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

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**Abstract**

Strategic alliances range from short-term cooperative projects, through long-term partnerships and joint ventures, to transactions that permanently restructure firm boundaries and asset ownership. In this paper, we draw on detailed discussions with practitioners to present a rich model 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). We use this model to generate a large number of strategic alliance possibilities, including simple cooperative arrangements (coopetition), strategic divestitures, total divestitures, licensing agreements, and royalty agreements. We show that any of these possible strategic alliances could be optimal.

*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 short-term cooperative projects, through long-term partnerships and joint ventures, to transactions that permanently 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 integrates spillovers and ex post contracting problems. We use this model to examine a collection of governance structures that our interviewees described, such as coopetition (where non-integrated parties compete and cooperate at the same time[1]), acquisitions (where one parent acquires and controls the joint

[1] See Brandenburger and Nalebuff (1996). The term "coopetition" was originally coined by Novell founder Ray Norda.

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 payoff rights are extricated from their native assets and 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.[2]

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 grocers. In addition to theoretical discussions that have dissented from the focus on authority

[2] 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.

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, Richardson (1972) gave a rich description of "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." Cheung's (1983) description of contractual structures between firm and market, Eccles's (1985) work on quasi-firms, and Powell's (1990) discussion of networks ("Neither Market Nor Hierarchy") all continue this tradition of empirically grounded criticism of the simple dichotomy between markets and firms.

The many governance structures between firms and markets are sometimes summarized as "hybrid" governance structures; see Williamson (1985; 1996) and Menard (2004). 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. Early work along roughly these lines includes Cheung (1983), Goldberg and Erickson (1987), Joskow (1985), Masten and Crocker (1985), and Palay (1984). More recently, Arruñada, Garicano, and Vazquez (2001), Bajari and Tadelis (2001), Bidwell (2004), Elfenbein and Lerner (2003), Kaplan and Stromberg (2003), Klein (2000), Lafontaine and Masten (2002), Lerner and Merges (1998), Robinson and Stuart (2002), and Ryall and Sampson (2002) 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 theoretical framework that captures a wide range of governance structures beyond the simple dichotomy between markets and firms.

Our theoretical framework includes assets, contracts, and other hybrids. To do so, we expand on the Grossman-Hart-Moore (GHM) approach, as follows.

In the GHM approach, asset ownership conveys rights to make decisions ex post that were not contracted on ex ante. That is, ownership conveys residual-decision rights. In the contractual literature, in contrast, we have seen decision rights moved across fixed firm boundaries (*i.e.*, without changing asset ownership). Some decision rights can be alienated from their native assets, while others cannot, and are left attached to the asset after all alienable decision rights have been reallocated. Our theoretical framework thus distinguishes between (and incorporates both) the residual-decision rights from the GHM approach and the alienable decision-rights from the contracting approach.

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 show that a plethora of governance structures is used for a wide range of purposes.

Section 3 introduces our theoretical framework, which includes two (or three) parties, four assets, two decision rights and two payoff rights. We define "governance structures" as an allocation of decision rights and payoff rights to parties through either contracts or asset ownership. We allow for a variety of observed governance structures for coordinating activities between firms, including acquisitions, coopetition, divestitures, licensing agreements, and royalty contracts. We then show in Section 4 that each of the governances structures enumerated can be optimal under some circumstances, but that (in general) none of them is first-best. Section 5 extends the model to an arbitrarily large number of parties, assets, decision rights, and payoff rights.

In Section 6, we briefly consider two extensions to our framework. First, our framework restricts attention to governance structures with "unique control" (i.e., any given asset, decision right, or payoff right is owned by exactly one firm). An important type of strategic alliance—the joint venture—is an example of a governance structure that does not exhibit this type of unique control. Because our model emphasizes contracting problems ex post, joint control raises complex theoretical issues that have gone unnoticed in the property-rights approach to joint ownership. Second, we consider how relationships (and self-enforcing relational contracts) can mitigate the *ex post* bargaining problem and achieve better adaptation to the state-of-the-world. While a thorough analysis both of these issues (relational contracting and joint control) is beyond the scope of this paper, we offer a brief discussion of these issues before concluding.

## 2. Bridges in Biotechnology

In this section, we offer suggestive evidence on the importance of 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?

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.

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.

The existence of this "dense network of [bridges] by which firms are inter-related" raises a question: what do these bridges do? The Recombinant data shed some light on this question as well, 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. Most of the observed alliances involve research and/or development activities (55%) and are structured as licensing agreements (66.5%).

Overall, the evidence confirms 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.[3] Based on suggestive evidence of this kind, we turn next to theoretical analyses of how governance structures aid or impede ongoing relationships.

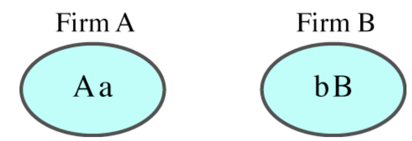
[3] For an example of networks in the internet sector, see http://www.orgnet.com/netindustry0104.gif.

## 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 in the joint project are denoted $d_a \in D_a$ and $d_b \in D_b$ respectively. Coordinated use of the assets {a, b} produces profits $\pi_a$ and $\pi_b$, both positive; any other uses of {a, b} produce profits of zero.[4] We assume, initially, that the profits $\pi_a$ and $\pi_b$ accrue to the owners of assets a and b.

*Figure 3*
**Economic Environment**




If the holders of both $d_a$ and $d_b$ agree, coordinated use of {a,b} yields:

Direct profits: $\pi_a$, $\pi_b$ alienable
Spillovers: $\pi_A$, $\pi_B$ private benefits

In addition to producing profits $\pi_a$ and $\pi_b$, coordinated use of {a, b} can also affect the profits from the core activities of Firms A and B. Let $\pi_A$ and $\pi_B$ 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 $\pi_A$ and ignored hereafter, and likewise for Firm B.) We assume that the payoffs $\pi_A$ and $\pi_B$ are private benefits, and 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 $F(\pi_A, \pi_B)$.

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

We define assets a and b to be a combination of payoff rights $\pi_a$ and $\pi_b$ and decision rights $D_a$ and $D_b$. In Section 3c below, we assume that the decision rights are inextricably linked to the payoff rights, so that decision rights and payoff rights can be transferred only as a bundle, by transferring ownership of the assets. In Section 3d, in contrast, we introduce the possibility of transferring either the decision rights or the payoff rights separately, by contract.

The timing of the model is as follows. Initially, the parties choose a "governance structure," which is an allocation of decision rights and payoff rights, possibly allocated through asset ownership. This allocation may be accompanied by state-independent side payments. Next, the state of the world (s) is revealed, after which the parties make decisions. Finally, after decisions are made, payoffs are realized by the parties holding the payoff rights.

We assume that the opportunities presented by the revelation of s are fleeting, in the sense that decisions must be made immediately after the state is revealed: there is no time to re-contract on either decision rights or payoff rights between the time that s is revealed and decisions must be made.

We also make the important assumption that decisions (as distinct from decision rights) are not contractible either before or after the state of the world is known. As mentioned in the Introduction, this issue of contracting problems ex post was emphasized to us by practitioners. This assumption rules out the possibility of *ex post* renegotiation to achieve efficient decision making. Whoever holds the decision right *ex ante* will make the decision that is in his best interest *ex post*, and no Coasian bargaining will occur to achieve *ex post* efficiency.

*3b: First Best Implementation and Mergers*

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

In this paper, we are interested in governance structures that do not involve the transfer of ownership of either A or 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. Our argument rests on the assumption of some (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 the costs of moving decision-makers farther from the consequences of their actions – are small compared to the value of assets being combined. Therefore, while we assume that these costs can be ignored in governance structures that involve combining assets a and b, they would loom large if we considered integrating the parent firms A and B solely to achieve coordinated use of assets a and b.

*3c: Governance Structures Involving Asset Ownership of a and b*

We now analyze feasible governance structures that involve transferring (or not transferring) ownership of assets a and b. There are four possible arrangements, which we label coopetition, an acquisition, a total divestiture, and a strategic divestiture.

*Coopetition* 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. In one-shot interactions between the parties, this means that the project will be implemented only when it is in each of their interests to proceed.

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. In a *total divestiture*, both A and B divest a and b to a third party, C. Since the project payoffs $\pi_a$ and $\pi_b$ 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 table below. Recall that ownership of an asset confers both the decision right over that asset and the payoff right flowing from that asset.

**Table 3: Governance Structures Involving Asset Ownership**

| Governance Structure | Party A holds: | Party B holds: | Party C holds: |
|---|---|---|---|
| Coopetition | $(d_a, \pi_a)$ | $(d_b, \pi_b)$ | - |
| | $(d_b, \pi_b)$ | $(d_a, \pi_a)$ | - |
| Acquisition | $(d_a, \pi_a)$, $(d_b, \pi_b)$ | - | - |
| | - | $(d_a, \pi_a)$,$( d_b, \pi_b)$ | - |
| Total Divestiture | - | - | $(d_a, \pi_a)$, $(d_b, \pi_b)$ |
| Strategic Divestiture | $(d_a, \pi_a)$ | - | $(d_b, \pi_b)$ |
| | - | $(d_a, \pi_a)$ | $(d_b, \pi_b)$ |
| | $(d_b, \pi_b)$ | - | $(d_a, \pi_a)$ |
| | - | $(d_b, \pi_b)$ | $(d_a, \pi_a)$ |

*3d: Governance Structures Involving Contracting*

We now explore the possibility that certain decision rights and payoff rights can be allocated by contract rather than by asset ownership.[5] We do this not only to examine the

[5] For our purposes, allocating decision rights through contracting allows us to separate decision rights from payoff rights (recall that we defined assets as an inseparable coupling of decision and payoff rights). More broadly, Maskin and Tirole (1999) show that theories of integration through asset ownership are formally equivalent to theories of contracting.

theoretical possibilities that such contracts introduce, but also because our discussion with practitioners and our reading of the empirical literature suggest that contracts that allocate decision rights and payoffs are a common feature of strategic alliances.

We maintain the assumption throughout that *decisions* are not contractible. We assumed above that decision rights over an asset could only be transferred by transferring ownership of the asset. However the *decision right* over whether or not to use an asset could be allocated to another party, without transferring ownership. Consider, for instance, the right to market a product that is the result of a development effort by two firms. These marketing rights could be licensed to either party, giving them sole right to decide whether and how to market the product.

We define the transfer of a decision rights (without the transfer of payoffs) to be a license agreement. Such contractual arrangements offer many new governance structures. In Table 4 below, we only consider 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 gives A all of the decision rights over the project, but none of the profits (other than the inalienable spillovers).

**Table 4: Governance Structures Involving Contracting Over Decision Rights**

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

Contractual transfers of payoff rights from a particular asset without the transfer of decision rights is more complex. We consider two possible assumptions. The first assumption, which is parallel to our assumption about decision rights, is that payoffs themselves are not contractible, but payoff rights are. That is, it might be possible to transfer the payoffs from an asset to another party in their entirety, but since the actual amount of the payoff is not contractible, payoffs are not divisible. We imagine that such a situation might arise when it is possible for one party (say A) to siphon-off cash flows from a project. Thus if a contract promised party B 10% of the profits, these profits would mysteriously fail to materialize.[6] Only by giving all of the payoffs to the B, along with the rights to siphon, can payoffs be transferred between parties. If one makes the reasonable assumption that these siphoning rights are residual control rights then transferring payoff rights is equivalent to transferring ownership in the asset, while licensing back the implementation decision rights. Since we have already considered this case above, we will not analyze governance structures that allocate payoff rights.

Another possible assumption is that payoffs themselves are contractible. 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 in the introduction, suggest to us that such royalties are often a feature of strategic alliances. While a full analysis of how royalty rates could be added to the set of governance structures enumerated above is beyond the scope of this paper, we will suggest one possibility. The asset ownership specified in the Coopetition structure, combined with a royalty rate which allows all possible allocations of the total payoffs ($\pi_a+\pi_b$) between A and B is one possible type of Royalty contract. It is shown in Table 5 below.

**Table 5: Governance Structures Involving Contracting Over Payoff Rights**

| Governance Structure | Party A holds: | Party B holds: | Party C holds: |
|---|---|---|---|

[6] For example, Hollywood is replete with examples of people who have contracted for a share of the "net profits" from a movie which turn out to be small or zero even after the movie is highly successful (Weinstein, 1998).

| | | | |
|---|---|---|---|
| Royalty Contract | $d_a,\alpha(\pi_a+\pi_b)$ | $d_b,(1-\alpha)(\pi_a+\pi_b)$ | - |

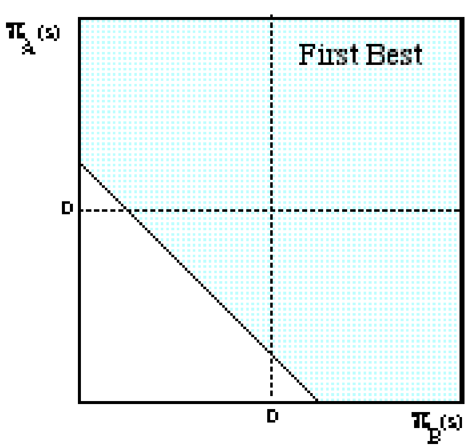
## 4. Efficient Governance

Having defined a set of governance structures—that is, an allocation of decision rights and payoff rights to the parties—in Section 3, we now examine which of these structures will generate the highest surplus when the parties are interacting in a one-shot transaction. This requires calculating the expected value of each governance structure. We will show that each of the governances structures enumerated 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 will show how each governance structure results in a different pattern of implementation across possible states of the world. This will allow us to prove both that none of the structures is first best, and that each can be second best.

**Figure 4**

**First-best implementation**



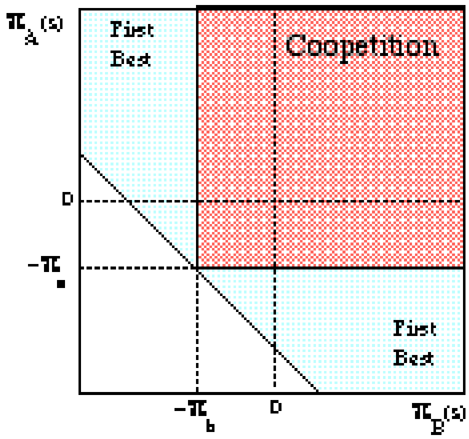

The vertical axis shows the private benefit to A, $\pi_A(s)$, and the horizontal axis shows the private benefit to B, $\pi_B(s)$. The first-best area is defined as outcomes for which $\pi_A(s) + \pi_B(s) + \pi_a + \pi_b > 0$.

Since the pair $\{\pi_A(s),\pi_B(s)\}$ completely characterizes the state in this model, we will show each governance structure as a shaded region of implementation in the $(\pi_A,\pi_B)$ plane. Figure 4 shows first best implementation, defined as all realizations of the state s such that $\pi_A(s) + \pi_B(s) + \pi_a + \pi_b > 0$. Expected surplus from first best implementation equals:

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

**Figure 5**

**Implementation under Coopetition**




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 area is defined as outcomes for which $\pi_A(s) + \pi_B(s) + \pi_a + \pi_b > 0$. The Coopetition area is defined as outcomes where $\pi_A(s) + \pi_a > 0$ *and* $\pi_B(s) + \pi_b > 0$.

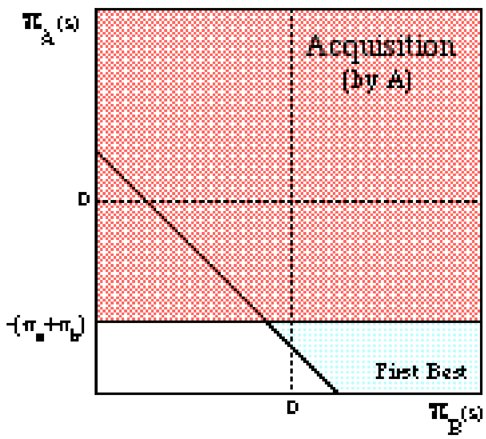
Under Coopetition, each party will choose to implement only when the sum of his spillovers and his payoff from the project is positive. Thus party A will choose to implement whenever $\pi_A(s)+\pi_a>0$. B will only choose to implement when $\pi_B(s)+\pi_b>0$. This leads to the implementation pattern shown in Figure 5. Surplus under Coopetition is:

$$V^{CO} = \int_{-\pi_a}^{\overline{\pi_A}} \int_{-\pi_b}^{\overline{\pi_B}} (x + y + \pi_a + \pi_b) f(x, y) dx\, dy$$

As is clear from the shading, Coopetition is inefficient since 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.

**Figure 6**

**Implementation under Acquisitions**




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 area is defined as outcomes for which $\pi_A(s) + \pi_B(s) + \pi_a + \pi_b > 0$. The Acquisition area is defined as outcomes where $\pi_A(s) + \pi_a + \pi_b > 0$.

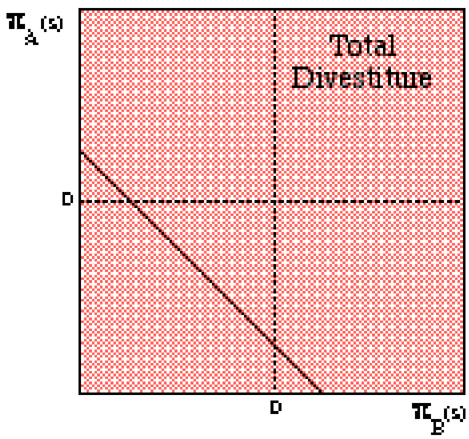
In an Acquisition (by party A), A has all of the decision rights, and all of the project payoffs. But he ignores party B's spillovers. Thus he will choose to implement the project whenever $\pi_A(s) + \pi_a + \pi_b > 0$. This pattern of implementation is shown in Figure 6. Surplus in an Acquisition by A is:

$$V^{ACQ(A)} = \int_{-(\pi_a+\pi_b)}^{\overline{\pi_A}} \int_{\underline{\pi_B}}^{\overline{\pi_B}} (y + x + \pi_a + \pi_b) f(x,y) dxdy$$

An Acquisition is also not first best, as is clear from the figure: it leaves projects unimplemented in states where they should be, and implements projects when they should not be. In addition, either an Acquisition or Coopetition could be the second-best governance structure. Note than an Acquisition implements in states when Coopetition does not, but it also fails to implement in some when Coopetition does. Whether an Acquisition or Coopetition is more efficient depends on the relative likelihood of these outcomes.

**Figure 7**

**Implementation under Total Divestiture**




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 Total Divestiture area is defined as outcomes where $(\pi_a + \pi_b) > 0$ (which, given our assumptions, is always true).

A Total Divestiture implements in all states, since the payoffs $\pi_a$ and $\pi_b$ are always positive, and so party C will always choose to go ahead with the project. This implementation pattern is shown in Figure 5, and results in surplus

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

Here again, a Total Divestiture is not first best, since it implements in many states where implementation is not optimal. However, it also implements whenever implementation is efficient. Thus, it could be the second best governance structure.

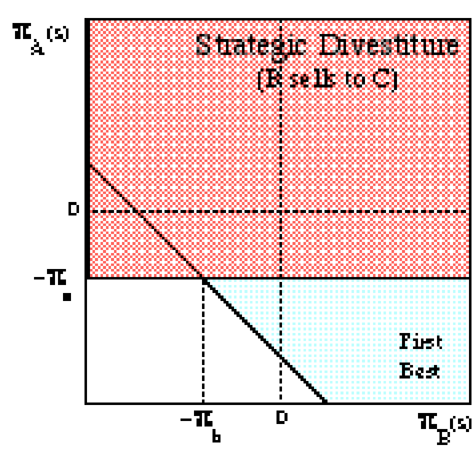
A Strategic Divestiture can result in four possible implementation patterns, as shown in Table 3. Figure 8 below shows only one: the divestiture by B of b to C. In this case, C will always choose to go ahead with the project (because $\pi_b > 0$) and A will go ahead with the project only if $\pi_A(s) + \pi_a > 0$. The surplus is:

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

Similarly, the surplus associated with a

**Figure 8**

**Implementation under Strategic Divestiture**




The figure depicts a strategic divestiture in which B sells b to C. 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 Strategic Divestiture area is defined as outcomes where $(\pi_A + \pi_a) > 0$.

divestiture by A of a to C is given by:

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

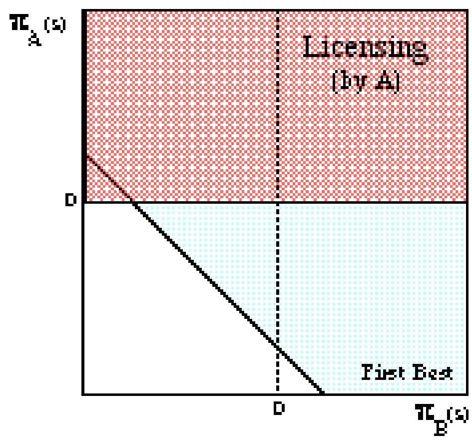
Clearly, these governance structure do not achieve the first best, but could be second best.

A License Agreement, in which B receives the payoffs from both $\pi_a$ and $\pi_b$ but "licenses" the decision rights $d_a$ and $d_b$ to A is shown in Figure 9. In this case, A will wish to go ahead with the project whenever $\pi_A(s) > 0$, independent of B's payoffs. The surplus associated with this particular licensing agreement is given by

$$V^{L(A)} = \int_{-(\pi_a+\pi_b)}^{\overline{\pi}_a} \int_{0}^{\overline{\pi}_b} (x + y + \pi_a + \pi_b) f(x,y) dx\, dy$$

**Figure 9**

**Implementation under License Agreement**

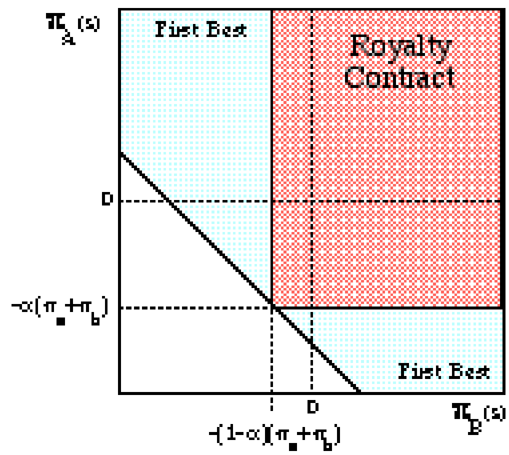



The figure depicts a licensing agreement in which B receives the payoffs from both $\pi_a$ and $\pi_b$ but "licenses" the decision rights $d_a$ and $d_b$ to A. The vertical axis shows the private benefit to A, $\pi_A(s)$, and the horizontal axis shows the private benefit to B, $\pi_B(s)$. The Licensing area is defined as outcomes where A's private benefit is positive, $\pi_A > 0$.

A Royalty Contract, in which A makes decisions over $d_a$ and receives a share $\alpha$ of the gains from implementation ($\pi_a + \pi_b$), and B makes decisions over $d_b$ and receives a share ($1 - \alpha$), is shown in Figure 10. 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 $\pi_A(s) + (1-\alpha)(\pi_a + \pi_b) > 0$. Since both parties must choose to implement, the resulting surplus is:

**Figure 10**

**Implementation under Royalty Contract**




The figure depicts a royalty agreement in which A and B receives $\alpha$ and ($1 - \alpha$) respective shares in the payoffs from implementation, $\pi_a + \pi_b$. 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 Royalty area is defined as outcomes where $\pi_A + \alpha\,(\pi_a + \pi_b) > 0$ *and* $\pi_B + (1-\alpha)(\pi_a + \pi_b) > 0$.

$$V^{R(\alpha)} = \int_{-\alpha(\pi_a+\pi_b)}^{\overline{\pi_A}} \int_{-(1-\alpha)(\pi_a+\pi_b)}^{\overline{\pi_B}} (x + y + \pi_a + \pi_b) f(x,y)\,dx\,dy$$

Note that, by varying the royalty payment $\alpha$ in Figure 10, implementation will occur in different states. The implementation will not be first best (since there are first-best regions in Figure 10 that cannot be implemented with a simple royalty payment), but can be second best depending on the relative probabilities of different states.

As is evident from inspection of Figures 4-10, none of these governance structures dominates any other: each is a possible second best structure. This result demonstrates that, even in a simple set-up like this one, many possible structures could be optimal. Thus the plethora of forms that we see in the data on strategic alliances is not surprising. Optimal governance in the one-shot game requires choosing, from this plethora of possible structures, the one that maximizes total surplus. Thus the optimal one-shot governance structure solves:

$V^{ONE\text{-}SHOT} \equiv \max[V^{CO}, V^{ACQ}, V^{TD}, V^{SD}, V^{L}, V^{R}]$

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 these one-shot governance structures is first best suggests that mergers 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. Efficient Governance in an Enriched Environment

We now analyze a more general model than in Section 3 and 4, which allows for arbitrary numbers of (a) parties, (b) assets (*i.e.*, inseparable bundles of decision and payoff rights), (c) alienable decision rights not linked to any payoff rights, (d) alienable payoff rights not linked to any decision rights, and (e) inalienable private decision rights. Formally, we assume there are I parties, J assets, K decision rights not linked to payoff rights, and M payoff rights not linked to decision rights. Party $i \in I$ receives inalienable private benefit $\pi_i$ and controls inalienable decision rights $d_i \in D_i$. Asset $j \in J$ consists of the inalienable pair of decision rights $d_j \in D_j$ and payoff rights $\pi_j$. Decision right $k \in K$ is not linked to any payoff right and is denoted $d_k \in D_k$. Payoff right $m \in M$ is not linked to any decision rights and is denoted $\pi_m$. We continue to denote the state by s, drawn from the finite set S according to the probability density f(s). We write **d** for the vector of decisions, chosen from a set D with domain $D \equiv \prod_{i \in I} D_i \times \prod_{j \in J} D_j \times \prod_{k \in K} D_k$. These decisions affect both the inalienable private benefits and the payoffs associated with alienable payoff rights and alienable assets.

As above, we define a "governance structure," $g \in G$, as an assignment of assets, decision rights, and payoff rights across parties. Let G be the set of feasible governance structures. We define $J(i,g) \subset J$ as the assets held by party i under governance structure g,

$K(i,g) \subset K$ as the decision rights (not attached to payoff rights) held by party i under governance structure g, and $M(i,g) \subset M$ as the payoff rights (not attached to decision rights) held by party i under governance structure g.

We define $\pi_{ig}(\mathbf{d},s)$ as the total payoff to party i under governance structure g in state s; this total payoff includes private benefits $\pi_i$, plus payoffs from assets $j \in J(i,g)$, plus payoffs from payoff rights not associated with decision rights $m \in M(i,g)$:

(1) $$\pi_{ig}(\mathbf{d},s) \equiv \pi_i(\mathbf{d},s) + \sum_{j \in J(i,g)} \pi_j(\mathbf{d},s) + \sum_{m \in M(i,g)} \pi_m(\mathbf{d},s).$$

Similarly, we define $D_{ig}$ as the decision space for party i under governance structure g; this decision space includes inalienable decision rights $D_i$, and alienable decision rights $k \in K(i,g)$, and decision rights associated with assets $j \in J(i,g)$:

(2) $$D_{ig} \equiv D_i \times \prod_{j \in J(i,g)} D_j \times \prod_{k \in K(i,g)} D_k.$$

We write $\mathbf{d}_{ig}$ as a typical element of $D_{ig}$.

We assume that, for each governance structure g, and for each state s, there is a unique Nash equilibrium, $\mathbf{d}_g^{NE}(s)$. That is, for each party i, $\mathbf{d}_{ig}^{NE}(s)$ solves:

(3) $$\max_{\mathbf{d}_{ig} \in D_{ig}} \pi_{ig}((\mathbf{d}_{ig}, \mathbf{d}_{-ig}^{NE}(s)), s).$$

The expected payoff to Party i under the static (i.e., spot) governance structure g is then

(4) $$V_{ig}^{ST} \equiv E_s\left[\pi_{ig}(\mathbf{d}_g^{NE}(s),s)\right].$$

and we write $V_g^{ST}$ for the total expected surplus, $V_g^{ST} \equiv \sum_{i \in I} V_{ig}^{ST}$. The optimal (second-best) governance structure solves

(5) $$V^{ST} \equiv \max_{g \in G} V_g^{ST}.$$

## 6. Discussion and Conclusion

### *6a. Joint Control*

All of the governance structures discussed above involve what we call "unique control:" any given asset or decision right is owned by exactly one party. We observe, however, that governance structures exist in strategic alliances that do not have this property. For instance, control over an asset might be vested in a joint venture owned by two or more parties. Such joint ownership requires a voting procedure, by which the varied preferences of the owners are combined into a decision on any given matter. Examples of such voting procedures include majority rule with votes proportional to ownership, majority rule by a board of directors appointed by owners, unanimity, or universal veto.

While a full analysis of the consequences of such voting procedures is beyond the scope of this paper, we note that these types of governance structures offer yet more possibilities for allowing decisions that cannot be contracted on *ex ante* to be decided *ex post* in ways that achieve efficient adaptation.

[More on this to come.]

### *6b. Relationships in Strategic Alliances*

The fact that the governance structures explored in Sections 3, 4 and 5 are generally 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 efficient.

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 Fuji-Xerox relationship 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 have another, then A's current actions with B may be influenced by A's potential future dealings with C. More generally, a network of indirect ties can facilitate information flows between firms that have not yet been alliance partners (Gulati, 1995b).

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.[7] 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.

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

[7] These data exclude 12 proposed mergers or acquisitions that were terminated prior to completion.

negligible. Finally, as discussed in Section 2 and depicted in Table 1 and Figures 1 and 2, the dense network of inter-relations in the biotechnology industry clearly suggests indirect ties between firms in the industry.

How might the presence of repeat interactions and a network or relationships affect decision-making, and the allocation of formal decision rights in strategic alliances?

[More to come]

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**Table 1**

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

| *Panel A*<br>*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*<br>*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 |

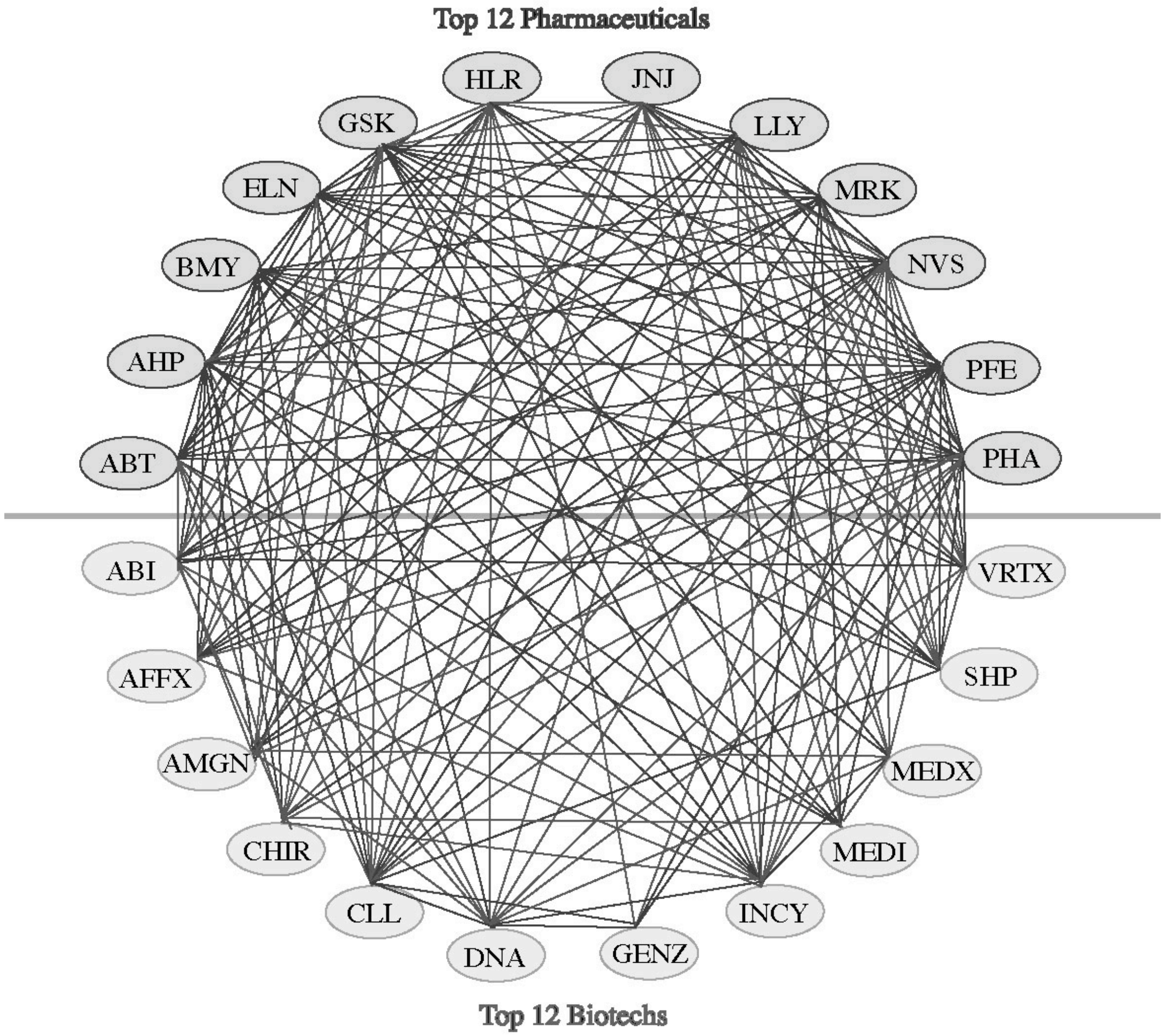
Note: Data extracted from Recombinant Capital database of alliances in the pharma-biotech industry, based on approximately 12,500 publicly disclosed contracts and arrangements. Companies ranked (and "top companies" defined) by number of alliances. The number of alliances reported excludes alliances with 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**

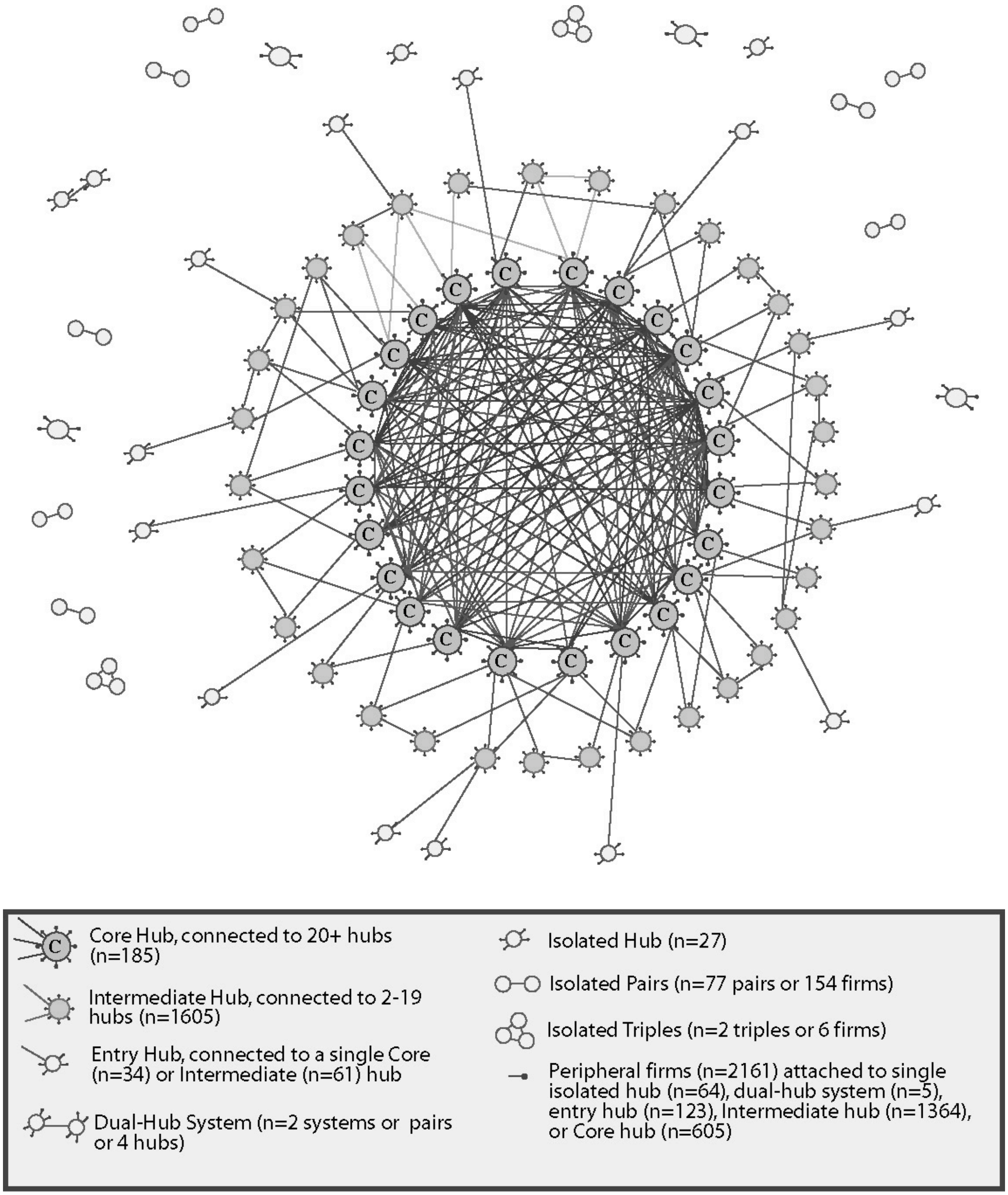
**Strategic Alliances Among the Top 12 Pharmaceuticals and Top 12 Biotechs**




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).

**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.