**Marshallian Forces and Governance Externalities:**
**Location Effects on Contractual Safeguards in R&D Alliances**

## ABSTRACT

We examine the impact of geographic location of alliance activities on the design of safeguards in contracts governing R&D partnerships. Joining research on agglomeration and alliance governance, we argue that the Marshallian agglomerative forces at work in a given location produce governance-related externalities that extend beyond productivity-related externalities considered in previous research. We investigate how location characteristics linked to Marshallian forces such as local knowledge spillovers, R&D rivalry, dense industry employment, and the strength of professional organizations have an impact on the specification of formal governance mechanisms. In particular, these Marshallian forces have a bearing on formal governance mechanisms that safeguard the execution of the R&D partnership, such as joint administrative interfaces and termination provisions. We analyze R&D partnerships between biotech and pharmaceutical firms and find that misappropriation hazards arising from greater knowledge spillovers and R&D competition in the region where R&D activities are located promote the use of these formal governance mechanisms in R&D partnerships. We also find that factors supporting thick interpersonal networks such as the intensity of sectoral employment and the strength of professional bodies reduce the use of formal governance mechanisms in R&D partnerships.

# INTRODUCTION

Many industries exhibit agglomeration, or geographic concentration of economic activity. Following the classic work of Marshall (1920), scholars have sought to study the geographic distribution of factors of production and its consequences for trade, competition and economic organization in general (e.g., Porter, 1990; Krugman, 1991; Saxenian, 1994). In explaining the causes behind the high density of activity in a location, Marshall's original inquiry extended beyond transportation costs and other natural endowment advantages to emphasize the economic benefits arising from the accumulation of skilled labor, specialized suppliers, and knowledge in the location. Researchers in economics, management, and other fields have built on these Marshallian micro-foundations to identify the local determinants of agglomeration economies, and the performance advantages firms can derive from them (e.g., Ellison, Glaeser & Kerr, 2010; Audretsch & Feldman, 1996; Rosenthal & Strange, 2003; Greenstone, Hornbeck & Moretti, 2010).

Agglomeration theory suggests that Marshallian forces driving agglomeration significantly influence the conduct of firms (e.g., Pouder & St. John, 1996; Tallman et al., 2004). Attending to understanding the effects of geographic concentration on the internal organization of the firm, one stream of agglomeration research has shown that clustering of firms creates externalities that in turn influence firm location decisions (Alcácer & Chung, 2007; Ghemawat & Thomas, 2008; Shaver & Flyer, 2000) as well as decisions related to the organization of R&D and other value chain activities (Alcácer & Zhao, 2012; Furman, 2003). While this evidence indicates that factors underpinning localization have an impact on several internal and organizational choices firms make, little is known about the effects of agglomeration on the cooperative strategies of firms. A few studies offer initial insight into the effects of agglomeration on firms' investment decisions (e.g., Almazan, De Motta, Titman & Uysal, 2010; McCann, Reuer & Lahiri, 2015), but gaps exist in understanding about how the organization of boundary-spanning activities, such as alliances, is shaped by the agglomerative forces found in locations that host these critical corporate development activities. Addressing the organization of such activities allows us to bridge the two large literatures on agglomeration and alliances that have largely developed independently from one another, but that have featured some common theoretical mechanisms that provide the basis for joining these research streams.

More specifically, our aim in this paper is to extend agglomeration theory by unpacking the governance implications of Marshallian agglomerative forces for R&D partnerships. In particular, we investigate whether Marshallian forces associated with the location where alliance R&D activity takes place shape firms' governance choices, which leads us to address the question: how do location characteristics associated with foundational agglomerative forces affect the stipulation of formal contractual governance provisions that facilitate mutual adjustment to exchange hazards in R&D partnerships? Contracts establish the framework that guides interfirm exchange, and prior research has shown the utility of studying contractual provisions to understand better the interplay among the different formal and informal mechanisms that enable firms to infuse order in their relationships (Poppo & Zenger, 2002; Ryall & Sampson, 2009). Our focus on contractual R&D partnerships is also motivated by the fact that agglomeration is commonly observed in several innovation-intensive sectors which have also increasingly adopted collaborative exchanges through complex contracts (Hagedoorn, 2002; Carlino & Kerr, 2015).

We join ideas identified in prior research on localization economies and alliance governance that indicate the geographic concentration of industry activity will influence the governance of inter-organizational relationships (Oxley, 1997; Rosenthal & Strange, 2004; Phene & Tallman, 2012). Linking these two research streams allows us to sharpen the theoretical understanding of the specific mechanisms through which Marshallian forces exert governance effects on R&D partnerships. We expect to see systematic differences in governance choices depending on the Marshallian characteristics of the location hosting the collaborative R&D activity, such as whether it is an industry cluster home to many firms similar to one or both the partners. For instance, we argue that a greater intensity of local knowledge spillovers and R&D competition within the regional economic system where a partnership's R&D activity takes place can escalate leakage hazards and result in more formal governance mechanisms in contracts for safeguarding alliance execution. At the same time, however, we also argue and show that supporting external governance economies are also likely to exist, depending on the density of individuals and professional relationships in the regional area of partnership R&D activity. More specifically, dense informal and interpersonal relationships mediated by institutions can increase cohesion in the location and aid in safeguarding exchange (Ahuja & Yayavaram, 2011; Rugman & Verbeke, 2003). These social ordering mechanisms deliver positive external effects on the governance of inter-organizational exchange and can, therefore, support bilateral adaptation (Gordon & McCann, 2000). In sum, we suggest that Marshallian forces that are known to drive increasing returns and firm productivity may also carry important implications for interfirm governance. The location of R&D activities in partnerships may, therefore, raise exchange hazards (e.g., knowledge spillovers) as well as offer informal governance supports to these partnerships, so it is valuable to unpack the influence of Marshallian forces on alliances' formal governance.

We test our hypotheses in the empirical context of contractual R&D partnerships in the biotechnology industry. This industry has served as the context for numerous prior agglomeration studies (Prevezer, 1997; DeCarolis & Deeds, 1999; Folta et al., 2006) as well as many studies of client firms' alliance activities with R&D firms in vertical partnerships (e.g., Deeds & Hill, 1996; Rothaermel & Deeds, 2004), so it provides a natural setting to join these two research streams. In order to investigate the governance effects of agglomeration, we consider two key contractual provisions that serve adaptation and safeguarding functions: (1) the inclusion of a contractually-designated steering committee, which is a board-like structure used to monitor and control the actions of the partnership; (2) the design of detailed termination provisions. Previous studies have described the key roles of these administrative bodies and termination provisions in the management of partnerships in a variety of industry settings (e.g., Jones, 2007; Hagedoorn & Hesen, 2006; Weber, Mayer & Macher, 2011). Together, these provisions serve the purpose of efficient safeguarding of alliance execution (Robinson & Stuart, 2007a; Gilson, Sabel & Scott, 2009).

We contribute by joining agglomeration theory with organizational economics to clarify the governance ramifications of Marshallian agglomerative forces for interfirm alliances. Extant literature studying the effects of agglomeration has largely focused on performance implications of clusters and how agglomeration influences the location and internal organization of corporate activities (e.g., Alcácer & Zhao, 2012; Shaver & Flyer, 2000). We contribute to and extend a more recent research stream that has begun to consider the implications of agglomeration for external corporate development activities. Our research explicates specific mechanisms that elevate or diminish the need for formal governance mechanisms to safeguard alliance execution rather than relying on informal governance mechanisms generally available in agglomerations, as suggested by prior literature (Iammarino & McCann, 2006). Knowledge spillovers and R&D competition in a location can require formal safeguards, whereas the prospects for relational governance are enhanced when norms of reciprocity develop from interpersonal interactions made possible by dense sectoral employment or professional bodies. Thus, our results suggest both merits as well as drawbacks of the forces in action in clusters for partners designing safeguards for R&D alliances. In sum, beyond identifying the varied implications of agglomeration for the governance of inter-organizational partnerships, our work responds more broadly to calls to contextualize agglomeration theory when assessing the benefits of clusters for firms (e.g., McCann & Folta, 2011).

## THEORETICAL BACKGROUND

### Agglomeration Economies and Marshallian Forces

Agglomeration work in the management area has investigated the geographic concentration of companies in industries such as semiconductors and biotechnology, which exhibit significant patterns of aggregation in areas such as Silicon Valley and Boston (e.g., Saxenian, 1994; Prevezer, 1997; Decarolis & Deeds, 1999; Rosenkopf & Almeida, 2003; Martin, Salomon & Wu, 2010). When located in such geographic agglomerations, firms and individuals tend to enjoy cost and productivity advantages that increase with the size of the regional economy.

Marshall (1920) identified three different sources that underpin these localized increasing returns: (i) sharing intermediary inputs, (ii) pooling in labor markets, and (iii) knowledge / technological spillovers (see Storper (1997) and McCann and Folta (2008) for literature reviews). These three characteristics generate advantages in a location in several ways. They allow participants in a regional economy to share indivisible resources, gains from specialization, and risks. They also improve both the likelihood and the degree to which matches occur between economic opportunities and resources. Finally, increasing returns arise from learning and diffusion of knowledge in the location and the attendant impact it has on the generation and commercialization of new ideas (Duranton & Puga, 2004). All of these three characteristics associated with the scale of industry activity in a location have been found to positively influence productivity, wages, and growth in the region (Rosenthal & Strange, 2004).

The impact of Marshallian forces can extend beyond efficiency gains in production, however. We contend that Marshallian forces also have an impact on the hazards firms encounter when partnership activities are located in a cluster, as well as the informal governance supports partners receive, so they will also influence the formal governance mechanisms deployed in these collaborations. The logic underlying the drivers of external economies in part builds on the idea that thick local markets can alleviate hold-up concerns and promote industry-specific investments by firms and individuals (Helsley & Strange, 2007). Accordingly, firms seeking to draw on the rich pool of talent and resources in agglomerations have to take the effects of Marshallian forces into account when organizing their activities in such locations. This is a particularly relevant concern as many high technology sectors are spatially agglomerated and frequently use collaborations to innovate. Given that both knowledge spillovers and highly skilled labor are key inputs to the innovation process (e.g., Audretsch & Feldman, 1996), we develop arguments that propose specific mechanisms through which the Marshallian forces of knowledge spillovers and labor market pooling exert governance effects at a regional level. This choice is apt because advancement in technology-based sectors occurs through the processes of experimentation, trial and error learning, and scientific investigation, all of which employ ideas and people as the main inputs (Romer, 1990; Glaeser et al., 1992). Before we discuss the implications of agglomeration for alliance governance in greater detail below, we first review some of the key ideas related to the governance of inter-firm partnerships in order to be able to connect these two separate research streams.

**Alliance Governance and Adaptation Considerations**

Transaction cost theory provides a useful theoretical lens to understand the governance and structuring of inter-firm partnerships. The theory emphasizes adaptability as the main problem of economic organization, and proposes discriminating alignment of transaction attributes with governance mechanisms as a means of promoting efficiency (Williamson, 1971; 1991). The main adaptation challenge is dealing with *ex post* opportunism arising from holdup of specific investments and misappropriation of proprietary knowledge (Mayer & Nickerson, 2005; Oxley, 1997; Pisano, 1989). To adapt to this challenge, parties can use private mechanisms in the form of an array of rules, processes, and managerial interfaces for monitoring and decision-making. Specifically, safeguards against opportunism, information sharing, and disclosure processes become integral to these private instruments that support adaptation in hybrids with bilateral dependency (Williamson, 1991, p. 280). These contractual provisions can describe in detail the specific procedures to be followed for managing ongoing interactions, resolving emergent conflict, or terminating the relationship. As such, they facilitate *ex post* adaptation and safeguard execution by reducing the scope of defection from cooperative behavior.

We are interested in order preserving formal provisions that embody the functions of monitoring, safeguarding, and adjusting to disturbances, so we focus here on two common provisions that address these issues in R&D partnerships. Our focus on specific contractual provisions is guided by the premise that not all contractual provisions are aimed at mitigating concerns of opportunism and safeguarding alliance execution. In particular, both partners may be interested in erecting structural barriers that can limit spillovers as well as creating disincentives that curb actions that can cause spillovers. Addressing these common concerns requires partners to not only monitor each other, but also to jointly oversee collaborative activities by developing rules and policies for accessing knowledge proprietary to the alliance, and by coordinating responses to any unwarranted behavior. First, alliance partners can create board-like structures with joint representation, and partners can delegate responsibility and authority to these committees to administer the activities of the alliance (Smith, 2005). These structures fill contractual gaps while also enabling partners to systematically exchange information, decide on resource allocation, and respond to incipient conflicts and other concerns of the alliance. In this sense, they are comparable to boards, but with a bounded purview of authority as well as administrative burden. Second, termination provisions can aid in *ex post* adjustment by describing not only the specific conditions determining whether and how a relationship ends that are bilaterally observable or verifiable by courts (e.g., the emergence of a contingency, unresolved conflict, opportunistic actions, etc.), but such provisions also specify the partners' obligations and procedures in the event they opt for termination (Hagedoorn & Hesen, 2007; Barthélemy & Quélin, 2006; Lerner & Malmendier, 2010). They can also serve as punitive and more extreme measures partners can take to cut off access to resources and the returns to collaboration.

These two formal provisions that we investigate are conceptually bound by the governance functions they perform in enforcing the collaborative agreement and safeguarding alliance execution. Steering committees, which closely resemble hierarchy with administrative authority embedded in the contract, become a natural choice for making *ex post* monitoring operational. Similarly, termination provisions improve efficiency when contracting parties find it difficult to ascertain whether the counter party is committed to a course of action that fulfills contractual obligations and when third parties (i.e., courts) are not positioned to credibly establish deviation from contractual commitments (Arruñada, Garicano & Vazquez, 2001; Lerner and Malmendier, 2010). Thus, steering committee and termination provisions both offer contractually defined bilateral solutions to maintain efficient exchange between partners and safeguard partners' interests. Consider the specification of the administrative functions of the steering committee in an alliance between Archemix and Takeda. Both parties agreed to manage the research collaboration by delegating oversight responsibility to a joint steering committee that would meet regularly. The contract also specified that the agenda of the steering committee meetings should take into account the "planning needs" of the collaboration, and proposed convening of "special meetings" within a specific time period to deal with "urgent cases." The specific responsibilities delegated to the joint steering committee encompassed nomination and approval of lead compounds to pursue, adjudication of disputes, and designation of success or failure of target compounds. Similarly, the detail present in termination clauses also embodies partners' *ex post* adaptation concerns discussed above. For example, in an R&D agreement between Roche and ArQule, the parties delineated the conditions when unilateral rights to terminate existed as well as what grounds would be sufficient for termination, specified time intervals for remedying specific types of breach, and described the obligations of each of the parties following termination. The explicit enumeration of the various procedural elements of both committees and termination provisions is indicative of the increasing formalization of alliance governance.

In the following section, we develop arguments about how these formal contracting choices can be shaped by the Marshallian forces underlying agglomeration. Potential opportunistic behavior around the knowledge contributed to and generated from an R&D partnership raises the most significant adaptability issues, so we focus on the characteristics of the geographic location of the firm where R&D activity takes place. We first explain how misappropriation hazards are increased when there is greater intensity of knowledge spillovers and higher R&D rivalry in the R&D firm's local region. We develop the argument that both of these conditions make it more likely that contractual agreements will employ steering committees and more detailed termination provisions. We then explain how relational mechanisms can develop from thick industry labor markets and strong professional community relations backed by institutions in the R&D firm's local region, thus enabling a firm to rely less on formal governance mechanisms for safeguarding the R&D partnership.

## HYPOTHESIS DEVELOPMENT

### Knowledge Misappropriation Hazards and Agglomeration

Agglomeration scholars relate the spatial concentration of sectors that thrive on innovative activity to the importance of access to new knowledge to advance ideas and bring inventions to market (Audretsch & Feldman, 1996). The close connection between the scale of industry activity and innovation derives from the idea that there exist opportunities for firms to learn from each other and tap into the accumulated knowledge in a region (Rosenthal & Strange, 2004). Although R&D productivity at the regional level can benefit from firms taking advantage of knowledge spilling over from other firms in the location without bearing the associated costs, collaborating firms face the important downside of their knowledge spilling over *to* other firms situated nearby the R&D firm. Thus, such spillovers may reduce a firm's ability to appropriate returns from an R&D partnership. We therefore propose that the strength of knowledge spillovers and R&D rivalry in the location of the R&D firm can magnify the need for designing formal governance mechanisms to address a partnership's adaptation needs.

*Knowledge Spillover Intensity*. While knowledge spillovers are a benefit to the recipients of the knowledge, they can be detrimental to the firms producing the knowledge. As a consequence, Shaver and Flyer (2000) argue that this is one reason why firms more likely to produce knowledge spillovers may be less likely to choose agglomerations as a location for operation in the first place. We anticipate similar concerns when firms are forging alliance relationships with firms that conduct R&D in areas prone to strong knowledge spillovers. The threat of leakage and diffusion of sensitive information and experimental outcomes within the local region can negatively affect the value of the technological opportunities partners are jointly pursuing or discovering during the partnership.

Several factors suggest locations will vary in the intensity of spillovers and the appropriation hazard borne by partnering firms. Knowledge spillovers within a region can be impacted by the nature of task specialization, organization of knowledge production activities, and knowledge exchange culture (Saxenian, 1994; Von Hippel, 1987). As one example, the intensity of spillovers may vary across locations because of the way in which individuals specialize in their skills. This may either augment or limit their ability to learn and benefit from day-to-day interpersonal interactions with individuals from other firms (Cohen & Levinthal, 1990; Maskell, 2001). Also, the "local culture" may influence the nature of face-to-face interactions, and the degree to which the constraints imposed by organizational boundaries extend to the social context (Saxenian, 1994; Owen-Smith & Powell, 2004). Regardless of the specific source, variance in intensity of spillovers is relevant to evaluating exchange hazards. High intensity of knowledge spillovers in the location of the firm conducting the R&D activity elevates the hazard of diffusion of valuable knowledge in the region. To account for these threats, partners are more likely to employ formal mechanisms that allow them to monitor alliance activities and take necessary actions to adjust to any potential leakage concerns if and when they arise. For instance, steering committees can use their authority to reallocate resources and tasks if spillovers become a concern. Similarly, the shadow cast by a termination threat alleviates concerns about the counterpart engaging in opportunistic behavior that leads to spillovers in the region. For this reason, we propose that:

> *Hypothesis 1: Location knowledge spillover intensity is positively associated with the likelihood that partners devise detailed formalized governance provisions within an R&D partnership, ceteris paribus.*

*R&D Rivalry Intensity*. The misappropriation concerns we have highlighted in the previous hypothesis relate to the general level of knowledge spillovers in the region in which the R&D firm is situated. Knowledge spillovers can prove particularly detrimental to appropriating returns to investments in collaborative R&D when local conditions facilitate immediate exploitation of spillovers by others. Agglomeration research argues that competition within a region can be an important force that encourages firms to innovate or risk failure (Porter, 1998). This competition therefore encourages firms to extract knowledge spillovers from the region, which reduces the value the focal firm can appropriate from its R&D efforts (Gans & Stern, 2003).

More intense local R&D competition therefore increases the magnitude of the threat from spillovers to the local economy. We expect a location with more intense R&D competition will have elevated exchange hazards, thereby increasing the need for more elaborate formal governance mechanisms for several reasons. To begin with, an increase in the presence of competing organizations in the R&D firm's location increases the scope for informal social contact with competitors that can increase the potential for unintended spillovers (Casper, 2007). Moreover, opportunities for the R&D firm to cherry-pick and pursue collaborative opportunities with rivals of the client firm can also undermine the client firm's appropriation of returns from its investment in a partnership (Sable, 2006). Localized R&D competition also increases the risk of imitation by multiple competitors, resulting in a sharp deterioration of the value of any novel innovations. A large number of local organizations with the requisite capacity to absorb and quickly build on any new technical knowledge proprietary to the partnership can severely impair the value of these new ideas (Glaeser *et al*., 1992; Baptista, 2000; Tallman *et al*., 2004). Under these conditions, greater pressures will exist for oversight and adaptation of the collaborative agreement, leading firms to make greater use of formal governance mechanisms supporting an R&D partnership. For these reasons, we propose that:

> *Hypothesis 2: Location R&D rivalry intensity is positively associated with the likelihood that partners devise detailed formalized governance provisions within an R&D partnership, ceteris paribus.*

**Relational Mechanisms and Agglomeration**

So far, location characteristics associated with the transmission and diffusion of knowledge in the regional economy have yielded governance diseconomies for collaborations that lead firms to employ protective formal governance mechanisms when facing knowledge spillovers and R&D competition in the location of the R&D firm. We now turn to the externalities that derive from the other Marshallian factor of local labor markets and associated institutions. We build on the idea that the depth of personal ties in the local economy gives rise to agglomeration benefits in general. We explain below how location characteristics associated with labor markets can provide access to important relational mechanisms that reduce the need for detailed formal governance provisions in the contract between the partners.

The benefits of formal mechanisms must be balanced against their costs, as the discriminating alignment principle would suggest. Formal mechanisms come with the costs of negotiating the associated contractual provisions, potential legal liabilities created during implementation, as well as direct and opportunity costs related to members discharging their responsibilities. Thus, when alternatives to formal governance mechanisms exist, partners may actively consider using them to achieve their governance objectives without the added contracting and execution costs. In the ensuing hypotheses, we draw on this line of reasoning to argue that the pressures to design more formal instruments or integrative modes that rely on authority are likely to be lower when linkages in the regional economy offer less costly relational alternatives to sustain order as described above (e.g., Gulati, 1995; Macaulay, 1963; Poppo & Zenger, 2002; Puranam & Vanneste, 2009).

*Location Sector Employment Intensity*. Spatial proximity of individuals with common career or personal interests and backgrounds serves as an important antecedent to the formation, growth and stability of local social networks in a region (Blau, 1977; Sorenson & Stuart, 2001; Powell *et al*., 2005).

As the density of the individuals who belong to an industrial sector increases, individual actors face more opportunities to establish contact with others who share similar occupational and industry backgrounds, which aids in the development of informal relationships. For example, the San Diego metropolitan area, where the life sciences sector (e.g., biochemists, biophysicists, medical scientists) employs about 6 out of 1000 people, offers more opportunities for a life sciences scientist to meet others in his or her field compared to the Nashville metropolitan area, where the incidence is 1 out of 1000 employees. Such social network ties within the region extend beyond firm boundaries partly because of employee mobility and shared affiliations in the employment histories of individuals (Casper & Murray, 2005). Multiple points of contact also stabilize the ties within the regional social network, and firms embedded in such locations can benefit from the externalities that arise from the dense set of the interpersonal associations (Uzzi, 1996).

The local social network that emerges from the employment intensity of a region in a given sector offers information benefits that can support the governance of inter-firm arrangements (Dahl & Pedersen, 2004). In high-velocity contexts such as biotechnology or telecommunications where employees move jobs at a high rate and firms face a high risk of failure, interpersonal relationships within the region acquire significance in determining governance choices because of their stability (Sorenson & Rogan, 2014). Interpersonal networks enable efficient communication to a large set of recipients within the region (Uzzi, 1997). To the extent that regional interpersonal networks can rapidly diffuse information about any opportunistic actions in the R&D activity location, partners are less likely to obstruct cooperation and adaptation of relationships as this would have adverse reputational consequences that could foreclose other collaborative opportunities with other firms in the region. Accordingly, due to the informal networks and associated reputational considerations that foster cooperation, we expect that partners will see less need to institute formal governance mechanisms to promote adaptation of a collaborative agreement. Although sector employment intensity might also provide a foundation for knowledge spillovers, we anticipate that sector employment intensity will reduce the need for formal governance, holding constant the effects of spillover intensity and other Marshallian forces in the local region discussed above. We thus propose that:

> *Hypothesis 3: Location sector employment intensity is negatively associated with the likelihood that partners devise detailed formalized governance provisions within an R&D partnership, ceteris paribus.*

*Location Professional Community Density*. The externalities of agglomeration on transaction governance described above can also originate from other sources that shape relationships among individuals within the region in which the R&D firm is located and can also curb opportunism. Individuals participate in a variety of formal institutions through which they can systematically access and connect with people who share common professional and personal interests. Formal institutions such as unions, business groups, or professional associations provide basic structures for such interactions to develop. These professional bodies provide a framework for interaction by stipulating rules of membership and by developing norms and conventions applicable to members. As such, they not only allow members to exchange information about a broad range of topics of interest but also create a social environment that supports mutual obligations, forms expectations, and shapes the behavior of individuals as well as the organizations they represent (Coleman, 1988).

The intensity of membership in a professional body in a given location can indicate strength of the community in the region that shares common pursuits and actions guided by a common set of standards. A location with dense affiliation to a professional body can promote a web of thick institution-based relationships and increase the benefits from mutual interaction (Martin, 2000). Moreover, this web extends beyond those directly employed in the industry.

The strength of professional bodies in the location of the R&D firm can in turn mitigate the concerns partners have when entering into a transaction in several ways. First, professional bodies help establish common social norms that allow members to evaluate each other's actions. In this sense, broader membership in professional associations contributes to enhanced development of region-specific assets that "take the form of conventions, informal rules and habits that coordinate economic actors under conditions of uncertainty" (Storper, 1997: 5). Second, a thicker local institutional environment reduces the incentive of firms to engage in opportunistic actions because of the greater likelihood of transmission of this information to other parties. Although the professional body by itself does not have the power to sanction opportunistic behavior, it provides the means to facilitate community enforcement (Kandori, 1992). Regions with greater participation in professional associations provide more cohesive aggregation of private information of individual members and more reliable reputation information. When professional networks are more densely developed in the location of the R&D firm, transgression of institutional norms may be communicated more effectively. A negative reputation acquired in this way can have an adverse impact on future transactions either because partners refuse to transact or do so on less favorable terms. Paralleling the forgoing discussion, these informal supports to the governance of collaborative agreements reduce the need to employ formal governance mechanisms to facilitate adaption. We therefore hypothesize:

*Hypothesis 4: Location professional community density is negatively associated with the likelihood that partners devise detailed formalized governance provisions within an R&D partnership, ceteris paribus.*

## METHODS

### Sample and Data

We test our hypotheses using data from biopharmaceutical alliances. This industry suits our objective of combining research on agglomeration theory and alliance governance because it has been established as a particularly useful empirical setting both for agglomeration research (e.g., DeCarolis & Deeds, 1999; Folta, Cooper & Baik, 2006; McCann & Folta, 2011) and alliance studies (e.g., Powell, Koput & Smith-Doerr, 1996; Rothaermel & Deeds, 2004). To build our sample for analyses, we concentrate on dyadic R&D partnerships formed in the 1990-2010 timeframe. The time period spans the industry phase where firms relied heavily on partnerships to fill critical resource gaps.

We draw the sampled partnerships from Thomson Reuters' Recap (Recap) database. Recap has provided alliance information in the biopharmaceutical industry by following alliance news and other public sources such as statutory filings with the Securities and Exchange Commission. Recap has been found to offer robust data about alliances in the biopharmaceutical sector (Schilling, 2009), and many studies in economics, finance and management have used this database (e.g., Lerner, Shane & Tsai, 2003; Robinson & Stuart, 2007a).

Because our interest lies in contractual alliances with an R&D component, we sampled on alliances that Recap classifies as "Research", "Development", "Co-Development" or "Collaboration" and did not include partnerships from categories such as "Equity", "Marketing", or "Manufacturing". In these agreements, Recap ascertains which company is the primary technology provider and designates it as the R&D firm. The R&D firm is the principal, but not necessarily the sole, provider of technology. For example, a typical deal might involve a small biotech company and a pharmaceutical company in which the biotech company provides the technology and the pharmaceutical company contributes funding as well as services such as manufacturing or marketing in addition to research and development. Our final sample includes 393 R&D partnerships. We supplement the data from Recap and the United States Patent and Trademark Office (USPTO) with information from several additional data sources, as described below.

**Measures and Analysis**

**Dependent Variables.** Our analysis aims to investigate how Marshallian agglomerative factors generate governance externalities in alliances, and thereby influence the degree to which firms include detailed formal provisions in the contract to cope with *ex post* transactional disturbances. Our particular interest lies in examining the design of provisions that allow for monitoring and private enforcement using dedicated administrative interfaces, as well as clearly defined rules to end the relationship when unforeseen events emerge. We employ two dependent variables to measure the contract's ability to safeguard alliance execution. The first dependent variable is an indicator of whether or not the partner firms establish a joint steering committee to govern the alliance. *Steering committee* equals one when the contract specifies the establishment of this committee and zero otherwise. We reviewed each contract to determine whether the partners devised a steering committee to support the alliance's governance.

We analyzed the text of termination provisions to measure our second binary dependent variable, *Termination complexity*. Previous research has employed very broad measures such as contract length and byte size of the contracts to measure complexity based on the idea that detailed specification of contractual provisions increases their complexity (Joskow, 1988; Robinson & Stuart, 2007a). In a similar spirit, we rely on the number of unique words used to define termination provisions after excluding common grammatical forms such as articles and prepositions. For each contract, we then calculate the proportion of the number of elements in the set of words present in the termination clause of the contract to the number of elements of the set of words from termination clauses across the sample (i.e., the union of the sets of words in sample termination clauses). The higher this proportion is for given contract, the more detailed is the contract with respect to termination provisions. The variable *Termination complexity* takes the value of 1 if the proportion of unique words falls above the sample mean of this ratio. The binary nature of the two dependent variables allows us to employ bivariate probit models in order to simultaneously analyze the determinants of termination complexity and steering committees and account for the fact that the same unobservables might affect both aspects of alliance contracts.

**Independent Variables.** Our principal explanatory variables capture Marshallian sources of externalities in agglomerations. Because our specific concern relates to the potential of these Marshallian forces to generate governance externalities related to hazards of knowledge misappropriation, we focus on the location of the R&D firm because, in our empirical session, this location is the locus of R&D activities during alliance execution. To this end, we locate the major R&D facilities of each of the partners from statutory filings and other publicly available sources. Next, we link these laboratory locations with a specific metropolitan statistical area (MSA) as defined by the U.S. Office of Management and Budget (OMB) and used by the U.S. Census Bureau. We have identified 36 different MSAs where R&D firms have located their R&D facilities (*cf.* Tallman & Phene, 2007).

The first theoretical variable is related to the intensity of knowledge spillovers within the region. Building on the widely-acknowledged idea of using patent citations to study knowledge flows (e.g., Jaffe, Trajtenberg & Henderson, 1993; Almeida & Kogut, 1999; Tallman & Phene, 2007), we use patent and geographic information from a disambiguated patent inventor database (Lai *et al*., 2011) to construct a measure for the localized intensity of knowledge spillovers. We start by identifying patents classified at the three-digit level under classes that include core subject matter related to the biopharmaceutical sector (424, 435,436,514,530, 536, 800) (Phene, Fladmoe-Lindquist & Marsh, 2006). We count the number of distinct *cited-citing* patent pairs that belong the same metropolitan statistical area in a five-year window before the focal year, and divide it by the number of establishments that belong to the biopharmaceutical sector to calculate *Location spillover intensity*. Thus, higher values of this variable reflect a greater degree of localized knowledge spillovers in the MSA in which the R&D firm is located.

Our second theoretical variable is the intensity of R&D rivalry in the region (i.e., *Location R&D rivalry intensity*). We develop a measure based on the Herfindahl-Hirschman index (HHI) using information about the geographic distribution of funding to research projects from grants awarded by the U.S. National Institutes of Health (NIH). NIH reports information every year about the organizations that have received funding awards to conduct research and where they are located. We match these data with data from the US Census Bureau to obtain the distribution of awards across various organizations in an MSA. We track the NIH annual funding grants to organizations in any given region. Using an organization *i*'s share of total awards at the MSA level, we calculate a Herfindahl index ( $H = \sum_{i=1}^{n} s_i^2$ ) and subtract it from 1 to get the degree of dispersion. We are interested in whether these grants are concentrated among a few organizations in a region (lower rivalry) or whether many organizations in the region compete for these grants. Research projects funded by the NIH have played a key role in promoting the biopharmaceutical sector by supporting advancements such as DNA sequencing, structural biology, and computational biology. Selection of proposals follows a highly competitive process nationally, with only around 15-20 percent of the grant applications receiving funding (Alberts, Kirschner, Tilghman and Varmus, 2014). *Location R&D rivalry intensity* ranges between 0 and 1, and higher values for this measure indicate greater intensity of R&D rivalry within the regional unit.

Our third theoretical variable concerns the density or strength of employment base of given industry in the regional economy as it relates to the potential formation of dense networks among individuals. Specifically, we use the number of employees that belong to the pharmaceuticals sector (NAICS code

3254) or biotech and other research services (NAICS code 54171) and calculate the variable *Location sector employment density* as a share of the total employment in the aggregated regional unit (MSA) of the R&D firm's location. Data were provided by the U.S. Census Bureau.

Our final theoretical variable relates to the thickness of professional relationships and interactions by means of multilateral professional institutions. We use membership data from the Federation of American Societies for Experimental Biology (FASEB) to develop the measure *Location professional community density*. FASEB is an umbrella organization covering 27 U.S. societies in the field of biological and medical research; it represents the largest coalition of professionals engaged in the health sector with over 120,000 members. We obtained the geographic distribution of FASEB members and matched it with data from the US Census Bureau. We measure *Location professional community density* using FASEB membership as a share of the biopharmaceutical sector employment in the regional aggregated unit (i.e., the MSA).

**Control Variables.** We control for several partner- and alliance-level variables that might be related to the contractual governance mechanisms of interest as well as the aforementioned explanatory variables. At the partner level, we first control for the alliance experience of both the partners because firms can learn to manage alliances from previous experience, thus reducing the need for the formal governance mechanisms we study (Anand & Khanna, 2000; Hagedoorn, Lorenz-Orlean & van Kranenburg, 2009). We measure *R&D firm alliance experience* and *Client firm alliance experience* as the number of alliances (logged) of the firm prior to the focal alliance (Ha & Rothaermel, 2005). We built a dataset that is a union of Recap and Thomson Financial's Securities Data Corporation (SDC) database to compute these experience measures. We also control for the knowledge stocks of both of the partners, partly because firms holding a greater amount of accumulated knowledge are more likely to have the absorptive capacity to effect knowledge transfers from external sources (Dushnitsky & Lenox, 2005). We construct a composite measure for the value of the firm's patent portfolio, using all issued patents applied for prior to the alliance. We calculate the average number of claims (Lerner, 1995), the average number of forward citations received in the 5 year window after issue (Jaffe & Trajtenberg, 1996), and the average originality from the backward citations (Gompers, Lerner & Scharfstein, 2005; Trajtenberg, Henderson & Jaffe, 1997). We then take the sum of the logarithm of each of these three averages to derive a composite of value (Lanjouw & Schankerman, 2004) which we label *R&D firm knowledge value* and *Client firm knowledge value*.

We also control for several variables at the individual partnership level. We control for partners' ability to appropriate knowledge by measuring the overlap of partners' technological knowledge bases (i.e., *Technology overlap*). Specifically, we calculate the overlap of the partner's patent portfolios as the uncentered correlation coefficient of the distribution of each of the firm's patents across the various three-digit patent classes (Jaffe, 1986). We also control for the coordination needs of the alliance by measuring the degree of interdependence between partners as they implement the alliance. We base this variable on Thompson's (1967) interdependence scale, which indicates three types of interdependence (i.e., pooled, sequential and reciprocal) and orders them based on the degree of difficulty in achieving coordination. Guided by these descriptions, we measure interdependence in the following way: we set *Reciprocal interdependence* equal to one for alliances classified as "Collaboration" or "Co-Development" agreements, and sequential interdependence is the reference category of "Research" or "Development" agreements. Whenever an alliance is classified under multiple categories, we take the highest form of interdependence observed for that alliance. We also controlled for alliance scope by measuring the breadth of tasks covered by the collaboration. Using Recap's description of the subject matter of the deals, we identify those that have been designated "broad focus" to indicate the broad therapeutic scope of R&D activities. Our binary variable *Alliance scope* takes the value of 1 for such alliances and 0 otherwise.

Because the monitoring and control needs of an alliance may be associated with the size of the collaboration (Fama & Jensen, 1983), we include *Deal size,* measured as the maximum possible payments through the life of the partnership agreement (Robinson & Stuart, 2007a). We also include overall *Contract complexity* measured by the byte size of the contract analysis by Recap (Robinson and Stuart, 2007a). In sensitivity analyses, we also employed residual values of contract complexity to account for potential endogeneity and obtained similar results. Co-location of exchange partners in an agglomeration will be consequential for structuring the partnership because it can reduce concerns over opportunistic behavior and promote adaptation between exchange partners based on cooperative norms that exist within a cluster (e.g., McCann & Gordon, 2000). To account for this, we include *Shared cluster location,* which is an indicator variable for whether or not the partners are co-located in a biopharmaceutical agglomeration. Because prior ties engender trust and offer relational support to collaborative agreements in mitigating opportunism threats (Gulati, 1995; McEvily, Perrone & Zaheer, 2003) as well as facilitate the development of stable routines that can address coordination and communication problems in alliances (Zollo, Reuer & Singh, 2002), we include *Prior ties*, which is measured by counting the number of prior alliances between the partners (Gulati, Lavie & Singh, 2009). Since geographic distance between partners affects their ability to oversee the collaborative activities (Coval & Moskowitz, 1999), we include *Partner distance* measured by the distance between the partners' locations. Finally, some of the alliances are cross-border deals, so we include a dummy variable *International deal* (Gulati, 1995) to distinguish such partnerships from domestic collaborations.

We also control for a variety of sources of unobserved effects. We include the indicator variable *Biotech-Biotech deal* (Lerner, Shane & Tsai, 2003) to distinguish alliances formed by two biotech firms and alliances formed by a pharmaceutical firm and a biotech firm. We also incorporated a series of fixed effects for the phase of the alliance in the drug discovery cycle (*Phase Fixed Effects*), the focal therapeutic indication for the alliance (*Therapeutic Area Effects*) (Macher & Boerner, 2006), its technological domain (*Technology Area Effects*) (Adegbesan & Higgins, 2009), and the year in which the collaborative agreement was signed (*Time Fixed Effects*).

## RESULTS

Table 1 presents descriptive statistics and a correlation matrix. Steering committees are utilized in 39 percent of the partnerships in our sample. The partnerships' R&D activities are located in regions with an average of nine cited-citing patent dyads per biopharma establishment, our measure of location spillover intensity. Alliances with steering committees are associated with higher levels of density of local cited-citing patent dyads. R&D activity is significantly dispersed in the locations present in our sample. Alliances with steering committees are also associated with locations that have higher levels of R&D rivalry in the region ($p<0.05$). Table 2 shows the results of bivariate probit models for the likelihood that a particular R&D partnership includes specific contract adaptation, monitoring and enforcement safeguards in the form of a steering committee and complex termination provisions. Models 1 and 2 provide estimates of our baseline model that comprises the controls. Models 3 and 4 incorporate the main explanatory variables for hypothesis testing. Because some client firms occur multiple times in our sample, we report standard errors clustered on the client firms.

Our first hypothesis predicts that a greater intensity of regional knowledge spillovers increases misappropriation risks for the alliance, thus making partners more likely to incorporate formal mechanisms to govern alliances through steering committees and complex termination provisions. The positive and significant sign for the coefficient of *Location spillover intensity* in Model 3 confirms this expectation for steering committees ($p=0.001$). A one standard deviation increase in the spillover intensity of the location is associated with a 16.67 percent increase in the probability of incorporating a steering committee in the alliance contract ($p<0.001$; the effect is averaged over the estimation sample). Model 4 indicates that spillover intensity, however, is not significantly associated with the use of more complex termination provisions.

Our second hypothesis considered the effect of regional R&D rivalry on the choice of formal adaptation and monitoring mechanisms in R&D contracts. We posited that greater R&D rivalry in the location of the R&D firm exerts a negative governance externality that would reduce reliance on informal mechanisms external to the partnership and lead firms to use more formal and complex contractual provisions. Accordingly, we predicted a positive sign for the coefficient of *Location R&D rivalry intensity*. In support of this hypothesis, the coefficient for *Location R&D rivalry intensity* is positive and significant in both Model 3 for steering committees ($p=0.028$) and Model 4 for complex termination provisions ($p=0.014$). Using estimates from Model 3, we find that the likelihood of putting in place a steering committee increases by 13.8 percent given a one standard deviation increase from the mean in the regional R&D rivalry (*p*=0.025). For the same increase in R&D rivalry, the probability of more complex termination provisions increases by 12.5 percent on average (*p*=0.012).

In our third hypothesis, we posited the positive governance externality arising from dense biopharma employment in a location, which supports intense personal interactions and infuses reputational considerations into collaborations and therefore makes formal adaptation mechanisms less necessary. Accordingly, we expect a negative sign for the coefficient of *Location sector employment density* in both Models 3 and 4. Consistent with this expectation, the coefficient is negative and significant in Model 3 (*p*=0.009). The probability of the partnership being governed by a steering committee decreases by 13.3 percent on average for a one standard deviation increase from the mean of location sector employment density (*p*=0.01). The coefficient estimate is also negative and significant in Model 4 (*p*=0.043), and using these estimates we find that the probability of observing complex termination provisions decreases by 11.2 percent on average (for observed covariate values in our sample) for a one standard deviation increase from the mean in location sector employment density (*p*=0.044).

The development of our fourth hypothesis suggested that the thickness of membership in professional communities supported by institutions in the region can offer external support to adapt and enforce the contract. Thus, we again anticipated a negative sign on the coefficient for *Location professional community density*. The results in Models 3 and 4 provide partial support for our expectation because we observe a negative and significant sign for the point estimate (*p*=0.032) in Model 3. This negative effect translates to a 8.9 percent decrease in the probability of observing a steering committee in the contract for a one standard deviation increase from the mean in the density of professional community (*p*=0.033). Thus, greater professional membership density appears to reduce the likelihood of using steering committees, but not complex termination provisions, as a means of facilitating adaptation.

We also compare the coefficients of our hypothesized variables to verify whether the relative impact on the two formalized provisions. While the coefficient for *Location spillover intensity* in steering committee model is significantly different from that in the termination complexity model (*p*=0.007), the difference is not significant for *Location R&D rivalry intensity* (*p*=0.96). Similarly, we find that the difference in the coefficient for *Location professional community density* is significant ($p$ = 0.06), but not for *Location employment intensity*. These results suggest that agglomerative forces influence the opportunism concerns firms face and they design contractual provisions accordingly. However, the effect is stronger in the case of steering committees, which allow dynamic and continual oversight but also come at a cost during contract implementation (managerial time and implementation costs).

**Supplementary Analyses**

We conducted several robustness checks to assess the sensitivity of our results to alternative ways of measuring our independent variables. We obtained consistent results when we measure local thickness of industry conditions using sector establishment counts. We also alternatively measured the intensity of spillovers at the employee level instead of establishments. Our results remain robust when we use establishment counts for this purpose.

Next, we investigated potential selection concerns arising from the likelihood of any deal occurring between the parties and the possibility that unobservables shaping selection of partners and the formation of alliance might also be related to the governance mechanisms firms employ. For this purpose, we constructed a dataset that includes both the observed alliances and a set of potential alliances that could have occurred. For each realized deal in our sample, we created a set of non-deal dyads by randomly pairing the R&D firm with client firms who had formed an alliance in similar therapeutic areas in a 12-month window around the time the focal deal has occurred. We employed a first-stage probit model for estimating the determinants of alliance formation utilizing both partner and dyad characteristics (including knowledge stocks, alliance experience, knowledge overlap, prior ties and distance) as well as prior universities licensing arrangements entered into by the R&D firm for identification purposes (Robinson & Stuart, 2007b). We derived the inverse Mill's ratio from the first stage model (Wald Chi-Squared =465.58, $p$<0.001), which we used to re-estimate our primary results. This supplemental analysis yields results which are consistent with our primary results, and we did not find evidence suggesting the presence of selection bias (results from all supplemental analyses available from the authors upon request).

We also performed additional tests to verify whether our main results are robust to concerns arising from our focus on contractual alliances rather than joint ventures or other equity alliances. To this end, we collected information on equity alliances and estimated a two-stage model where the first stage model concerns the choice between equity or non-equity alliance using several partner (alliance experience, knowledge stocks) as well as alliance characteristics (knowledge overlap between partners, prior ties, deal size, partner distance) as explanatory variables (Wald Chi-Squared =628.21, $p<0.001$). Re-estimating the models we used to test the hypotheses after including inverse Mills ratio from the first stage, we found that our hypothesized relationships continue to hold, and the null of no sample selection bias could not be rejected. We also tested whether Marshallian factors we examine affect the choice between equity and nonequity forms. This analysis reveals that the effects of location characteristics on the equity-nonequity choice are largely consistent with their impact on steering committee and termination provisions. Location sector employment density and location professional community density are negatively associated with the use of equity ($p<0.001$ and $p<0.10$, respectively) while location R&D rivalry intensity has a positive coefficient ($p<0.05$).

Finally, we also sought to explore whether the governance effects of the Marshallian forces we investigated are contingent upon partners being co-located in a region. For example, a client firm is exposed to appropriation hazards when it is located elsewhere since knowledge spillovers and R&D rivalry in the location of the R&D firm can reduce the value the client appropriates from its investments in a partnership, yet its involvement in localized relationships and institutions might be more significant when it is co-located with the R&D firm. We therefore tested for interactions between our core variables and *Shared cluster location*. We find the coefficient of the interaction terms are not significant for three out of our four core variables. The insignificant interaction effects suggest that the governance externalities of Marshallian forces do not differ depending on whether partners share a cluster location or not i.e., the effects are similar when the R&D firm and the client firm are co-located compared to cases when they are in separate locations. The one significant interaction indicated that the relational supports offered by professional community membership and potential for avoiding more elaborate formal governance mechanisms become even more pronounced when the partners share a location.

## DISCUSSION

In this paper, we outline a theory that draws on agglomeration research to account for the different effects of agglomeration of industry activity on the governance of firms' inter-organizational partnerships. Using R&D partnerships as our analytical focus, we examined how Marshallian agglomeration externalities acting in a location have an impact on the design of contractual provisions that help safeguard alliance execution. Empirically, we have investigated how location characteristics associated with the principal Marshallian micro-foundations of knowledge spillovers and labor market pooling (e.g., intensity of knowledge spillovers and R&D rivalry, employment conditions, and professional institutions) influence the stipulation of formal administrative interfaces and termination provisions in contractual agreements for R&D partnerships. Our study enriches our understanding of agglomeration economies by illuminating the governance consequences of agglomeration. Thus, we conclude that not only do Marshallian forces have implications for firm productivity, innovation, and internal organization, as previous research has emphasized, but these forces also carry important consequences for external activities such as alliances and the specific means by which firms organize these activities.

Our research also contributes to the growing literature highlighting some of the limitations or downsides of agglomeration. Our findings show that when partnership activities are located in regions with greater knowledge spillovers and R&D competition, partners are more likely to craft formal contractual safeguards and procedures to support their collaborative agreements. This result is consistent with previous findings that competitive conditions that escalate the potential losses from spillovers and imitation might cast a shadow on firms' location and sourcing choices (Shaver & Flyer, 2000; Alcácer & Chung, 2007). Although we do not address the location choice question, our findings are broadly in accord with the argument that firms operating in a cluster safeguard their knowledge by how they organize their knowledge-creating activities (Alcácer & Zhao, 2012). We build upon and extend this research by demonstrating how firms govern their R&D partnerships to enhance contract adaptation and enforcement based on the functioning of the regional innovation system.

Our arguments and findings also shed light on new mechanisms through which positive governance externalities obtain in a given location. Previous research has suggested the prospect of transaction economies of locating in a cluster in general (Rotemberg & Saloner, 2000; Helsley & Strange, 2007). Our study teases out two related sources of personal interactions that contribute to governance externalities when partnership activities are located in a cluster. We find that the greater the employment density of individuals in the focal industry, the lower is the likelihood of formal contractual procedures to deal with adaptation. This finding supports the claim that agglomerations offer informal ties that provide transactional monitoring and adaptation benefits. Future research can expand further on the impact of employment-based ties by examining the effects of mobility of individuals in clusters on the design of specific contractual provisions in interfirm arrangements.

Another source of positive governance externalities our study identifies is the thickness of institution-based relationships in a location. We provide evidence that greater intensity of professional association membership also reduces the incidence of formal governance mechanisms, such as steering committees supporting R&D partnerships. Institutions with greater presence in a region might not only facilitate the development of strong linkages among professionals in a sector but also promote common norms that enable social ordering and help mitigate transactional adaptation concerns (Ahuja & Yayavaram, 2011). Our results also offer support to the idea that regional institutions in the cluster can promote rules and “farsighted contracting” that protect participants’ knowledge and allow untraded interdependencies to flourish (Rugman & Verbeke, 2003). Based on these results, it would be interesting to examine the specific ways in which local institutions reinforce the governance effects of agglomeration (e.g., promoting coordination).

This study also has important implications for the broader literature on inter-organizational relationships. We contribute to the ongoing debate regarding the relationship between formal and relational governance mechanisms (Poppo & Zenger, 2002; Gulati & Nickerson, 2008; Puranam & Vanneste, 2009). Our evidence of negative relationships between formal governance mechanisms and employment density as well as the thickness of institutional relationships suggests that firms treat the relational governance features of agglomeration as a substitute for formal contractual provisions. In broad terms, our results are consistent with previous research that considers the impact of the relational context in which the transaction is embedded on the governance of a transaction (e.g., Granovetter, 1985; Gulati, 1995; Robinson & Stuart, 2007; Polidoro, Ahuja & Mitchell, 2011). By taking the perspective of the interpersonal relationships within geographic clusters in the location of the R&D firm, our findings complement work on firms' prior inter-organizational ties and offer support to the idea that individuals may be the carriers of relational benefits for firms (Zaheer, McEvily & Perrone, 1998; Rogan & Sorenson, 2014). Our evidence suggests that these informal supports are beneficial even when the client firm is not co-located in the cluster of the R&D firm, though co-location can augment the impact of informal relationships supporting R&D partnerships.

**Limitations and Future Research Directions**

While our study sheds new light on the design of formal governance mechanisms and the roles that Marshallian forces play for alliance contracting, it also has several limitations that offer some new avenues for future research. To begin with, the biopharmaceutical industry is characterized by high R&D intensity, high rates of alliance formation as well as complex product development processes (e.g., Nerkar & Roberts, 2004) – factors that may limit the generalizability of the results of this study. Although some of these features extend to other technology-intensive industries, the extent to which regional agglomerations provide governance supports may vary. For example, other industries such as semiconductors have much shorter product lifecycles and new products need not go through prolonged regulatory approval processes. Firms may also not customarily apply for patents as biopharmaceutical firms do (e.g., Katila & Mang, 2003). Some of these considerations may affect appropriation and other concerns that shape the design of R&D alliances. Furthermore, it is important to emphasize that our study explicitly focuses on the oversight and safeguarding role of formalized contractual provisions. It would therefore be valuable to investigate and assess the extent to which agglomerations influence other functions such as coordination by offering informal governance support to formal contracts that underpin inter-organizational relationships (Phene & Tallman, 2012). Further, in different industry settings other transactional hazards might be more prominent (e.g., hold-up versus appropriation), and other types of interactions within clusters besides the ones we have studied might support the governance of alliances or undermine the prospects of informal mechanisms to suffice for inter-organizational governance.

Our results imply that cluster locations with strong R&D competition might drive partners to choose equity structures to govern a partnership. Although formal administrative control and termination rules represent important instruments for addressing *ex post* concerns in contractual alliances, firms have other alternatives to efficiently govern their partnerships. These instruments include not only the crafting of various provisions and conflict resolution mechanisms in contractual partnerships, but also the share of equity, the structuring of boards and voting rights in equity-based partnerships. Moreover, because we observe these governance decisions at the formation of the alliance, our study does not account for dynamics in contractual agreements (e.g., Reuer et al., 2002). A longitudinal study of such design changes can expand this research into how the changes in the conditions of the agglomeration and particularly the movement of employees across organizations (e.g., Agarwal, Cockburn & McHale, 2006) affect the governance of alliances over time. Examining these questions may illuminate new aspects of the dynamics of contract design as well as relational mechanisms.

An important implication of the findings of our paper is that Marshallian forces exert both positive and negative governance externalities. While our study has not investigated the outcomes of alliances, future research may also examine how the structuring of such external corporate activities potentially mediates the relationship between agglomeration and performance, a continuing theme of agglomeration studies (Baptista & Swann, 1998; Chung & Kalnins, 2001; Folta et al., 2006). The performance of firms may not be limited to traditional metrics such as long term financial performance but may also include innovative outcomes and new product launches. Future research can examine the implications of agglomeration externalities for how buyers and suppliers structure their linkages for enhancing joint value creation (e.g., Porter, 2000). Research in directions such as these could greatly enhance the agglomeration literature by developing additional connections with research on inter-organizational governance.

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## Table 1: Descriptive Statistics

| | Variables | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Steering committee | 1.00 | | | | | | | | | | | | | | | | | | | |
| 2 | Termination complexity | 0.12 | 1.00 | | | | | | | | | | | | | | | | | | |
| 3 | Location spillover intensity | 0.22 | 0.01 | 1.00 | | | | | | | | | | | | | | | | | |
| 4 | Location R&D rivalry intensity | 0.11 | 0.00 | 0.21 | 1.00 | | | | | | | | | | | | | | | | |
| 5 | Location sector employment density | 0.04 | -0.03 | 0.24 | 0.32 | 1.00 | | | | | | | | | | | | | | | |
| 6 | Location professional community density | -0.01 | 0.06 | -0.12 | -0.36 | -0.28 | 1.00 | | | | | | | | | | | | | | |
| 7 | R&D firm alliance experience | 0.09 | 0.00 | 0.14 | 0.08 | 0.08 | -0.08 | 1.00 | | | | | | | | | | | | | |
| 8 | Client firm alliance experience | 0.13 | 0.01 | 0.17 | 0.10 | 0.10 | -0.01 | 0.05 | 1.00 | | | | | | | | | | | | |
| 9 | R&D firm knowledge value | 0.17 | 0.06 | 0.16 | -0.06 | -0.04 | 0.04 | 0.24 | 0.02 | 1.00 | | | | | | | | | | | |
| 10 | Client firm knowledge value | 0.18 | 0.05 | 0.08 | 0.02 | 0.08 | -0.01 | -0.02 | 0.52 | -0.02 | 1.00 | | | | | | | | | | |
| 11 | Technology overlap | 0.20 | 0.04 | 0.16 | -0.03 | 0.09 | 0.06 | 0.04 | 0.17 | 0.25 | 0.16 | 1.00 | | | | | | | | | |
| 12 | Reciprocal interdependence | 0.24 | 0.07 | 0.19 | 0.10 | 0.08 | 0.04 | 0.13 | 0.19 | 0.09 | 0.09 | 0.21 | 1.00 | | | | | | | | |
| 13 | Alliance scope | -0.01 | -0.03 | -0.05 | 0.02 | -0.03 | 0.05 | 0.04 | 0.01 | -0.07 | 0.05 | 0.05 | 0.14 | 1.00 | | | | | | | |
| 14 | Deal size | 0.33 | 0.22 | 0.22 | 0.03 | 0.16 | 0.04 | 0.09 | 0.38 | 0.20 | 0.28 | 0.31 | 0.30 | 0.01 | 1.00 | | | | | | |
| 15 | Contract size | 0.34 | 0.41 | 0.19 | 0.04 | 0.07 | 0.05 | 0.10 | 0.25 | 0.11 | 0.23 | 0.12 | 0.27 | 0.04 | 0.53 | 1.00 | | | | | |
| 16 | Shared cluster location | -0.03 | -0.07 | 0.21 | 0.20 | 0.12 | -0.08 | 0.01 | 0.16 | -0.01 | 0.04 | 0.00 | 0.13 | 0.06 | 0.04 | 0.05 | 1.00 | | | | |
| 17 | Partner distance | -0.04 | -0.04 | -0.06 | -0.12 | 0.04 | -0.03 | -0.02 | 0.15 | 0.06 | 0.09 | 0.00 | -0.04 | -0.07 | 0.03 | -0.04 | -0.53 | 1.00 | | | |
| 18 | International deal | 0.08 | 0.09 | -0.13 | 0.03 | 0.04 | 0.03 | -0.05 | -0.14 | -0.01 | -0.14 | 0.11 | -0.04 | -0.02 | -0.03 | -0.04 | -0.20 | -0.07 | 1.00 | | |
| 19 | Prior ties | 0.05 | 0.01 | -0.02 | -0.05 | -0.05 | -0.04 | 0.21 | 0.16 | 0.04 | 0.12 | -0.04 | 0.05 | 0.03 | 0.03 | 0.12 | 0.03 | 0.04 | 0.01 | 1.00 | |
| 20 | Biotech-biotech deal | -0.09 | -0.13 | -0.05 | 0.06 | 0.00 | -0.04 | -0.02 | -0.27 | -0.02 | -0.16 | 0.00 | 0.05 | -0.04 | -0.05 | 0.00 | 0.01 | 0.01 | -0.23 | -0.05 | 1.00 |
| | Mean | 0.39 | 0.39 | 9.33 | 0.71 | 0.004 | 0.14 | 2.08 | 3.47 | 3.18 | 4.51 | 0.38 | 0.63 | 0.27 | 132.02 | 24.68 | 0.21 | 1.95 | 0.44 | 0.19 | 0.17 |
| | S.D. | 0.49 | 0.49 | 7.10 | 0.25 | 0.002 | 0.38 | 0.93 | 1.18 | 2.44 | 1.66 | 0.32 | 0.48 | 0.44 | 238.05 | 11.63 | 0.41 | 1.87 | 0.50 | 0.58 | 0.38 |

N = 393. Correlation coefficients > 0.10 significant at p<0.05.

**Table 2: Effects of Location Characteristics on Alliance Contract Provisions**

| Variable | Steering Committee (I) | Termination Complexity (II) | Steering Committee (III) | Termination Complexity (IV) |
|---|---|---|---|---|
| Location spillover intensity | | | 0.265** | -0.145 |
| | | | (0.082) | (0.112) |
| Location R&D rivalry intensity | | | 0.220* | 0.202* |
| | | | (0.100) | (0.083) |
| Location sector employment density | | | -0.215** | -0.181* |
| | | | (0.083) | (0.090) |
| Location professional community | | | -0.143* | 0.019 |
| | | | (0.066) | (0.062) |
| R&D firm alliance experience | -0.060 | -0.017 | -0.088 | 0.001 |
| | (0.081) | (0.081) | (0.087) | (0.081) |
| Client firm alliance experience | -0.236* | -0.121 | -0.310** | -0.163 |
| | (0.100) | (0.120) | (0.099) | (0.120) |
| R&D firm knowledge value | 0.075* | -0.009 | 0.067† | -0.019 |
| | (0.037) | (0.033) | (0.038) | (0.033) |
| Client firm knowledge value | 0.159** | 0.009 | 0.172** | 0.021 |
| | (0.053) | (0.065) | (0.054) | (0.063) |
| Technology overlap | 0.137† | 0.024 | 0.157† | 0.054 |
| | (0.083) | (0.100) | (0.085) | (0.101) |
| Reciprocal interdependence | 0.531** | 0.015 | 0.533** | -0.034 |
| | (0.164) | (0.164) | (0.169) | (0.171) |
| Alliance scope | -0.147 | -0.188 | -0.126 | -0.219 |
| | (0.232) | (0.225) | (0.240) | (0.239) |
| Deal size | 0.164† | -0.121 | 0.201* | -0.149 |
| | (0.088) | (0.095) | (0.090) | (0.096) |
| Contract size | 0.508*** | 0.981*** | 0.517*** | 1.031*** |
| | (0.105) | (0.108) | (0.105) | (0.114) |
| Shared cluster location | -0.816** | -0.803*** | -1.039*** | -0.768** |
| | (0.269) | (0.242) | (0.284) | (0.267) |
| Partner distance | -0.273** | -0.138 | -0.282** | -0.107 |
| | (0.091) | (0.090) | (0.091) | (0.090) |
| International deal | 0.112 | 0.043 | 0.151 | 0.011 |
| | (0.175) | (0.170) | (0.168) | (0.156) |
| Prior ties | 0.123 | -0.096 | 0.161 | -0.127 |
| | (0.121) | (0.125) | (0.125) | (0.135) |
| Biotech-biotech deal | -0.982*** | -0.599* | -1.090*** | -0.691** |
| | (0.220) | (0.253) | (0.222) | (0.253) |
| State fixed effects | 30.66*** | 0.70 | 36.18*** | 0.33 |
| Phase fixed effects | 7.19 | 8.07 | 8.41 | 8.86 |
| Therapy fixed effects | 11.68* | 3.40 | 15.63** | 4.38 |
| Technology fixed effects | 11.77 | 23.22** | 10.56 | 25.68*** |
| Year fixed effects | 32.97** | 37.10** | 37.99** | 42.06*** |
| Constant | -2.569*** | 1.096* | -2.533*** | 1.086* |
| | (0.527) | (0.482) | (0.553) | (0.476) |
| Rho | -0.006 | | 0.003 | |
| | (0.100) | | (0.109) | |
| Log likelihood | -356.939 | | -343.772 | |
| $\chi^2$ (Wald) | 2747.171 | | 3604.909 | |

N=393. *** p<0.001, ** p<0.01, * p<0.05, † p<0.10. Clustered robust standard errors in parentheses. Wald $\chi^2$ statistic for joint significance is reported for fixed effects.