requires that the decision about whether or not to implement the project be contractible, in order that the vote of the parties be binding on whoever is charged with implementing. We believe that at least part of the goal of setting up more complex governance mechanisms in joint ventures is to make such *ex post* decision-making contractible. More generally, we believe that decision-making in actual joint ventures is substantially more complex and relational than this simple voting procedure. Recall that the fundamental source of inefficiency in our model is an inability to achieve efficient implementation after the state of the world is revealed: none of the many governance structures defined above are able to adapt efficiently to fleeting situations. We believe that joint ventures (and possibly other governance structures) attempt to solve this adaptation problem by having a manager whose job it is to adapt, flexibly and efficiently, to the opportunities that arise. A board of directors hires the manager and evaluates her—after the state of the world is revealed and her decisions have been made—on the basis of whether she achieved efficient adaptation. Such evaluation requires that the board be able, at least after the fact, to observe what the state of the world was, to determine whether the actions taken by the manager were correct, and to reward and punish the manager appropriately. Such evaluation requires expert board members, the installation of costly measurement and control systems, and the forging of a set of contracts that will motivate the manager. We predict that such a costly mechanism is likely to only be optimal when the value of adaptation is very high.

5b. Relationships in Strategic Alliances

The fact that the governance structures explored in Sections 3 and 4 are not first-best in the one-shot game suggests that relationships—which allow self-enforcing relational contracts to solve the *ex post* bargaining problem and achieve efficient adaptation to the state-of-the-world—could be an improvement. In particular, decisions that are non-contractible (that is, not verifiable or enforceable by the courts) ex post may still be observable to the affected parties and could therefore be used in a self-enforcing informal contract in which the threat of breaking the relationship causes parties to adhere to the agreement. These agreements are more likely to be self-enforcing when the "shadow of the future looms large" (*i.e.*, when the long-run benefits from continuing the relationship into the future far surpass the benefits of reneging on the agreement for short-term gains).

There are several ways in which the shadow of the future can "loom large" for alliance partners. First, alliances are often long-lived and involve continuing interactions between the parties over an extended period. For example, the relationship between Fuji and Xerox to develop, produce and sell products and services in the Asia-Pacific region lasted for decades and included several important restructurings at key junctures (McQuade and Gomes-

Casseres, 1992). Second, firms often engage in repeat alliances with the same partners (Gulati, 1995a). In both of these settings, each partner may choose its current actions with an eye on the likely future responses of the other party.

A third possible way that the future may loom large is through indirect ties. For example, if Firms A and B have one alliance, and Firms B and C may come to have another, then B's current actions with A may be influenced by B's potential future dealings with C, if B believes that A and C may communicate. More generally, a network of indirect ties can facilitate information flows between firms may never be alliance partners themselves, but may partner at different dates with a given third firm (Gulati, 1995b, and Robinson and Stuart, 2007b).

The Recombinant Capital database summarized in Section 2 provides evidence on each of the three forms of relationships just described: long-lived contracts, repeated contracting, and indirect ties. Regarding long-lived contracts, the database does not offer complete information on the longevity of individual alliances, but we can nonetheless provide some suggestive evidence. First, of the 12,5000 alliances in the data, only 372 are listed as formally terminated between 1973 and 2001. Second, even for those that were terminated, the median time between the initial contract and the termination was 33 months.[6] Third, 1,548 alliances were formally revised (but not terminated) during the sample period, and the median time from the initial contract to the revision was 21 months (constituting a lower bound on alliance longevity for these contracts). Finally, for over 10,000 alliance contracts, there is no evidence that the contract was not open-ended. In sum, these data suggest that alliances are often not one-shot transactions, but instead hold the prospect of continuing interactions.

6 These data exclude 12 proposed mergers or acquisitions that were terminated prior to completion.

Regarding repeat contracting, Table 6 presents evidence on repeat alliances between the same partners. In the Recombinant Capital database, most pairs of firms (9,462) do only one deal with each other, but over a thousand pairs of firms do more than one deal together; 57 pairs do five or more deals together. Thus, the prospect of doing another deal is not negligible. Finally, as discussed in Section 2 and depicted in Table 1 and Figures 1 and 2, the dense network of contracts in the biotechnology industry clearly suggests indirect ties between firms in the industry.

Table 6

Repeated Strategic-Alliance Transactions Between Unique Pairs of Organizations, 1973-2001

Number of Transactions Between Unique Partner-Pairs	Number of Transactions	Total Number of Alliances	% of Total Alliances
1	9,462	9,462	76.0%
2	805	1,610	12.9%
3	182	546	4.4%
4	60	240	1.9%
5 or More	57	360	2.9%
Alliances between organizations ultimately merged or combined		912	7.3%

Note: Data extracted from Recombinant Capital database of alliances in the pharma-biotech industry, based on publicly disclosed contracts and arrangements from 1973-2001. Alliances are assigned to the surviving parent, regardless of whether the parent was involved in the original arrangement. Totals sum to more than 100% because some alliances have more than two partners.

6. Conclusion

This paper has three goals: (1) to document the plethora of governance structures that might be called "strategic alliances;" (2) to build a simple theoretical framework, using observations from practitioners, that defines and potentially explains this plethora of forms; and (3) to look beyond this simple framework into the more complex realm of joint ventures and relational contracting in strategic alliances. Our framework shows that many possible governance structures could emerge as the second-best way to allocate assets, decision rights, and payoffs. However, our hope is that this framework, supplemented with richer and more detailed data and institutional knowledge, will allow empirical researchers to build more-specific models and make more definite predictions that structure their empirical inquiries.

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Table 1

Pharmaceutical and Biotech Firms Most Active in Strategic Alliances, 1973-2001

Panel A *Top 12 Pharmaceutical Firms*	Number of Contracts	Number of Partners	Pharma Partners	Biotech Partners	Partners in Top 24
1. GlaxoSmithKline (GSK)	373	248	11.7%	58.5%	20
2. Pharmacia (PHA)	370	271	12.2%	44.1%	21
3. Pfizer (PFE)	287	194	14.4%	57.7%	19
4. Novartis (NVS)	230	167	16.2%	54.5%	18
5. Elan (ELN)	228	153	22.2%	38.6%	14
6. Hoffmann-La Roche (HLR)[a]	224	164	11.7%	62.0%	17
7. Johnson & Johnson (JNJ)	212	170	16.5%	37.6%	16
8. Abbott (ABT)	201	174	13.3%	49.7%	14
9. American Home Products (AHP)	175	124	21.0%	56.5%	19
10. Lilly (LLY)	164	132	13.6%	62.9%	16
11. Merck (MRK)	164	118	16.1%	58.5%	16
12. Bristol-Myers Squibb (BMY)	150	128	10.9%	57.8%	15

Panel B *Top 12 Biotech Firms*	Number of Contracts	Number of Partners	Pharma Partners	Biotech Partners	Partners in Top 24
1. Applera (ABI)	214	183	13.7%	38.3%	15
2. Chiron (CHIR)	172	136	20.0%	31.1%	12
3. Genentech (DNA)	124	92	14.1%	54.3%	14
4. Genzyme (GENZ)	122	102	14.7%	32.4%	6
5. Shire Pharmaceuticals (SHP)	119	85	24.7%	36.5%	12
6. Incyte Genomics (INCY)	107	90	25.8%	42.7%	17
7. Celltech (CLL)	106	89	25.8%	37.1%	15
8. Affymetrix (AFFX)	91	69	26.1%	30.4%	10
9. Medarex (MEDX)	88	73	16.4%	41.1%	10
10. Medimmune (MEDI)	86	67	22.4%	25.4%	10
11. Vertex (VRTX)	79	63	25.8%	32.3%	12
12. Amgen (AMGN)	78	66	21.2%	42.4%	12

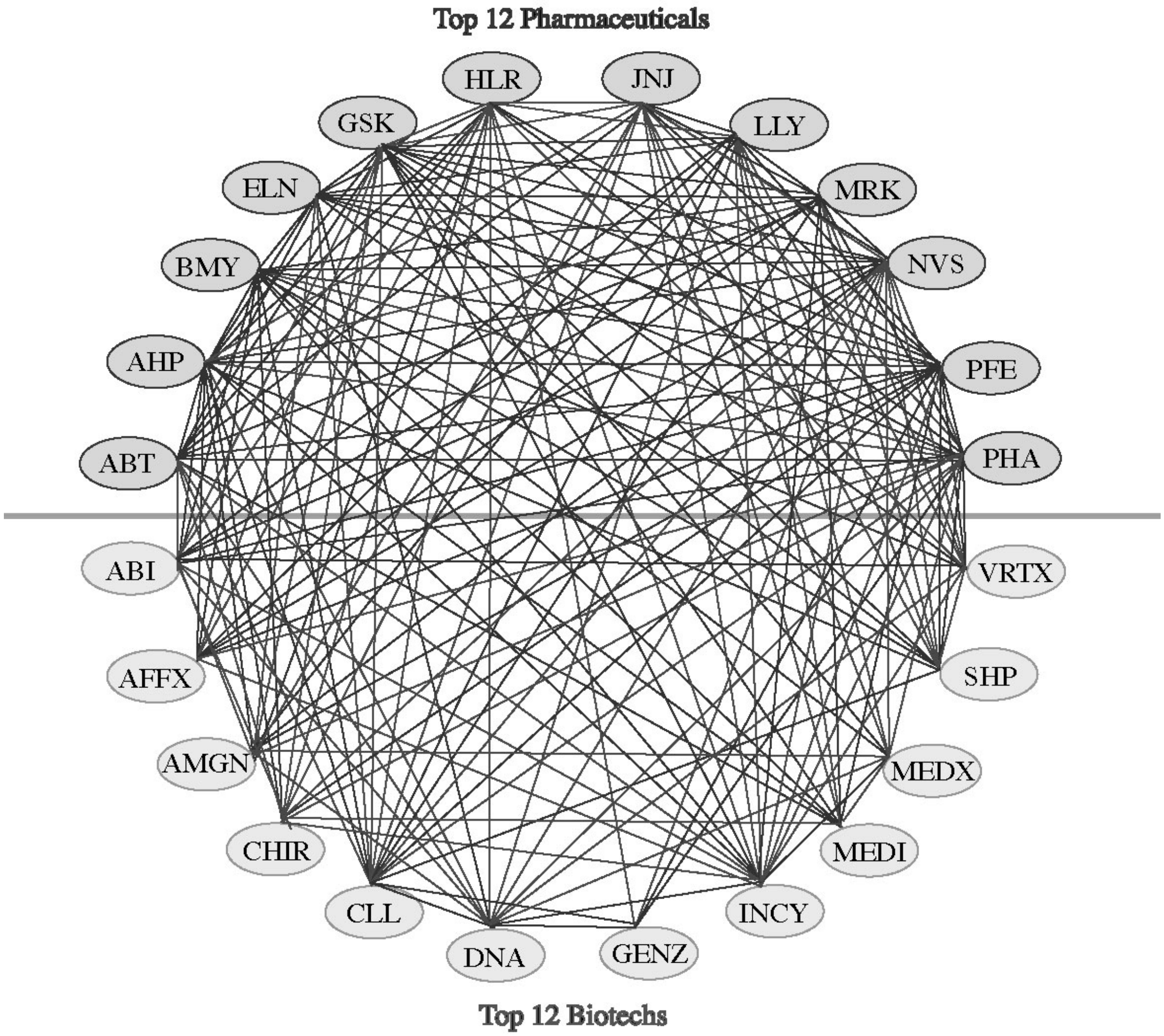
Note: Data extracted from Recombinant Capital database of alliances in the pharma-biotech industry, based on approximately 12,500 publicly disclosed contracts and arrangements. Companies ranked (and "top companies" defined) by number of alliances. The number of alliances reported excludes alliances with entities that ultimately became wholly owned subsidiaries of the companies in the table. Contracts are assigned to the surviving parent, regardless of whether the parent was involved in the original arrangement.

[a]Hoffmann-La Roche is a wholly owned subsidiary of privately held Roche Holdings.

[b]Applera, formed by the combination of Applied Biosystems and Celera Genomics, trades under two tracking stocks, ABI (Applera-Applied Biosystems) and CRA (Applera-Celera Genomics).

Figure 1

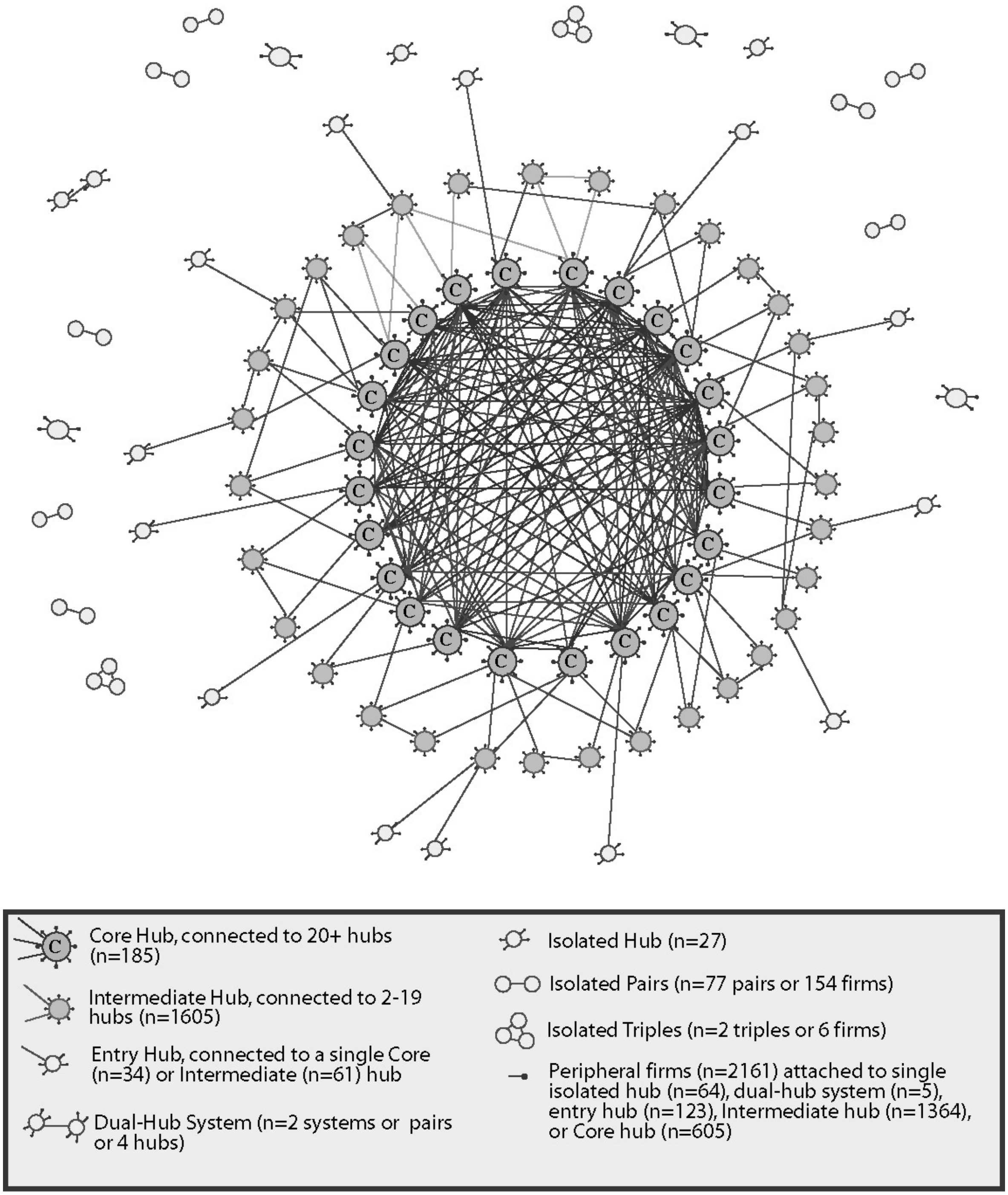
Strategic Alliances Among the Top 12 Pharmaceuticals and Top 12 Biotechs



Note: Ticker symbols correspond to companies included in Table 1. Data extracted from Recombinant Capital database of alliances in the pharma-biotech industry, based on approximately 12,500 publicly disclosed contracts and arrangements from 1973-2001. Contracts are assigned to the surviving parent as of year-end 2001, regardless of whether the parent was involved in the original arrangement.

Figure 2

Networks in Recombinant Capital Database of Pharmaceutical-Biotech Alliances



Note: Data extracted from Recombinant Capital database of alliances in the pharma-biotech industry, which includes 4,231 unique entities (surviving parents as of year-end 2001).

Table 2

Operational Objectives and Governance Structures for Biotech Alliances, 1973-2001

	Governance Structure for Alliance					
Operational Objective of Alliance:	License	Investment	Merger or Acquisition	Joint Venture	Structure not Specifed	Total
Development	16.2%	4.6%	0.1%	0.7%	7.7%	29.4%
Research	13.3%	3.5%	0.1%	0.4%	7.3%	24.6%
Manufacturing or Marketing	4.7%	1.8%	0.4%	0.3%	10.6%	17.9%
Collaboration	7.3%	2.2%	0.0%	0.2%	6.9%	16.7%
Supply	4.3%	1.3%	0.3%	0.1%	3.1%	9.2%
Objective not specified	20.6%	4.9%	12.8%	2.1%		40.3%
Total	66.5%	18.4%	13.8%	3.8%	35.7%	

Note: Data extracted from Recombinant Capital database of alliances in the pharma-biotech industry, based on approximately 12,500 publicly disclosed contracts and arrangements from 1973-2001. Totals sum to more than 100% because contracts frequently mention multiple objectives (e.g., research *and* development) and often note multiple governance structures (e.g., investment *and* license agreement).