

**WHO I AM AND HOW I CONTRACT: ROLES, RELATIONAL CAPITAL  
AND EVOLUTION OF CONTRACT STRUCTURE IN  
UNIVERSITY-INDUSTRY RESEARCH AGREEMENTS**

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Abstract

In this paper, we explore how contract structure is influenced by relational capabilities developed in cross-boundary innovation-based relationships. Differing from other studies, we focus on the organizational positions, roles, and responsibilities of the parties involved. We hypothesize that as technical personnel gain contracting experience with an exchange partner, their focus on *value creation* supports the establishment of trust-based relationships and operational routines that cause subsequent contracts to become less detailed. We also hypothesize that administrators responsible for contracting, because of their focus on *value capture*, primarily accumulate joint governance experience and establish negotiation routines which cause subsequent contracts to become more detailed. Analyzing the monitoring terms and intellectual property terms of corporate sponsored university research agreements, we find support for both of our theoretically-grounded hypotheses.

**Key Words for Paper:** Contract Structure, Relational Capabilities, Sponsored Research Agreements

With the enhanced breadth and depth of knowledge required for innovation, corporations no longer are able to limit their search for relevant knowledge to internal sources (Ahuja, 2000; Cohen & Levinthal, 1990; Dussauge, Garrette & Mitchell, 2000). Accordingly, many firms are establishing cross-boundary agreements to access the expertise of researchers at external organizations (Chesbrough, 2003; Duysters & Hagedoorn, 1996; Inkpen & Dinur, 1998). Determining the appropriate contract structure, and managing the terms of the agreement as these relationships evolve, is an important contributor to success in such cross-boundary activities (Sampson, 2004; Arino & de la Torre, 1998; Doz, 1996; Ring & Van de Ven, 1994). Most of the extant research on the evolution of inter-organizational agreements implicitly assumes a unitary decision-maker in governance design and selection. However, it is quite common for cross-boundary innovation-based relationships to involve multiple decision-makers (Cyert & March, 1963; Zajac & Olsen, 1993). At a minimum these relationships have administrative and technical personnel simultaneously engaged in developing, negotiating, and implementing cross-boundary activities (Argyres & Mayer, 2007). Thus, there is a need to further explore how these multiple- cross-boundary ties affect the design of contracts as the relationship evolves.

Two streams of thought have emerged in the contracting literature regarding the effect of priorities on the development of contract structure in cross-boundary agreements. One stream maintains that relationship-specific learning occurs during the implementation of tasks resulting in the development of trust and operational routines (Doz, 1996; Dyer & Singh, 1998; Eisenhardt & Martin, 2000; Zollo, Reuer & Singh, 2002; Zollo & Winter, 2002). Such relational capabilities, stemming from increased knowledge about exchange partner character and activities, can then substitute, to some extent, for formal contracting leading to less detailed contracts (Dyer & Chu, 2004; Gulati, 1995; Zaheer & Venkataraman, 1995). The second stream examines relation-specific learning processes and suggests that, through repeated contracting, firms learn to better manage alliances, gain broader awareness of potential transaction hazards, and devise more suitable governance structures (Anand & Khanna, 2000; Arino & de la Torre, 1998; Poppo & Zenger, 2002). This stream contends that repeated ties result in “learning to contract”

which complements and extends formal contracting leading to more detailed agreements (Argyres, Bercovitz & Mayer, 2007; Mayer & Argyres, 2004). The empirical results from these studies have been mixed leaving the debate regarding the effect of prior relationships on contract structure unresolved.

To advance this debate, the current study seeks to explain how the involvement of personnel from multiple organizational units influences contract complexity in cross-boundary, innovation-based, relationships. We submit that contracts governing these cross-boundary relationships reflect relational capabilities developed between contracting partners based on the organizational position and the primary roles and responsibilities of the exchange parties involved (Argyres & Mayer, 2007; Faems, et al., 2008; Ring & Van de Ven, 1994). We hypothesize that as technical personnel gain contracting experience with an exchange partner, their focus on *value creation* supports the establishment of trust-based relationships and operational routines, both of which cause subsequent contracts to become less detailed (Lepak, et al., 2007; Priem, 2007). However, we hypothesize that administrative personnel and their legal counsel, because of their focus on *value capture* (i.e., appropriation and risk management) primarily accumulate joint governance experience and establish negotiation routines, which cause subsequent contracts to become more detailed (Daft, 1978; March 1994; Reitzig & Puranam, 2009). In regards to contract detail or complexity, we take a more fine-grained approach than most prior research and focus on the nature of the contract provisions (e.g., specific content regarding monitoring and intellectual property rights) rather than the presence or absence of provisions (Faemes, et al., 2008). Furthermore, we limit our hypothesized relationships to innovation-based agreements, recognizing that in this context the uncertainty of the outcomes encourages contractual provisions that emphasize monitoring of behaviors as opposed to the monitoring of outcomes more common in transactional agreements (Eisenhardt & Martin, 2000). We test this theoretical reasoning using data from corporate sponsored university research agreements. Taking advantage of the multi-point contacts of these cross-boundary agreements, this study examines how relational capability established across two organizational units relate to the specification of monitoring and intellectual property (IP) rights. Our empirical findings support our hypothesized relationships.

Our study makes three significant contributions to the research literature. First, we contribute to the relational capabilities literature by linking the primary roles and responsibilities (value creation and value capture) of two aspects of the relationship (technical and administrative/legal) to three types of inter-organizational relational capabilities (trust, routines, and governance skills). Secondly, we contribute theoretically and empirically to the contracting literature by positing and showing that relationships between personnel in these two organizational units have opposite effects on contractual formalization (i.e., detail or complexity). Empirically we are able to decompose the effects of technical-based relational capability and administrative-based relational capability, while controlling for transaction, organizational, and investigator attributes. Finally, we present refined measures of sponsor monitoring and intellectual property rights contractual clause content, which provide a richer understanding of how contacts are explicitly specified.

We begin by reviewing the relevant literature and presenting our main theoretical arguments and specific hypotheses. Next, we detail the research context, describe our data and methods, and explain our results. We conclude by discussing the implications and limitations of the study and providing suggestions for future research.

## **THEORY DEVELOPMENT AND HYPOTHESES**

### **Innovation and Relational Capabilities**

Kogut and Zander maintain that an organization's capacity to be innovative rests both on available stocks of knowledge and "in the organizing principles by which relationships among individuals, within and between groups, and among organizations are structured" (1992, p. 384). Further, an organization's capability to benefit from innovation is linked to success in both value creation and value capture (Bradenburger & Stuart, 1996; Pitelis, 2009; Zajac & Olsen, 1993).

Given the size and complexity of many organizations, the stocks of knowledge and organizing principles relevant to innovation are differentially dispersed within and across organizations as they are held by specific groups and individuals based on their departmental affiliations, professional roles, and organizational responsibilities (Dougherty, 1992; Grant 1996). This knowledge and task specialization

engenders differentiation that is expressed as variation in key attitudes and behaviors (Lawrence & Lorsch, 1967). Roles in formal organizations are tied to identified social positions and, following the “logic of appropriateness,” are associated with specific rules for behavior (March 1994). Based on these roles and responsibilities organizational members develop distinct cognitive understandings, which influence what information they focus on as they complete their assigned tasks as well as the conclusions they draw from their experiences (Dearborn & Simon, 1958; Melon, 1994; Tyler & Steensma, 1998).

Because of their assigned organizational tasks, administrative/legal and technical personnel play different roles in the innovation process. Administrators are the experts with regard to organizational arrangements and are more likely concerned with governance problems and new developments that apply to these problems. Value appropriation is a central concern of these individuals (Granstrand, 2000). Technical personnel are the experts on the organization’s scientific core and generally focus on technology acquisition and development; the emphasis is on value generation (Daft, 1978; Reitzig & Puranam, 2009). Diversity in work assignments result in the development of different bases of knowledge and routines related to the synthesis of diverse stimuli as administrative and technical personnel focus on their assigned tasks (Utterback, 1971, Faems et al, 2008). These stocks of knowledge evolve as relevant tasks are learned contributing to a firm’s dynamic capabilities (Teece et al., 1997; Tyler, 2001; Zollo & Winter, 2002).

Relational capabilities are particularly important in the use of cross-boundary agreements to access technological expertise (Dyer & Singh, 1998; Teece, 2007). The relational capability of an organization refers to its ability to interact with and manage inter-organizational relationships (Lorenzoni & Lipparini, 1999). Relational capabilities, like other capabilities, are developed via prior related experiences (Eisenhardt & Martin, 2000; Teece, et. al. 1997; Zollo & Winter 2002). Research has shown that a history of cross-boundary cooperation can facilitate learning, leading to relational capability based on selected features of the relevant inter-organizational tasks. There is evidence that specific learning processes are at work at different levels within and across organizations; integrating and institutionalizing are the most critical at the organizational level while interpreting and sense making are the key processes

at the individual level (Inkpen & Dinur, 1998). These critical learning processes can be expected to result in administrative and operational routines associated with the characteristics of the tasks involved (Nelson & Winter, 1982; Zollo & Winter, 2002).

The relational capabilities literature has posited two distinct forms of learning related to partner-specific relational capabilities – learning about: (1) exchange partner beliefs and expected behavior (i.e., trust), and (2) operational and administrative routines and advantageous inter-organizational practices. First, through repeated interactions, transacting partners gain familiarity with one another, build personal ties, and generate confidence in the goodwill of their partner resulting in [inter-organizational] trust (Gulati, 1995; Zaheer & Venkataraman, 1995). Such trust, “produced through interpersonal interactions that lead to social-psychological bonds of mutual norms, sentiments, and friendships,” (Ring & Van de Ven, 1994, p. 93), forms a relational capability that serves as a means to deal with uncertainty in inter-organizational relationships. Second, through repeated interactions, partners can develop an enhanced understanding of the managerial procedures, organizing systems, and problem-solving processes of their partner (Nickerson & Zenger, 2004). Based on this relationship-specific knowledge, the exchange partners can then devise and refine inter-organizational routines that have the potential to smooth interaction patterns and raise exchange efficiency (Dyer & Singh, 1998; Zollo et al., 2002).

### **Relational Capability and Contract Structure**

Contracting research has considered the evolution of trust, the routinization of operational activities, and the development of governance solutions in the context of recurrent contracting (Ring & van de Ven, 1992). This literature recognizes the relationship between the execution of an agreement as a basis for learning and relational capability as a consequence of repeated ties (Arino & de la Torre, 1998), and has found differences in firms’ ability to learn to manage research alliances based on contract-specific experience (Anand & Khanna, 2000).

Against this backdrop, the effect of prior transacting experience and the development of relational capabilities on the complexity of contracts to govern subsequent transactions between a set of exchange partners is often debated. Some research, evaluating factors affecting contract formalization, have

emphasized the development of trust-based or routine-based relational capabilities and assert that prior experience between exchange parties will lead to a *reduction* in the use of formal contractual safeguards (Gulati, 1995; Gulati & Nickerson, 2008). As parties repeatedly transact with one another it is claimed that their expectation of opportunism (Parkhe, 1993) and their perception of exchange hazards decreases (Deeds & Hill, 1998) due to the development of trust (Ring & Van de Ven, 1994; Zaheer & Venkataraman, 1995) and growing co-specialization (Levinthal & Fichman, 1988; Teece, 1986). Thus, the need for formal contractual safeguards also decreases. Similarly, the development of inter-organizational routines can facilitate coordination, knowledge-transfer, and monitoring activities and thus reduce the need to include detailed provisions with respect to these items in the contract (Reuer & Arino, 2007; Zollo et al., 2002). Other research has focused on the refinement of contracting capabilities and holds that formalization of contracting safeguards will *increase* over time (Mayer & Argyres, 2004; Poppo & Zenger, 2002; Ryall & Sampson, 2009). Exchange partners learn to contract as they interact, negotiate, and revise exchange agreements over time and across transactions (Argyres et al., 2007; Argyres & Mayer, 2007; Mayer & Argyres, 2004). In any single transaction, exchange partners may encounter unexpected communication, coordination, adaptation, and/or dispute resolution challenges, which result in learning about governance needs. Subsequent agreements may be refined to address the problems identified and/or incorporate newly devised governance solutions. Prior interaction may be translated into a greater use of formal contractual clauses and a more detailed specification of the contract in subsequent transactions between a set of partners.

This debate remains unresolved as the empirical evidence linking prior contracting experience and the accumulation of relational capabilities to contract complexity and/or contract explicitness remains mixed. While recent studies have done much to increase our understanding of what may be learned through prior relationships (trust, routines, or governance skills), we propose that the missing piece is clarification as to where in the organization these different relational capabilities accumulate. The capabilities literature suggests that organizational capabilities accumulate differentially at different places within the organization depending on the organizational task to be learned (Eisenhardt & Martin, 2000;

Teece, 2007; Zollo & Winter, 2002). Organizational decision-makers with specific roles and responsibilities have distinct interpretive schema and are likely to draw different lessons from their experiences, which may then influence contract structure (Dearborn & Simon, 1958; Dougherty, 1992; Melon, 1994). Specifically, contract structure can be expected to reflect experiential learning (Sampson, 2005) associated with the accumulation of relational capabilities as they evolve at multiple points of interaction across organizations (Inkpen & Currall, 2004; Inkpen & Dinur, 1998). If, as the contracting literature suggests different relational capabilities – character insights, inter-organizational routines, and/or governance skills – affect contract structure in unique ways, then understanding where and when these different capabilities accumulate is necessary for untangling how contract structures differ as experience grows. We suggest that a primary driver of the type of relational capabilities accumulated at various points in repeated cross-boundary innovation-based relationships is a result of the relative focus on *value creation* and *value capture* or appropriation of the players at each of these points.

### **Hypothesis Development**

***Technical repeated ties.*** To cope with the growing level of knowledge needed to operate at the technical frontier, innovators are becoming increasingly specialized (Jones, 2009). As a consequence of such specialization, the technical personnel involved in cross-boundary innovation projects in a particular domain are often a consistent set of technical experts, who are then called upon to implement subsequent projects. Through repeated interactions, the scientists have the opportunity to gain a deep understanding of each other and build strong personal ties enabling them to develop trust-based relational capabilities. Further, innovation often involves the use and generation of tacit knowledge (Arora & Gambardella, 1994; Rosenberg, 1982). Nonaka (1994) suggests that for effective transfer of tacit knowledge between alliance partners, individual relational capital must be developed, because the transfer normally requires intimate personal interaction and a willingness to admit limits to one's own knowledge. While professional training and norms in science set the stage for transfer of some aspects of technology, competence-based trust may be required to successfully encourage the transfer of more tacit forms of technology (Chua et al., 2008; Faems et al., 2008). This experience of sharing tacit knowledge among a

select set of scientists suggests a fertile basis for the development of trust between technical personnel across organizations.

In addition to trust, the intense interactions needed to create value may lead to a greater understanding of the operational requirements for knowledge exchange resulting in the development of relationship-specific routines to guide the interactions between scientists across organizations (Dyer & Singh, 1998; Zollo, et.al., 2002). Technical personnel will be aware of technical problems and have the expertise necessary to help solve these problems and adopt routines that address these operational issues (Mayer & Argyres, 2004; Thompson, 1967). Further, given the professional norms of scientists, we can expect that the technical routines and processes that evolve will be loosely coupled with evolving administrative routines (Daft, 1978; Weick, 1976).

Due to their technical value-creation orientation, individual scientists and engineers across organizations may build a foundation of experience and understanding over time that makes them increasingly confident in the technical competency of their exchange partner and that their exchange partner will not take undue advantage. Simultaneously, the development of relationship-specific sense-making and problem-solving routines may reduce coordination and communication challenges (Faems et al., 2008). Based on this foundation, technical personnel may choose to forgo the expense of negotiating detailed monitoring and intellectual property rights contractual safeguards and, because over-specification or excessive formalization can interfere with trust development, may even remove terms from the agreement (Malhotra & Murnighan, 2002; Ring & Van de Ven, 1994). As trust and/or routines are developed, authority and control systems related to behaviors and outcomes can be more loosely specified in the contract, and production related matters may be left relatively open-ended (Barney & Hansen, 1994; Reuer & Arino, 2007; Ring & Van de Ven, 1992). This flexibility enables the technical personnel to avoid over-specification of the contact, increasing productivity and knowledge-based resource accumulation when the value and characteristics of the knowledge are difficult to comprehensively specify *a priori* in a contact (Dyer & Singh, 1998; Mowery, Oxley & Silverman, 1996).

This reasoning is not meant to suggest that scientists and engineers do not develop some contracting capabilities associated with value capture and governance refinement (Argyres & Mayer, 2007), but simply that because they are focused on value creation associated with innovation-oriented tasks, trust and operational routine-related relational capability accumulation may be most prevalent at these organizational positions (Moran, 2005). Thus, as technical personnel gain experience contracting with one another, contracts can be expected to be less detailed. As such, we hypothesize:

*Hypothesis 1. As technical personnel gain experience contracting with each other, monitoring and intellectual property terms will be less explicitly specified.*

**Administrative repeated ties.** Cross-boundary innovation-based agreements are generally devised to 1) specify parameters for value creation via scientific and technical activities; and 2) capture a portion of the value created while managing the associated risks. Given their well-established roles, administrators and lawyers tend to be more focused on the governance elements of the exchange than on the actual flow of technical knowledge associated with the contract (Ferlie, et al., 2005). In their professional role, these experts are called upon to be detail oriented in regards to legally formalized contracts. As the experts with regard to legal administrative arrangements, we can expect administrators and lawyers to bring their experiences with prior contractual problems to the tasks and to use the lessons learned from these experiences to avoid hazards resulting from serious contract incompleteness. In addition, these experts are in tune with new developments inside and outside the organization associated with value capture and risk management (Daft, 1978). In this regard, past experience that captures benefits derived from innovation may influence how decision makers structure subsequent value-creating efforts (Lepak, 2007). Further, company administrators and lawyers often become the primary repositories of contract design capabilities with regard to contingency planning, the allocation of decision rights, and dispute resolution (Argyres & Mayer, 2007). Minimization of risk through formalized governance may be given priority even at the expense of facilitating the achievement of operational objectives of the innovation-based relationship (Bagely & Dauchy, 2008).

In repeated contracting of innovation-based agreements, we suggest that company administrators, because of their focus on *value capture* (i.e., appropriation and risk management) will produce integrating and institutionalizing learning processes resulting in joint governance experience and administrative contracting routines (Blyler & Coff, 2003; Inkpen & Crossan, 1995; Ramirez, 1999). At this contracting interface, these learning processes can be expected to result in enforcement related contracting capabilities more so than in trust-based capabilities. Through experience contracting with a given exchange partner, administrators learn what types of monitoring mechanisms and intellectual property terms encourage cross-boundary integration and institutionalize the routines necessary for value capture.

While the importance of scientific expertise in a specific domain limits interchangeability of personnel in technical positions, multiple individuals with general contractual knowledge may be brought in to negotiate administrative solutions. The continual introduction of new participants slows the development of the foundation of “deep understanding” and social norms that can substitute for formal governance.<sup>1</sup> With less personal understanding of and interaction with their counterparts, organizational administrators are apt to focus on the potential hazards and use the repository of related contracts to which they have access to identify previous issues encountered and viable safeguards developed (Argyres, et al., 2007; Mayer & Bercovitz, 2008). Thus, when repeated research agreements occur between two organizations, we submit that for administrators these repeated ties are more representative of an accumulation of knowledge related to the formal contracting of monitoring and intellectual property rights terms, and administrative routines rather than trust, obligation, reciprocity and technical routine forms of relational capability. Based on the above logic, we expect:

*Hypothesis 2: As administrative personnel gain experience contracting with each other, monitoring and intellectual property term content will be more explicitly specified.*

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<sup>1</sup> Argyres and Mayer make a similar point maintaining that since lawyers often lack an ongoing relationship with the contracting partner, “Lawyers are less likely to be an integral part of the relationships that develop at the operating level and, thus, are less likely to have the knowledge possessed by the managers and engineers about what is likely to occur during the execution of the project” (2007, pp. 1064-1065).

## METHODS

### Sponsored Research Context

In line with the growth of inter-firm alliances, firms are establishing an increasing number of sponsored research relationships with academic institutions (Hagedoorn, 2002; Industrial Research Institute, 2002; National Science Board, 2002). These partnerships with university academics assist firms in both exploiting their existing capabilities and exploring new opportunities (Cohen, Nelson & Walsh, 2002; March, 1991; Rosenkopf & Nerkar, 2001).<sup>2</sup> Sponsored research agreements exhibit important characteristics, which are relatively common to other cross-boundary innovation-based agreements: a multi-point relationship, and exchange hazards.

**Multi-point relationship.** Sponsored research agreements involve participants, as well as negotiations, at multiple points. An evaluation of sponsored research contracts provide a context for examining innovation where the administrators and lawyers representing the corporation serve as “contextual influences” on scientists conducting the innovative activity (Gupta, Tesluk & Taylor, 2007). When a company sponsors research at a university, there are negotiations between university and company scientists involved in the technical aspects of the relationship, and between technology-transfer personnel and corporate managers and lawyers. Initial discussions often occur between technical individuals – the academic investigator (also known as the principal investigator, PI) and the company scientist. The core elements of the project including specification of research responsibilities and contributions of the exchange parties as well as preliminary monitoring and intellectual property allocation terms are drafted at this juncture. This information is then passed on to the technology transfer personnel who meet with management and/or legal personnel from the sponsor company to finalize the contract with an eye to broader organizational administrative interests. Here, umbrella agreements codifying overall guidelines and contract terms can be expected to have evolved in both the company and

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<sup>2</sup> The number of sponsored research contracts and the dollars associated with these contracts has been growing for much of the past 25 years (AUTM, 2006; Bercovitz & Feldman, 2007; Graft, Heiman & Zilberman, 2002). The National Science Foundation reported that between 1980 and 1998 industrial support for university research had increased from 4% of academic research spending to 7.4% and has remained above the 7% level since (Mowery, et al., 2004; National Science Board, 2002).

the university, which then must be adjusted to address specific sponsored research project goals put forth by the technical participants and then negotiated across all participants (Gerwin & Ferris, 2004; Ring & Rands, 1989). The end result is typically a formal contract signed by multiple personnel e.g., the technical PI and the technology transfer officer or other administrator representing the university as well as company management. In general, the statement of work drafted by the scientists in both organizations is attached and considered part of the formal, legal agreement.

Further, sponsored research agreements are often recurrent, enabling the exchange parties to build their relationships and experiment with safeguards incorporated into the contract calibrated to higher degrees of risk (Ring & Van de Ven, 1992). Relationships may develop both technically and administratively, as it is relatively common for an academic scientist to conduct multiple research projects for a particular company sponsor over time. Similarly, companies may have repeated involvement with a particular university as they conduct numerous projects with multiple investigators. The multi-point character of sponsored research agreements along with the commonality of repeated interaction provides an opportunity to explore how prior experience across different organizational units may be related to contract design.

***Exchange hazards.*** Although corporate sponsors are increasing their investments in university research, these alliances have unique characteristics that may present contracting challenges. Sponsored research agreements, by their nature, involve discovery and the generation of knowledge (value creation) and thus may face appropriability hazards (Oxley, 1997, Williamson, 1991). Specific investments also commonly play a role in sponsored research agreements. The funds provided for the research may be invested in specific assets and/or the company may contribute proprietary materials to the project, which can give rise to hold-up hazards. Given these concerns about value appropriation, terms regarding intellectual property protection and IP ownership are often at the center of sponsored-research negotiations. Measurement-related hazards may be an issue as academic scientists follow different rules of “timeliness” and record-keeping than is common in the private-sector (David, Mowery & Steinmueller, 1997; Thursby & Thursby, 2000). As such, monitoring and reporting is often another focal

point of discussion when sponsored research agreements are drafted. Finally, exchange hazards associated with technological and behavioral uncertainty can be expected to affect contract structure (Carter & Hodgson, 2006). The potential for numerous exchange hazards within the sponsored research relationship provides an excellent context within which to examine inter-organizational relationships and the evolution of contract structure, while controlling for the hazards associated with transaction attributes.

### **Data**

To test the above hypotheses, we have collected non-clinical Industry Sponsored Research Agreements (SRA) from a private research university with a well-known medical school. The university provided access to the more than 1000 non-clinical research agreements that were signed between 1994 and 2005. The dataset we use for this paper is based on a sample of 136 of these agreements pulled via a stratified random sample selection process. Specifically, contracts were separated into categories based on the number of interactions between a principal investigator-company pair. Some investigator-company pairs have only one agreement while others have signed multiple contracts over time. Then, agreement sets were randomly selected from each category in proportion to the distribution across the full population of contracts. While slightly smaller in dollar amount than the population, the sample is representative in terms of the home departments of the principal investigators.

### **Dependent Variables**

Four dependent variables, which are drawn directly from the contract documents, are used in this study; two to capture the explicitness of monitoring term content and two to capture the explicitness of intellectual property term content. We chose to look specifically at the monitoring and intellectual property terms for several reasons. First, in discussions leading up to this research project, the personnel in the technology transfer office highlighted these two categories of terms as ones that they paid particular attention to in the negotiation process. Similarly, and as documented in the literature, corporate sponsors of university research also identify monitoring and intellectual property issues as central concerns (Thursby & Thursby, 2000; Bercovitz & Feldman, 2007; Somers, 2003). Second, initial reviews of the

contracts showed that, as compared to other categories of contractual terms, the monitoring and intellectual property provisions varied significantly across contracts. Third, these categories fall within the two underlying dimensions of contractual complexity (based on the coordination and enforcement functions of different contractual provisions) specified, and held to be differentially influenced by the presence of prior ties, in recent research (Reuer & Arino, 2007).

The first monitoring variable, ACCESS, quantifies the level of company access specified in the contract. Across the sample contracts, six specific content terms relating to sponsor access were found. These include statements stipulating that: (1) the sponsor will be allowed to visit the research site; (2) the sponsor will be given access to data generated through the research project; (3) review meetings between the principal investigator and company scientists will be scheduled; (4) research results will be jointly evaluated and know-how developed will be shared; (5) a company representative will be specifically named; and (6) a joint scientific advisory board will be formed. The measure ACCESS is simply the sum of the number of the above items included in the contract.<sup>3</sup> The value of ACCESS ranged from 0 to 5 with a mean of 1.43.

The second monitoring variable codes the reporting requirements (REPORTS) detailed in the contract. There is significant variation in reporting terms. Contracts varied by whether it was explicitly stated that (1) the principal investigator needed to maintain records documenting project activities; (2) a final report was required; (3) interim progress reports were called for in (4) a specific number with dates for the delivery of these interim reports to the sponsor. The fifth clause outlined content elements to be included in the reports. The variable REPORT, calculated as the sum of the above terms present in the contract, ranged from 0 to 5, with a mean of 2.17.

The first intellectual property dependent variable, ALLOCATE, measures the attention paid in the contract to the specification and allocation of intellectual property rights for inventions resulting from the sponsored research. In general, ownership of inventions made by the principal investigator remains with

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<sup>3</sup> This summation approach is limited in that it gives each clause equal weight. This is a reasonable default given no grounded reasons for assigning different weights to each clause.

the University, with the sponsor being given an option to negotiate a license. A typical boilerplate term reads:

To the extent that the UNIVERSITY has title to any new Inventions resulting from the Research solely or jointly with SPONSOR, Sponsor is hereby granted, without option fee other than consideration of the Research sponsored herein and the reimbursement to UNIVERSITY for patent expenses incurred prior to or during the option period, an option to acquire a royalty-bearing license to UNIVERSITY'S right in the Invention.

Where contracts differ is in

- (1) the expansiveness of the option offered – is the license to be negotiated worldwide, exclusive, perpetual, and does it give the sponsor sub-license rights?;
- (2) the length of time allowed for the sponsor to exercise and negotiate a license. A basic option clause provides for a 3 month exercise period and a 3 month negotiation period.
- (3) the licensing framework laid-out – whether the contract sets parameters for acceptable license terms, details a process for license term negotiations and/or specifies that the sponsor, even if they initially do not exercise the option, has a first right of refusal to the license the invention on terms negotiated with any third party<sup>4</sup>; and
- (4) the number of terms included to insure that the sponsor has an unobstructed right to the invention – a warranty clause confirming that no third-party will have rights to intellectual property developed, restrictions on the principal investigators right to engage in other sponsored research projects, specification that the sponsor owns the data generated through the sponsored research, and/or the delineation of a subset of inventions for which, ex ante, the sponsor is granted ownership rights.

The ALLOCATE measure was constructed by summing the scores from each of the four categories. The scores for categories (1), (3), and (4) simply count the presence of each element in the contract, whereas the score for category (2) is determined by the total exercise/negotiation period granted with one point given for each 3-month interval. The value of ALLOCATE in the dataset ranges from 0 to 11, with an average value for this variable of 5.57.

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<sup>4</sup> As an example one such right of first refusal clause states, "If Institution and Sponsor are unable to reach agreement within six (6) months after SPONSOR exercised the Option Right, Institution will be free to offer its right under the relevant Patent Right to any third parties; *provided, however*, that for one (1) year following termination of negotiations with Sponsor, Institution may only offer such rights to third parties on terms and conditions that are not more favorable than the last offer made by Institution to SPONSOR, unless the more favorable terms and conditions have first been offered in writing to SPONSOR and either (x) SPONSOR has declined in writing to accept the offer or (y) SPONSOR has failed to respond to the offer within thirty (30) days after receiving such offer.

The second intellectual property variable, PUBLICATION, is a measure of the publication constraints included in the sponsored research agreement. The publication and dissemination of research findings is a core value in the academic arena. Both personal and societal advancement are linked to this traditional open science norm. Industry sponsors, in contrast, often desire to limit and/or delay the release of new knowledge in order to use such private knowledge to secure a competitively advantageous position. Almost all sponsored research agreements contain a publication clause that sets terms to balance these competing interests. Standard publication clauses generally provide the Sponsor with a short window of confidentiality to allow for the filing of patent applications before public dissemination of research results.

Publication clause content varies in four respects. First, the allowable period for review and delay, while typically 90 days, may be extended in the contract. Second, in addition to allowing the sponsor to review publications, some contracts specify that the sponsor also has the right to comment on the publication and that such comments will be “considered in good faith” by the authors. More substantially, the language in some contracts provides the sponsor with the additional right to delay publication given concerns about content. Finally, and perhaps most constraining on the investigator’s right to publish, a small number of contracts give the sponsor the right to require specific revisions to articles before they are released for publication. The PUBLICATION variable is coded to reflect the presence of such terms. Specified review/delay periods are coded as 1 for periods up to 90 days, 2 for periods between 91-120 days, 3 for periods between 121-150 days, and 4 for periods greater than 150 days. The score is increased by one for each of the remaining three variations – right to comment; right to delay given content concerns; and right to require revisions. The value of the PUBLICATION variable ranged from 1-7 with an average of 1.68. Table 1 summarizes the frequency of each element of the four contract measures found in the 136 contracts in the dataset.

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### **Independent Variables**

Two different relationship history variables are used to test our hypotheses. The first variable, PI-CO HISTORY used to test H1, is a count of the number of sponsored research agreements that the individual principal investigator has conducted with the same company prior to the current contract. The number of previous contracts between an individual PI and a specific company range from 0 to 4. The second variable, UNIV-CO HISTORY used to test H2, measures the contracting experience between the University-Company pair via the log of the number of previous sponsored research interactions between these two parties. This variable is calculated using the full population of contracts signed by the university in the 1994 to 2005 research period. A particular company may engage in sponsored research agreements with a number of different investigators at the same university. For example, in our sample, the most active company sponsored a total of 119 research projects with a total of 70 different principal investigators in the 1994 to 2005 study period.

### **Control Variables**

Our first three control variables operationalize transaction-level attributes of the sponsored research agreement that, according to transaction cost logic, may influence contract structure. Sponsored research transactions differ in terms of the contributions of the partners. It is not uncommon for the sponsor to provide proprietary inputs to be used by the investigator in conducting the sponsored project. For example, the sponsor may supply laboratory testing equipment or medical diagnostic devices for either equipment validation or investigative studies. Similarly, sponsors may provide materials – transgenic mice or experimental drugs – to allow the investigator to explore new applications or test efficacy. Contribution of such proprietary assets may give rise to hold-up and appropriability hazards and thus are expected to require increased levels of contractual safeguards. We use two dummy variables EQUIPMENT and MATERIAL, coded as 1 if the sponsor provides such an item; 0 otherwise, as controls for such concerns.

We also include a binary variable, BASIC, as an indicator of the technical uncertainty associated with the sponsored research project. Technical uncertainty makes it difficult to contract ex ante for

contingencies that may occur ex post and thus may be associated with the adoption of less explicit contract terms (Crocker & Reynolds, 1993; Williamson, 1985).<sup>5</sup> Scientific research always involves some degree of uncertainty (Freeman, 1982; Mowery & Rosenberg, 1989). The uncertainty of projects focused on basic, fundamental, scientific advancement, however, is expected to be greater than the uncertainty of projects in applied fields with developmental goals. We use the terminal degree of the principal investigator – PhD or MD – as a proxy for project type. Conversations with technology transfer officers suggest that faculty members with PhD degrees are more likely to engage in basic research than faculty members with the more applied MD.

We include several other control variables in the estimation. First, we add the variable, DURATION, to control for the specified period of performance (in months) of the sponsored research project. More attention may be given to the negotiation and design of contracts that will be in force over a longer period of time. Second, we enter a variable, BUDGET, measuring the total monetary value of the sponsored research project. We use the natural log of this value in order to constrain the effect of outliers. Third, we include a measure of company age as start-up or adolescent firms may behave differently than well established firms. The variable AGE takes the value of 0 if the firm was started prior to 1980 (<1980), 1 if the firm was formed between 1980 and 1990 ( $\geq 1980$  but <1990), and 2 if the firm began operations in the 1990s or later ( $\geq 1990$ ). Fourth, we use YEAR as a proxy for the University's cumulative experience drafting and engaging in sponsored research agreements. In the period of interest, the university's involvement with sponsored research projects increased significantly – from less than 60 in 1994 to more than 200 in 2005. This increase in activity allowed for growth in the stock of knowledge regarding contract design. YEAR is coded as 1 for 1996, 2 for 1997, through 10 for 2005.

We also control for PI-related differences. First, we include CONTRACTING EXPERTISE to control for the PI's experience in structuring, negotiating and conducting sponsored research agreements. This variable is measured as the number of non-clinical sponsored research agreements (SRAs) across

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<sup>5</sup> With higher levels of technical uncertainty, the challenges as well as costs associated with codifying terms and enforcing these terms may outweigh the benefits.

multiple companies this faculty member has participated in prior to the date of the focal SRA. Experience levels vary considerably, ranging from 0 to 14 previous engagements. Second, we control for the quality or TECHNICAL EXPERTISE of the principal investigator using a citation rate measure. This measure is constructed as total citations within the five year post-publication period for the papers published by the PI in the five years prior to the commencement of the focal SRA. PI expertise, contracting or technical, could translate into increased bargaining power enabling the principal investigator to shape the structure of the sponsored agreement. Finally, we control for departmental context of the principal investigator by coding the PI's home department in terms of the percentage of faculty members in that department who have PhDs. Previous research has shown that the behavior of academic scientists is often strongly influenced by the composition of their localized social environment (Bercovitz & Feldman, 2008). Descriptive statistics and correlations are presented in Table 2.

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Insert Table 2 about here  
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### **Methodology**

We test the hypotheses using seemingly unrelated regression (SUR). SUR allows for comparison across models and improves the efficiency of parameter estimation when the error terms for multiple regression equations are correlated (Pindyck & Rubinfeld, 1991). If the dependent variables of interest are produced by a common set of factors, as we believe to be the case in the selection of contract terms, and these factors are imperfectly captured by the regression equation (either due to measurement error or omitted variables) it is likely that the residuals from separate regression equations would be correlated. Thus, a SUR approach is warranted.

### **RESULTS**

Table 3 reports the results of the seemingly unrelated estimation.<sup>6</sup> Consider first the monitoring equations, Model 1 and Model 2. H1 and H2 are supported in both the access and reporting equations. The coefficient on PI-Co History is negative and significant ( $p < 0.01$  and  $p < 0.05$  for ACCESS and

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<sup>6</sup> We also ran the analysis using OLS and tobit procedures. Results were robust.

REPORT respectively); when the principal investigator and the company have previously engaged in sponsored research projects, the reporting and access terms detailed in the contract are less onerous (H1). This finding is indicative of an accumulation of relational capital associated with trust or operational routines that allows for the substitution of informal governance for formal governance. Conversely, the coefficient on Univ-Co History is positive and significant for access ( $p < 0.05$ ) and reporting ( $p < 0.01$ ). In line with H2, we find that the greater the company's experience in contracting with the university, the more thoroughly reporting and access terms will be detailed in subsequent sponsored research agreements. It appears that in administrative units, repeated agreements result in greater awareness of potential problems (perhaps problems encountered in other agreements) which is manifest in more explicit specification of contract terms.

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Insert Table 3 about here  
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The results for the intellectual property (IP) right equations, Model 3 and Model 4, are summarized in the final two columns of Table 3. Consider first Model 3 where ALLOCATE is the IP dependent variable. Our results provide consistent support for the relationship hypotheses, H1 and H2. As predicted, previous sponsored research activity within an investigator-company dyad is negatively and significantly ( $p < 0.01$ ) related to the level of IP contractual detail in the current agreement. When gained between technical individuals, experience with a transaction partner may produce "trust" and reduce the perceived need to draft explicit formal contracts. However, and as predicted in H2, the coefficient on UNIV-CO HISTORY is positive and significant ( $p < 0.001$ ). The greater the number of prior sponsored research agreements conducted between the university and a particular firm, the more explicit the IP allocation terms. It appears that firms use the knowledge gained across university-company dyads to refine and expand IP allocation terms in subsequent agreements. We find very limited support for our hypotheses in Model 4 where PUBLICATION is the dependent variable. Neither prior investigator-company cooperation nor organizational experience has an effect on the latitude of publication terms.

These results indicate that the stated university policy of protecting the academic's right to publish is generally supported in its contracting practices.

Turn now to the control variables. As predicted by transaction-cost logic, transaction attributes play a significant role in determining contract terms. In Models 1 and 2, we find that monitoring terms are more explicitly specified in transactions where appropriability concerns are greater, such as when materials or equipment are supplied by the sponsor. As indicated by the positive and significant coefficients on equipment, both access ( $p < 0.001$ ) and reporting terms ( $p < 0.05$ ) are specified in more detail when the sponsor contributes proprietary equipment for use in carrying out the sponsored research activities. The coefficient on material is also positive and significant ( $p < 0.01$ ) in both Model 1 and Model 2. These findings support the contention that more comprehensive monitoring requirements are included in the contract when the sponsor supplies the investigator with proprietary materials. Model 3, IP allocation, also provides some support for the transaction cost logic as the coefficient on the material variables is positive and significant, ( $p < 0.001$ ). The coefficient on the equipment variable, while in the expected direction is only significant with a one-tailed test. It appears that the sponsor generally makes a greater effort to clarify and negotiate the allocation of property rights when they have valuable intellectual assets at risk. Finally, within Model 4, we find that publication constraints are greater when materials are supplied by the sponsor.

For the monitoring models, our findings are also consistent with the TCE-based argument that technological uncertainty is associated with less complete contracts. We find that access and reporting terms are less explicitly specified in projects that focus on basic research ( $p < 0.001$  and  $p < 0.05$  for ACCESS and REPORT respectively). This relationship does not appear to hold in Model 3 and 4 where IP allocation and Publication terms are the dependent variables. While the coefficient on the basic dummy is negative in Model 3, it is not significant. No less detailed IP allocation terms are drafted when the research project is associated with the more technically uncertain basic sciences. This may reflect the increasing location of innovations in "Pastuer's Quadrant" -- breakthroughs that address fundamental scientific questions while simultaneously having immediate practical implications for commercial

products (Stokes, 1997). Similarly, publication constraints appear to be determined independent of uncertainty issues.

Contract duration has a strong and consistent effect across all four models. The positive coefficient on this variable indicates that terms are more explicitly detailed when the period of performance is longer. Surprisingly, we find that project cost has relatively little impact on contract design. In the one case where the BUDGET variable shows significance (Model 1: ACCESS), the coefficient is negative. We find that company age significantly influences reporting requirements and publication constraints. Younger firms negotiate agreements with more detailed reporting requirements and accept contracts with fewer publication constraints than do older firms.

Interestingly, the coefficient on PI CONTRACTING EXPERTISE is not significant in any of the four models. This finding provides further support that, for PIs, it is the within relationship experience, rather than increased bargaining power accruing to the PIs broader experience, that drives the move to less detailed contracts.<sup>7</sup> TECHNICAL EXPERTISE is significant only in Model 1 – Access terms are less explicitly specified for PIs with stronger research records/reputations. Finally, we find that departmental context has a significant effect on the level of publication constraints and access requirements specified in the contract. When there is a higher percentage of PhDs in the department, more access is granted in the contract. However, fewer publication constraints are written into the contract when the PI is a member of a department that has a large number of PhDs as compared to MDs. It may be that academic norms of open science are more strongly defended in these traditionally research-based departments. Since the university is limited in its ability to provide financial incentives internally, departments may carefully safeguard the opportunities for faculty to gain fame from original research contributions (Graft, et al, 2002).

### **Robustness Tests**

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<sup>7</sup> This finding is in-line with that of Mayer and Argyres (2004) who note that, at the project management level, the predominant sources of learning were internal to the contractual relationship.

We adopted a summation approach in the design of our dependent variables, including all related sub-elements identified and giving each sub-element of a term equal weight. While this is a reasonable default when no grounded reasons exist for excluding particular sub-elements or assigning different weights to each contributing sub-element, we conducted several robustness tests to explore some effects of these variable construction choices. First, we removed the time elements in both of the Intellectual Property terms. It is possible that timing considerations may be different in character than the other, more proscriptive/restrictive elements of these terms. For the ALLOCATE term, we recalculated the value of this variable without the score for total exercise/negotiation period granted (i.e., dropping category 2). Our results hold for the hypothesized relationship variables and improve for one of the transaction cost control variables (Table 4, Model 1). Under this specification, the coefficient on the equipment dummy is positive and significant ( $p < 0.10$ ). For the PUBLICATION term, the counts for allowable review period were dropped to create a variable that focuses solely on the editorial rights given to the sponsor. Using this new PUBLICATION variable, we find additional support for our multi-level hypotheses (Table 4, Model 2). The delineation of specific editorial rights for the sponsor decreases when the principal investigator and the company have previously engaged in sponsored research projects (the coefficient on PI-Co History becomes negative and significant,  $p < 0.05$ ) and increases the greater the number of prior sponsored research agreements conducted between the university and a particular firm (the coefficient on Univ-Co History is positive and significant,  $p < 0.05$ ). Interestingly, under this specification the control for AGE loses its significance, and PI contracting expertise and departmental composition become significant ( $p < 0.10$  and  $p < 0.05$  respectively). Publication restrictions decrease as the PI gains contracting experience and as the relative percentage of PhDs in the home department increases.

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Insert Tables 4 & 5 about here  
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We also explored the effects of using finer access measures. In reviewing the elements in the access terms, it seems feasible to categorize these terms more finely by separating into two access variables: one (Access-M), in which the sub-terms are more squarely focused on monitoring concerns,

and another (Access-IS), in which the sub-terms seemed designed to support both information-sharing activities as well as monitoring.<sup>8</sup> In line with the scheme used in Reuer and Arino (2007), we are effectively segmenting the access term by enforcement versus coordination functions. Running the estimation with these two Access dependent variables is revealing. As summarized in Table 5, we find that our results hold for Access-M, which captures the enforcement function. The coefficient on PI-Co History remains negative and significant indicating that as relational capabilities build between technical specialists, contract terms become less explicit while the coefficient on Co-Univ. History is positive and significant underscoring the greater formalization of contracts given repeated interactions between administrators. With respect to the Access-IS dependent variable, which captures the coordination function, only the technical effects are significant as we predicted. We find no significance effects associated with the administrators – Access sub-elements that have an information-sharing focus become no more formalized overtime. This finding gives credence to earlier arguments that trust and operational routines related relational capital plays a stronger role in explaining the coordination aspect of governance (often linked to new, innovation-oriented tasks) while contracting related relational capabilities plays a stronger role in explaining the enforcement aspects of governance. This finding is also consistent with that of Reuer and Arino (2007: 313) who in their recent study of alliance contracts observe that, “Firms that have collaborated with each other in the past are not less likely to negotiate enforcement provisions: rather, repeat collaborators are less likely to adopt contractual provisions that are informational in nature and are geared to the coordination of the alliance”. The results reported in Table 5 suggest that a consideration of the roles and responsibilities of the negotiating parties, as well as the provision content under investigation, help to explain what forms of relational capability evolve in repetitive contractual relationships (Vanneste & Puranam, 2009).

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<sup>8</sup> Access-M includes the first two sub-elements: (1) the sponsor will be allowed to visit the research site and (2) the sponsor will be given access to data generated through the research project. Access-IS captured the remaining four sub-elements; (3) review meetings between the principal investigator and company scientists will be scheduled; (4) research results will be jointly evaluated and know-how developed will be shared; (5) a company representative will be specifically named; and (6) a joint scientific advisory board will be formed.

## DISCUSSION AND CONCLUSION

In this study, we argue that within the context of cross-boundary innovation agreements relational capabilities are developed between contracting organizations based on the organizational positions, roles and responsibilities of the parties involved. We hypothesize that trust and operational routines are more likely to accumulate between technical personnel where the role and responsibility of the participants is the transfer technical knowledge and value creation. While the administrative problem-solving skills needed to design governance mechanisms are more likely to accumulate between top management and their legal counsel where the emphasis is on value capture. Our empirical tests inform the on-going debate about the influence of prior relationships on contract structure by showing that contract structure, and the evolution of this structure, reflects this differential accumulation of relational capital.

Our study makes three contributions to the literature. First, we extend the relational capabilities literature by linking inter-organizational learning processes to three forms of relational capital (trust, routines, and governance) accumulated in different positions (technical and administrative/legal) based on roles and responsibilities. This study draws attention to how capabilities accumulate differentially at different places within the organizations depending on the organizational task assigned. We propose that the roles and responsibilities associated with value creation between technical personnel result in the development of trust and operational routines while those associated with administrative and legal personnel, focused on value capture, result in the refinement of administrative routines and governance solutions. Secondly, we move the ongoing debate in the contracting literature towards a resolution by theorizing and testing hypothesized relationships arguing that contracts are affected differently by these various forms of relational capital based on the roles and task assignments of participants. Thus, we argue that trust and technical routine forms of relational capital can substitute for formal contracting, while simultaneously relational capital associated with administrative routines and governance solutions can complement and extend formal contracting.

Finally, we present refined measures of sponsor monitoring and intellectual property rights contractual terms, which provide a richer understanding of how contracts are explicitly specified. Through

careful consideration of a stratified random sample of 136 contracts signed by a major research university with corporations between 1995 and 2005, we were able to consider the terms of the agreement that varied substantially: monitoring and intellectual property rights. Our fine grained evaluation and coding of these terms resulted in a set of terms associated with access and reporting forms of monitoring and IP right allocations and publication restrictions which broadly represent intellectual property rights issues. In robustness tests, we considered alternative methods of aggregation of these measures, found additional support for our hypotheses, and considered how access associated with monitoring was primarily related to the administrative roles while access associated with information sharing was primarily related to the technical roles. This represents advancement in the detailed metrics used in contracting research to date published in the management literature.

#### **Implications, Limitations, and Future Research Directions**

Our findings have implications for future research and practice. Relational capabilities across the different units influenced the specifications of the contracts in opposite directions. This reinforces prior work that has argued that contracting is a complex organizational activity and illustrates the need for more multi-point research related to contract specification. More broadly, our study argues for more research that explicitly considers how capabilities are accumulated in different locations within organizations. Appreciation of the path dependent yet dispersed accumulation of capabilities is likely to have significant implications for understanding the leveraging, transfer, and/or replication of these capabilities.

Implications for practice are twofold. Our analysis shows that contracts are differentially adapted in accordance with the experience and interests of those directly involved in contract negotiation, with a push towards more complex contracts coming from the administrators and a push to less specified contracts coming from the technical specialist. Lawyers, given their professional focus on minimizing risk and capturing value, may have a tendency to over-specify contracts, which can hamper technology transfer and interfere with the accumulation of relational capabilities at the technical core. Conversely, technical personnel, focused on project tasks and value creation, may overestimate the safeguarding value of relational capital and under-specify protective contractual provisions. Thus, our study highlights the

importance of a balanced involvement of individuals across the different units of the organization. Second, but related, while specialization can encourage efficiency in the development of technological and administrative routines, it also can create barriers between technologists and lawyers. In order to effectively manage the loosely coupled relationship between specialists as contracts are jointly negotiated, managed, and revised, individuals in different units will need to have some understanding and appreciation of the others' world view (Reitzig & Puranam, 2009). As such, organizational efforts to promote the documentation of contractual history, the establishment of open repositories for these documents, and the creation of forums for active communications between all involved with the contracting process are recommended.

Like most research, this study has a number of empirical limitations which provide direction for future research. First, in an effort to control organizational characteristics and general contracting experience, we limited our study to the sponsored research agreements of a single research University. Though we are confident this university is an excellent representative for the population of top academic research universities with highly esteemed medical schools, we encourage research that would replicate our results with other universities, as well as federal laboratories and other not-for-profit organizations. Second, due to the fine tuned nature of our measures, the need to collect the actual contracts, and the time required to analyze each contract, our sample size is completely adequate but not extensive. We accepted the challenge of a more rigorous evaluation of contract terms recognizing that this would, of necessity, lead to a smaller sample size because we feel that a more complete explanation of effects of relational capital on contracting requires a more detailed evaluation of contract terms. We believe our stratified technique for sample selection helps to assure the representativeness of our results and that our robustness tests reveal the confidence of our findings. However, future research with larger samples is encouraged to substantiate our arguments and conclusions.

Third, our detailed focus of two key terms in sponsored agreement contracts – monitoring and IP rights – is also a limitation that needs to be addressed in future research. The question remains as to whether our findings relating contract formalization/de-formalization to experience at different

relationship points is generalizable across other categories of contract terms. For example, it may be that the effect of prior relationship on contract terms used to set expectations by delineating tasks is different from the effect of such interactions on terms that are used to enforce desired behavior or allocate rents. Careful evaluations of the statement of work would be required to consider these possibilities in detail.

We provide theoretical arguments and initial empirical tests in support of the contention that trust and operational routines accumulated by the technical personnel are more likely to result in less specified contracts and that administrative routines and governance skills accumulated by administrative personnel are more likely to result in more specified contracts as the inter-organizational relationship evolves. However, more work is needed to confirm our results. At issue are the simple repeated ties count measures we use to test these arguments as these proxies do not allow us to directly measure these three forms of relational capital. An in-depth case study of sponsored research should be conducted, which investigates how interpreting and sense-making learning processes by PIs and the evolution of trust between scientists in universities and companies result in trust and operational routine relational capital. Case study research should also consider how integrating and institutionalizing learning processes established by the management and legal representatives of universities and companies result in administrative routines and governance skill development.

Additional research incorporating data on alliance performance and the generalizability of our findings to other cross-boundary contexts would also be valuable. The arguments posed regarding both the influence of relational and transaction attributes on contract design are driven by performance expectations. There is a need to empirically investigate whether the proposed positive performance expectations hold for less specification of the contract by the technical personnel and more specification of the contract by the administrative personnel as the relationship evolves. The need to understand how such relationships operate is clearly becoming more important as research relationships between corporate sponsors and academic research universities emerge as common elements in the corporate innovation process. Although corporate sponsored academic research is increasing, other forms of cross-boundary alliances are prevalent as sources of knowledge required for innovation and new product development.

Research is needed to establish the extent to which dynamic relational capabilities accumulate in various organizational units based on the roles and responsibilities of individuals and groups assigned various tasks in these other types of cross-boundary relationships.

There is much work yet to be done. It is our hope that the theory we put forth and our findings will encourage further research that will provide a deeper and richer understanding of the complex, multiple-point relationships that evolve in inter-organizational relationships.

## REFERENCES

- Ahuja, G. 2000. Collaboration networks, structural holes, and innovation: A longitudinal study. *Administrative Science Quarterly*, 45: 425-455.
- Anand, B.N., & Khanna, T. 2000. Do firms learn to create value? The case of alliances. *Strategic Management Journal*, 21: 295-315.
- Argyres, N. S., Bercovitz, J., & Mayer, K. J. 2007. Complementarity and evolution of contractual provisions: an empirical study of IT services contracts. *Organization Science*, 18(1): 3-19.
- Argyres, N., & Mayer, K. J. 2007. Contracting design as a firm capability: an integration of learning and transaction cost perspective. *Academy Management Review*, 32(4): 1060-1077.
- Ariño, A., & de la Torre, J. 1998. Learning from failure: Towards an evolutionary model of collaborative ventures. *Organization Science*, 9(3): 306-325.
- Arora, A. & Gambardella, A. 1994. The changing technology of technology change: General and abstract knowledge and the division of innovative labor. *Research Policy*, 23(5): 523-532.
- Bagley, C.E. & Dauchy, C.E. 2008. *The entrepreneur's guide to business law, 3<sup>rd</sup> edition*. Mason, OH: South-Western Cengage Learning.
- Barney, J.B. & Hansen, M.H. 1994. Trustworthiness as a source of competitive advantage. *Strategic Management Journal*, 15(S1): 175-190.
- Baum, J. A. C., & Singh, J. V. 1994. Organizational hierarchies and evolutionary processes: Some reflections on a theory of organizational evolution. A. J. C. Baum, J. V. Singh, eds. *Evolutionary Dynamics of Organizations*. New York: Oxford University Press, 3-20.
- Bercovitz, J. & M. Feldman. 2007. Fishing upstream: Exploration and exploitation of university research by Canadian R&D performers. *Research Policy*, 36(7): 930-948.
- Bercovitz, J & M. Feldman. 2008. Academic entrepreneurs: Organizational change at the individual level, *Organization Science*, 19(1): 69-89.
- Blyler, M. & Coff, R.W. 2003. Dynamic capabilities, social capital, and rent appropriation: Ties that split pies. *Strategic Management Journal*, 24(7): 677-686.
- Brandenburger, A.M., & Stuart, H.W. 1996. Value-based business strategy. *Journal of Economics & Management Strategy*, 5(1): 5-24.
- Carter, R. & Hodgson, G.M. 2006. The impact of empirical tests to transaction cost economics on the debate on the nature of the firm. *Strategic Management Journal*, 27(5): 461-476.
- Chesbrough, H.W. 2003. *Open innovation. The new Imperative for creating and profiting from technology*. Boston, MA: Harvard Business School Press.
- Chua, R.J., Ingram, P., & Morris, M.W. 2008. From the head and the heart: Locating cognitive- and affect-based trust in managers' professional networks. *Academy of Management Journal*, 51(3): 436-452.

- Cohen, W., & Levinthal, D. 1990. Absorptive capacity: A new perspective on learning and innovation. *Administrative Science Quarterly*, 35: 128-152.
- Cohen, W., Nelson, R., & Walsh, J. 2002. Links and impacts: The influence of public research on industrial R&D. *Management Science*, 48(1): 1-23.
- Crocker, K.J. Reynolds, K.J. 1993. The efficiency of incomplete contracts: an empirical analysis of air force engine procurement. *RAND Journal of Economics*, 24(1): 126-146.
- Cyert, R. & March, J.G. 1963. *A behavioral theory of the firm*. Englewood Cliffs, NJ: Prentice Hall.
- Daft, R. L. 1978. A dual-core model of organizational innovation. *Academy of Management Journal*, 21(2): 193-210.
- Damanpour, F. 1991. Organizational innovation: A meta-analysis of effects of determinants and moderators. *Academy of Management Journal*, 34(3): 555-590.
- David, P., Mowery, D., & Steinmueller, E. 1997. University-Industry research collaborations: Managing missions in conflict," in P. David & E. Steinmueller (Eds.), *A productive tension: University-industry research collaborations in the era of knowledge-based economic development*, Stanford, CA: Stanford University Press.
- Dearborn, C.C. & Simon, H.A. 1958. Selective perception: a note on the department identifications of executives'. *Sociometry*, 21: 140-144.
- Deeds, D.L. & Hill, C.W.L. 1998. An examination of opportunistic action within research alliances: Evidence from the biotechnology industry. *Journal of Business Venturing*, 14: 141-163.
- Dougherty, D. 1992. Interpretive barriers to successful product innovation in large firms. *Organization Science*, 3(2): 179-202.
- Doz, Y. L. 1996. The evolution of cooperation in strategic alliances: Initial conditions or learning processes? *Strategic Management Journal*, 17(1): 55-83.
- Dussauge, P., Garrette, B., & Mitchell, W. 2000. Learning from competing partners: Outcomes and durations of scale and link alliances in Europe, North America and Asia. *Strategic Management Journal*, 21: 99-126.
- Duysters, G., & Hagedoorn, J., 1996. Internationalization of corporate technology through strategic partnering: An empirical investigation. *Research Policy*, 25: 1-12.
- Dyer, J, & Singh, H. 1998. The relational view: Cooperative strategy and sources of interorganizational competitive advantage. *Academy of Management Review*, 23: 660-679.
- Eisenhardt, K.M., & Martin, J.A. 2000. Dynamic capabilities: What are they? *Strategic Management Journal*, 21: 1105-1121.
- Faems, D., Janssens, M., Madhok, M. and Van Looy B. 2008. Toward an integrative perspective on alliance governance: Connecting contract design, trust dynamics, and contract application. *Academy of Management Journal*, 51(6): 1053-1078.

- Ferlie, E., Fitzgerald, L., Wood, M., & Hawkins, C. 2005. The nonspread of innovations: The mediating role of professionals. *Academy of Management Journal*, 48(1): 117-134.
- Freeman, C. 1982. *The Economics of Industrial Innovation*. London, UK: F. Pinter.
- Gerwin, D., & Ferris, J. S. 2004. Organizing new product development projects in strategic alliances. *Organization Science*, 15(1): 22-37.
- Graft, G., Heiman, A., & Zilberman, D. 2002. University research and Offices of Technology Transfer. *California Management Review*, 45(1): 88-115.
- Granstrand, O. 2000. *The Economics and Management of Intellectual Property: Towards Intellectual Capitalism*. Cheltenham, UK: Edward Elgar.
- Grant, R. 1996. Prospering in dynamically-competitive environments: Organizational capability as knowledge Integration. *Organization Science*, 7(4): 375-387.
- Gulati, R. 1995. Does familiarity breed trust? The implication of repeated ties for contractual choice in alliances. *Academy of Management Journal*, 38: 85-112.
- Gulati, R. & J. A. Nickerson. 2008. Interorganizational trust, governance choice, and exchange performance. *Organization Science*, forthcoming.
- Gupta, A.K., Tesluk, P.E., & Taylor, M.S. 2007. Innovation at and across multiple levels of analysis. *Organization Science*, 18(6): 885-897.
- Hagedoorn, J. 2002. Inter-firm R&D partnerships: An overview of major trends and patterns since 1960. *Research Policy*, 31: 477-492.
- Industrial Research Institute. 2002. Industrial Institute's R&D Trends Forecast for 2002. *Research Technology Management*, January-February: 16-20.
- Inkpen, A. C., & Crossan, M. M. 1995. Believing is seeing: Joint ventures and organizational learning. *Journal of Management Studies*, 32, 595-618.
- Inkpen, A. C., & Currall, S. C. 2004. The coevolution of trust, control, and learning in joint ventures. *Organization Science*, 15(5): 586-599.
- Inkpen, A. C., & Dinur, A. 1998. Knowledge management processes and international joint ventures. *Organization Science*, 9(4): 454-466.
- Jones, B. 2009. The burden of knowledge and the "death of the renaissance man": Is innovation getting harder? *Review of Economic Studies*, 76: 283-317.
- Kogut, B. & Zander, U. 1992. Knowledge of the firm, combinative capabilities, and the replication of technology. *Organization Science*, 3(3): 383-397.
- Lawrence, P.R. & Lorsch, J.W. 1967. *Organizations and environments: Managing differentiation and integration*. Cambridge, MA: Harvard University Press.

- Lepak, D.P., Smith, K.G., & Taylor, M.S. 2007. Value creation and value capture: A multilevel perspective. *Academy of Management Review*, 30(1): 180-194.
- Levinthal, D.A., & Fichman, M. 1988. Dynamics of interorganizational attachments: Auditor-client relationships. *Administrative Science Quarterly*, 33: 345-369.
- Lorenzoni, G., & Lipparini, A. 1999. The leveraging of interfirm relationships as a distinctive organizational capability: A longitudinal study. *Strategic Management Journal*, 20: 317-338.
- Malhotra, D., & Murnighan, J. K. 2002. The effects of contracts on interpersonal trust. *Administrative Science Quarterly*, 47: 534-559.
- March, J. 1994. *A Primer on Decision Making*. New York: Free Press.
- Mayer, K. J., & Argyres, N. A. 2004. Learning to contract: Evidence from the personal computer industry. *Organization Science*, 15: 394-411.
- Mayer, K. J. & Bercovitz, J. 2008. The Influence of Inertia on Contract Design: Contingency Planning in Information Technology Service Contracts. *Managerial and Decision Economics*, 29(2/3): 149-153.
- Melone, N.P. 1994. Reasoning in the executive suite: the influence of role/experience-based expertise on decision processes of corporate executives. *Organization Science*, 5(3): 438-455.
- Moran, P. 2005. Structural vs. relational embeddedness: social capital and managerial performance. *Strategic Management Journal*, 26: 1129-1151.
- Mowery, D., Nelson, R., Sampat, B., & Ziedonis, A. 2004. *Ivory tower and industrial innovation: University-industry before and after the Bayh-Dole Act*. Stanford, CA: Stanford University Press.
- Mowery, D.C., Oxley, J.E., & Silverman, B.S. 1996. Strategic alliances and interfirm knowledge transfer. *Strategic Management Journal*, Winter Special Issue, 17: 77-91.
- Mowery, D., & Rosenberg, N. 1989. *Technology and the pursuit of economic growth*. Cambridge, U.K.: Cambridge University Press.
- National Science Board. 2002. *Science and Engineering Indicators 2002*. Washington, D.C.: U.S. Government Printing Office.
- Nelson, R., & Winter, S. 1982. *An evolutionary theory of economic change*. Cambridge, MA: Harvard Business School Press.
- Nickerson, J. & Zenger, T. 2004. A knowledge-based theory of the firm. The problem-solving perspective. *Organization Science*, 15(6): 617-632.
- Nonaka, I. 1994. A dynamic theory of organizational knowledge creation. *Organization Science*, 5: 14-37.
- Oxley, J. 1997. Appropriability hazards and governance in strategic alliances: A transaction cost approach. *Journal of Law, Economics, and Organization*, 13: 387-409.
- Parkhe, A. 1993. Strategic alliance structuring: a game theoretic and transaction cost examination of interfirm cooperation. *Academy of Management Journal*, 36(4): 794-829.

- Pindyck, R. & Rubinfeld, D. 1991. *Econometric models and economic forecasts*. New York, NY: McGraw-Hill.
- Pitelis, C. 2009. The co-evolution of organizational value capture, value creation, and sustainable advantage. 30: 1115-1139.
- Poppo, L., & Zenger, T. 2002. Do formal contracts and relational governance function as substitutes or complements? *Strategic Management Journal*, 23: 707-725.
- Priem, R.L. 2007. A consumer perspective on value creation. *Academy of Management Review*, 32(1): 219-235.
- Ramirez, R. 1999. Value co-production: intellectual origins and implications for practice and research. *Strategic Management Journal*, 20: 49-65.
- Reuer, J. J., & A. Arino. 2007. Strategic alliance contracts: Dimensions and determinants of contractual complexity. *Strategic Management Journal*, 28: 313-330.
- Reitzig, M., & Puranam, P. 2009. Value appropriation as an organizational capability: The case of IP protection through patents. *Strategic Management Journal*, 30(7): 765-789.
- Ring, P. S., & Rands, G. 1989. Sensemaking, understanding, and committing: Emergent transaction processes in the evolution of 3M's microgravity research program. In A. H. Van de Ven, H. Angle, & M. S. Poole (Eds.), *Research on the management of innovation: The Minnesota studies*: 337-366. New York: Ballinger/Harper & Row.
- Ring, P. S., & Van de Ven, A. H. 1992. Structuring cooperative relationships between organizations. *Strategic Management Journal*, 13: 483-498.
- Ring, P. S., & Van de Ven, A. H. 1994. Developmental processes of cooperative interorganizational relationships. *Academy of Management Review*, 19(1): 90-118.
- Rosenberg, N. 1982. *Inside the black box: Technology and Economics*. New York: Cambridge University Press.
- Rosenkopf, L. & Nerkar, A. 2001. Beyond local search: Boundary-spanning exploration, and impact in the optical disk industry. *Strategic Management Journal*, 22: 287-306.
- Ryall, M. D., & Sampson, R. C. 2009. Formal contracts in the presence of relational enforcement mechanisms: Evidence from technology development projects, *Management Science*, 55(6): 906-925.
- Sampson, R. C. 2004. The cost of misaligned governance in R&D alliances. *Journal of Law, Economics, and Organization*, 20(2): 484-526.
- Sampson, R. C. 2005. Experience effects and collaborative returns in R&D alliances. *Strategic Management Journal*, 26(11): 1009-1031.
- Somers, J.P. 2003. Special contractual and IP rights considerations: Sponsored research agreements, university and government licensing, clinical trial agreements. *Morse, Barnes-Brown, Pendleton, P.C.*

- Stokes, D. 1997. *Pasteur's quadrant: basic science and technological innovation*. Washington DC : Brookings Institution Press.
- Teece, D. 1986. Profiting from technological innovation: Implications for integration, collaboration, licensing and public policy. *Research Policy*, 15: 285-305.
- Teece, D. J. 2007. Explicating dynamic capabilities: The nature and microfoundations of (sustainable) enterprise performance. *Strategic Management Journal*, 28(13): 1319-1350.
- Teece, D.J.G., Pisano, A., & Shuen, A. 1997. Dynamic capabilities and strategic management. *Strategic Management Journal*, 18: 509-533.
- Thompson, J.O. 1967. *Organizations in action*. New York: McGraw-Hill.
- Thursby, J. G., & Thursby, M. C. 2000, "Industry Perspectives on Licensing University Technologies: Sources and Problems" *The Journal of the Association of University Technology Managers* 12: 9-22.
- Tyler, B. 2001. The complementarity of cooperative and technological competencies: A resource-based perspective. *Journal of Engineering and Technology Management*, 18: 1-27.
- Tyler, B., & Steensma, H. 1998. The effects of executive's experiences and perceptions on their assessment of potential technological alliances. *Strategic Management Journal*, 19: 938-965.
- Utterback, J.M. 1971. The process of technology innovation within the firm. *Academy of Management Journal*, 14(1): 75-88.
- Vanneste, B. & P. Puranam. 2009. Repeated interactions and contractual detail: Identifying the learning effect. *Organization Science*, *Forthcoming*.
- Weick, K.E. 1976. Educational organizations as loosely coupled systems. *Administrative Science Quarterly*, 21: 1-19.
- Williamson, O.E. 1985. *The economic institutions of capitalism: Firms, markets and relational contracting*. New York: The Free Press.
- Williamson, O.E. 1991. Comparative economic organizations: the analysis of discrete structural alternatives. *Administrative Science Quarterly*, 6: 269-296.
- Zaheer, A., & Venkataraman, N. 1995. Relational governance as an interorganizational strategy: An empirical test of the role of trust in economic exchange. *Strategic Management Journal*, 16(5): 373-392.
- Zajac, E.J., & Olsen, C.P. 1993. From transaction cost to transactional value analysis: Implications for the study of interorganizational strategies. *Journal of Management Studies*, 30(1): 131-145.
- Zollo, M., Reuer, J.J., Singh, H. 2002. Interorganizational routines and performance in strategic alliances. *Organization Science* 13(6): 701-713.
- Zollo, M., & Winter, S.G. 2002. Deliberate learning and the evolution of dynamic capabilities. *Organization Science*, 13(3): 339-351.

**TABLE 1**  
**Sponsored Research Agreement Contract Clause Frequency (No. of Contracts: 136)**

	#	%
<b>Company Access</b>		
The sponsor will be given access to data generated	80	58.82%
A company representative will be specifically named	45	33.09%
The sponsor will be allowed to visit the research site	31	22.79%
Review meetings between the PI and the company scientists will be scheduled	22	16.18%
Research results will be jointly evaluated and know-how developed will be shared	17	12.50%
A joint scientific advisory board will be formed	1	0.74%
<b>Reporting Requirements</b>		
A final report was required	109	80.15%
Interim progress reports were called for	89	65.44%
Number/Dates of delivery for interim reports specified	49	36.03%
Content elements to be included in the report outlined	30	22.06%
PI required to maintain records documenting project activities	20	14.71%
<b>IP Allocation</b>		
Option Offered	124	91.18%
Option Expansiveness (Category 1)		
Worldwide	104	76.47%
Exclusive	122	89.71%
Sub-License Rights	40	29.41%
Perpetual	10	7.35%
Option Exercise and Negotiation Periods (Category 2)		
None Specified	19	13.97%
3 Months	28	20.59%
6 Months	51	37.50%
9 Months	24	17.65%
12 Months or More	14	10.29%
Licensing Framework (Category 3)		
Parameters for acceptable license terms	38	27.94%
Process for license term negotiation	6	4.41%
Right of first refusal to license on terms negotiated with a third-party	39	28.68%
Unobstructed Rights (Category 4)		
Warranty clause -- No third-party has rights to the IP	43	31.62%
Restrictions on the PI's right to engage in other sponsored research projects	26	19.12%
Specification that the sponsor owns the data generated through the project	34	25.00%
Previous conceptions reserved	39	28.68%
<b>Publication Constraints</b>		
Specified review and delay period		
None specified	4	2.94%
Up to 90 days	92	67.65%
Between 91-120 days	35	25.74%
Between 121-150 days	2	1.47%
More than 150 days	3	2.21%
Right to comment	36	26.47%
Right to delay given content concerns	4	2.94%
Right to require revisions	4	2.94%

**TABLE 2**  
**Descriptive Statistics**

<b>Variables</b>	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1 Access	1															
2 Report	0.26	1														
3 Allocate	0.47	0.33	1													
4 Publication	0.11	0.22	0.20	1												
5 Material	-0.04	0.17	0.26	0.16	1											
6 Equipment	0.30	-0.09	-0.06	-0.11	-0.37	1										
7 Basic	-0.22	-0.17	-0.08	-0.06	0.16	0.12	1									
8 Pi-Co History	-0.08	-0.13	-0.16	-0.14	-0.02	0.10	0.13	1								
9 Univ-Co History (Ln)	0.19	0.01	0.23	0.02	-0.01	0.05	-0.04	0.12	1							
10 Dept. Composition	-0.02	-0.11	0.01	-0.13	0.22	0.12	0.61	0.18	-0.07	1						
11 PI Contracting Expertise	0.04	-0.01	-0.12	-0.20	-0.09	0.04	0.05	0.23	-0.08	0.03	1					
12 PI Technical Expertise	-0.21	0.17	0.15	0.09	0.27	-0.15	0.20	-0.10	-0.03	0.23	-0.09	1				
13 Duration (mo.)	0.24	0.42	0.30	0.32	-0.10	-0.12	-0.09	-0.05	-0.14	-0.11	0.00	0.18	1			
14 Budget (Ln)	-0.14	0.21	0.12	0.06	0.13	-0.25	0.11	-0.07	-0.13	0.06	0.02	0.13	0.37	1		
15 Age	-0.16	0.27	-0.01	-0.06	0.12	-0.29	-0.09	0.41	-0.52	0.16	0.26	0.01	0.25	0.20	1	
16 Year	0.24	0.01	0.04	-0.11	-0.18	0.27	-0.06	0.32	0.36	-0.03	0.39	-0.31	-0.01	-0.16	0.07	1
<b>Summary Statistics</b>																
Mean	1.43	2.17	5.57	1.68	0.43	0.15	0.52	0.76	1.47	0.44	2.06	6.42	15.15	10.58	0.57	4.67
Standard Deviation	1.28	1.31	2.65	0.93	0.5	0.36	0.50	1.04	1.24	0.26	2.35	6.53	11.78	2.38	0.84	2.71
Min.	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	1
Max.	5	5	11	7	1	1	1	4	4.78	1	14	32.33	60	14.22	2	10

**TABLE 3**  
**Contract Terms and Analysis**

<i>Independent Variables</i>	Model 1 Access			Model 2 Report			Model 3 Allocate			Model 4 Publication		
	Coef.	s.e		Coef.	s.e.		Coef.	s.e.		Coef.	s.e.	
H1: Pi-Co History (Count)	-0.227	0.091	**	-0.176	0.100	*	-0.516	0.204	**	-0.049	0.076	
H2: Univ-Co History (LN)	0.184	0.100	*	0.271	0.109	**	0.711	0.223	***	-0.057	0.083	
<i>Control Variables -- Transaction Attributes</i>												
Material	0.662	0.200	**	0.596	0.219	**	1.719	0.446	***	0.473	0.166	**
Equipment	1.200	0.287	***	0.656	0.314	*	1.003	0.639		-0.113	0.238	
Basic (Using individual w/ PhD Dummy)	-0.754	0.215	***	-0.478	0.236	*	-0.657	0.480		0.126	0.179	
<i>Control Variables -- Other</i>												
Duration	0.049	0.008	***	0.041	0.009	***	0.081	0.019	***	0.032	0.007	***
Budget(LN)	-0.095	0.040	*	0.025	0.044		-0.008	0.090		-0.036	0.033	
Age	-0.126	0.148		0.519	0.162	**	0.371	0.331		-0.242	0.124	*
Year	0.030	0.047		-0.015	0.051		0.045	0.105		0.014	0.039	
PI Contracting Expertise	0.051	0.041		-0.007	0.045		-0.081	0.091		-0.049	0.034	
PI Technical Expertise (Cites/Pubs)	-0.053	0.015	**	0.014	0.017		0.007	0.035		-0.002	0.013	
Department Composition (% faculty w/ PhD)	1.045	0.443	*	0.224	0.485		1.136	0.988		-0.702	0.368	+
Constant	1.229	0.482	*	0.532	0.527		2.414	1.075	*	1.945	0.401	***
Number of Observations		136			136			136			136	
R-sq		0.421			0.334			0.316			0.228	
Chi-sq		99.06	***		68.26	***		62.78	***		40.05	***

\*\*\*p<0.001; \*\*p<0.01; \*p<0.05, +p<0.10

Significance is one-tailed for hypothesized variables and two-tailed for control variables

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**TABLE 4**  
**IP Terms: Robustness Test**

	Model 1 Allocate		Model 2 Publication	
	Coef.	s.e.	Coef.	s.e.
<i>Independent Variables</i>				
H1: Pi-Co History (Count)	-0.352	0.154 *	-0.094	0.053 *
H2: Univ-Co History (LN)	0.542	0.168 ***	0.118	0.058 *
<i>Control Variables -- Transaction Attributes</i>				
Material	0.911	0.336 **	0.200	0.116 +
Equipment	0.799	0.482 +	0.158	0.166
Basic (Using individual w/ PhD Dummy)	-0.556	0.362	0.157	0.125
<i>Control Variables – Other</i>				
Duration	0.055	0.014 ***	0.021	0.005 ***
Budget(LN)	-0.016	0.068	-0.038	0.023
Age	0.184	0.250	-0.080	0.086
Year	-0.011	0.079	-0.006	0.027
PI Contracting Expertise	0.017	0.069	-0.040	0.024 +
PI Technical Expertise (Cites/Pubs)	-0.008	0.026	0.001	0.009
Department Composition (% faculty w/ PhD)	1.104	0.745	-0.635	0.257 *
Constant	1.724	0.811 *	0.625	0.279 *
Number of Observations		136	136	
R-sq		0.246	0.285	
Chi-sq		44.26 ***	54.14 ***	

\*\*\*p<0.001; \*\*p<0.01; \*p<0.05, +p<0.10

Significance is one-tailed for hypothesized variables and two-tailed for control variables

Mis en forme : Français (France)

**TABLE 5**  
**Access Terms: Robustness Test**

<i>Independent Variables</i>	Model 1		Model 2	
	Access: Monitoring		Access: Info-Sharing	
	Coef.	s.e.	Coef.	s.e.
H1: Pi-Co History (Count)	-0.081	0.053 +	-0.146	0.062 **
H2: Univ-Co History (LN)	0.150	0.058 **	0.034	0.068
<i>Control Variables -- Transaction Attributes</i>				
Material	0.300	0.116 **	0.361	0.136 **
Equipment	0.684	0.167 ***	0.516	0.195 **
Basic (Using individual w/ PhD Dummy)	-0.502	0.125 ***	-0.251	0.146 +
<i>Control Variables -- Other</i>				
Duration	0.019	0.005 ***	0.030	0.006 ***
Budget(LN)	-0.042	0.023 +	-0.053	0.027 +
Age	-0.042	0.086	-0.083	0.101
Year	0.018	0.027	0.013	0.032
PI Contracting Expertise	0.047	0.024 *	0.004	0.028
PI Technical Expertise (Cites/Pubs)	-0.037	0.009 ***	-0.016	0.010
Department Composition (% faculty w/ PhD)	1.209	0.258 ***	-0.163	0.301
Constant	0.385	0.281	0.845	0.327 *
Number of Observations	136		136	
R-sq	0.441		0.290	
Chi-sq	107.09 ***		55.61 ***	

\*\*\*p<0.001; \*\*p<0.01; \*p<0.05, +p<0.10

Significance is one-tailed for hypothesized variables and two-tailed for control variables

Mis en forme : Français (France)