Governance Mechanisms in Collaborative Relationships Involving Not-for-Profit Organizations*

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Current Draft: September 15, 2004

* The authors are grateful to Harold Mulherin, Martin Grace, Keith Crocker, Rick Dark, and Rich Phillips for helpful discussions and comments, and to David Gaines for research assistance. The authors acknowledge the data support of the personnel from the Air Force Office of Technology Transfer and the financial support of the Defense Systems Management College. The U.S. Securities and Exchange Commission disclaims responsibility for any private publication or statement of any SEC employee or Commissioner. This study expresses the authors' views and does not necessarily reflect those of the Commission, the Commissioners, or other members of the staff.

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Abstract

Relying on a database of cooperative research and development agreements (CRDAs) between government agencies and other not-for-profit (or for-profit) organizations, this paper shows that governance mechanisms vary based on the characteristics of the contracting partners. Governance in CRDAs with not-for-profit partners is more "organizational" in nature – these CRDAs tend to be longer in duration and partners are often geographically proximate. In contrast, governance in CRDAs with a for-profit partner is more "market like." Shorter duration and greater geographical separation suggest that for-profit partners value liquidity and flexibility more highly than the ability to monitor. Partners' reputation matters regardless of profit status. The "softer incentives" in not-for-profit organizations help to explain both entry patterns and governance in CRDAs.

1. Introduction

While research on the governance of publicly traded firms has exploded in the last two decades, relatively little is known about governance mechanisms in not-for-profit organizations (Brickley and Van Horn, 2002). The studies of not-for-profit firms that do exist generally have data from a single industry like health care (Brickley and Van Horn, 2002; Eldenburg and Krishnan, 2003). Understanding the operative governance mechanisms in not-for-profits in a broader context would be a worthy research endeavor, given not-for-profits' increasing importance in the economy (Weisbrod, 1998).

This paper relies on a repository of Government contracts that provides a rare opportunity to both examine a cross section of not-for-profit organizations and to compare governance mechanisms in not-for-profit and for-profit organizations side-by-side. Cooperative Research and Development Agreements (CRDAs) are the result of the Stevenson-Wydler Technology Innovation Act of 1980 and Executive Order 12591 (*Facilitating Access to Science and Technology*, April 10, 1987). Developed to enhance "spillovers" of technology into commercial applications, CRDAs permit federal agencies to share assets with other public and private sector entities (Jaffe and Lerner, 2001).

The data set, which consists of 582 CRDAs between federal (U.S. Air Force) agencies and other not-for-profit (or for-profit) organizations from 1989 through 1999, allows a direct examination of contracts supporting collaborative research and development efforts. Air Force agencies include laboratories, test facilities, and logistics depots. Partners in CRDAs consist of universities, large defense contractors, small businesses, local school districts, and other not-for-profit and for-profit organizations. The sample is quite heterogeneous in both types of partners and types of technology exchanged, but the uniformity of the CRDA contracting form provides a

genuine research benefit. It allows for the control of a range of factors that generally complicate cross-sectional analyses of governance and contracting (Anand and Khanna, 2000).

The focus of this paper is the examination of differences in CRDA contracts between the Air Force agencies and their not-for-profit (or for-profit) partners. Building on prior research by Williamson, (1991), Crocker and Reynolds (1993), Brickley and Van Horn (2002), and Eldenburg and Krishnan (2003), the comparisons reveal several differences. CRDAs with not-for-profit partners tend to be very long in duration relative to CRDAs with for-profit partners. Not-for-profit partners also tend to be more geographically proximate to their Air Force partner. These relative duration and proximity findings suggest that governance in a CRDA with a not-for-profit partner is like that in an organization, where monitoring and proximity are important factors (Williamson, 1991; Boot and Macey, 2004). In contrast, governance in CRDAs with for-profit firms depends less on monitoring and more on liquidity (Bhide, 1993).

The distinguishing characteristic of a not-for-profit organization is its inability to distribute "any profits it earns to persons who exercise control over the firm" (Hansmann, 1996). Hansmann argues that since it cannot distribute profits, the not-for-profit firm may focus on improvements in the working environment for its employees. The longer duration of CRDAs involving not-for-profit organizations is consistent with interests of employees, who may value the added security the longer agreement brings to their position (Glaeser, 2002). Longer agreements may also be of interest to local communities. They are concerned with supporting jobs and the local Air Force facility in a period of military downsizing. The evidence of not-for-profit organizations' concern for employees and the local community are in line with arguments by Brickley and Van Horn (2002), who assert that not-for-profits deal with a broader set of objectives than for-profit firms.

The shorter duration of CRDAs with for-profit partners reflects a greater concern these partners have for their owners' profit interests – a focus on efficiency in a more narrow sense. The combination of shorter duration and greater geographic distance between parties in CRDAs with for-profit partners is evidence of a market-oriented governance mechanism in their agreements (Williamson, 1991; Boot and Macey, 2004). For-profit partners value flexibility (the real-option to abandon the relationship) more highly than they do the ability to monitor their partner (Schwartz, 2003).

While partners' "not-for-profit" and "for-profit" status informs governance, the results also suggest partners' technological and contracting reputation matters. Reputation effects are observed in patterns of CRDA formation "within-sample." Not-for-profit partners tend to form agreements with Air Force logistics depots to share mature technologies while for-profit partners enter into CRDAs with Air Force labs or test facilities to share more novel technologies. Universities with track records of receiving Department of Defense grants tend to enter CRDAs early in the sample period when the CRDA form was new. In contrast, for-profit firms with venture capital backing tend to enter into CRDAs later in the sample period after formalizing regulations had reduced contracting risk.

The formation and technology sharing results are consistent with Glaeser and Shleifer (2001) who argue that not-for-profit status can be a solution to severe expropriation problems. While for-profits' focus on the "bottom line" promotes efficiency in contracting, sufficient "hold-up" risk might deter for-profit firms from entering into agreements. Not-for-profit organizations' broader (and softer) set of objectives are often necessary for parties to be willing to establish a joint research and development effort, where the outcomes are difficult to specify *ex ante*.

The article proceeds as follows: Section 2 reviews the related literature and develops the empirical predictions. Section 3 describes the data. Section 4 presents and discusses the empirical results. Section 5 concludes.

2. Prior literature and research questions

Organizations are a nexus of contractual relationships. Studying contracts is a direct means to examine mechanisms of governance using either agency or transactions cost theory (Coase, 1937; Jensen and Meckling, 1976; Williamson, 1979, 1983a, 1983b 1991; Klein, Crawford, and Alchian, 1978). The spirit of this paper from a theoretical perspective is similar to that in Hart (2003). Hart argues against applying narrowly either transactions or agency cost theory in the analysis of public-private partnerships.

Organizational theory is alluring, but obtaining the contracts that form the institutional basis for production is often difficult (Coase, 1992). Empirical research in contracting and governance has generally progressed from the analysis of samples of contracts for tangible inputs (such as coal) toward the analysis of samples for intangible inputs similar to those in joint research and development (Joskow, 1987: Crocker and Masten, 1988; Pisano, 1989; Oxley, 1997).

Several researchers have studied contract duration in the context of tangible inputs (Crocker and Masten, 1988; Joskow 1987). The basic premise of this research is that the length of a contract is a tradeoff between the costs incurred from negotiating the terms of trade on a period-by-period basis and the hazards associated with being bound to an inflexible agreement for an additional length of time. If payoffs to the contract are uncertain upon entry, parties may find themselves in a different position (relative to their prior) once information is revealed. This can make negotiations to renew the agreement more difficult, or impossible. Having a longer agreement, *ceteris paribus*, delays these negotiations and maintains the status quo of the existing

contract. On the other hand, having a longer agreement binds the parties together for a longer period of time.

Schwartz (2003) examines real options in research and development (R&D) projects. He argues that the abandonment option represents a large part of the project's value when uncertainty is large. CRDAs are joint R&D projects, and their outcomes would be hard to measure *ex ante*. The threat of expropriation would also be credible, given the intangible nature of production inputs (Taylor, 1995). The option to abandon could vary across contract participants. Those with shorter-term incentives, viable alternatives to the existing agreement, and access to capital might be more inclined to value the option to abandon, for example.

The option to abandon reflects the preference for liquidity in the contracting relationship. Bhide (1993) argues that liquidity is relevant to governance. If a party can leave if the enterprise falls short of expectations, that option is powerful. Coffee (1991) contrasts the governance applied by liquidity with the notion of "voice" in governance. As opposed to "voting with one's feet," voice implies that the parties have the power to influence governance and affect the performance of the organization. Boot and Macey (2004) relate liquidity and voice to objectivity and proximity, respectively. They argue that objectivity comes with distance, a market-oriented system of governance where liquidity matters. Proximity is linked with "voice" as physical closeness enhances the ability to monitor and influence activity. Proximity leads to more of an organizational form of governance. The spectrum of governance along a line from market to organization is the context proffered by Williamson (1991).

CRDAs are alliance-type relationships that have both market and organization-like governance mechanisms. Long duration makes CRDAs more like an organization, where short-duration is more of a market form of governance. Controlling for aspects of CRDAs that influence uncertainty about payoffs, such as the characteristics of the technology being shared, as

well as other contracting hazards (Joskow, 1987), we examine where for- and not-for-profit partners exist on the spectrum. If for-profit partners value flexibility, and have short-term incentives and/or access to alternative sources of capital, we would expect them to enter into shorter duration CRDAs than not-for-profit partners. The latter may have incentives to protect employment, or to maintain long-term relationships, as opposed to making a quick profit.

Similarly, if the real option to abandon is less important, then the desire for voice in governance might become more important. If this is so, then CRDAs involving not-for-profit partners ought to involve greater geographic proximity.

Klein (1980) argues that reputation is a key contributor to governance. If parties have engaged in previous relationships, uncertainty as to payoffs in those activities has been resolved. What has also been determined is each party's reaction to the resolution of that uncertainty. In this situation, contracting risks in the current agreement are reduced. We examine whether reputation matters in CRDAs with for- and not-for-profit partners. Besides contracting familiarity, parties may share technological familiarity. In the context of CRDAs, we examine whether Air Force Agencies of various types tend to enter into agreements with either for- or not-for-profit partners. We also examine the progression of CRDA contract formations over time.

3. Data

3.1. Sources

The sample consists of 582 CRDAs entered into by Air Force agencies over the period from 1989 through 1999.[1] The data on CRDAs comes from the Air Force Office of Technology Transfer (AFOTT). This office has the primary responsibility for oversight of Air Force CRDAs, and the sample contains every CRDA in their database – including those that have been

[1] See Lerner (2000) and Jaffe and Lerner (2001) for more information on CRDAs.

completed. The data includes each CRDA's original contractual start and end dates, CRDA title and objective (a short paragraph describing the major activities), technology novelty classification, codes indicating the identity and classification of the Air Force agency and the non-Air Force partner, and whether the CRDA is open or closed on the sample collection date of February 1999.

Air Force agencies in the sample include laboratories, test facilities, and logistics depots. Partners include both not-for-profit and for-profit organizations. The data contains only partner codes, not actual partner names. However, based on the merger of several other DOD databases, we are able to determine CRDA partner identity. To evaluate whether for-profit partners have extensive dealings with the Air Force outside of CRDAs, we rely on 1989 through 1999 annual rankings of contractors compiled by *Government Executive*.[2] For not-for-profit partners, we rely on a ranking of Department of Defense (DOD) science and engineering grants, as compiled by the National Science Foundation (NSF) on an annual basis.

3.2. Construction and description of variables

We develop variables to characterize the CRDA parties and the features of the agreement. Table 1 contains a summary of these variable descriptions.

CRDA Parties Table 2 provides some descriptive statistics for the parties to the CRDA agreements. Table 2 shows that that just over twenty percent of CRDAs are with not-for-profit partners, with about a quarter of those being "top 100" organizations in terms of DOD grants. Since these are all research universities, we refer to them as TOPUNIVs. Later we will examine if TOPUNIV reputation and status matters to the governance in CRDA agreements.

[2] We also created alternative variables for the for-profit partners by taking the percentage of contracts of the partner divided by the total Air Force contracts during the year of CRDA formation, and for the not-for-profit partners by taking the percentage of federal grants won by the partner in the year of CRDA formation. We rounded to zero any share not in the top 100. The results using these variables are qualitatively similar to those in the paper.

Among the for-profit partners to CRDAs, there are several interesting variations. Table 2 shows that about 21 percent of the for-profit partners are "top 100" contractors (TOPCON), as listed by *Government Executive*. Twenty eight percent of the CRDA partners have publicly traded equity while seven percent have venture capital (VC) backing. We will subsequently examine if reputation and access to capital impact CRDA governance.

Regarding the Air Force partners, about 90 percent of all CRDAs involve either laboratories or test facilities. The remaining partners are logistics depots. Labs and test facilities specialize in technology R&D; logistics depots focus mainly on support of existing systems. We will test whether these relative degrees of R&D specializations matters in CRDA governance.

Agreement Variables To reflect Air Force designations, we construct a 1-5 scale variable NOVELTY, as well as five individual dummies (NOVEL1, … , NOVEL5).[3] We also distinguish CRDAs based on technology that is basic research, exploratory development, or advanced development from CRDAs based on technology in either the demonstration/validation or mature phases (NOVELDUM). This distinction reflects Air Force management policy, which separates the responsibility for development and production level technology (Air Force Regulation 5000-1). Traditionally, managerial transfer of a system or technology occurs when that system or technology leaves the development phase.

When CRDA parties are located within 50 miles of each other in driving distance, LOCAL takes a value of one (zero, otherwise).[4] The REPEAT variable that takes the value of the number of previously established CRDAs between the same Air Force agency and partner.

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[3] The Air Force Office of Technology Transfer defines the novelty of the technology transferred in the CRDA in accordance with the following scheme: (1) *Basic research* emphasizes increased knowledge and understanding. (2) *Exploratory development* translates basic research into solutions for broadly defined needs. (3) *Advanced development* attempts to prove feasibility and assess operability. (4) *Demonstration/ validation* emphasizes evaluation in as realistic an operating environment as possible. (5) *Mature* has already received approval for production use.

[4] In the event that a partner is a large entity with multiple locations, we use the location specified by the CRDA as its place of business (as opposed to the corporate headquarters). We use MapQuest to determine approximate driving

The CRDA statement of objective distinguishes whether the CRDA is formed to develop a specific product (CRDAPLUS equals one) or formed to share information (CRDAPLUS equals zero). This distinction follows Pisano (1989) and Oxley (1997), who classify joint research and development contracts as either "R&D Only" or "R&D Plus" contracts.

CRDA technology is classified into one of the following Securities Data Corporation (SDC) industry classifications: (1) advanced materials, (2) biotechnology, (3) communications, (4) propulsion, (5) optics/lasers, (6) electronics, (7) advanced manufacturing, (8) computers, (9) other. Table 3 provides example CRDAs showing both industry classification and objective (CRDAPLUS).

To control for CRDA contracting impacts associated with the passage of time, the variable LASTHALF takes a value of one if the CRDA is formed in 1995 or later, which is the last half of our 1989-1999 sample period.

4. Results and discussion

4.1. Comparisons of CRDAs with not-for-profit and nor-profit partners

Table 4 provides the initial comparison of CRDAs involving not-for-profit and for-profit partners. At this stage, several differences emerge. In particular, CRDAs with not-for-profit partners appear to be more likely to be with Air Force logistics depots (less likely with Air Force laboratories). Not-for-profit partners also appear to be more geographically proximate to their Air Force counterparty.

What is also apparent is that there are a number of variables for which CRDA partner profit status does not result in a large difference. Among these are novelty of technology exchanged, industry classification (other than electronics), specific product goal as opposed to R&D only, and time of CRDA formation. We will defer from making more definitive

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distances and the JCSZIP database for direct "as the crow flies" distances. Results from these alternative measures

statements until the multivariate analysis. We will also consider the impact of profit-status sub-samples in the followings sections.

Table 5 provides the logit results that show the relationship between partner profit status and other aspects of the CRDA. The dependent variable takes a value of zero if the CRDA is formed with a not-for-profit partner and one if the CRDA is formed with a for-profit partner. Consistent with the descriptive analysis in Table 4, Air Force laboratories are more likely to contract with for-profit partners located at greater geographic distance.

4.2. CRDA duration analysis

Table 6 provides ordinary least squares (OLS) regressions of CRDA duration on various partner and agreement variables. The most striking result is the highly significant difference on the profit-status variable (PAPROFIT). Controlling for other aspects of the agreement, such as the technology exchanged, CRDAs are over 14 months longer (on average) if the partner is a not-for-profit organization (28 versus 42 months).

What can explain the difference in duration in CRDAs involving for- and not-for profit firms? Hansmann (1996) argues "the critical characteristic of a non-profit firm is that it is barred from distributing any profits it earns to persons who exercise control over the firm." Instead, not-for-profits tend to "distribute" profits through improvements in the working environment (Hansmann, 1996). Glaeser (2002) builds on the same theme by stating "non-profits evolve into organizations that resemble workers' cooperatives." Consistent with these arguments, not-for-profit organizations in CRDAs are likely to be interested in job security for their workers. Longer agreements represent greater job security. This motivation would also support jobs in the local community. Recall that not-for-profit partners tend to be more geographically proximate to

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are qualitatively similar.

the Air Force partner. Job security and community interests may also be present for the employees on the Air Force side, especially during this period of Defense downsizing.

For-profit firms, on the other hand, view efficiency in a more narrow fashion. Shorter duration reflects a desire for flexibility, and the real option to abandon the agreement. Schwartz, (2003) argues that the real option to abandon is quite valuable in highly uncertain R&D projects. Bhide (1993) asserts that liquidity is a form of governance. In CRDAs with for-profit firms, the enhanced ability to abandon coupled with the greater geographical distance between parties represents market type governance (Williamson, 1991; Coffee, 1991; Boot and Macey, 2004).

Governance in CRDAs with not-for-profit firms, on the other hand, is much more like that in an organization (Williamson, 1991). The CRDA itself is a quasi-organizational type of vehicle, akin to an alliance (Oxley, 1997; Oxley, 1999). As the CRDA grows longer in duration, parties' ability to monitor each other grows. Monitoring is also made easier by geographic proximity, which could help the parties address hidden information or moral hazard risks.

4.3. Air Force agency sub-sample analysis

Table 7 shows a logistic regression with the dependent variable being the type of Air Force partner. The results show that Air Force laboratories/test facilities (AFLABs) are more likely to enter into CRDAs with for-profit partners. They are also more likely to enter CRDAs in the second half of the sample period. Not-for-profit partners are thus more likely to enter into CRDAs with Air Force logistics depots in the earlier half of the sample period. These findings are consistent with an alignment of interests with regard to employee security. Logistics depots were under extreme consolidation pressure during the early 1990s. Similar to their not-for-profit partners, their interests lie more in job security for employees as opposed to profit efficiency (Hansmann, 1996).

Table 7 also shows that AFLABs are geographically more distant from their CRDA partners. Since their partners are predominately for-profit organizations, this is consistent with market-type governance discussed earlier. In contrast, the geographic proximity of logistics depots to their CRDA partners suggests that monitoring is a more important factor in governance. Geographic proximity is also consistent with arguments that both parties have concern for supporting community employment. The efficient matching of parties' interests is consistent with Ackerberg and Botticini (2002).

Another interesting finding in Table 7 is the pattern of technology sharing. Air Force laboratories are more likely to share novel technology, and attract for-profit partners interested in such. Although sharing novel (as opposed to mature) technology makes the ex ante specification of outcomes more difficult, for-profit partners tend to enter to shorter agreements (Table 6) and be at greater geographic distance (Table 5). Unlike the not-for-profit results, this suggests less interest in supporting community employment and more interest in profit potential. Labs' technological reputation may also be a factor in facilitating agreements that can be maintained over large geographical distance (Orlando, 2004).

4.4. Partner sub-sample analysis

Table 8 provides a breakdown of CRDA formation by partner type, with emphasis on the sub-categories of for- and not-for-profit partners. There is also evidence of varying motivation for entering into CRDAs based on the type of partner. Table 8 shows that CRDAs involving a VC-financed partner are the most likely to enter into a CRDA oriented toward a particular product. CRDAPLUS is over 45 percent in VC CRDAs versus 29.8 percent in "top" contractor agreements and 27.8 percent in not-for-profit partner CRDAs. Although "top" contractors are for-profit firms, they are more interested in using CRDAs for information sharing than VCs partners. This may be linked to the CRDA providing access to particular data or other

intangibles, as opposed to more tangible inputs oriented at a particular product. "Top" contractors rarely share Advanced Manufacturing technology (2.4%) compared to other partners. Not-for-profit organizations, such as universities, also tend to use CRDAs more for information sharing, as opposed to for development of a particular product.

Table 8 also reinforces prior results suggesting an efficient matching of contracting parties. Only one in 42 VC-backed CRDA partners enters into an agreement with a logistics depot. Nearly one-quarter of CRDAs with not-for-profit partners involve a logistics depot. VC-backed partners' desire for novel technology and efficiency in the profit sense are a better match for Air Force laboratories than for logistics depots.

Table 8 also reveals an interesting pattern of entry over time. Since our sample is a repository, not a survey, we are able to make statements about changes in contracts during the decade of study.[5] While the overall pattern of entry across all for- and not-for-profit firms is similar (64.9 versus 63.5% entry in the second half of the sample period), there are some interesting differences within sample. Of all the partner types, VCs have the highest percentage (76.2 percent) of entry in the second half of the sample period (1995-1999). "Top" Universities have the highest percentage (48.3 percent) of entry in the first half of the sample (1989-1994).

The pattern of entry can be explained in the context of technological and contracting risk as well as reputation. CRDAs were new in the late 1980s. Government approvals, changes in CRDA regulation, and political pressures on a new "DOD program" all had to be considered.[6] Even if the CRDA parties could agree, there was the threat of delay or re-negotiation in higher levels of the DOD.

As of 1988, there was only a DOD Regulation governing CRDAs. An Air Force Regulation became available to provide "service specific" guidance in 1990. A detailed Air

Force Instruction (the current rules and regulations) was finalized in 1994. In the early days of CRDAs, parties would have to willing to accept the "contracting risk" inherent in the new organizational form along with any technological risks in the agreement itself.[7] Because of their "softer incentives" and technical reputation, not-for-profit "Top" Universities were able to accept these risks. Top contractors are next in line in terms of time. They bring technical reputation and dealings with the Air Force into the relationship as well. In stark contrast, partners backed by VC were apparently unwilling to accept the risks of being "held up" by contracting (institutional) uncertainty in the early stages of CRDA contracting. They wait until contracting risk abates to enter.

Table 9 provides OLS regressions of CRDA duration for the for- and not-for-profit samples separately. The results show how technical risk factors (such as novelty of technology exchanged) and contracting risk factors (time effects) impact duration in both samples. In the for-profit sample, CRDAs sharing novel technology are longer in duration, *ceteris paribus*, consistent with increased hold-up risks inherent in trying to specify highly uncertain R&D outcomes *ex ante* (Taylor, 1995). Regarding contracting risks, time has the effect of reducing CRDA duration in the for-profit sample. In the not-for-profit sample, these technical and contracting effects are less significant. While this may be due to a loss of statistical power, the results do suggest that the desires for liquidity and flexibility are stronger in the for-profit sample. Not-for-profit agreements relate more to employee security.

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[5] We overcome the survivorship bias that affected previous survey-based studies such as those by Joskow (1987) and Crocker and Masten (1988).

[6] In the early days of CRDAs, there was quite a bit of skepticism about whether the contracting concept would work.

[7] CRDAs in the first half of the sample (1989-94) are nearly nine months longer in duration (on average) than those in the second half (1995-99) of the sample. CRDA duration decreases by about two months each year. Over the eleven-year sample period, the cumulative effect is almost two years.

4.5. Not-for-profit organizations' role in R&D

What do the results suggest about governance of not-for-profit organizations? Longer duration (*ceteris paribus*) in CRDAs involving not-for-profit firms suggest there is inefficiency in these relationships, yet the patterns of entry suggest there is value. Not-for-profit partners, especially TOPUNIVs, were critical in getting the CRDA program "off the ground." Weisbrod (1998) argues that "high-powered incentives" resulting from profit maximization encourage shirking of quality (in an R&D environment). Not-for-profit status softens the incentives associated with profit status. Especially in the case of R&D where payoffs (eventual quality) are so uncertain, softer incentives are needed for contracting to occur. The joint R&D contract can be so incomplete that not-for-profit status is necessary to enter it – a commitment to softer incentives (Hansmann, 1980). Not-for-profit status is a solution to the severe expropriation problems associated with sharing intangible assets in a joint R&D agreement (Glaeser and Shleifer, 2001).[8]

Besides not-for-profit status, reputation building and competition are other solutions to severe expropriation problems (Glaeser and Shleifer, 2001, p.102). The entry of TOPCONs in the early part of the sample is evidence of the impact of reputation. TOPCONs would have reputations that increase the chances of fair bargaining over *quasi rents*, perhaps due to "hostages" in other contexts (Williamson, 1983a). Firms with VC backing are driven by the competition to bring innovative products to market, and the subsequent financial rewards.

5. Conclusions

Not-for-profit firms are increasingly important to economic growth, yet little is known about the economics of not-for-profit organizations. This article analyzes a sample of 582 cooperative research & development agreements (CRDAs) between federal (Air Force) agencies

[8] Also see Crocker and Reynolds (1993).

and other not-for-profit (or for-profit) partners. A survivorship bias-free federal repository database combined with other data sources offers detailed information about the technology exchanged, goals, and the parties involved.

Agreements with not-for-profit partners tend to be long in duration and involve parties that are geographically proximate. This suggests that the operative governance mechanism in these agreements is organizational in nature, based on monitoring that becomes more effective over time and when the parties are geographically close. In contrast, CRDAs with for-profit partners tend to be short in duration and involve geographically distant parties. The operative governance mechanism in these agreements is market-like, as the parties favor the ability to exit the agreement to the ability to monitor each other.

While profit-status informs the choice of governance mechanisms, an analysis of sub-samples reveals that reputation also matters. Reputation exists in both the for- and not-for-profit samples, and is of both a technical and contractual nature. Reputation helps to explain the efficient selection of partners, goals, and technologies. The dominant role of research universities in the early years of CRDA development suggests that not-for-profit organizations are critical to technology development and transfer. When outcomes are difficult to specify *ex ante*, the softer incentives present in not-for-profit organizations are a way to address *ex post* expropriation risks.

References

Ackerberg, D., and Botticini, M., 2002. Endogenous matching and the empirical determinants of contract form. Journal of Political Economy 110, 564-591.

Anand, B., and Khanna, T., 2000. The structure of licensing contracts. Journal of Industrial Economics 48, 103-135.

Bhide, A., 1993. The hidden costs of stock market liquidity. Journal of Financial Economics 34, 31-51.

Boot, A., and Macey, J., 2004. Monitoring corporate performance: the role of objectivity, proximity, and adaptability in corporate governance. Cornell Law Review 89, 356-393.

Brickley, J., and Van Horn, R., 2002. Managerial incentives in nonprofit organizations: evidence from hospitals. Journal of Law and Economics 45, 227-249.

Coase, R., 1937. The nature of the firm. Econometrica 4, 386-405.

Coase, R., 1992. The institutional structure of production. American Economic Review 82, 713-719.

Coffee, John C. "Liquidity Versus Control: The institutional investor as corporate monitor." Columbia Law Review 91 (1991): 1277-1368.

Crocker, K., and Masten, S., 1988. Mitigating contractual hazards: unilateral options and contract length. Rand Journal of Economics 19, 327-343.

Crocker, K., and Reynolds, K., 1993. The efficiency of incomplete contracts: an empirical analysis of Air Force engine procurement. Rand Journal of Economics 24, 126-146.

Eldenburg, L., and Krishnan, R., 2003. The influence of ownership on hospital financial performance Strategies. Unpublished working paper.

Glaeser, E., 2002. The governance of not-for-profit firms. NBER working paper no. W8921.

Glaeser, E., and Shleifer, A., 2001. Not-for-profit entrepreneurs. Journal of Public Economics 81, 99-115.

Hansmann, H., 1980. The role of the non-profit enterprise. Yale Law Journal 89, 835-901.

Hansmann, H., 1996. The ownership of enterprise. Harvard University Press: Cambridge, MA.

Hart, O., 2003. Incomplete contracts and public ownership: remarks, and an application to public-private partnerships. Economic Journal 113, 69-76.

Jaffe, A., and Lerner, J., 2001. Reinventing public R&D: patent law and technology transfer from federal laboratories. Rand Journal of Economics 32, 167-199.

Jensen, M., and Meckling, W., 1976. Theory of the firm: managerial behavior, agency costs, and ownership structure. Journal of Financial Economics 3, 305-360.

Joskow, P., 1987. Contract duration and relationship-specific investments: empirical evidence from coal markets. American Economic Review 77, 168-185.

Klein, B., 1980. Transaction cost determinants of 'unfair' contract arrangements. American Economic Review 70, 356-362.

Klein, B., Crawford, R., and Alchian, A., 1978. Vertical integration, appropriable rents, and the competitive contracting process. Journal of Law and Economics 21, 256-285.

Lerner, Josh. Venture Capital and Private Equity: A Casebook. New Jersey: John Wiley & Sons, 2000.

Orlando, M. 2004. Measuring R&D spillovers: on the importance of geographic and technological proximity. Federal Reserve Bank of Kansas City working paper.

Oxley, J., 1997. Appropriability of hazards and governance in strategic alliances: a transaction cost approach. Journal of Law, Economics, and Organization 13, 387-409.

Oxley, J., 1999. Institutional environment and the mechanisms of governance: the impact of intellectual property protection on the structure of inter-firm alliances. Journal of Economic Behavior and Organization 38, 283-309.

Pisano, G., 1989. Using equity participation to support exchange: evidence from the biotechnology industry. Journal of Law, Economics, and Organization 5, 109-126.

Schwartz, E., 2003. Patents and R&D as real options. NBER working paper no. W10114.

Taylor, C., 1995. Digging for golden carrots: an analysis of research tournaments. American Economic Review 85, 872-890.

Weisbrod, B., 1998. To profit or not to profit: the commercial transformation of the nonprofit sector. Cambridge University Press: Cambridge, MA.

White, H., 1980. A heteroskedasticity-consistent covariance matrix estimator and a direct test for heteroskedasticity. Econometrica 48, 817-838.

Williamson, O., 1979. Transaction cost economics: the governance of contractual relations. Journal of Law and Economics 22, 233-261.

Williamson, O., 1983a. Credible commitments: using hostages to support exchange. American Economic Review 73, 519-540.

Williamson, O., 1983b. Organization form, residual claimants, and corporate control. Journal of Law and Economics 26, 351-366.

Williamson, O., 1991. Comparative economic organization – the analysis of discrete structural alternatives. Administrative Science Quarterly 36, 269-296.

Table 1

Summary of variables

Variable	Definition
Partner variables	
For-profit (PAPROFIT)	Coded 1 if the partner is a for-profit organization. Coded 0 for a not-for-profit organization.
Venture capital -financed (VENTCAP)	Coded 1 if the partner has venture capital financing at CRDA formation. Coded 0, otherwise.
AF agency research expertise (AFLAB)	Coded 1 if the Air Force agency is a laboratory or test facility. Coded 0 if the Air Force agency is a logistics depot.
Top 100 contractor (TOPCON)	Coded 1 if the partner listed as a top 100 Air Force contractor by *Government Executive* in year of CRDA formation. Coded 0, otherwise.
Top 100 university (TOPUNIV)	Coded 1 if the partner is a top 100 recipient of Department of Defense grants in year of CRDA formation. Coded 0, otherwise.
Agreement variables	
Novelty of technology (NOVEL)	Coded 1 if the technology is classified as Basic Research, Exploratory Development, or Advanced Development. Coded 0 if technology is classified as Demonstration/Validation or Mature.
Distance between parties (LOCAL)	Coded 1 if the CRDA partners are located within 50 miles driving distance of each other. Coded 0, otherwise.
Repeat CRDAs (REPEAT)	Number of previously established CRDAs linking the Air Force agency with the same partner.
Specific product (CRDAPLUS)	Coded 1 if the CRDA envisions a particular product. Coded 0, otherwise.
Industry classifications	Dummy variables reflecting Securities Data Corporation (SDC) industry sectors.
Time trend (LASTHALF)	Coded 1 if CRDA begins in 1995 or later, the last half of the 1989-1999 sample period. Coded 0,otherwise.

Table 2

CRDA sample breakdown by type of partner

CRDA partners	Number of CRDAs	% of total
Air Force agency		
Laboratories or test facilities	521	89.5%
Logistics depots	61	10.5%
Partner type		
Not-for-profit	126	21.6%
"Top 100" university	29	5.0%
For-profit	456	78.4%
Publicly-traded equity	168	28.9%
"Top 100" contractor	124	21.3%
Venture capital financed	42	7.2%

Table 3

Examples of CRDA industry classification and objective

Industry	CRDA objective	Specific product?
Advanced materials	Develop polymer composite for use in a pedestrian bridge	Yes
Advanced manufacturing	Manufacture self-propelled micro-robotic devices	Yes
Computer	Share information on intelligent tutoring systems	No
Biotechnology	Study ergonomic and anthropometric issues of helmet mounted systems	No
Lasers/optics	Develop finger-mounted laser spotlight	Yes
Electronics	Study methods for packaging for electronic circuits	No
Communications	Share voice and data transmission over high frequency radio links	No
Propulsion	Develop turbine engine lubricant	Yes

Table 4

Breakdown CRDA characteristics by partner type: for-profit vs. not-for-profit [a]

Frequency in each category (% of n)	CRDA partner type	
	For-profit (n=456)	**Not-for-profit (n=126)**
Novelty of technology exchange:		
Basic research, exploratory, or adv. development	74.1%	73.8%
Demonstration/validation or mature	25.9	26.2
Industry classifications of technology exchange:		
Electronics	24.6	15.1
Communications	11.4	17.5
Biotechnology	11.0	11.9
Lasers/optics	9.2	8.7
Computer equipment	10.3	4.8
Advanced manufacturing	8.8	8.7
Advanced materials	6.8	7.1
Propulsion	6.1	6.3
Familiarity with CRDAs:		
First CRDA	90.1	90.5
Repeat CRDA	9.9	9.5
Is a specific product envisioned?		
Yes – R&D plus product	34.2	27.8
No – R&D only	65.8	72.2
Year of CRDA formation:		
Started before 1995	35.1	36.5
Started 1995 or later	64.9	63.5
Air Force counterparty type:		
Laboratory or test facility	93.2	76.2
Logistics depot	6.8	23.8
Air Force counterparty geographic proximity:		
Located within 50 miles of partner	14.2	25.4
Located more than 50 miles away from partner	85.8	74.6

[a] This table shows the breakdown of CRDA categories by partner types. The numbers in the cells refer to the percentage of CRDAs of a partner type that corresponds to each category. "Novel" is technology in the basic, exploratory, or advanced development phases as opposed to the demonstration/ validation or mature phases. Repeat CRDAs refer specifically to repeat agreements between the same two partners. Industry classifications correspond to the Securities Data Corporation industry sectors.

Table 5

Logistic regression of CRDA characteristics on partner type [a]

Dependent variable: 1=for-profit, 0=not-for-profit	
Intercept	-0.30 (0.47)
Novelty dummy	-0.29 (0.32)
Industry classifications	
Electronics	0.76 (0.04)
Communications	-0.26 (0.49)
Biotechnology	0.55 (0.21)
Lasers/optics	0.41 (0.35)
Computer equipment	0.96 (0.07)
Advanced manufacturing	0.87 (0.06)
Advanced materials	0.44 (0.36)
Propulsion	0.26 (0.60)
Repeat CRDA	0.21 (0.57)
Specific product is envisioned (R&D plus product)	0.33 (0.17)
Last half of the sample period	0.02 (0.92)
Air Force counterparty is a lab or test facility	1.60 (0.00)
Air Force counterparty is located within 50 miles	-0.63 (0.02)
Likelihood ratio statistic	46.87 (0.00)
Number of observations	538

[a] This table provides a logistic regression of partner type on several explanatory variables.

Table 6

OLS regression of CRDA characteristics and partner type on contract duration [a]

Dependent variable: contract duration (in months)	
Intercept	40.39
	(0.00)
Novelty dummy	6.51
	(0.00)
Industry classifications	
Electronics	-3.44
	(0.24)
Communications	1.78
	(0.59)
Biotechnology	-2.19
	(0.54)
Lasers/optics	2.47
	(0.49)
Computer equipment	10.33
	(0.01)
Advanced manufacturing	4.50
	(0.22)
Advanced materials	9.84
	(0.01)
Propulsion	5.75
	(0.16)
Repeat CRDA	-5.12
	(0.08)
Specific product is envisioned (R&D plus product)	1.09
	(0.55)
Last half of the sample period	-5.76
	(0.00)
Air Force counterparty is a lab or test facility	-2.97
	(0.32)
Air Force counterparty is located within 50 miles	5.12
	(0.03)
For-profit partner	-14.75
	(0.00)
Adjusted R-squared	0.16
F-statistic	7.83
	(0.00)
Number of observations	535

[a] This table provides ordinary least squares (OLS) regressions of Cooperative Research and Development Agreement (CRDA) duration in months (DURATION) on several explanatory variables.

Table 7

Logistic regression of CRDA characteristics on Air Force agency type [a]

Dependent variable: 1=AFLAB, 0=logistics depot	
Intercept	1.01 (0.02)
Novelty dummy	2.07 (0.00)
Industry classifications	
Electronics	-0.24 (0.60)
Communications	0.60 (0.13)
Biotechnology	-0.15 (0.82)
Lasers/optics	0.65 (0.38)
Computer equipment	0.55 (0.39)
Advanced manufacturing	-0.99 (0.05)
Advanced materials	-0.14 (0.84)
Propulsion	-0.06 (0.94)
Specific product is envisioned (R&D plus product)	0.23 (0.51)
Last half of the sample period	0.92 (0.01)
Partner a for-profit organization	1.43 (0.00)
Air Force counterparty is located within 50 miles	-1.45 (0.00)
Likelihood ratio statistic	79.63 (0.00)
Number of observations	522

[a] This table provides a logistic regression of partner type on several explanatory variables.

Table 8

CRDA formation by partner type

Frequency (% of n) in each category	Partner type					
	For-profits				Not-for-profits	
	ALL For-profits (n = 456)	Publicly traded (n = 168)	VC-financed (n = 42)	"Top" contractor (n = 124)	ALL Not-for-profits (n = 126)	"Top" university (n = 29)
Technology Exchanged						
Novel Technology	74.1%	76.2%	85.7%	79.8%	73.8%	79.3%
Specific Product Envisioned	34.2%	29.2%	45.2%	29.8%	27.8%	24.1%
Industry classifications						
Electronics	24.6%	32.1%	33.3%	34.7%	15.1%	10.3%
Communications	11.4%	10.7%	0.0%	13.7%	17.5%	10.3%
Biotechnology	11.0%	11.3%	16.7%	8.1%	11.9%	6.9%
Lasers/optics	9.2%	10.7%	7.1%	10.5%	8.7%	13.8%
Computer equipment	10.3%	8.9%	11.9%	9.7%	4.8%	3.4%
Advanced manufacturing	8.8%	4.8%	9.5%	2.4%	8.7%	6.9%
Advanced materials	6.8%	2.4%	4.8%	4.8%	7.1%	20.7%
Propulsion	6.1%	7.7%	4.8%	7.3%	6.3%	6.9%
Distance - Parties <50Miles						
Local	14.2%	8.1%	9.9%	5.3%	25.4%	27.0%
Time Effects						
Started Before 1995	35.1%	42.9%	23.8%	41.1%	36.5%	48.3%
Started 1995 or Later	64.9%	57.1%	76.2%	58.9%	63.5%	51.7%
Air Force Agency						
Laboratory or Test Facility	93.2%	96.4%	97.6%	95.2%	76.2%	65.5%
Logistics Depot	6.8%	3.6%	2.4%	4.8%	23.8%	34.5%

This table shows the breakdown of CRDA categories by the types of Air Force agencies and partners. The numbers in the cells refer to the percentage of CRDAs of a partner type that corresponds to each category. "Novel" is technology in the basic, exploratory, or advanced development phases as opposed to the demonstration/ validation or mature phases. Industry classifications correspond to the Securities Data Corporation industry sectors.

Table 9

OLS regression of CRDA characteristics and partner type on contract duration: For-profit and not-for-profit sub-samples [a]

Dependent variable: contract duration (in months)		
	For-profits	Not-for-profits
Intercept	33.69	34.27
	(0.00)	(0.00)
Novelty dummy	6.06	5.77
	(0.01)	(0.37)
Industry classifications		
Electronics	-3.79	-7.51
	(0.23)	(0.34)
Communications	-1.83	5.56
	(0.62)	(0.46)
Biotechnology	-4.33	1.50
	(0.25)	(0.87)
Lasers/optics	5.11	-9.89
	(0.18)	(0.28)
Computer equipment	7.90	14.17
	(0.04)	(0.24)
Advanced manufacturing	1.72	7.79
	(0.66)	(0.41)
Advanced materials	6.60	17.20
	(0.12)	(0.10)
Propulsion	3.66	13.04
	(0.40)	(0.22)
Repeat CRDA	-3.63	-4.73
	(0.25)	(0.60)
Specific product is envisioned (R&D plus product)	1.43	0.28
	(0.46)	(0.96)
Last half of the sample period	-5.77	-5.30
	(0.00)	(0.34)
Air Force counterparty is a lab or test facility	-10.71	4.77
	(0.00)	(0.46)
Air Force counterparty is located within 50 miles	4.01	7.35
	(0.13)	(0.19)
Top Contractor	2.63	
	(0.22)	
Venture Capital Financed	0.78	
	(0.81)	
Top University		-0.72
		(0.91)
Adjusted R-squared	0.09	0.07
F-statistic	3.54	1.59
	(0.00)	(0.09)
Number of observations	421	114

[a] This table provides ordinary least squares (OLS) regressions of Cooperative Research and Development Agreement (CRDA) duration in months (DURATION) on several explanatory variables. The first column is for-profit partners only; the second is not-for profit partners only.