Strategic Alliances and the Boundaries of the Firm

David T. Robinson*
Fuqua School of Business
Duke University

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Abstract

Strategic alliances are long-term contracts between legally distinct organizations that provide for sharing the costs and benefits of a mutually beneficial activity. In this paper, I develop and test a model that helps explain why firms sometimes prefer alliances over internally organized projects. I introduce managerial effort into a model of internal capital markets and show how strategic alliances help overcome incentive problems that arise when headquarters cannot pre-commit to particular capital allocations. The model generates a number of implications, which I test using a large sample of alliance transactions in conjunction with Compustat data.

Diversification, corporate focus, and the allocative role of internal capital markets have received a great deal of recent attention as scholars explore how the organization of corporate investment affects firm value. Yet much of this work overlooks the fact that many investments take place between distinct firms, rather than within a single organization. What determines which activities occur inside firms and which activities occur between distinct firms? In this paper, I address this question by exploring the rise in popularity of strategic alliances.

As an illustration, consider the May, 2000, alliance between Novartis, a large, pharmaceutical firm, and the biotechnology research company Vertex. Through an initial $15 million payment, staged research grants totalling $200 million, and a licensing agreement, Novartis secured worldwide distribution, development and marketing rights to 8 drug candidates developed by Vertex.[1] Presumably, Novartis could have chosen to pursue similar investment internally by hiring scientists, purchasing equipment, and setting up a new division devoted to this activity. Why did Novartis instead choose to conduct this research through an arms-length contract with another firm?

The deal between Novartis and Vertex is hardly an isolated occurrence. According to the National Science Foundation, the amount of 'company-financed R&D contracted to outside organizations by R&D-performing companies' grew from $6 billion in 1997 to over $10 billion in 2003. Lerner and Merges (1998) suggests that throughout much of the 1990s, biotechnology firms relied on strategic alliances for the provision of capital to a greater extent than venture capital, IPOs or secondary offerings. Indeed, Lerner and Merges (1998) show that in 1995 alliance funding surpassed the next three most common sources combined. Nor are strategic alliances and joint ventures unique to research-oriented activities: my results illustrate that they are common across a wide range of business activities, including the retail, financial, and service sectors, pharmaceuticals, and computers.

My analysis proceeds in two steps. To motivate the empirical analysis, I start by developing a simple theory of project selection inside a firm, and then show how alliances can sometimes resolve the problems that arise when certain actions are non-contractible. The basic point of the model is that certain types of contracts are enforceable in alliances, but not in purely internal capital markets. When these contracts are important for providing incentives, alliances arise as a natural means of organizing economic activities. Like Fulghieri and Sevilir (2003), the model generates predictions about which type of organizational structure arises as a function of economic characteristics. These predictions guide the empirical analysis.

The basic intuition behind the model is as follows. Building on Stein (1997), the point of departure is a multi-division firm held together by a headquarters that operates an internal capital market. Internal capital markets allow headquarters to flexibly allocate what I call *implementation capital*—the resources required to bring a project to fruition, which may include production and marketing know-how, access to distribution channels, etc.—towards the projects with the most profitable opportunities. Each division's profitability is a function of the division-manager's effort, the state of nature, and the amount of implementation capital that it receives. Implementation capital is a scarce resource that is allocated after the headquarters learns about the profitability of each project. Headquarters can enhance the value of a diversified firm by moving resources ex post from low to high productivity projects (winner-picking). This is always ex post efficient, but when division-level managers base their effort choice on the expected actions of headquarters, the *ex post* efficiency of winner-picking is sometimes (but not always) offset by an adverse impact on *ex ante* effort choice.

Critically, I assume that headquarters cannot contract on how implementation capital is directed within the firm. This feature of the model follows Rajan, Servaes, and Zingales (2000) and Scharfstein and Stein (2000), and is designed to capture an important feature of the legal system, described by Williamson (1996) as legal forbearance. As Williamson argues, as a matter of practice courts refuse to hear disputes arising inside a firm that they would otherwise consider if the very same dispute were between two distinct parties in an arms-length contract. In essence, a contract within the firm to curtail winner-picking would be meaningless, because it would essentially be a contract between the firm and itself—no one would have standing to sue for breach if the contract were not honored. I capture this important feature of the legal system by assuming that ex post capital reallocation (i.e., winner picking) is non-contractible.

Because winner-picking is non-contractible, incentive problems arise for certain types of projects, which I call 'longshots.' Longshot projects have low success probabilities, but high payoffs conditional on success. Even though the longshot has the same expected value as its peer project (conditional on the same capital allocation), managers may be unwilling to supply effort: since the probability of success is relatively low for the longshot, the probability that resources will be diverted away from it is relatively high.

Since headquarters cannot contract with individual projects over the allocation of implementation resources, they instead choose the most efficient organizational structure given the incentive problems they face. I compare organizing the projects as two stand-alones, as a single conglomerate, or as two firms linked by an alliance, and study how each organizational form creates incentives for division-level managers to supply effort. In this model an alliance occurs when a division operates as a stand-alone firm but receives its implementation capital from the headquarters of the affiliated alliance partner, rather than developing it on its own. The contract, which is legally enforceable because it is written between two legally distinct entities, guarantees that the division will receive at least a baseline level of financing. In exchange, the parent firm receives a fraction of the alliance partner's output. Thus, alliances resolve contracting problems that surround resource allocations made in internal capital markets by facilitating the commitment to abandon winner-picking when it is ex ante inefficient. In the model longshot projects are the natural choice for alliance partners, since their ex ante incentives are the most compromised by winner picking.

The model generates empirical predictions linking the propensity of alliance activity to project characteristics. In the second part of the paper, I use these predictions to explore a large sample of alliance transactions coupled with COMPUSTAT industry and segment-level data. Two core findings emerge from my analysis.

First, I find that alliances are used to pursue related diversification. A firm is unlikely to initiate an alliance with another firm to conduct an activity in its main line of business; instead, alliances occur in secondary or tertiary lines of business, or else in lines of business in which a firm has no existing business segments.

Second, I find that alliances are used when the activity in question is riskier than a firm's primary activities. To illustrate this, I develop a number of distinct measures of risk. Comparing alliances to internal divisions, I find that the risk of a firm's alliance activity is significantly greater than the average of its internally organized projects. This holds for each of these measures. At a macro level, I compare the propensity of firms in two industries to be linked through an alliance to the propensity of a single, multi-division firm to operate lines of business in the same industries. Relating alliance intensity to differences in risk characteristics between the two industries, I find that inter-industry alliance intensity loads positively on risk differences.

These empirical findings support the main predictions of the model, which are that risk differences between projects are an important determinant of how projects are organized. In addition, I include controls for a variety of alternative explanations proposed in the economics and management literature. One explanation is that ownership should be allocated in order to provide incentives for marginal effort most efficiently (see, for example, Grossman and Hart (1986), Hart and Moore (1990)). Others are that alliances cluster in time depending on the technological life cycle (Cainarca, Colombo, and Mariotti 1992), or that absorptive capacity and differences in organizational types in different industries plays a role in facilitating knowledge transfers between firms (Mowery, Oxley, and Silverman (1996), Gans, Hsu, and Stern (2002)). I find a good deal of empirical support for these explanations, however introducing controls for these alternatives does not destroy my main empirical findings.

This work builds on a number of recent theoretical and empirical papers in corporate finance. The model is closely related to recent internal capital markets models (see Stein (1997), Stein (2002), and Brusco and Panunzi (2000)).[2] The closest theoretical work is probably Fulghieri and Sevilir (2003), which studies a spectrum of organizational alternatives available for the efficient production of R&D. While this paper also provides a model in which a variety of organizational structures arise as efficient responses to the contracting environment, in my model the contracting problem is driven by internal capital markets, whereas they study the effects of downstream competition on optimal organizational structure.

While this paper is the first to study alliances from an internal capital markets perspective, it adds to an empirical literature that studies strategic alliances and joint ventures more broadly. Chan, Kensinger, Keown, and Martin (1997) and Johnson and Houston (2000) and McConnell and Nantell (1985) study stock price reactions to alliance and joint venture announcements, and document a positive and significant announcement return. Allen and Phillips (2000) study changes in the operating characteristics of firms as a result of forming alliances with other companies. Lerner and Merges (1998), Lerner and Elfenbein (2003) and Lerner, Shane, and Tsai (2003) have investigated the allocation of control in strategic alliance agreements between pharmaceuticals and biotechnology research companies. Lerner and Merges (1998) finds that more control rights are allocated to the biotech when outside financing opportunities are relatively abundant. Robinson and Stuart (2006) study how formal and informal control mechanisms available to the contracting parties substitute for one another in strategic alliances.

The remainder of the paper is organized as follows. I provide the theoretical motivation for the empirical analysis in section 1. In section 2, I explore the empirical implications of the model. Section 4 tests the model, and section 5 concludes.

1. Theory

In this section, I develop a model that explores the tradeoff between internal capital markets and strategic alliances. The key feature of the internal capital market that is relevant for my analysis is the fact that internal capital markets create opportunities for winner picking. Winner picking is always optimal ex post, but can distort incentives ex ante, since the firm cannot contract on allocations of implementation capital.

1.1. Legal framework

Before exploring the model in detail, the key assumptions of the model warrant discussion. The main assumption that is critical for my analysis is that winner picking within a firm is not contractible. Assumptions along these lines appear in other internal capital markets models in which managerial effort is endogenous. For example, Rajan, Servaes, and Zingales (2000) and Scharfstein and Stein (2000) make similar assumptions analyzing how divisional managers may engage in costly rent-seeking activities.

More generally, I assume that contracts can be enforced only if they are written between legally distinct entities: contracts between two parts of the same legal entity are meaningless, since in such a case no party has standing to dispute the contract.[3] This assumption is based on the doctrine of forbearance, and is designed to capture an important distinction in the way the law treats contracts between distinct parties versus actions that take place inside firms. Williamson (*The Mechanisms of Governance*, 1996, chapter 4, p.98) describes forbearance as follows: "whereas courts routinely grant standing to firms should [disputes arise between firms] ...courts will refuse to hear disputes between one internal division and another over identical technical issues." The issue of forbearance is an important feature of the legal system that is relevant to the organizational design problem I study.

Numerous examples support this idea. The fact that management has the discretion of business judgment creates opportunities for it deprive others in the firm of private benefits. For example, if a computer company refuses to fund internal development for a new class of web-servers, disgruntled employees do not have standing to sue, since the decision to build web-servers is a matter of business judgment. In addition, there are a number of examples from the courts in which a firm has reneged on a commitment to an employee. A recent example is the case of Morris v. Schroder Capital Management International, detailed in Krasner (2005), in which an employee and a firm were in dispute over whether a clause in an employment granting the firm the right to renege was appropriate in a particular situation. The court ultimately allowed the firm to renege on a contingent claim (without regard to whether the clause is reasonable), because the action that led the firm to renege came about as a consequence of a normal business decision over which the employee had no recourse.

There are also examples involving organizational change, such as the spinoff of AT&T that created Lucent and NCR. News reports from the mid-1990s indicate that many workers were concerned about the spinoff. Many AT&T employees were attracted to the firm because they perceived working for phone company to be a stable, secure job (see Russakoff and Pearlstein (1996)). Workers who would later be employed by Lucent perceived high-tech start-ups to be risky organizations where the implicit, unwritten rules of employment were different, offering them far less job security. In the language of my model, it is as if the employees derived private benefits from job stability, and that these private benefits were undermined by the spinoff. Yet the employees had no means for restoring these private benefits, because the firm was simply exercising business judgment.

A second key assumption, which I discuss in greater detail below, is that employees of the firm are motivated by private benefits that are tied to the execution of the project they work on. Thus, in a sense, they face a holdup problem inside the firm, because they earn private benefits at the discretion of the headquarters, but they have no recourse if their project is not funded. The model illustrates how strategic alliances can solve this holdup problem by taking the activity outside the firm, where a stronger notion of contract enforcement gives the project manager recourse he would not otherwise have inside the firm.

Of course, it is natural to ask why firms do not rely on other mechanisms for hardening commitments when they face contracting impediments. After all, firms may be able to resort to a variety of alternatives, such as tracking stock, internal investment programs, employee equity programs, or other mechanisms for hardening its commitment to an employee. For example, consider the case of tracking stock: it separates the cash flow claims on a division from other divisions inside the firm, creating the potential for a distinct set of investors to own the division's cash flows. However, shareholders of tracking stock are shareholders in the parent company, not the division: therefore, this mechanism may be of limited value in hardening commitment, since it does not create a distinct organization (Chemmanur and Paeglis (2001), Logue, Seward, and Walsh (1996)). It does, however, potentially allow for greater division-level transparency, which may help to create scope for reputational concerns to play a role in enforcing commitments. In general, any mechanism that allows the headquarters to stake its reputation against a promise to provide future private benefits will help to harden the firm's commitment to a division.

The ability of firms to employ commitment hardening devices moves us away from the knife-edge, world of the simple theory set forth below to a more complex world in which alliances are chosen among a menu of alternatives. In such a world, the simple inequalities that give rise to sharp kinks in decision functions would be replaced by smooth lines which trace out the changing relative cost of an alliance as a function of the availability of these alternatives. Even so, the underlying economic rationale for an alliance, sketched forth below, would still be present.

1.2. Model Setup

The basic setup involves two operating units, $i = 1,2$, that can potentially be organized in a number of different ways. Because the legal boundaries of an organization are critical to the nature of the incomplete contracting problem, I distinguish between *operating units*, which are economic projects, and *firms*, which are legal entities. Each operating unit is a production function, $y_i = y_i(e_i, k_i, \theta_i)$, that combines effort ($e_i$) supplied by division managers, implementation capital (k_i) supplied by headquarters, and luck (θ_i) to generate output.

There are two types of agents in the model: division managers, who supply effort to economic projects, and a headquarters, which allocates implementation resources across the two projects. Following Stein (1997) and Stein (2002), I assume that division managers and headquarters are compensated solely through private benefits, which are proportional to gross output. Formally, for a given level of output y_i, this is given by $b_i(e_i, k_i, \theta_i) = \alpha y_i(e_i, k_i, \theta_i)$. This is their sole source of compensation. Thus, all agents are empire builders, but with different scope: headquarters prefers more profitable projects to less profitable ones, *ceteris paribus*, but will invest all the implementation capital it has available in at least one of the projects. In the case of a conglomerate, each manager prefers to see funds directed towards his own project, even if it is at the expense of more profitable investment elsewhere in the firm.

Figure 1 shows a time-line for the model. First, projects are paired and an organizational structure is chosen. This occurs at time 0. The two operating units can be organized in one of three ways: (a) as a single, centrally managed firm (one headquarters and two divisions); (b) as two independent, owner-managed firms; or (c), as two, legally distinct firms interlinked by an alliance contract. In an alliance, one project operates as a stand-alone firm but receives its implementation capital from the interlinked firm, rather than developing it on its own.

Conditional on the organizational arrangement chosen, managers supply effort at time 1. This can be either high (H) or low (L). High effort costs $c(H)$ and results in positive output; low effort is costless but produces nothing, regardless of the value of the other inputs.

After effort has been expended, the state of nature for each project is revealed. This is represented by θ, which is either good (G) or bad (B).[4] The good state of nature occurs for project 1 with probability p, for project 2, probability q. Without loss of generality, I assume that $q \leq p$: in particular, this means that project 2 will always be less likely to be the good project when only one of the projects is good. For simplicity, I assume that projects are statistically independent and have the same expected value conditional on high effort and a single unit of investment: $E(y_1(H,1,\theta_1)) = E(y_2(H,1,\theta_2))$. This, of course, means that $y_2(H,1,G) > y_1(H,1,G)$.

Conditional on the state of nature, the headquarters makes a noncontractible allocation of implementation capital, k, to a project. Implementation capital is a resource developed by the headquarters of the firm that encompasses the managerial oversight, production processes, marketing efforts, and other inputs required to take an idea from a division manager and bring it to fruition. To capture the idea that implementation resources are scarce, even in potentially large organizations, I assume that firms develop the resources that comprise implementation capital over time. Thus, it is not possible to simply go to capital markets and raise implementation capital at time 3, after the state of nature has been realized, by communicating a signal to the market that is correlated with θ. Instead, the firm must use implementation resources that have already been put into place before the resolution of uncertainty occurs.

A project can receive 0, 1, or 2 units of investment, and only two units of implementation capital are available in total to share across the projects. A project with zero investment is worthless, regardless of the effort spent. Otherwise, expected output is increasing in investment. I assume that there are (weakly) diminishing returns to investment, and that while the expected NPV of the first unit of capital is positive, the second unit of capital is positive NPV only if the good state of nature arises. Thus, a firm operating a stand-alone division has one unit of implementation capital, while a dual division firm has two units of implementation capital.

In the final period, all outputs materialize, rents are disbursed, and the firm is dissolved.

The timing of the model is such that the headquarters is always able to devote resources towards the project with the highest ex post return, regardless of the ex ante effort level chosen. Following Stein (1997), I make several assumptions to ensure that this winner-picking is sometimes appropriate. In addition, I assume that $y_1(H,1,G)+y_2(H,1,G) \geq y_i(H,2,G) \geq y_j(H,1,G)+y_i(H,1,B)$. The first inequality guarantees that both projects receive one unit of funding if both are good; the second inequality ensures that winner-picking is optimal in some states of nature.

1.3. The Benchmark Case: A stand-alone firm

To set a benchmark case for the subsequent analysis, consider the behavior division-manager operating in a stand-alone firm. In this case, the firm has a single unit of implementation capital which it always uses, regardless of the state of nature. In a stand-alone firm, the manager supplies high effort when the expected payoff conditional on high effort exceeds the cost of high effort:

$$c(H) < qb(H,1,G) + (1-q)b(H,1,B) = \alpha[qy(H,1,G) + (1-q)y(H,1,B)] \tag{1}$$

Since low effort is costless but produces nothing, it does not appear in Equation 1.[5] When this condition holds, the division manager finds it optimal to exert high effort, since the expected private benefits from supplying high effort exceed their cost. The important features of Equation 1 are that it guarantees one unit to the project in either state of nature, and that private benefits only depend on the project's own success probability, since there is only one project in the firm. This will serve as a basis of comparison in what follows.

1.4. Investment Opportunities in a Centrally Managed Firm

Now I examine which sets of projects can be feasibly conducted in a centrally managed firm facing a common internal capital market. To do this, I will assume that the firm is organized as a conglomerate and compare the feasible projects with those that exist under other organizational forms.

From the assumptions outlined above, the optimal strategy for headquarters, conditional on the managers' effort, is to provide one unit of funding to both projects if (G,G) or (B,B) arises, and to devote both units of funding to the good project if only one project is good (i.e., if either (G,B) or (B,G) arises). However, managers will anticipate this strategy, and this will affect their effort choice at time 0. Because each manager faces the possibility of being shutdown if his project is bad while the other project is good, the effort constraint for project 2 in the multi-division firm becomes:

$$c(H) < pqb_2(H,1,G) + (1-p)qb_2(H,2,G) + (1-p)(1-q)b_2(H,1,B) \tag{2}$$

When this inequality is satisfied, the manager of project 2 finds it optimal to supply high effort, since the cost of high effort is below its expected private benefit to the division-manager. Unlike Equation 1, Equation 2 shows that managerial incentives are driven by the outcome of their own project as well as the other manager's project, since the outcome of the other project helps to determine the allocation of implementation capital that each project receives. This creates two off-setting effects. On the one hand, there is more capital available in a conglomerate than in a stand-alone. On the other hand, this capital may be diverted to other uses. The following proposition summarizes this trade-off:

Proposition 1 (*Ex Ante* Incentives) *The manager of project* 2 *will supply more costly effort operating as a division of a centrally managed firm than as a stand alone if and only if* $(1-p)q[b_2(H,2,G) - b_2(H,1,G)] > p(1-q)b_2(H,1,B)$.

Proof: This result follows immediately by subtracting Equation 1 from Equation 2, from which the right-hand side of Equation 2 can be written as:

$$\underbrace{qb_2(H,1,G)+(1-q)b_2(H,1,B)}_{\textit{Stand Alone}}+\underbrace{q(1-p)(b_2(H,2,G)-b_2(H,1,G))}_{\textit{Expected Gain}} - \underbrace{p(1-q)b_2(H,1,B)}_{\textit{Expected Loss}} \quad (3)$$

If $q(1-p)(b_2(H,2,G)-b_2(H,1,G)) > p(1-q)b_2(H,1,B)$ holds, the cost of being shut down ex post by headquarters is outweighed by the extra incentives generated by the potential for a second unit of investment, which would otherwise not be possible in a stand-alone firm. If the inequality is reversed, then the incentive costs of being shut down exceed the gains generated by the second unit of investment. □

Based on Proposition 1, we can index projects by $c(H)$ and compare the types of projects that can be implemented under the two regimes. This is depicted in Figure 2, which plots incentive compatibility constraints as a function of relative success probabilities, holding the expected value of the projects constant. To derive this example I set p = .2, $y_1(H,2,G)$

= 2.6, $y_1(H,2,B) = y_1(H,1,G) = 1.3$, $y_1(H,1,B) = 1.1$, $y_2(H,2,G) = 2.8$, $y_2(H,2,B) = y_2(H,1,B) = 1.1$, and varied $y_2(H,1,G)$ along with q to keep the expected value of Project 2 equal to Project 1 as the payoffs changed. Along the horizontal axis is the ratio $\frac{q}{p}$, representing the degree to which project 2 is less likely to succeed. The horizontal line at c' represents the feasible effort set for an owner-managed firm facing constant expected value projects with a success probability q that varies between zero and one. The upward-sloping line represents the feasible sets available to the conglomerate. To the right of q^*, centrally managed firms dominate in the sense that they can elicit more costly effort from managers. These are situations in which the conglomerate can create added *ex ante* incentives with the promise of winner-picking because the projects are on sufficiently equal footing to make favorable resource diversion sufficiently likely.

Figure 2 also illustrates that the adverse affects of diversification on managerial effort prevent centrally managed firms from undertaking certain types of project pairs. This occurs when one of the projects is relatively more successful than the other–regardless of the size of the payoff in the successful state. To focus on this situation, when $q \ll p$, I say that project 1 is a *mainstream* project, whereas project 2 is the *longshot*. To the left of q^*, owner-managed firms dominate centrally managed firms, because the longshot expects resources to be diverted away from his project in a centrally managed firm but not in an owner-managed firm. This is captured in the following result:

Proposition 2 (Infeasible Investment) *Consider a project with success probability q and assume that high effort can be elicited if it were organized as a stand-alone. Assume that if it operates in a multi-division firm, it will operate alongside a project with success probability p. If $\frac{q}{p}$ is sufficiently low, it cannot be financed inside the multi-division firm, even though it could be financed as a stand-alone.*

Proof: The proof follows from Equation 3. For a given $c(H) > 0$, define q^* to satisfy Equation 1 with equality:

$$c(H) = q^* b_2(H,1,G) + (1-q^*) b_2(H,1,B).$$

Now consider the remainder of Equation 3; this captures the costs and benefits of operating a project with success probability q^*. From Equation 3, the incentive costs of multidivisional organization for a project with success probability q^* exceed the benefits whenever the following condition holds:

$$q^*(1-p)(b_2(H,2,G)-b_2(H,1,G)) < p(1-q^*)b_2(H,1,B)$$

Using the fact that private benefits are scalar multiples of output, this expression can be rearranged to obtain the following inequality:

$$\frac{q^*}{p} < \frac{1-q^*}{1-p}\left[\frac{y_2(H,1,B)}{y_2(H,2,G)-y_2(H,1,G)}\right] \tag{4}$$

Whenever the inequality in Equation 4 holds, q^* is too low relative to p to induce appropriate effort in a multidivision firm, even though by assumption q^* is sufficient to induce appropriate effort in a single-division firm. Since $q < p$ by assumption, the first expression on the right-hand side is greater than 1, and a sufficient condition for Equation 4 to hold is $\frac{1-q^*}{1-p} > \frac{y_2(H,2,G)-y_2(H,1,G)}{y_2(H,1,B)}$. $\square$

Intuitively, if q is sufficiently small, $q(1-p)$ is guaranteed to be too small for the expected benefits of winner picking to outweigh the longshot manager's expected effort costs. Therefore, he does not supply high effort, and the project is worth zero. Since the project is worthless ex ante, the firm can no longer raise a second unit of investment, and the multi-unit firm cannot be an equilibrium for two such projects.

1.5. Using Strategic Alliances to Solve the Longshot Problem

In this section, I show that (1) a strategic alliance between two owner-managed firms can resolve the longshot problem, and (2) alliances are sometimes preferred to simply having two, dissociated firms. In the context of the model, I say a strategic alliance occurs when the two projects are organized as separate legal entities, but are linked by a contract that specifies an amount of implementation capital k that flows from one firm to the other, and a rule for sharing the output that arises from the two projects. The main result from this section is that an alliance, if feasible, always features the mainstream project operating as an internal project, while the longshot project operates as an alliance partner, receiving its investment from the headquarters of the mainstream.

As before, I assume that all agents are motivated by private benefits. In particular, headquarters of the mainstream firm has private benefits which are proportional to the payoff of the mainstream, internally financed project, plus the proceeds coming in from the longshot, externally financed project. Similarly, I assume that the private benefits of the now-independent longshot are proportional to the output produced by that firm. This ensures that the total private benefits are held constant as the organizational structure is allowed to vary. Since contracts occurring between legally distinct entities are enforceable in this model, I suppress discussion of the sharing rule between the two firms and just assume that the entire output is transferred to the mainstream headquarters in exchange for the promise of investment capital. Thus, an alliance contract offers a guarantee to the longshot that a baseline level of funding will be provided. It is easy to see that the only optimal guarantee is to promise a single unit—two units is not positive NPV in expectation, and a guarantee of zero provides no added incentives.

Under this organizational structure, the headquarters of the internal project commits not to shut down the external project, but it still retains the ability to shut down the internal project if it fails. If j is the external project and i is the internal project, the condition for this to be optimal is $E[y_j(H,2,\theta) - y_j(H,1,\theta)] > y_i(H,1,B)$, which states that the expected gain from a second unit of funding in the external project has to exceed the value of the internal project, conditional on the bad state of nature arising for the inside activity. Whenever this condition holds, the headquarters will engage in 'one-sided winner-picking' provided that the bad state arises for the internal project.

Anticipating this behavior, the effort constraint for the division manager of project j under an alliance contract becomes:

$$c(H) < qb_j(H,1,G) + (1-q)b_j(H,1,B) + E(\Delta b_j(H,k^*,\theta_j|\theta_i = B)) \tag{5}$$

where $\Delta b_j(\cdot,k^*,\cdot)$ describes the expected change in private benefits brought about by an additional unit of implementation for the outside project. Since this term is always greater than or equal to zero, the maximum effort that can be sustained in an alliance is higher than in either a stand-alone or a conglomerate. Thus, comparing Equation 5 with Equation 1 illustrates that higher effort can be sustained under an alliance than if the project were operated as a stand-alone and developed its own implementation capital.

The analogous incentive condition for the manager of the inside project reflects the incentive costs associated with the one-sided winner-picking:

$$c(H) < pb_i(H,1,G) + (1-p)b_i(H,1,B) - E(\Delta b_j(H,k^*,\theta_j|\theta_i = B)) \tag{6}$$

These equations lead us to a comparison of the types of projects that can be undertaken through an alliance to those undertaken in stand-alone projects. Comparing these two equations to Equation 1, we see that any feasible longshot for a stand-alone is also feasible as an alliance. This is because $E(\Delta b_1(H,k^*,\theta_1|\theta_1 = B)) > 0$. However, for the same reason, an alliance may not be a feasible alternative for the mainstream firm.

The preceding discussion leaves open the issue of which project is organized in the alliance, and which project is organized as the internal project. There are two possible configurations. One is to have the longshot operate internally, facing possible one-sided winner-picking, while the mainstream project has guaranteed funding with an option for additional funding. The second configuration is to have the mainstream operate internally with the longshot operating as an alliance partner, relying on the mainstream headquarters for its allocation of implementation capital. The first configuration is never optimal. If an alliance is feasible, the latter configuration will always prevail. The following proposition establishes this result:

Proposition 3 (Risk-Ranking) *Consider two projects, 1 and 2, with equal expected values but different success probabilities p and q, respectively, with $q \ll p$. If the firm finds it optimal to form a strategic alliance with one of the projects, it will always choose to place project 2 in an alliance and operate project 1 internally.*

The intuition for this result follows from the fact that, in general, if the longshot's effort constraint is satisfied, then the mainstream's effort constraint is too. Moving a mainstream project inside a centrally managed firm generally eases the effort constraint, while moving an longshot inside generally tightens it. This is because the longshot provides a net effort subsidy to the mainstream project, since the presence of a second project allows the headquarters to seek a second unit of funding, but this funding will more likely go to the mainstream project, since it is successful more often. From the point of view of headquarters, this subsidy is sub-optimal whenever the effort constraint is slack for the mainstream project. If it is, the alliance will shift incentives from the agent whose effort constraint is slack towards the agent whose effort constraint is violated.

2. Testing the Model

2.1. The Longshot Hypothesis

The main prediction from the model is that projects with similar risk characteristics should be executed within the same firm, while otherwise similar projects with divergent risk characteristics should be executed through alliance agreements. When an alliance is chosen, the project with the lower success probability should be the alliance activity, and the safer projects should remain within the firm.

To formalize this prediction, I offer the following hypothesis:

Hypothesis 1 (The Longshot Hypothesis) *Longshot projects should be organized through alliances, while relatively safer projects should be organized within the firm. Thus, the risk difference between an alliance and an internal activity should be positive.*

This prediction arises because no contract is available between the headquarters and the division to ensure that the firm allocates its implementation capital in a manner that guarantees each project will receive a unit of funding. In the model, the closest that a firm can come to contracting on a capital allocation is to modify the organizational structure of the investment opportunity.

A natural empirical question that arises in light of this prediction is what alternative measures could firms adopt to address the longshot problem they face. In particular, why do wages not solve the incentive problem? In keeping with prior literature, I rule out the use of wages. This is done largely for simplicity. Even if I depart from prior literature and allow wages to enter the model, a firm would generally prefer to form a strategic alliance over paying a wage to a longshot manager, because paying a wage involves an ex ante commitment to reducing the firm's cash flows, whereas an alliance provides incentives by restoring private benefits.

But the focus on non-wage compensation can be justified in a number of ways. Aghion and Tirole (1997) assume that agents are infinitely risk-averse in monetary income, and thus receive a flat wage equal to zero. Likewise, effort may be non-contractible; the "division manager" can be thought of as an abstraction of a division-level team, in which each team member provides unobservable effort. In general, my assumption is consistent with private benefits driving marginal effort choices.

Notwithstanding the fact that private benefits drive marginal effort choices, there are essentially two types of wage contracts that could, in principle, resolve the ex ante effort problem in longshot projects. Since the problem arises because the project is shut-down when its state realization is low and the other project's is high, one solution is to pay the longshot manager in the shutdown state for his project an amount sufficient to cover the difference between his private benefits and effort costs in expectation.

I rule out this type of contract on the grounds that it creates internal pay equity problems inside the firm. That is, it looks like an insurance contract ex post; it optimally pays more when the project is shut down to smooth out the distortions that shutdown causes on ex ante effort.

A second type of wage contract that would work is to pay the longshot manager a bonus in the state in which his project is implemented. This gets around the internal pay equity problem, but cannot always be implemented if wages are paid from the internal proceeds of the firm. Since his longshot project is likely to be shutdown, the actual wage paid in that state must be large in order to have a sufficient effect on the division-manager's ex ante incentives. Therefore, a wage contract that does not violate an internal pay equity constraint generally offers large wages in the states in which they pay off, and thus may not be feasible.

2.2. Related Evidence on the Longshot Hypothesis

Before testing the longshot hypothesis on a large sample of alliances, it is worth noting that a number of recent papers on alliance activity have found evidence that supports this motivation for alliance formation. Comparing clinical trials data from biotechnology and pharmaceutical firms, Guedj and Scharfstein (2004) finds that small biotechnology firms are more likely to advance their drugs from Phase I to Phase II, even though their ultimate Phase II results are less promising than those of the larger pharmaceutical firms. This is especially true in firms with larger cash reserves.

Given that many small biotechnology firms receive substantial cash infusions from larger firms through alliance contracts (see Robinson and Stuart (2002), Robinson and Stuart (2006), Lerner and Merges (1998), or Lerner and Malmendier (2004)), this evidence is consistent with greater commitment in an alliance contract facilitating project continuation even when the ultimate success probability is low. Guedj (2004) sharpens this interpretation by directly examining alliance activity in pharmaceuticals: alliance-researched drug development is more likely to make it past phase I, but less likely to make it through phase II than in-house researched development. This finding is consistent with the alliance being used to "contract around" the fear of early termination in order to provide stronger incentives to the researcher.

More project-level support for the longshot hypothesis can be found in Palia, Ravid, and Reisel (2004), who study co-financing agreements in the film industry. Using measures of film-project risk such as the film's rating, they find that co-financing agreements are more likely the riskier the film, and that film companies are more likely to develop safer films in-house. They interpret this evidence as consistent with the model presented here.

2.3. Testing the Longshot Hypothesis

My goal here is to test the longshot hypothesis across a much larger sample of alliances than related work has considered. To do this, I develop a large sample of strategic alliances and examine characteristics of the alliance partners, comparing the risk of the alliance activity with the risk of activities that are conducted inside the partner firms. The sample and data set construction are described in detail in the next section; here I describe the empirical proxies that help me test the longshot hypothesis.

The main quantities of interest in the model are p and q, parameters which describe the success probability of each project, and thus the relative risk of the two activities studied in the model. Ex ante success probabilities at the project level are not generally observable, even if one had access to project level data. Therefore, one must generate a series of variables that allow us to proxy for the link between project success and organizational design choices. I develop four proxies for the risk difference between the alliance activity and the activity of the partner firms.

The first measure of risk is the intensity of research and development. This variable proxies for the human capital intensiveness of the alliance activity. At the same time, R&D intensive activities, by their very nature, often involve a high degree of uncertainty. Therefore R&D intensiveness is likely to capture an important dimension of the degree to which the riskiness of projects may differ. The longshot hypothesis predicts that the alliance activity would have higher R&D intensiveness than the mainstream project.

The next three measures of risk are based on an analysis of new firm creation in the industries in which alliances occur. Small firms often face a choice between accessing the public capital markets and relying on alliance financing (Lerner, Shane, and Tsai 2003). Thus, it is reasonable to think that recent IPOs operate projects that are in many ways similar to the projects operated through strategic alliances.

The three measures are the failure rate of new IPOs in an industry, the skewness in IPO returns, and the standard deviation in IPO returns. The failure rate of new IPO firms in the industry is intended to capture the idea that the alliance activity has a low ex ante success probability. If the success probability of an IPO is low, then this should manifest in a large number of IPOs de-listing either through merger or bankruptcy. The longshot hypothesis predicts that on average the failure rate should be higher in the alliance activity than in the firm's mainstream projects.

While the IPO failure rate proxies for the value of q in the model, the skewness in IPO returns proxies for the overall value of the payoff to the alliance activity. In the model, the alliance activity has a low success probability, but a high payoff conditional on success. Since ex post returns reflect shocks to cash flows, this feature of the model translates into skewness in returns.

The standard deviation of IPO returns is perhaps the most direct measure of risk. Given that the volatility of returns is increasing in the uncertainty surrounding the firm, this measure naturally captures the idea that alliances are riskier than a firms' internal projects. The longshot hypothesis predicts that the IPO return volatility is higher in alliance-intensive industries.

3. Data Description

3.1. Overview

I use the Securities Data Corporation (SDC) Strategic Alliance database to identify firms involved in strategic alliances. These data include 90,417 alliance transactions between 1985 and 2001. These data provide a broad survey of alliance activity across a variety of industries and countries over time, but also suffer from at least two important limitations. For one, alliances are self-reported events; there is no regulatory definition a business transaction must meet in order to qualify as an alliance. In addition, almost all project-specific details are absent from the data.

Due to these data limitations, I use only a handful of variables from the SDC data. First, I obtain the CUSIP identifiers for each firm in the alliance. Second, I obtain the SIC codes for each firm from SDC. SDC also reports the country of origin for each of the firms involved in the alliance; this is the third variable. The fourth variable is the SIC code of the alliance activity; as I show below, the industry classification of the alliance activity is often distinct from at least one of the firms involved in the alliance. The alliance may operate in a different country than any of its alliance partners (e.g., if a French company and a US company formed an alliance to mine for gold in Africa). Therefore, the fifth variable I use from SDC is the SDC record of the country in which the alliance operates.

3.2. The Time-Series of Alliance Activity

Table 1 provides descriptive information on alliance activity from 1985-2001 and compares alliance activity with other types of corporate events. I divide alliance activity into four (non-mutually exclusive) categories in the four columns on the left of Table 1. The first column simply records the total number of alliance transactions each year on the SDC tapes. The second column reports the time-series of alliances involving at least one US firm, or an alliance activity that took place in the US. In the earlier part of the data, US deals comprise a large fraction of total recorded deal activity, but this fraction is much lower in recent years. This surely reflects data collection biases inherent in the SDC database, and not a geographic shift in alliance activity.[6]

The next two columns of Table 1 report two sub-categories of alliance activity. The first shows the time-series of R&D-oriented transactions, and the second shows deals that are structured as joint ventures. A joint venture occurs when two or more firms form a new firm to undertake the activity in question. These classifications are based on flags on the SDC database. The columns reporting joint ventures and R&D deal activity are not restricted to include at least one US-firm, as in the second column; they are subsets of the column labeled “Total”.

Table 1 also reports the time-series of other corporate organizational events: spinoffs, mergers, and initial public offerings. IPOs are relevant partly because they proxy for new firm creation, but also because they reflect the availability of capital for small firms. As Lerner, Shane, and Tsai (2003) has shown, alliances in high-tech settings are often an alternative source of capital for small firms when the IPO market is cold. Mergers and spinoffs represent organizational changes in which a set of assets is moved across firm boundaries.

3.3. Related Diversification in Strategic Alliances

This subsection illustrates that strategic alliances are often used to pursue related diversification. This is important for two reasons. First, the fact that firms pursue related diversification through strategic alliances squares with the basic setup of the model. Second, many of the empirical proxies are calculated at the industry level. The fact that many alliance partners operate in related, but distinct, industries from the alliance activity creates scope for industry-level variation in risk proxies.

To show this, I relate the activity of the firms involved in the alliance to the alliance activity itself based on the industry classification data taken from SDC. Recall that SDC records an industry classification for each alliance partner, as well as for the alliance activity itself. The firms in question may have primary operations in the same industry as one another, or they may operate in industries distinct from one another. Likewise, the alliance activity itself may belong to the same industry as one (or all) of the collaborating firms, or it may involve an activity that belongs to a distinct industry from all of the firms collaborating in the activity.

Using industry overlap as a measure of diversification, we can define three levels of diversification. We can think of complete industry overlap between alliance activity and partner firm of as zero diversification. Similarly, we can define total diversification as the situation that occurs when there is zero overlap between the alliance industry and any of the firms in question. Finally, we can define related diversification as the situation that arises when one firm, but not all firms, operates in the same industry as the alliance activity. This is admittedly a crude way of defining diversification, but given the coarseness and breadth of the data, it is a convenient way of understanding the industry configurations that exist between alliance partners and between partners and the alliance activity itself.

Table 2 shows that related diversification is the norm in alliance activity. The left-hand side of Table 2 presents a tally of alliance activity each year and a measure of industry relatedness between the alliance industry and the main industry of the firms entering into the alliance. Each column reports the average proportion of alliances each year in which the industry of the alliance activity exactly matches one, but not all of the firms entering into the alliance. At the 1-digit industry level, roughly 70% of alliances involve related diversification. At the 2-digit level, 60% of alliances involve related diversification. This number drops to about 50% for the 3-digit classification level, and below 40% for the 4-digit industry level.

Thus, the left-hand side of Table 2 illustrates that alliances do not commonly involve a situation in which one alliance partner is operating in exactly the same industry as the alliance itself, but most alliances are situations in which one of the firms is operating in a nearby industry. Moreover, if we condition on similarity at the 1-digit level, and examine the conditional probability of similarity at the 2-digit level, we see that it is far more likely than what would be suggested by chance alone: roughly 85% (.60 divided by .71) of related diversification at the 1-digit level also matches the definition of related diversification at the 2-digit level. If the alliance partner that matched the industry of the alliance at the 1-digit level were drawn at random from the 2-digit sub-industries, and each sub-industry were equally likely, it would have roughly a one in ten chance of matching. Thus, industry affiliation is much higher than what would be suggested by chance.

While the left-hand side of Table 2 shows that at least one partner is often in a related industry as the alliance, the right-hand side of Table 2 shows that it is rare for both firms to belong to the same industry as the alliance. This part of Table 2 only considers alliances between exactly two partners: a quick comparison of the 'Total' column from the left-hand and right-hand side of the table indicates that these are the vast majority of alliances; over 85% of alliances satisfy this criterion.[7] Looking at only two-partner alliances, the remaining columns on the right-hand side tabulate the proportion in which both partners come from the same industry. It shows a much higher incidence of diversification, in that less than half of all two-partner alliances involve firms belonging to the same 1-digit industry classification. However, almost 75% of 1-digit matches also match at the two-digit level; if we use two-digit classification, thirty-five percent of alliances pair together firms from the same industry. Only 1 alliance in 5 pairs partners from the same 4-digit industry.

3.4. Empirical Strategy

Throughout the remainder of the analysis, I use two-digit SIC codes as my primary industry classification for the purposes of matching alliance activity to industry aggregate information. None of the results presented here, however, hinge on one particular industry classification scheme or another.[8] As discussed above, alliances most commonly involve exactly two firms. In this situation, SDC tracks 3 industry classifications of interest: the industry of each of the two partner firms, and the industry of the alliance activity. Typically one of the partner firms operates in the same industry as the alliance activity while the other firm operates outside that industry. I use this distinction to label an 'alliance firm' as the partner operating in the same industry as the alliance activity, and an 'outside firm' as the other firm.

In order to use the four risk proxies discussed above to test the longshot hypothesis, I merge data from COMPUSTAT in a number of ways. In the remainder of this section, I describe this in greater detail. First I describe a procedure for examining risk differences between firms involved in an alliance. Then I describe a procedure for comparing the risk of an alliance activity to the risk of other internal projects internal projects in the "outside" firm. Finally, I describe a procedure for examining industry-level variation in alliance intensity, to explore how it varies with risk proxies measured at industry level.

3.4.1. Firm-level Comparisons

The first test of the longshot hypothesis comes from firm-level comparisons based on classifying one firm as the "alliance" firm and the other firm as the "outside" firm. For this, I merge Compustat industrial data onto the SDC data in two ways: at the firm level using the CUSIP identifier, and at the industry level using the 2-digit SIC code associated with the firm in question.

The first approach allows me to measure R&D intensiveness at the firm level and relate it to alliance activity. I measure R&D intensiveness with the R&D/Sales Ratio, which is calculated using firm-level data from COMPUSTAT. For this measure, I use Compustat data item 45 divided by item 12, and merge this onto the SDC data at the firm-year level using the CUSIP identifier. For the outside firm this occurs in 25,556 alliances; for the alliance firm (the firm operating primarily in the same 2-digit industry as the alliance activity), I match SDC and Compustat in 18,062 alliances.

The second approach allows me to create the IPO-based risk proxies. These are all calculated using Compustat data at the 2-digit SIC level and then merged onto the SDC data. This merge is less problematic, since in this case I only require the 2-digit SIC classification of each to be present on the SDC and Compustat files, not the CUSIP. Here I am able to merge data for the outside firm in 87,830 alliances, but I only match on 61,835 alliances for the alliance firm.

To calculate each of the IPO-based risk measures, I begin by taking CRSP monthly stock returns and keeping only the first 60 months of data for each firm. This includes the initial IPO return, and all returns up to the firm's five year anniversary as a publicly traded firm. If the firm exits CRSP prior to its five year anniversary, I label this a failure. Then for each of the three measures, a forward-looking annual value is computed from the rolling, sixty-month pool of observations in a given 2-digit SIC industry. (I.e., sixty monthly observations are used to compute a single annual number assigned to the first year of the computation, and the pool rolls forward annually by adding twelve new monthly observations and dropping the oldest twelve observations.) The IPO variables are then constructed as follows.

The IPO failure rate is the number of failed IPOs (as defined above) divided by the total number of IPOs in that industry during that analysis window. This is expressed as a percent. The longshot hypothesis predicts that on average the failure rate should be higher in the alliance activity than in the firm's mainstream projects.

I measure skewness in IPO returns by calculating the Pearson's skewness of the pooled distribution of monthly stock returns. The longshot hypothesis predicts that on average the skewness should be higher in the alliance activity than in the firm's mainstream projects.

The standard deviation of IPO returns is perhaps the most direct measure of risk. This is simply the standard deviation of the pooled distribution of monthly stock returns. The longshot hypothesis predicts that the IPO return volatility is higher in alliance-intensive industries.

3.4.2. Comparing Alliance to Internal Business Segments

To compare the riskiness of the alliance activity to a firm's internal projects, I also examine these risk proxies among the subset of firms that are present both on the SDC data and the

Compustat segment tapes. For this part of the analysis, I append the Compustat segment file to the SDC data, keeping only "outside" firms that are present in both data sets in a given year. (If a firm was involved in an alliance in year t as the "outside" firm, then its segment-level data are aggregated to the firm-level and kept for that year.) This results in 8,033 firm-years and 8,285 alliances. A firm is kept only if it is the outside firm in the alliance; this facilitates a comparison between the projects that are operated inside the firm through internal segments, versus the projects that are operated outside the firm through strategic alliances.

Although I merge SDC data with the Compustat business segment data, I do not require that the R&D/Sales ratio is available from the segment data for a firm to be included in this part of the analysis. Instead, I simply take the average R&D/Sales ratio for the 2-digit SIC industry in question. Thus, all four risk proxies are calculated at the industry level for this part of the analysis. I then use the 2-digit SIC code of each business segment to merge these values onto the segment data.

3.4.3. Measuring Inter-industry Alliance Intensity

Finally, to study the relative intensity of alliance activity as compared to internal organization, I construct an industry-level matrix of alliance intensity. I begin by counting the number of alliances in year t that involve an alliance activity in industry i and an alliance partner in industry j. Since many alliances involve exactly one alliance partner operating in the same industry as the alliance activity, this places many observations along the diagonal of the matrix. (This biases against my finding significant results, since my tests are based on industry risk differences.) If no alliance occurred in industry i, then a zero vector is recorded for that industry. Similarly, if no alliance coupling involved industries i and j, then I record a zero for that element of the alliance matrix.

I perform a similar calculation to obtain the business activity occurring in internal segments between industries i and j. That is, anytime a multi-segment firm operates segments in industries i and j, I record an internal segment link between these industries. For example, AAR Corporation, which operates in the aerospace and aeronautics sector, reported segments in three 2-digit SIC industries. These were industries 35, 45, and 50. Thus, AAR Corp. would have contributed one link between industries 35 and 45, 35 and 50, and 45 and 50. Doing this for all such firms each year generates a measure of intra-firm segment intensity.

To create a measure of alliance intensity, I then calculate the natural log of the ratio of inter-industry (inter-firm) alliance activity to inter-industry (intra-firm) segment activity. This variable captures the relative propensity for two industries to be linked via alliances rather than being linked through connections that occur within the firm. If two industries are more commonly linked through alliances, this number will be large, while if two industries are more commonly linked within the firm, this number will be small.

I then calculate each risk proxy as the difference in the risk measures for the industries i and j in year t. Thus, a positive loading on a risk difference measure means that alliance intensity is higher between industries i and j when industry i, the alliance industry, is riskier than the industry of the partner firms.

In addition to calculating differences in the four risk measures developed above, I also calculate inter-industry differences in four other control variables. The dividend yield difference is the difference in the average dividend yield for firms in i versus firms in j. The excess cash measure is similarly calculated, and uses an excess cash measure obtained by deducting interest expense (item 15), CAPEX (item 128) and R&D expense (item 46) from net income (item 172). The difference in excess cash and dividend yields across industries measures differences in financing constraints between alliance industries and partner industries. I also measure the difference in the PP&E/Sales ratio for industries i and j to gauge the relative capital intensiveness of the two industries. Fourth, to control for alliance motives stemming from learning, licensing, or managerial risk-aversion discussed above, I also calculate the average difference in the market value of equity. For example, Mowery, Oxley, and Silverman (1996) argue that a firm's capacity to absorb knowledge from its partners is positively related to its size:

this suggests that we should expect to see a negative loading on the market value variable, since alliances initiated from industries dominated by large firms into industries dominated by small, innovative firms presumably reflects a desire to maximize knowledge flow into the larger organization.

4. Empirical Evidence on the Longshot Hypothesis

4.1. Evidence from Firm-level Comparisons

Table 3 compares risk characteristics between alliance firms and outside firms. Each row reports the mean value of a risk characteristic for the group of alliance firms and for the group of outside firms. The third column of numbers reports the t-statistic for the test that the outside firm group mean equals the alliance firm group mean.

The alliance activity is significantly riskier than the outside firm by any risk measure considered. The R&D to sales ratios for alliance firms are 50% higher on average than for the outside partner. And each of the industry-based risk measures is higher for the alliance firm than for the outside partner.

A number of other papers make predictions that are broadly consistent with these findings. For example, Contractor and Lorange (1988) argue that managerial risk-aversion may lead managers in larger companies to push riskier projects outside the firm. Gans, Hsu, and Stern (2002) argue that young start-up companies are more likely to license their technologies than pursue stand-alone strategies when they operate in regimes with stricter intellectual property rights, and where established firms have market power. These explanations would predict, among other things, that the outside partner firm would be larger than the alliance firm. I find support for this in Table 3, when I compare the market value of equity for the alliance firm to that of the outside partner. This also supports Mowery, Oxley, and Silverman (1996), who argue that large firms may use alliances with smaller firms to acquire technology.

To explore this further, I also examine the dividend yield for alliance firms and outside partners as a measure of resource constraints. Higher dividend yields indicate older, more firms that are less cash hungry. The dividend yield is lower for alliance firms than for outside partners. This supports a possible alternative explanation offered by Cainarca, Colombo, and Mariotti (1992), who argue that alliances are more common in the early days of an industry: during the early days of an industry, the industry is likely in a growth phase, with profits being plowed back into the industry to fund subsequent growth. As the industry matures, its dividend yield increases. This also supports the broad predictions of Contractor and Lorange (1988) (since more risk-averse managers may select into older, more mature firms), as well as Mowery, Oxley, and Silverman (1996) and Gans, Hsu, and Stern (2002) (since dividend yields are lower in young, high-tech industries).

4.2. Comparing Alliances to Internal Segments

Table 4 repeats the basic message of Table 3, but performs the analysis using the SDC/Compustat segment merged data described in Section 3.4.2. The column labelled 'internal segment' reports the mean value for the firms' internal segments, while the column labelled 'alliance activity' reports the mean value of each risk characteristic for the firms' alliance activity. The third column of numbers again reports the t-statistic for the test of the equality of group means. Once again, the alliance activity is riskier than the firm's other internal segments by any measure considered. The only measure that is not statistically significant is the IPO skewness measure.

Tables 3 and 4 each demonstrate that alliances are typically organized in riskier areas than a firm's other lines of business. This can be seen either by comparing the firm in the industry of the alliance activity to the outside partner involved in the alliance, or by comparing the outside firm's internal projects to its alliance activity. In the next subsection, I explore this further with regressions of alliance intensity on differences in risk characteristics.

4.3. Explaining Inter-Industry Alliance Intensity

The previous two subsections presented firm-level evidence in favor of the longshot hypothesis. In this section, I examine the longshot hypothesis using the inter-industry matrix of alliance intensity described in Section 3.4.3.

Tables 5 and 6 report OLS regressions of alliance intensity on risk differences and the control variables. Organizing the data as a series of industry matrices of alliance intensity results in a panel data set in which each industry pair (i, j) in a given year t is a single observation. Thus, I cluster the standard errors annually to account for dependence across observations that might arise from alliance waves driving alliance formation across a range of industry pairings. For example, the tech boom no doubt produced many alliances across a variety of technology-intensive industry pairs that are potentially correlated within a given year. Clustering at the year level helps to control for this.

Columns (1) through (4) of Table 5 focus on each risk difference in isolation. Each regression includes control variables, but similar results obtain in univariate regressions. In each column, we see that alliance intensity loads positively on the risk difference measure. Except for the IPO failure rate variable, the measures are each statistically significant. The controls for financing constraints indicate that alliance intensive industries are generally more financially constrained than the industries from which their partner firms arise. Likewise, capital intensity is generally higher in the partner industry, although this variable is not statistically significant. The explanatory power of the regression is low, but in each case the F-test of the overall significance of the regression is highly statistically significant.

Column (5) includes each of the four risk difference measures simultaneously. The difference in IPO failure rate loses significance, but the other risk measures are each significant when included together. And regardless of the specification, the difference in size comes in negative and highly significant, indicating that outside industry firms are on average much larger when alliance intensity is high. By including the four risk measures simultaneously, this helps to account for the fact that a variable like R&D/Sales may be picking up some alliance motivation along the lines of Cainarca, Colombo, and Mariotti (1992) or Mowery, Oxley, and Silverman (1996), both of which (for different reasons) would posit a link between R&D intensity and alliance activity. The fact that these controls do not drive out the significance of the risk difference measures suggests that risk differences are important even after controlling for the learning, licensing and managerial risk-aversion alternatives discussed above.

One concern with the alliance intensity variable is that it tracks the activities of public and private firms in the numerator, but only public firms in the denominator. Thus, correlation between the prevalence of private firms and the risk characteristics of the industry might create measurement problems.[9] For example, Cainarca, Colombo, and Mariotti (1992) argue that the propensity to engage in collaborative agreements is a function of the phase of the industry technological life cycle. If many nascent firms are formed to commercialize variants of a newly developed technology, and these firms are too young to be publicly traded, then a correlation may naturally arise between the technological life cycle of the industry and the discrepancy in the numerator and denominator in the alliance intensity variable.

To guard against this, I construct a variable that helps to control for patterns of public ownership across industries. I use Standard Industrial Classification (SIC) data from the Bureau of Labor Statistics (BLS) Quarterly Census of Employment and Wages (QCEW) program to construct a measure of the total employment in publicly held and private firms in a two-digit SIC industry. The census program is supervised by BLS's Office of Employment and Unemployment Statistics, and provides tabulations on the employment, total wages, and reporting units of employers covered by various unemployment insurance programs.[10]

The Census tracks employment data on numerous types of reporting units, but I focus solely on firms operating in the private sector (i.e., publicly held and private firms) and obtain two-digit SIC level average annual employment. Then I turn to Compustat and compute an analogous measure by summing up the number of employees working in an industry. The difference between the Compustat measure and the BLS measure for each 2-digit SIC industry gives me a measure of the ratio of publicly held firms to total organizations.

Since the data in tables V and VI is at the industry-pair level, I compute:

$$Public/Private_{ijt} = (\mathrm{BLS} - \mathrm{Compustat})_{\mathrm{it}} - (\mathrm{BLS} - \mathrm{Compustat})_{\mathrm{jt}} \tag{7}$$

where BLS and Compustat refer to industry-level total employment figures from the two data sources. Basing the measure on average employment helps to address the fact that large organizations may have greater absorptive capacities and thus may be responsible for more alliance activity (see also Cohen and Levinthal (1990) and Gambardella (1992)). However, in unreported regressions I have replaced employment with an analogous calculation based on the number of reporting units and obtained similar results to the ones reported below.

The loading on the public/private control variable is highly significant. The interpretation of the point estimate is that when there are many private firms in an industry relative to public firms, alliance intensity is higher. Including this control helps guard against the possibility that the results are spuriously arising from cross-sectional variation in the propensity for industries to be composed of publicly traded firms. This might be the case if nascent firms cluster in risky industries, and also rely on alliances for commercialization (Gans, Hsu, and Stern 2002), but risky industries per se are no more likely than other industries to be alliance intensive. Given that private firms are also likely to be smaller, the loading is also consistent with Mowery, Oxley, and Silverman (1996), since it is further evidence that alliances facilitate knowledge flows from new, small organizations, to larger, older, more established organizations. Yet, in spite of these controls, we still see that risk differences are important for explaining patterns in alliance activity.

As a robustness check, I repeat this analysis in Table 6, but only use data from 1991 and onward. Since the data set records a dramatic increase in alliance activity in the early 1990s, this guards against the possibility that the earlier data are recorded with error, or are less representative of the overall alliance population. The results in Table 6 closely mirror those obtained over the entire sample, but are somewhat weaker.

Overall, the loadings on the risk difference measures indicate that alliance intensity relative to the intensity of internal organization is greatest when the risk difference between the industries is large. Alliance intensity between two industries falls when the risk difference is less pronounced. These findings support the predictions of the model.

5. Conclusion

In this paper, I propose and test one potential theory for the popularity of strategic alliances. The main idea behind the theory is that certain types of contracts are not enforceable when they are written within firms, but they are enforceable when they are written between distinct firms. To test the model, I employ a large data set of alliance transactions and relate the frequency of alliance activity to firm- and industry-level characteristics that are intended as proxies for project characteristics. The findings offer new evidence of the relative importance of various organizational forms in different industry settings. Comparing alliances and internal divisions, I find that on average alliances occur in riskier industries than do internal projects do. Thus, alliances are used to organize activities that are riskier than a firm's average inside project. Expanding this to an industry-level analysis, I find that alliance intensity across industries is positively associated with the risk difference between the two industries. The industry of the 'alliance' or 'target' activity is generally riskier, by a broad range of measures, than the activity of the firms internal projects.

The empirical picture that emerges from this analysis is that alliances are used when there is a disparity between a firm's existing operations and the firm's new activity. Internal capital markets are used when the projects in question are similar.

These empirical findings are important for several reasons. First, they complement a growing theoretical literature in corporate finance that examines alliance formation (see Fulghieri and Sevilir (2003) or Mathews (2006) for recent examples) with important facts about their use. As Zingales (2000) has argued, the theory and practice of corporate finance is predicated on a particular theory of organization. These findings provide strong evidence that optimal organizational arrangements vary considerably from one economic setting to another. Thus, the appropriate organizational basis for a particular view of corporate finance may depend on the particular economic setting in question.

Most importantly, the results illustrate the prevalence of cross-firm investment activity, suggesting that a deeper understanding of problems such as the relation between investment and cash-flow may hinge on a better understanding of the organizational arrangements chosen to conduct these activities. Indeed, alliance and joint venture activity provides an interesting opportunity to study the determinants of the boundaries of the firm, and to gain a better understanding of the effect of the organization of corporate investment on firm value.

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Notes

[1]Source: Vertex press release, obtained from Recombinant Capital <http://www.recap.com>.

[2]See also Scharfstein and Stein (2000) and Rajan, Servaes, and Zingales (2000) for two papers that study how wasteful rent-seeking, or sub-optimal investment choices arise in the context of an internal capital market.

[3]A recent line of television advertisements for Coca Cola's CokeOne product, in which Coke wishes to sue itself for infringing on its own product, plays on the humorous absurdity of suing oneself.

[4]Thus, effort is not modelled as an action that influences the probability that the good state arises. Equivalently, it is modelled as affecting the value of the cash flows that arise conditional on the good state occurring.

[5]Since y_i is a function of effort, capital allocation, and a random shock, so is the private benefit. Thus, I write $b_i = b(e_i, k_i, \theta_i)$ throughout the analysis that follows and suppress the αy.

[6]These trends in the data coincide with the passage of legislation such as the National Cooperative Research Acts, which lowered the penalties associated with inter-firm collaboration. Majewski and Williamson (2002) note that only a relatively small number of alliances are ever formally filed under the NCRA. Nevertheless, the passage of such legislation could act as a broad signal to industry indicating greater regulatory permissiveness, in which case its scope might extend beyond those firms that filed under it directly.

[7]To be precise, 78,678 involve exactly two alliance partners, while 8,117 records are transactions between three firms. 2,047 deals are four-way alliances, and the remaining 1575 in-

volve more than four partners.

[8]In Robinson (2001) I provide a broad range of findings similar to those reported here, but using Fama-French industry classifications. See Bhojraj, Lee, and Oler (2003) for a recent critique of this classification system.

[9]I am grateful to the referee for pointing out this issue.

[10]Frequently asked questions about the data are addressed online at http://www.bls.gov/cew/cewfaq.htm.

Figure Legends

Figure 1: This figure displays the timeline of investment decisions faced by headquarters and managers. First, an investment opportunity arrives at a firm that is already engaged in a single production activity. Initially, headquarters chooses whether the organizational structure of the two activities. Then, managers select an effort level, which is either H or L. Next, nature moves, determining whether the projects is good G, or bad, B. After the manager has exerted effort and the state of nature is revealed, the headquarters chooses a level of investment, which is either 0, 1, or 2 units. At time 3, $y(e,k,\theta)$ is determined, rents are disbursed, and the firm is dissolved.

Figure 2: This figure displays the maximum sustainable *ex ante* effort costs for project 2 as a function of the success probabilities of project 1 and 2. The horizontal axis displays the ratio of the success probability of project 2 to project 1. The horizontal dashed line is the effort cost that can be sustained in a stand-alone firm, whereas the upward-sloping line depicts the effort cost that can be sustained when the same activity is included in a centrally-managed firm with another project. The parameters are p = .2, $y_1(H,2,G)$ = 2.6, $y_1(H,2,B) = y_1(H,1,G) =$ 1.3, $y_1(H,1,B) = 1.1$, $y_2(H,2,G) = 2.8$, and $y_2(H,2,B) = y_2(H,1,B) = 1.1$, To motivate comparison between projects of different success probabilities, $y_2(H,1,G)$ is varied along with q to keep the expected value of Project 2 equal to Project 1 as the payoffs changed.

Table 1

Trends in Strategic Alliances and Other Corporate Events: 1985-2001

This table presents a summary of strategic alliance activity by year, for different types of alliances. Strategic alliance data come from Securities Data Corporation (SDC). Total refers to all deals recorded on the SDC database, regardless of the country of origin of the firms in the alliance. US deals refers to deals in which at least one firm involved in the alliance is a US firms. R&D deals are those flagged by SDC to pertain to research and development activity. JVs are deals structured as joint ventures, in which a new, legally distinct, firm is created to oversee the activity in question. 'Year' refers to the year in which the agreement was announced. Merger counts are from Mergerstat Review, IPO data are from Jay Ritter's IPO website, updated from Ibbotson, Sindelar, and Ritter (1994), and spinoff data are from the SDC M&A Database.

	Strategic Alliance Activity:				Other Corporate Transactions:		
Year	Total	US Deals	R&D Deals	JVs	IPOs	Spinoffs	Mergers
1985	610	552	26	111	507	28	3001
1986	799	713	40	287	953	39	3336
1987	819	707	71	211	630	31	2032
1988	984	804	89	429	227	50	2258
1989	1046	805	154	393	204	46	2366
1990	3639	2606	660	1848	172	58	2074
1991	6118	4026	1262	3128	367	25	1877
1992	5996	3815	1494	1910	509	55	2574
1993	6890	4031	1609	3018	627	52	2663
1994	8374	4845	1857	4411	568	43	2997
1995	9095	4989	1454	5699	566	71	3510
1996	5212	2987	683	2898	845	85	5862
1997	6776	4082	949	3439	602	81	7848
1998	7845	4550	542	2879	344	75	8047
1999	8759	5161	410	2997	505	72	9628
2000	10485	5221	602	3404	354	93	11,123
2001	6970	3367	534	2198	84	40	8545
Total	90,417	53,261	12,436	39,260	8,064	944	79,741

Table 2
Related Diversification in Strategic Alliances

For each year, this table reports the total number of alliances as well as the fraction of alliances satisfying certain diversification criteria. In each bank of numbers, column headings 1-dig. through 4-dig. refer to whether a 1, 2, 3, or 4-digit SIC classification scheme is used to define the industry. In the first bank of numbers, the total number of SDC alliance transactions is reported, along with the fraction in which one alliance partner, but not both alliance partners, operates in the same industry as the alliance activity in question. In the second bank of numbers, attention is restricted to alliances involving exactly two members. (Over 85% of total transactions satisfy this criterion; of the remainder, 8,117 alliances involve exactly three firms, 2,047 involve four firms, and the rest involve five or more firms.) The fractions indicate what percentage of alliances involve two partners from the same industry forming an alliance with one another.

		$\geq$ 1 firm in alliance industry:					Both firms in alliance industry:			
Year	Total	1-dig.	2-dig.	3-dig.	4-dig.	Total	1-dig.	2-dig.	3-dig.	4-dig.
1985	610	0.74	0.60	0.48	0.33	578	0.30	0.19	0.10	0.07
1986	799	0.76	0.60	0.50	0.35	750	0.37	0.23	0.14	0.09
1987	819	0.79	0.63	0.51	0.34	789	0.33	0.21	0.12	0.09
1988	984	0.78	0.64	0.53	0.41	909	0.40	0.26	0.18	0.13
1989	1,046	0.80	0.69	0.56	0.40	977	0.41	0.27	0.17	0.11
1990	3,639	0.78	0.66	0.54	0.39	3,205	0.50	0.35	0.26	0.18
1991	6,118	0.78	0.67	0.55	0.42	5,339	0.49	0.34	0.26	0.20
1992	5,996	0.62	0.53	0.43	0.32	5,418	0.53	0.39	0.31	0.23
1993	6,890	0.69	0.57	0.45	0.34	5,890	0.50	0.38	0.29	0.21
1994	8,374	0.74	0.63	0.51	0.39	6,961	0.50	0.37	0.27	0.20
1995	9,095	0.75	0.63	0.51	0.40	7,626	0.49	0.35	0.27	0.20
1996	5,212	0.68	0.56	0.44	0.33	4,466	0.47	0.33	0.24	0.17
1997	6,776	0.69	0.57	0.45	0.33	5,796	0.49	0.35	0.25	0.18
1998	7,845	0.69	0.58	0.48	0.38	6,935	0.49	0.36	0.27	0.20
1999	8,759	0.68	0.58	0.48	0.36	7,837	0.48	0.36	0.26	0.18
2000	10,485	0.70	0.62	0.51	0.37	8,987	0.45	0.35	0.26	0.17
2001	6,970	0.66	0.56	0.46	0.35	6,215	0.46	0.34	0.26	0.17
Total	90,417	0.71	0.60	0.49	0.37	78,678	0.48	0.35	0.26	0.19

Table 3
Are Risk Differences Important?: Alliance vs. Outside Firms

This table reports differences in risk characteristics between the alliance activity and the firms operating the alliance. In an alliance between exactly two firms in year t, the 'Alliance firm' is the firm operating in the same industry as the alliance activity. 'Outside firm' is the firm operating outside that industry. The column labelled 't(diff)' reports values of a t-statistic from an unpaired t-test of equality of the two groups. The risk measures are calculated at the 2-digit SIC code level, except for the R&D/Sales ratio, which is the R&D/Sales ratio for the firms in the alliance. IPO failure rate for 2-digit industry j at time t is the number of IPOs that delist within a 60 month window beginning in January of year t to the total number of IPOs occurring in the same window. IPO return skewness for industry j at time t is the skewness in the buy and hold return for IPOs in that window. IPO return volatility for industry j at time t is the standard deviation of monthly stock returns for all companies that IPO in that 60-month window beginning in January of year t. Market value of equity is year-end price times shares outstanding from Compustat, while dividend yield is annual dividends divided by year-end price, both from Compustat.

Risk Characteristic	Outside Firm	Alliance Firm	t(diff)
Firm-level risk measures:			
R&D/Sales Ratio	1.42	2.19	-43.23
Industry-level risk measures:			
IPO Failure Rate	8.09	8.54	-19.54
IPO Return Skewness	0.75	0.93	-14.15
IPO Return Volatility	1.56	1.63	-35.77
Other firm-level measures:			
Market Value of Equity	22,063	16,764	9.94
Dividend Yield	5.08	3.17	15.56
Total firms	87,830	61,835	

Table 4

Are Risk Differences Important?: Alliances vs. Internal Segments for Outside Firms

This table restricts attention to "outside" firms that appear on the Compustat segment tapes in the same year that they are recorded on SDC as conducting alliance activity. The table reports differences in risk characteristics between the alliance activity and the firm's internal segments. The column labelled 'Internal Segment' lists the mean of the risk measure for the firms' internal segments. The column labelled 'Alliance Activity' lists the same for the firms' alliances. The column labelled 't(diff)' reports values of a t-statistic from an unpaired t-test of equality of the two groups. The column labelled 't(diff)' reports values of a t-statistic from an unpaired t-test of equality of the two groups. See Table 3 for variable definitions.

Risk Characteristic	Internal Segment	Alliance Activity	t(diff)
Firm-level risk measures:			
R&D/Sales Ratio	1.59	1.71	2.47
Industry-level risk measures:			
IPO Failure Rate	8.22	8.55	4.93
IPO Return Skewness	0.61	0.65	1.22
IPO Return Volatility	1.60	1.63	4.99
Total firm-years/alliance-years	8,033	8,285	

Table 5
Risk Differences and Inter-Industry Alliance Intensity

The dependent variable is the alliance intensity between industries i and j at time t. This is the natural log of the ratio of alliances links between industries i and j to internal segment links between i and j. An alliance link between i and j occurs when an alliance activity in industry i is formed with firms operating in industries j. An internal segment link occurs when a segment in industry i is operated by a firm that also has a segment in industry j. The independent variables are calculated as the difference in the industry average between industries i and j in year t. Since the numerator of the dependent variable (from SDC) includes public and private firms, while the denominator of the dependent variable (from Compustat segment data) contains only public firms, the variable Public/Private is included to account for variation in public/private firms across industries i and j. This variables compares the number of employees reported on Compustat with the number the Bureau of Labor Statistics Census of Employment and Wages annual national survey of public and private firms. The variable is calculated as the difference in the two data sets in industry i minus the difference in industry j. 67,032 observations are used, corresponding to the number of i, j industry pairs for each year between 1983 and 2001. Industries are defined at the 2-digit SIC code level. Standard errors are clustered at the annual level, and the corresponding t-statistics are reported below point estimates. A single asterisk denotes significance at the 5% level; two asterisks, the 1% level. The F-statistic tests the null that the overall explanatory power of the regression is zero, which is rejected in all cases. A constant term is included in each regression but suppressed for brevity.

	(1)	(2)	(3)	(4)	(5)
R&D/Sales Ratio	0.008				0.008
	(2.57)*				(2.45)*
IPO Failure Rate		0.000			-0.000
		(0.86)			(0.20)
IPO Return Skewness			0.019		0.027
			(2.85)*		(3.66)**
IPO Return Volatility				0.012	0.020
				(2.53)*	(3.10)**
Dividend Yield	0.994	0.851	0.943	0.919	1.293
	(2.37)*	(2.00)	(2.28)*	(1.76)	(2.34)*
Excess Cash	-0.031	-0.031	-0.032	-0.029	-0.028
	(3.45)**	(3.61)**	(3.89)**	(3.21)**	(2.86)*
PP&E/Sales Ratio	-0.023	0.004	-0.005	0.015	-0.019
	(0.18)	(0.04)	(0.05)	(0.13)	(0.14)
Market value of equity	-0.002	-0.001	-0.002	-0.001	-0.002
	(1.65)	(1.49)	(1.90)	(1.40)	(2.28)*
Public/Private	0.012	0.011	0.010	0.011	0.010
	(3.69)**	(3.46)**	(3.28)**	(3.37)**	(2.70)*
F-test	18.27	12.78	16.46	10.35	22.59

Table 6
Risk Differences and Inter-Industry Alliance Intensity: post-1990

The dependent variable is the alliance intensity between industries i and j at time t. This is the natural log of the ratio of alliances links between industries i and j to internal segment links between i and j. An alliance link between i and j occurs when an alliance activity in industry i is formed with firms operating in industries j. An internal segment link occurs when a segment in industry i is operated by a firm that also has a segment in industry j. The independent variables are calculated as the difference in the industry average between industries i and j in year t. Since the numerator of the dependent variable (from SDC) includes public and private firms, while the denominator of the dependent variable (from Compustat segment data) contains only public firms, the variable Public/Private is included to account for variation in public/private firms across industries i and j. This variables compares the number of employees reported on Compustat with the number the Bureau of Labor Statistics Census of Employment and Wages annual national survey of public and private firms. The variable is calculated as the difference in the two data sets in industry i minus the difference in industry j. 42,051 observations are used, corresponding to the number of i, j industry pairs for each year between 1991 and 2001. Industries are defined at the 2-digit SIC code level. Standard errors are clustered at the annual level, and the corresponding t-statistics are reported below point estimates. A single asterisk denotes significance at the 5% level; two asterisks, the 1% level. The F-statistic tests the null that the overall explanatory power of the regression is zero. The difference between the number of clusters and explanatory variables does not allow the F-statistic to be calculated in column (5). A constant term is included in each regression but suppressed for brevity.

	(1)	(2)	(3)	(4)	(5)
R&D/Sales Ratio	0.009				0.009
	(2.38)*				(2.34)*
IPO Failure Rate		0.000			-0.001
		(0.10)			(1.01)
IPO Return Skewness			0.018		0.026
			(1.84)		(2.67)*
IPO Return Volatility				0.016	0.028
				(2.57)*	(3.45)**
Dividend Yield	1.211	1.055	1.154	1.162	1.491
	(2.21)	(1.93)	(2.21)	(1.60)	(1.86)
Excess Cash	-0.035	-0.036	-0.037	-0.033	-0.033
	(3.06)*	(3.30)**	(3.36)**	(2.82)*	(2.51)*
PP&E/Sales Ratio	0.010	0.043	0.043	0.053	0.033
	(0.07)	(0.39)	(0.44)	(0.41)	(0.21)
Market value of equity	-0.001	-0.001	-0.001	-0.001	-0.002
	(1.23)	(1.12)	(1.37)	(1.07)	(1.84)
Public/Private	0.017	0.016	0.015	0.015	0.016
	(4.97)**	(4.75)**	(4.55)**	(4.49)**	(4.01)**
F-test	16.53	12.74	14.89	13.08	-

Figure 1. Timing of Investment Decision

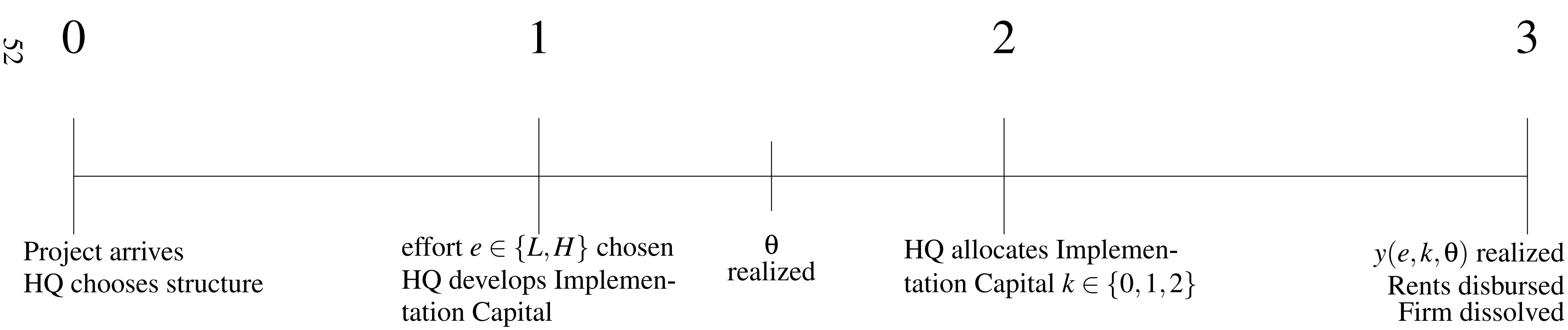

Figure 2. Ex Ante Incentive Constraints for Owner-Managed and Centrally-Managed Firms