DETERMINANTS AND CONSEQUENCES OF THE ALLIANCE PARTNER NETWORK DISTANCE

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DEDICATION

To my parents with love and respect

ABSTRACT

This dissertation consists of two essays on the determinants and innovation consequences of alliance partner choice. To narrow down the scope of alliance partner choices, I focus on how a focal firm and a partner firm are connected in their network. To understand the relational connection, I use the notion of *alliance partner network distance*, which refers to how far away the partner is from the focal firm in the network. Methodologically, the notion of alliance partner network distance is captured by the shortest alternative path to the partner firm from the focal firm in the time period prior to alliance formation. Theoretically, network distance explains the social mechanism and the characteristics of information flowing between the two firms. If there is a mutual partner between the two firms (i.e., a close partner), the relational risk is reduced (Coleman, 1988), and the novelty of information coming from an unconnected partner (i.e., a distant partner) is higher than that from a connected partner (Burt, 1992).

This dissertation examines the effects of corporate governance on network distance as a determinant of alliance partner network distance in the first essay and the innovation consequences of alliance partner network distance in the second essay. Drawing on multiple managerial perspectives and an innovation perspective, taken together, the essays in this dissertation provide a comprehensive understanding of alliance partner choices.

In the first essay, entitled *"Determinants of Alliance Partner Choice: Alliance Partner Network Distance and Agency Theory,"* I argue that an agency problem is involved in alliance partner choice, in particular between distant partners and close partners, as a determinant of alliance partner selection. I ask if managerial opportunism

may be a significant problem in the alliance partner choice and examine the role of corporate governance mechanisms designed to address agency problems in explaining alliance partner network distance. I propose that the increased relational risk of allying with distant partners may be mitigated by managerial incentives and monitoring by outsider directors. Using a sample of 310 alliances of U.S. firms from the pharmaceutical and biotechnology industries from 1996 to 2010, I find support for the presence and mitigation of agency hazards in alliance partner choice. Firms tend to form alliances with close partners to avoid employment and other risks, which are mitigated by managerial ownership and outside director ownership. In addition, managerial tenure moderates the relationship between network distance and managerial incentives, and the relationship between network distance and board monitoring. This study makes a theoretical contribution to the body of literature on alliance partner choice by adding a new lens of agency hazards.

The second essay, entitled "*How Does an Alliance Partner Network Distance Affect a Firm's Innovation*?" investigates how an alliance partner's network distance affects a firm's innovation. I propose that an alliance with a distant partner contributes to exploratory innovation and better-quality innovation with novel and non-redundant information from the distant partner, while an alliance with a close partner contributes to innovation quantity based on social capital with the close partner. Technological distance substitutes network distance for innovation quality. I test the effect of alliance partner network distance on innovation with 534 R&D alliances of 189 firms in the pharmaceutical and biotechnology industries in the U.S. between 1996 and 2009. This study makes theoretical contributions to the literature on innovation by addressing the

conflicting theories about the benefits of social capital and the benefits of novel information.

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Chapter 1 INTRODUCTION

1.1 Research Background and Research Objectives

This dissertation examines the determinants and consequences of an alliance partner choice. It particularly examines the effects of corporate governance on the network partner choice and the effects of alliance partners on firms' innovation in the biotechnology and pharmaceutical industries in the U.S.

Among many aspects of partner choice, I investigate the alliance partner choice from a network perspective by using the notion of alliance partner network distance in my dissertation. Conceptually, alliance partner network distance refers to the underlying network structure in a dyad between a focal firm and a partner firm, considering both the direct and indirect ties of firms. Methodologically, the network distance between a focal firm and its new partner is an alternative minimum path length (geodesic) between the partner and the focal firm; therefore, a close partner is connected to a focal firm through a mutual partner, while a distant partner and a focal firm do not share a mutual partner. Theoretically, network distance explains the social mechanism available between two firms and the characteristics of information flowing between the two firms. If there is a mutual partner between the two firms (i.e., a close partner), the relational risk is reduced (Coleman, 1988) and the novelty of information coming from an unconnected partner (i.e., a distant partner) is higher than that from a connected partner (Burt, 1992).

The notion of alliance partner network distance is theoretically distinctive from network transitivity (Uzzi & Gillespie, 2002). Network transitivity refers to the

mechanism by which a focal firm gains resources from a tie that improves the value that the actor derives from an exchange with an independent third relation (Uzzi & Gillespie, 2002). Network transitivity suggests that a relationship with a distant partner is also based on a social mechanism, which comes from other existing alliances of the focal firm, contrary to the theory of the notion of alliance partner network distance explained above. I suggest that the assumptions that the notion of network transitivity is based on are not valid in an inter-firm alliance context of my theory. A relationship between firms is difficult to simply define as an embedded relationship without taking into account the various aspects of relationships. In addition, what firms learn or obtain from a relationship is not easily transferred to another relationship given the complex characteristics of information and knowledge exchanged within each alliance.

Despite a large body of literature on alliance partner choice, gaps remain in our understanding of alliance partner decisions. There are two conflicting literature streams that examine alliance partner choice from a network perspective. One stream confirms firms' propensity to ally with embedded ties and suggests that firms tend to choose partners from embedded ties due to concerns about relational risk. The other stream explores when firms form nonlocal ties, given that such nonlocal ties help firms overcome their myopia of learning (Levinthal & March, 1993).

As determinants to form ties with nonlocal partners, the impact of managerial opportunism has been ignored in the literature on alliance partner choice. Top managers are involved in alliance formation (Eisenhardt & Schoonhoven, 1996; Lee & Park, 2008; Dickson & Weaver, 1997) and their adverse managerial motives may partially account for such alliance outcomes. Therefore, they may use alliance strategies to obtain private

benefits at the expense of shareholders' interests. Whereas agency theory has been applied to various strategic decisions such as divestiture, M&A, internationalization and R&D investment, the alliance literature has implicitly assumed that the interests of agent managers regarding alliances are aligned with those of shareholders.

Despite the considerable attention paid to the effects of network structures on firms, another gap is that previous research has yielded conflicting results about the influence of alliance partners' social capital and the information the partners bring concerning firm innovation between the benefits of structural holes (Burt, 1992) and those of closure (Coleman, 1988). A plausible reason for these conflicting results is that most studies have focused on the structural aspect of the network and have largely overlooked network evolution. Controlling for the existing network structure, no investigation has examined how an additional alliance formation, rather than the cumulated effect of all of the alliances, affects innovation.

Another reason for the mixed results is that the literature on networks and innovation focuses on only one aspect of innovation: either innovation output (Ahuja, 2000) or innovation characteristics (i.e., exploratory innovation by Phelps, 2010), even though a different network structure can affect different types of innovation. In my dissertation, I explore the effect of an additional tie, alliance partner network distance, on various types of innovation with a network dynamic perspective since this additional tie may change the existing network structure.

To fill the literature gap on partner choice, the current dissertation attempts to answer the following questions: 1) What are the determinants of alliance partner choice? and 2) How does alliance partner network distance affect firms' innovation?

1.2 Key Findings of the Dissertation

This dissertation consists of two essays, which are briefly summarized below. The first essay examines the effects of corporate governance on alliance partner network distance, and the second essay looks at the relationship between alliance partner network distance and a focal firm's innovation.

The key argument in Essay 1 is that appropriate corporate governance to mitigate agency problems increases the alliance partner network distance. Managers typically prefer alliances with close partners since relationships with distance partners lack an effective social mechanism leading to alliance failure. Since top managers have so much of their economic and human capital as well as their reputations tied to their firms, their interests are relatively "underdiversified." Thus, top managers worry too much about the downside and losses that may harm their own employment. This concern prevents them from allying with distant partners who are relationally riskier. However, alliances with distant partners that bring novel information are beneficial for long-term innovation. To discourage managers' risk aversion, firms strengthen corporate governance by offering ownership incentives and building monitoring systems. I focus on two aspects of corporate governance: managerial stock ownership as managerial ownership, and external director ownership as nonexecutive monitoring. Overall, the results show that corporate governance to address agency problems encourages agent managers to pursue alliances with distant partners. Managerial tenure moderates the relationship between alliance partner network distance and managerial incentives and board monitoring.

In Essay 2, I look at three aspects of innovation as innovation consequences: innovation quantity, exploratory innovation, and innovation quality. To address the

mixed results of prior research about the effects of alliances and alliance networks on innovation, I explore various types of innovation. I argue that trust, which is strongly available in relationships with close partners, leads to better innovation quantity, since trust with partners increases their willingness to share knowledge and similarity with close partners leads to quick production of innovative output. On the other hand, novel and non-redundant information from distant partners helps firms depart from path-dependence learning leading to exploratory innovation. In addition, I explore a moderating effect of technological distance on the relationship between alliance network distance and different types of innovation. Alliances with partners, both technologically and relationally distant, lead to better quality innovations and decrease exploratory innovations.

While these two essays are independent studies, they are significantly complementary. Essay 1, which discusses the antecedents of network distance, suggests that the interests of managers may not be aligned with those of shareholders regarding their alliance partner choices. By providing the innovation performance of network partner distance, Essay 2 provides an empirical test of the implications of the alliance partner choice that was investigated in Essay 1. Thus, Essay 2 allows us to test whether the decisions about alliance partner choice are consistent with the arguments developed in Essay 1. In addition, Essay 2 tests the premise of Essay 1 that alliances with distant partners will benefit long-term innovation and that board of directors and managers with ownership prefer distant partners.

A second commonality connecting the two essays is how social capital (trust) with a close partner and the novel information provided by a distant partner affect firms.

In Essay 1, I argue that agent managers are more dependent on the social capital of a close partner rather than novel information associated with long-term performance. In Essay 2, I emphasize both close and distant partners and show that firms should ally with both close and distant partners for both short- and long-term innovation. For each essay, I provide a brief summary of the motivation and research questions, a synopsis of the main arguments and hypotheses, findings, and a discussion of the potential contributions. Figure 1-1 presents a summary of the hypotheses and the theoretical framework of the dissertation.

1.3 Importance and Contribution of the Dissertation

The current dissertation makes four contributions. First, I extend prior literature on partner choice by adding the notion of alliance partner network distance of nonlocal ties relative to the prior literature which only distinguishes between new and existing partners (Beckman et al., 2004). Beckman, Haunschild, and Phillips (2004) make a distinction between exiting and new partners. I argue that all new partners are not the same because the social mechanism available with a new close partner would be different from the social mechanism available with a new distant partner. The concept of network distance is theoretically significant since it explains the social mechanisms that are available between two firms and the characteristics of information flowing between the two firms like an overall network structure. If there is a mutual partner between two firms (i.e., close partner), relational risk is reduced (Coleman, 1988). The novelty of information coming from an unconnected partner (i.e., distant partner) is higher than that from a

connected partner (Burt, 1992). In the dissertation, I suggest that network distance matters in business strategy, and I investigate the antecedents and consequences of the notion of alliance partner network distance which has not been explored by previous work.

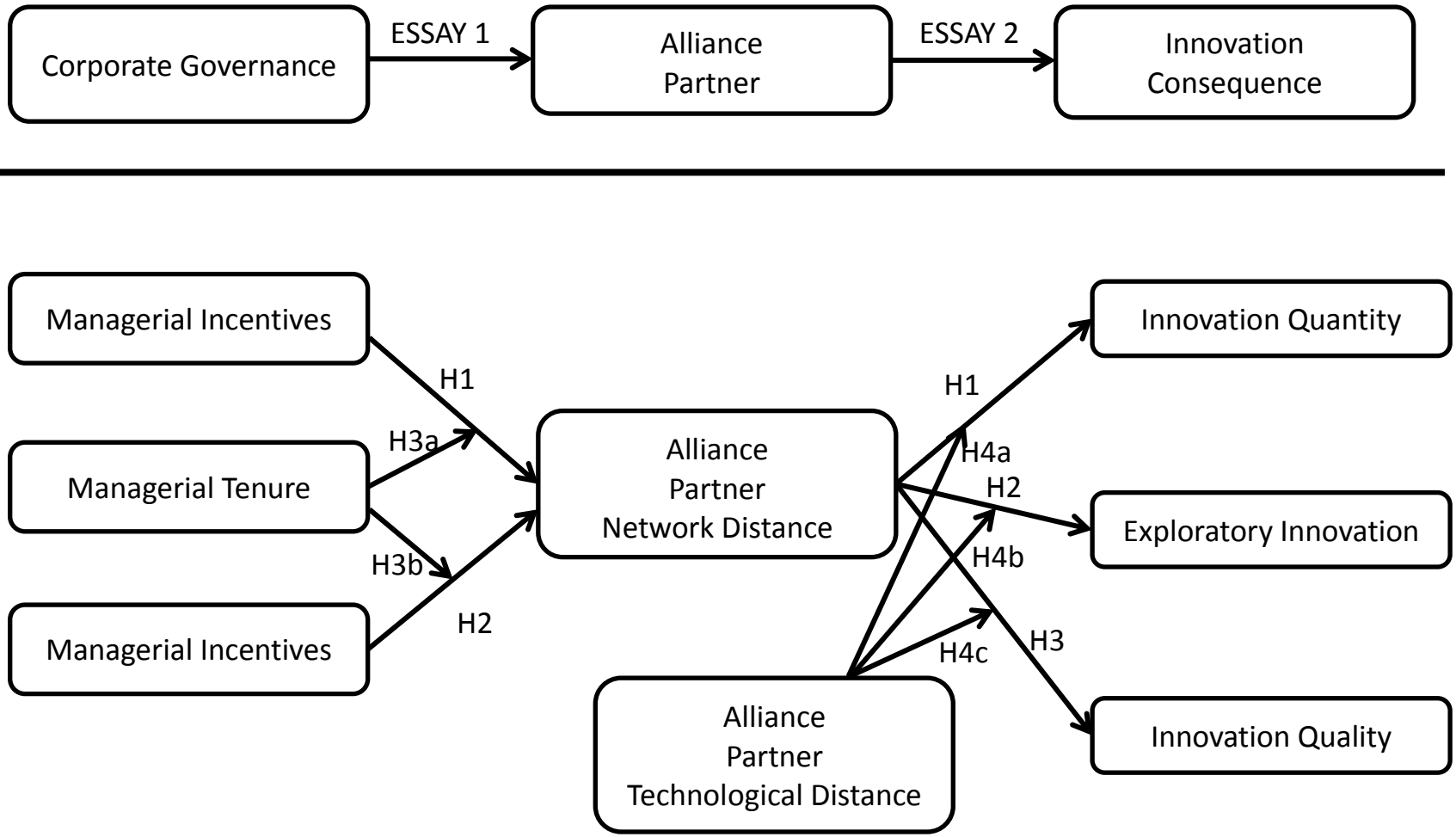
Second, the investigation of alliance partner network distance is also expected to contribute to the network literature by joining the conversation about what drives changes in network structure. The concept of network distance is theoretically and methodologically significant and interesting, building on the network literature. A partner's network distance is fundamental to its network evolution, as it is a critical driver of network changes and configurations (i.e., network density). Changes in a firm's egocentric network may result from the network distance of a newly added tie. I attempt to fill the literature gap by examining an additional tie rather than the cumulative effect of ties. With the notion of partner network distance, which goes beyond the distinction between existing vs. new partners (Beckman, Haunschild & Phillips, 2004), I capture changes in the network density of firms. In such a context, distant partners make a firm's network sparse, while close partners make a firm's network dense.

Third, my dissertation adds a new perspective to the explanation for alliance partner selection – agency theory – while previous work examining the determinants for partner selection has mainly explored the relational view (Dyer & Singh, 1998; Diestre & Rajagopalan, 2012; Connelly, Miller, Devers, 2012), exploration-exploitation view (Lavie & Rosenkopf, 2006), social network view (Sytch, Tatarynowicz, & Gulati, 2011), and the perspective of learning from performance feedback (Baum et al, 2005). The perspectives that prior literature adopts to explain partner selection offer different

predictions about the choice between a proximate and distant partner, leaving room for a contribution by introducing a new explanation that relies on a distinct theoretical framework. Viewing alliance partner choice from an agency lens – arguing that the interests of managers and principals differ with respect to alliance partner choice – has the potential to suggest a fresh perspective and explanation for partner choice. Further, if agency problems can be shown to be important determinants of alliance partner choice, leaving them out may amount to a misspecification of alliance choice models and research.

Finally, this dissertation builds on the literature on innovation by showing the effect of partner choice on innovation and by examining the various types of innovation in Essay 2. I attempt to reconcile the long theoretical debate between the benefits of structural holes (Burt, 1992) that a distant partner spans, and network closure (Coleman, 1988) that an alliance with a close partner creates on various types of innovation. I contribute to the literature by examining an additional tie with a dynamic perspective, controlling for network structure and by showing that the trust of a close partner (that creates a network closure) is associated with innovation quantity, while the novel information of a distant partner (that spans a structural hole) is associated with exploratory innovation.

FIGURE 1-1: The Theoretical Framework of the Study



Chapter 2 Determinants of Alliance Partner Choice: Alliance Partner Network Distance and Agency Theory

2.1 INTRODUCTION

Alliance partner selection has been a major topic of interest in the strategy literature because partner selection is a critical decision for a firm (Beckman, Haunschild, & Phillips, 2004; Diestre & Rajagopalan, 2012; Rothaermel & Boeker, 2008). To understand the determinants of partner selection decisions, prior literature has applied various lenses including the relational view (Dyer & Singh, 1998; Diestre & Rajagopalan, 2012; Connelly, Miller, & Devers, 2012), exploration-exploitation view (Lavie & Rosenkopf, 2006), social network view (Sytch, Tatarynowicz, & Gulati, 2011), and the perspective of learning from performance feedback (Baum et al., 2005). However, the agency perspective is missing in the previous literature on alliance partner choice. It has implicitly assumed that the firm making the alliance partner choice is a unitary actor, or that the firm making alliance partner choice decisions has a single, unified utility function. Recognizing that the firm's managers might have preferences that deviate from those of the firm's owners when it comes to making the risky decisions involved in alliance partner choice is the foundational thesis of this study.

Our point of departure is that embedded ties, such as past or close partners, imply lower risk (Walker, Kogut, & Shane, 1997; Gulati & Gargiulo, 1999; Li & Rowley, 2002). The risk involved in acquiring new alliance partners, sometimes labeled

"relational risk" (Das & Teng, 1998), derives from concerns about vulnerability, relationship imbalance, competition, value appropriation, and both the complexity and cost of monitoring (Park & Ungson, 2001; Katila, Rosenberger, & Eisenhardt, 2008). Prior literature suggests that social mechanisms between embedded ties help firms lower relational risk. Embedded ties provide greater access to information about potential exchange partners through shared third parties or previous direct ties, and reduce the costs and risks of searching for and screening potential partners and establishing new ties (Stuart, 1998). If agency concerns also prevail in making alliance partner choices with regard to relational risk, such as in other strategic decisions, then mechanisms that mitigate agency behavior in this setting are of considerable interest to both scholars and firms. More specifically, reducing relational risk implies a preference for embedded or close alliance partners over distant partners. Accordingly, agency mitigating mechanisms should reduce the proclivity of managers in agency-fraught firms to prefer close alliance partners over distant ones.

To answer the question of which partner a firm chooses in an alliance context between embedded and nonlocal ties, we introduce the concept of alliance partner network distance. The network distance between a focal firm and its new partner is an alternative minimum path length (geodesic) toward the partner from the focal firm; therefore, close partners are connected through a mutual partner with the focal firm. In other words, a close partner is the focal firm's partner's partner. Conversely, there is no mutual partner between the focal firm and a distant partner. Network distance captures the social mechanisms available between two firms and the characteristics of information flowing between the two firms. Essentially, if there is a mutual partner between the two

firms (i.e., a close partner) we suggest that relational risk is reduced, as we explain in more detail later (Coleman, 1988). At the same time, distant partners are valuable because the novelty and diversity of information coming from them is well established as being higher than that from close, connected partners (Burt, 1992). Thus, the decision regarding alliance partner distance choice represents something of a tradeoff: higher relational risk, but also greater information value.

We frame alliance partner network distance from the perspective of risk-related behavior and suggest that there exists a difference in views on alliance risk between the agent and the principal, the genesis of the agency problem. From the perspective of agent-managers, alliances with distant partners are riskier than those with close partners, and so managerially dominated firms tend to avoid alliances with distant partners. Firms that ally with distant partners are more exposed to the partner's opportunism, potentially leading to alliance failure. Relational protections available to close partners are lost, and the possibility of gaining information about and experience with potential partners' capabilities, conduct, and reliability are limited when firms ally with distant partners (Gulati, 1995; Uzzi, 1996; Gulati & Gargiulo, 1999; Li & Rowley, 2002). Therefore, managers who are concerned about alliance failure tend to avoid distant partners in order to secure their own employment and compensation. However, distant partners also have benefits, such as access to non-redundant information (Burt, 1992; Vassolo, Anand, & Folta, 2004) and solutions to myopia (Levinthal & March, 1993), particularly from the perspective of the principal, who is risk neutral.

Our research questions focus on whether principals and agents view alliance-related risk differently from each other, and whether managerial self-serving behavior –

agency behavior – is a significant concern in the context of an alliance partner choice. To answer these questions, we investigate whether and how corporate governance mechanisms that mitigate agency problems affect alliance partner choice. We examine two different mechanisms: managerial incentives and board monitoring. Our central thesis is that when strong governance to address agency problems successfully aligns the interests of managers with those of the firm's principals, top managers, who are typically risk-averse by nature, are likely to take greater risks in alliance partner choice and thus form alliances with distant partners.

In addition to examining the extent to which strong corporate governance contributes to alliance partner network distance, we consider how managerial tenure moderates the influence of managerial stock ownership and outside directors' stock ownership on alliance partner network distance because research suggests that managerial risk-taking behaviors are influenced by tenure (Sanders, 2001; Zhang, Bartol, Smith, Pfarrer, & Khanin, 2008). Our results show that strong governance leads longer-tenured managers, who are typically risk averse, to take on greater risk by aligning the interests of executives with a long-term perspective.

Our research contributes to the literature on partner selection decisions. While prior literature on partner choice has adopted various perspectives, including the relational view (Diestre & Rajagopalan, 2012; Connelly, Miller, Devers, 2012), the social network literature (Sytch, Tatarynowicz, Gulati, 2011), the exploration-exploitation literature (Lavie & Rosenkopf, 2006) or learning from performance feedback (Baum et al., 2005), none of the prior work has adopted agency theory to examine partner selection decisions. The perspectives that prior literature adopts to explain partner selection offer

different predictions about the choice between a proximate and distant partner, leaving room for a contribution by introducing a new explanation that relies on a distinct theoretical framework. Viewing alliance partner choice from an agency lens which argues that the interests of managers and principals differ with respect to alliance partner choice has the potential to suggest a fresh perspective and explanation for partner choice. Further, if agency problems can be shown to be important determinants of alliance partner choice, leaving them out may amount to a misspecification of alliance choice models and research.

Extensive research exists concerning the extent to which agency problems affect corporate strategies, such as acquisitions (Amihud & Lev, 1981), diversification (Denis, Denis, & Sarin, 1997), internationalization (Fernandez & Nieto, 2006), entry modes (Musteen, Datta, & Herrmann, 2009), and R&D investments (Kor, 2006; Chrisman & Patel, 2011; Kim, Kim, & Lee, 2008). It is appropriate to link agency problems with alliance contexts because top management teams (TMT) are involved in alliance formation (Eisenhardt & Schoonhoven, 1996; Lee & Park, 2008; Dickson & Weaver, 1997) just as they are in acquisitions, divestitures, and other forms of investments. TMT members often conceptualize alliance strategies and key sources to provide a set of potential alliance partners. TMT members also indirectly influence alliance formation by building organizational structures, processes, and cultures, but the actual implementations of alliances may be conducted at the operating manager level.

We test our ideas with 310 alliances of firms from the pharmaceutical and biotechnology industries between 1992 and 2010. Prior literature in strategy has frequently used these industries as the context to test their hypotheses for M&As (Danzon,

Epstein, & Nicholson, 2007), R&D investments (McGrath & Nerkar, 2004), and alliance partner choice (Diestre & Rajagopalan, 2012). We build on the literature by testing agency problems in alliance partner decisions using the same context. We deal with possible endogeneity from issues of selection using a Heckman correction by using the geographic alliance formation propensity as an instrument for the firm's decision to undertake an alliance when examining its choice of alliance partner, and subsequently incorporating the inverse Mills ratio in the second stage of the model.

2.2 LITERATURE REVIEW

In this review of prior literature, I summarize the key concepts and findings from two bodies of work that are relevant to this research: alliance partner choice and alliance partner network distance. For each body of research, I summarize the primary theories, relevant empirical findings, and literature gaps that this dissertation attempts to address.

2.2.1 Alliance Partner Choice

Risk related to partners or relationships is considered one of the most important factors when making a partner decision. At an early stage of a relationship, the lack (or insufficiency) of partner information and intention emerges as an issue. During the relationship, vulnerable relationships, imbalance, competition, and complexity in monitoring behaviors (Park & Ungson, 2001) increase the relational risk in alliances. Value appropriation in alliances is also viewed as a major risk in these relationships

(Katila, Rosenberger, & Eisenhardt, 2008). Thus, the mechanisms to mitigate relational risks are of interest to firms. Prior literature suggests that the social mechanism between embedded ties helps firms avoid being opportunistic with each other. Access to information about potential exchange partners through shared third parties or previous direct ties reduces the costs of establishing new ties and searching for and screening potential partners (Ellis, 2000; Stuart, 1998). Thus, the risk and uncertainty-reduction partnering logic predicts that organizational decision-makers will prefer embedded ties such as past partners and close partners (Walker, Kogut, & Shane, 1997; Gulati & Gargiulo, 1999; Li & Rowley, 2002).

Interorganizational networks, however, commonly exhibit both local clustering and nonlocal ties that cut across the clusters (Nohria & Garcia-Pont, 1991; Kogut & Walker, 2001; Baum, Shipilov, & Rowley, 2003). There have been efforts to explain the risky decisions of alliances with nonlocal ties. The controllability of uncertainty (Beckman, Haunschild, & Phillips, 2004), technology discontinuity (Rosenkopf & Padula, 2008), existing network structure (Sytch, Tatarynowicz, & Gulati, 2011) and performance relative to aspiration (Baum, Rowley, Shipilov, & Chuang, 2005) have been explored as determinants of partnering with non-embedded partners which is considered a risky decision.

A gap in the literature on the determinants of risky alliance partner choice is that it ignores the chance of managerial opportunism, which may lead to suboptimal results, viewing a firm as an entity where the interests of the firm's stakeholders are aligned when it comes to the alliance partner choice. The factors related to managerial opportunism that may affect the risk of partner choice have not yet been explored. The

interests involved in alliance formation vary within a firm. For example, the interests of the firm's owners (shareholders) concerning the alliance may not be aligned with those of the agent manager, according to agency theory.

Linking agency theory with alliance partner choice is theoretically relevant and significant. First, many of the motives and payoffs associated with acquisitions, diversification, and internationalization can also apply to partner choice. However, the unique features of a collaborative relationship, such as an alliance, also raise the question of whether the predictions of the theory extend to alliance contexts. Second, the literature on alliance highlights various benefits that firms achieve through alliances. Agency theory, nevertheless, may raise the possibility that adverse managerial motives may partially account for alliance outcomes, so the theory offers a distinct and contrarian perspective on alliances (Reuer & Miller, 1997). An agency theory view of firms' investments in alliances offers a revisionist perspective on these benefits of alliances, and cautions that alliance investments may be ambiguous and in the interests of shareholders, as the literature often implies (Park & Ungson, 2001). An alliance partner choice may be accounted for by incentive misalignment due to the separation of ownership and control in firms. Finally, given that top managers are involved in an alliance partner choice (Eisenhardt & Schoonhoven, 1996; Lee & Park, 2008; Dickson & Weaver, 1997), as their responsibilities include decisions about acquisitions and R&D strategies, it is significant to examine how agent managers take advantage of alliance partner choices, and how agency hazards affect agent managers' decisions in alliance contexts.

2.2.2 Alliance Partner Network Distance

Prior literature on exploratory alliance behavior has explored different types of non-embedded partners: new versus existing partners (Beckman et al., 2004; Rosenkopf & Padula, 2008), and local versus nonlocal ties (Baum et al., 2005). However, as a literature gap, these types of categories do not capture changes in the network structure after the tie formation and the underlying network structure between a focal firm and its partner. To fill the literature gap on partner choice, this paper extends the notion of nonlocal ties by adding the network distance of new partners, which captures the extent to which a partner is separated from the focal firm by the path length beyond the distinction between an existing partner and a new partner (Beckman, Haunschild, & Phillips, 2004). Put another way, our approach explains whether a *new* tie formation is close or distant rather than explaining the overall pattern of local or non-local ties or the choice between a new tie and an existing tie. Further, in this study we capture nonlocal partners with partner network distance, which measures the extent to which a partner is separated from the focal firm by the path length.

We posit that an alliance with a distant partner is a risk-taking behavior, and an alliance with a close partner is a risk-averse behavior, which are consistent with Baum, Rowley, Shipilov, and Chuang (2005), Li and Rowley (2002) and Gulati and Gargiulo (1999). Specifically, Baum, Rowley, Shipilov and Chuang (2005: 536) suggest that engaging past partners in "repeated ties" and "forming new ties with partners' partners" reduces uncertainty and risk in their exchanges.

Specifically, trustworthiness and collective mechanisms available with a close partner decrease the likelihood of excessive appropriation and opportunism by partners.

Common ties promote good behavior by facilitating the information flow to enable the collective monitoring and sanctioning of deviant behavior among partners, which fosters concern about their reputations (Walker, Kogut, & Shan, 1997). When two firms share a common partner, it signals that both are regarded as trustworthy by the third party. The sanction mechanism and trustworthiness deter appropriation, and conflicts of interest can be resolved more easily (Coleman, 1990). In addition, third-party endorsements offer significant savings in the time and resources needed to identify potential partners and build new relationships, since a common third party also provides reliable information about each other (Podolny, 1994; Uzzi, 1996; Gulati & Gargiulo, 1999).

In contrast, compared to close partners, an alliance with a distant partner, which lacks these social mechanisms, is risky and uncertain (Katila, Rosenburger, & Eisenhardt, 2008). The lack of social capital in the relationship with a distant partner can result in risk, that is, a possible loss from relational failure. It is harder to evaluate and control distant partners than close ones. With a distant partner, all of the benefits and protections afforded to close ties are lost, and the possibility of gaining information about and experience with potential partners' capabilities, conduct, and reliability are limited.

Despite the relational risks of distant partners, there are benefits from the perspective of corporate interests. The vast majority of literature asserts that distant partners, through whom the focal firm spans structural holes, are better able to access novel information and resources from remote parts of the network (Burt, 1992). Furthermore, they allow the focal firm to hear about potential threats and opportunities more quickly than firms that are not so positioned (Powell & Smith-Doerr, 1994).

Therefore, alliances with distant partners help firms overcome their myopia of learning (Levinthal & March, 1993).

Local searches are also known as a behavior in terms of searching for a solution in the related domain of current knowledge or expertise (Stuart & Podolny, 1996). However, such a focus may cause firms to develop core rigidities (Leonard-Barton, 1995) or to fall into a competency trap (Levitt & March, 1988). A search along different dimensions is the fundamental mechanism by which firms learn (March, 1991; Rosenkopf & Nerkar, 2001; Vassolo et al, 2004). An alliance with a distant partner enriches the knowledge pool by adding a distinctive new variation, which may provide a sufficient set of choices to solve problems (March, 1991) and generate recombinatory potential (Katila & Ahuja, 2002; Fleming & Sorenson, 2001).

2.3 THEORY AND HYPOTHESES

2.3.1 Agency Problems in Alliance Partner Choice

We posit that choices of a close alliance partner are plausible vehicles for managers to obtain private benefits at the expense of shareholders' interests in a high-risk and high-return context. Managers tend to avoid downside risk and prefer risk-reducing corporate strategies. They have so much of their economic and human capital, as well as their reputations tied to their firms that they are relatively under-diversified and stand to lose a great deal, including their employment and compensation, if their firms experience corporate insolvency or financial distress or they leave their firms due to the non-tradable

nature of their social capital investments (Wright, Kroll, Krug, & Pettus, 2007). As a result, managers worry about downside losses when it comes to strategic decisions. These concerns prevent them from taking needed risks, even when these projects would have a positive net present value. With this logic of managers' risk avoidance, managers are less likely to ally with distant partners because alliances with distant partners involve high risk, as discussed earlier.

As opposed to the risks managers face and their overexertion, there are benefits of alliances with distant partners from the perspective of larger corporate and shareholder – principal – interests, such as access to novel knowledge, innovation, and new ideas. This misalignment of risk preferences between the principal and agent results in agency costs (Jensen & Meckling, 1976). To address this agency problem, firms design various mechanisms in terms of managerial incentives and monitoring systems. As for the incentive mechanism, aligning the interests of the agent-managers and shareholders by awarding managers with long-term compensation (Musteen, Datta, & Herrmann, 2009) and equity-based incentives (Eisenmann, 2002) is meant to discourage managers' risk aversion, thereby reducing agency costs. As for the monitoring mechanism, the board's independence (Kroll, Walters, Wright, 2008), CEO duality (Kor, 2006), institutional investors or blockholders (Musteen, Datta, & Herrmann, 2009), and venture capitalist backing (Carpenter, Pollock, & Leary, 2003) are charged with reducing agency costs by establishing internal corporate governance mechanisms to discipline the CEO's risk behavior. In particular, board monitoring reduces agency costs by establishing internal corporate governance mechanisms to discipline the agency's risk behaviors. Based on the manager's opportunism with respect to the alliance partner choice, we develop

propositions that link corporate governance with a firm's risk-taking in alliance partner choice. Below, we discuss precisely how partner choice is affected under two types of corporate governance conditions: incentives in terms of stock ownership by managers and board monitoring with incentives by non-executive directors.

2.3.2 Managerial Incentives

Managers' preferences for making conservative strategic decisions can be attributed to managers' tendency to hold an "undiversified interest" in the form of their own employment, so they are more averse to financial distress that may harm their income and employment. Therefore, without an appropriate incentive, their decisions will manifest themselves as risk-averse in nature. In contrast, significant ownership imposes market discipline on managers and motivates them to pursue shareholder value maximization more aggressively. Thus, one remedy to the agency problem is stock ownership by top managers because their wealth (a function of their equity ownership) is directly tied to long-term performance (Jensen & Meckling, 1976). The work of several scholars provides strong support for the argument that equity ownership by executive managers results in risk-increasing strategic decisions (Beatty & Zajac, 1994; Wright, Kroll, Ladao, & Vanness, 2002). Stock ownership has been found to be more effective at aligning management interests with those of the shareholders than other executive compensation tools such as stock options (Pollock, Fischer, & Wade, 2002). We argue that the managerial ownership incentive motivates managers to employ a risk-enhancing strategy, so alliances with distant partners increase as the executive incentives converge with the

interests of shareholders and managers. Prior literature generally confirms that managerial ownership increases managerial risk-taking (e.g., Reuer & Ragozzino, 2006).

In sum, increased insider ownership results in reduced agency costs as the interests of insiders are aligned with those of the shareholders in pursuing long-term firm value. A manager with a significant portion of the firm's stock is likely to focus on maximizing long-term shareholder value and not be self-serving (e.g., opting for strategies that result in short-term gains and reduced employment risks). Extending this argument to partner choice, a manager with more equity ownership has greater incentives to take risks when it comes to partner choice and is more likely to ally with distant partners that have a less immediate payoff. Thus,

Hypothesis 1: A greater proportion of top managers' stock ownership will increase the likelihood of alliance formation with distant partners by the focal firm.

2.3.3 Monitoring by Outside Directors

The board of directors is usually responsible for decision control, which involves monitoring and evaluating management decision-making and performance. Outside members on the board, in particular, are more likely to question decisions made by the CEO and other executives. On the other hand, insider-dominated boards imply problematic self-monitoring and weak monitoring of the top managers, since top managers are likely to be in a position to influence an inside director's career

advancement within the firm (Beatty & Zajac, 1994). Thus, a high ratio of external board members, signifying the independence of the board of directors, is expected to lead to more vigilant monitoring for shareholders.

Nevertheless, the degree to which the independence of the board can be an effective monitoring mechanism of top management has been the subject of continued debate. Recent research suggests that the independence of the board of directors alone does not indicate a board's effectiveness at monitoring (Tuggle, Schnatterly, & Johnson, 2010). Some view external board members as often co-opted by top management teams. By deliberately identifying or promoting directors with similar philosophies on strategy and administration, CEOs can enhance board support for their initiatives and decisions or minimize the risk of dissension (Westphal & Zajac, 1995). In addition, outside directors should be understood as self-interested agents who also have to be incentivized to align their interests with those of the shareholders (Deutsch, Keil, & Laamanen, 2010).

Nonexecutive directors with ownership may provide a particularly important strategic contribution because of their direct and regular involvement in formulating the firm's mission and development strategy, steering a firm's decision-making toward higher risk-taking (Goodstein & Boeker, 1991; Oswald & Jahera, 1991). Along with interest alignment, Hambrick and Jackson (2000) indicate that nonexecutive directors who share ownership increase their identification with the company, making them more vigilant in their oversight and more generous with their time and attention. For example, with an incentive to increase the risk level of the firm, outside directors might take an active role and provide the top management team with advice on additional strategic moves that could further increase the risk level of the firm. From the perspective of

alliance partner choice, we suggest that when nonexecutive directors own a higher amount of stock, they will promote the choice of riskier, distant alliance partners. Formally,

> *Hypothesis 2: A greater proportion of nonexecutive directors' stock ownership will increase the likelihood of alliance formation with distant partners by the focal firm.*

We now proceed to argue that the effect of managerial incentives and outside board monitoring on alliance partner network distance does not occur in a vacuum. Situational contingencies may either strengthen or dilute the corporate governance effects on a risk-taking decision because contingencies may influence the framing of decisions and managerial evaluation of risk. We examine managerial tenure as a contingency variable because managerial tenure is closely linked to managerial perceived risk-bearing (Sanders, 2001; Zhang, Bartol, Smith, Pfarrer, & Khanin, 2008).

2.3.4 Contingent Effects of Managerial Tenure

Long-tenured top executives tend to be entrenched. According to the upper-echelons perspective, more managerial learning occurs during the first few years in the firm, and managers may commit to that with which they feel comfortable. Younger-tenured mangers are likely to take risks because they are compelled to produce outcomes and prove themselves as competent managers during their first few years. Furthermore,

younger tenured executives have less to lose so they tend to be more aggressive in building personal wealth (Brouthers, Brouthers, & Werner, 2000). Managers who are relatively new to the firm may also lack legitimacy in the eyes of certain internal or external stakeholders so they may feel more pressure to produce new initiatives and directions (Johnson, Hoskisson, & Hitt, 1993; Arthurs, Hoskisson, Busenitz, & Johnson, 2008; Kor, 2006). In contrast, when people are employed by a particular organization for a long time, they tend to develop organization-specific skills that are valuable to the organization but are much less so on the open market. Accordingly, longer-tenured executives may be less receptive to change and may increase perceived risk-bearing which will, in turn, increase loss aversion among insiders.

When long-tenured managers are associated with a passive decision-making approach and resistant to the firm's strategy, the firm's competitive position may be jeopardized in a high technology industry such as the pharmaceutical and biotechnological industries. Thus, firms build strong governance to prompt even long-tenured managers to take greater risks by allying with distant partners. When a strong managerial incentive and board monitoring are enforced, top managers may make an effort to escape the status quo. Their income is aligned with long-term performance, which includes taking greater risks. In addition, we suggest that the typical employment vulnerability of younger tenured executives also influences risk-bearing. Vulnerability is likely to exert a discounting effect on prospective wealth by lowering the probability of realizing the future wealth that is linked to a focal firm. With less wealth to gain out of stock ownership due to employment risk, executives should have less incentive to take risks in pursuit of this wealth. Thus,

Hypothesis 3a: Managerial tenure positively moderates the positive relationship between managers' stock ownership and alliance partner network distance, such that managerial tenure strengthens the relationship.

Hypothesis 3b: Managerial tenure positively moderates the positive relationship between nonexecutive directors' stock ownership and alliance partner network distance, such that managerial tenure strengthens the relationship.

2.4 METHODS

2.4.1 Sample and Data Sources

We tested our hypotheses in the context of the pharmaceutical and biotechnology industries in the United States between 1996 and 2010. The sample was drawn from all U.S. firms in the pharmaceutical and biotechnology industries present in the Acquisitions and Alliances database of the Security Data Company (SDC) from 1996 to 2010. Prior strategy literature has frequently used these industries as the context to test their hypotheses for M&As (Danzon, Epstein, & Nicholson, 2007), R&D investments (McGrath & Nerkar, 2004), and alliance partner choice (Diestre & Rajagopalan, 2012).

To construct the data, we went through several steps. First, we defined the sample firms from the pharmaceutical and biotechnology industries. Based on SIC codes, a total of 2,485 alliances (237 alliances from the biotechnology industry and 2,248 alliances from the pharmaceutical industry) of 544 firms (both public and private firms) were

observed during the sample period between 1996 and 2010. Second, starting with the sample firms, we pulled a comprehensive set of alliances of sample firms and of those firms' partners and of the partners' partners to construct the network.[1] Finally, for the analysis, we limited the sample firms to public firms, whose financial data and information on corporate governance were available from Compustat and Risk Metrics. This procedure left us with 310 alliances of 48 public firms. Our unit of analysis is the dyadic tie of an alliance.

We obtained alliance information from the Acquisitions and Alliances database of the SDC. We collected information on firms from Standard & Poor's Compustat, managerial incentives and boards of directors from ExecuComp and Risk Metrics, and innovation information from USPTO.

2.4.2 Measures

Dependent variables. The dependent variable is a categorical variable indicating whether a sample company chose among existing partners, new distant partners, or new close partners. The distance between a focal firm and its new partner was measured by an alternative minimum path length (geodesic) to the partner from the focal firm (Podolny, 1994; Gulati & Gargiulo, 1999; Shilling & Phelps, 2007). To compute the partner network distance, we extended the focal firm's ego network to two degrees, (i.e., including the alliance partners of the focal firms' partners). Unfortunately, the

[1] We added alliances that occurred up to four years prior to the sample years to control for possible left-censoring problems.

termination dates of alliances are unclear since firms typically do not declare their termination dates.[2] As a remedy for the lack of alliance termination dates, prior literature has used a moving window to construct the network structures (Gulati & Gargiulo, 1999; Podolny, Stuart, & Hannan, 1996). Consistent with this, we used a four-year moving window to account for the duration of each alliance. For example, when an alliance was formed in 1998, the alliance appears in our data until 2002. Thus, the adjacency matrix for a given year records alliances formed in that year and in any of the previous three years. We assigned *1* to each alliance if firms *i* and *j* entered into an alliance in a given year, and *0* otherwise.

Methodologically, partner network distance is captured by the shortest alternative path to a partner firm at the time period prior to alliance formation. For example, if the focal firm could reach its partner C through firm A (indicating that there was a mutual partner A between the focal firm and its partner C), the distance of partner C is 2, as Figure 2-1 illustrates. If the focal firm could reach its partner F through three firms, B, D, and E, then the shortest alternative path (before a direct relationship between the focal firm and its partner F was formed), and the distance is 4.[3]

Figure 2-2 shows examples of a network distant partner and a network close partner. As an example of a network distant partner, *Regulus* is a distant partner of *Glaxo Smith Klein*, a focal firm in my sample, since *Glaxo Smith Klein* and *Regulus* do not share a mutual alliance partner. An example of a close partner is *Top Meadow Farms*, a close

[2] The SDC usually does not provide a termination date. A total of 1,823 termination dates are reported out of 127,523 alliances from 1990 to 2010, which is approximately 1.4% of the total alliance observations, according to our calculation.

[3] Note that we treated the cases where there was no firm in between as infinite distance, meaning that the partner was an infinitely distant partner of distance 6, while the very first alliance partner for firms was treated as 0. As the definition implies, there is no common partner.

partner of *ProMetic BioSciences* Ltd., a focal firm in my sample, since they share a mutual partner, *ProMetic Science*.

FIGURE 2-1: Illustration of Alliance Partner Network Distance

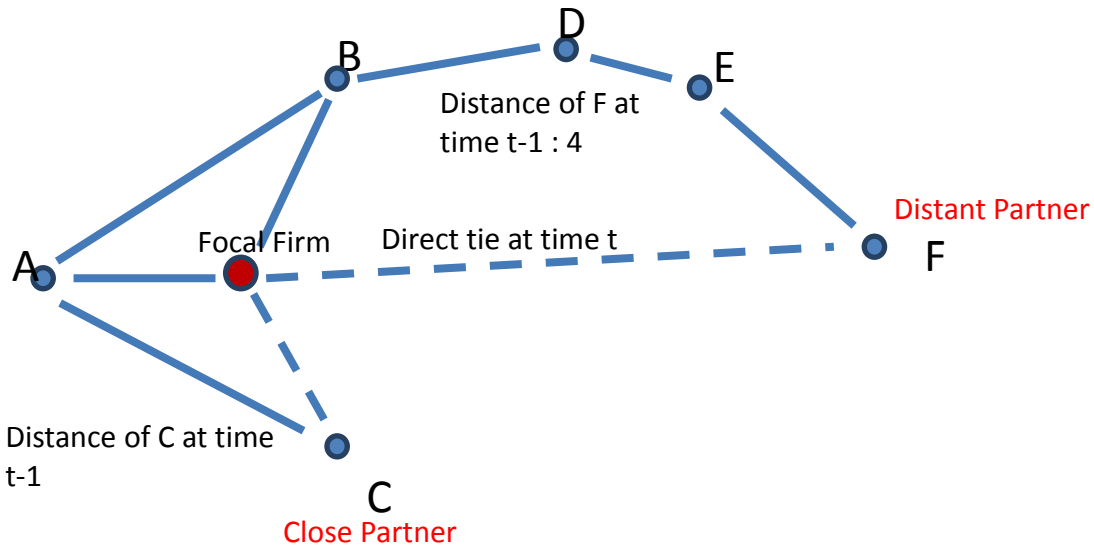
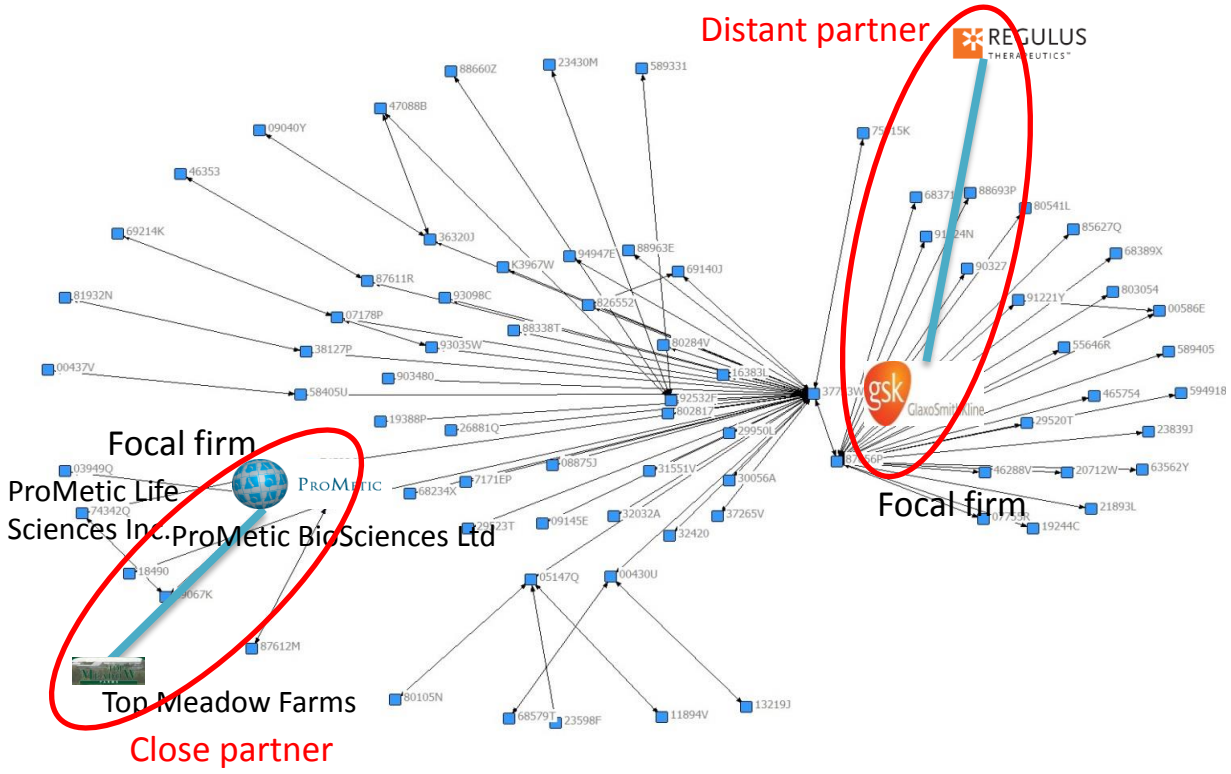


FIGURE 2-2: Examples of Alliance Partner Network Distance



We employed three categories to capture the network distance for the dependent variable as proxies for an existing partner, a new close partner, and a new distant partner. We categorized existing partners as *1* when the alliance partners was already in the alliance portfolio at the alliance formation[4]; new close partners as *2* when the distance of new partners is distance 2 (i.e., there is a mutual partner between the focal firm and the new partner); and new distant partners as *3* when the distance of new partners is 3 and beyond (i.e., there is no mutual partner between the focal firm and the new partner).

Explanatory variables. To capture managerial incentives, *Top managers' stock ownership* for Hypothesis 1 was measured as the percentage of the equity holdings of inside directors to the total outstanding common shares of the company (Hoskisson et al., 2002; Beatty & Zajac, 1994). For board monitoring, *Nonexecutive directors' stock ownership* for Hypothesis 2 was measured as the ratio of shares held by all nonexecutive directors to the total number of outstanding shares. We coded directors as "insider," "affiliated – family or former employee," "affiliated – professional relationship with firm" (coded as *0*) or "outsider" (coded as *1*). Hypothesis 3 postulates a moderating role of *Managerial tenure*, which was operationalized as the average tenure of executives. Tenure was the number of years that an individual had served as an executive of her or his present company.

[4] We excluded past partners that were no longer in the alliance portfolio from existing partners and considered them as new partners.

Control variables. Based on the past literature on alliance partner choice (Beckman et al., 2004; Baum et al., 2005), we controlled for several alliance-, network-, and firm-related factors associated with alliance partner choice. First, we included alliance-level controls such as an *Alliance purpose dummy,* which may indicate function distance (e.g., R&D coded as 1; otherwise as 0), *Alliance governance dummy* (joint venture coded as 1; otherwise as 0), *Cross-border dummy* (cross-border coded as 1; otherwise as 0), *Technological distance*, which indicated the extent to which partner firms patented in distinctive technology classes based on the class and subclass within the U.S. patent classification system with a four-year window. It was measured by a reverse ratio of the common technological domain with partners divided by the number of total technological classes of the focal firm (Ahuja & Katila, 2001). *Geographical distance*, which indicated the extent to which the cost of knowledge transfer increases and the frequency of personal contact that builds social relations decreases, was measured by miles based on the zip codes of their headquarters (Rosenkopf & Almeida, 2003).

Second, our study controlled for several network-related factors. We controlled for the *Size of alliances*, which was measured by the number of partners of alliances formed at time *t.* We controlled for *Network size,* measured by the number of partners of an alliance prior to time *t*. We assessed the presence or absence of *Structural holes* in the network of the focal firms and constructed structural holes as constraints using UCINET (Borgatti, Everett, & Freeman, 2002). We calculated the structural holes as one minus the firm's constraint score (Zaheer & Bell, 2005). The *Average clustering coefficient* is measured as the number of actual links connecting all neighbors of a focal firm with one another, divided by the number of all possible ties among those nodes to distinguish

small world networks from random networks to control for an alternative of network distance (Gulati, Sytch, & Tatarynowicz, 2012; Schilling & Phelps, 2007).

Finally, at the firm level, we controlled for *Board size*, measured by the total number of board members and *Board independence*, measured by the ratio of external directors to the board size. *Debt ratio* was measured by the long-term debt of total assets. *R&D intensity* was measured by in process R&D expenses/sales. We controlled for *Firm size*, measured by the assets in logged format. To control for any relationship between *Past performance* and alliance propensity, partner choice and partner distance, we used the prior ROA, measured as the ratio of net income to the year-end value of total assets as a control variable in testing all hypotheses. *Managerial age* was the average age of all executives. Together with managerial tenure, managerial age measured the perceived risk. Table 2-1 summarizes variable operationalization.

TABLE 2-1: Variable Operationalization

Variable	Type	Operationalization	Data Source
Partner Distance	Category	Alternative minimum path length toward the partner from the focal firm at time *t-1* Average value of distances of each alliance at time *t*	Derived from SDC
Managerial Ownership	Continuous	Ratio of the equity holdings of inside directors to the total outstanding common shares of the company owned by the top managers	RiskMetrics
Nonexecutive Ownership	Continuous	Ratio of the equity holding of outside directors to total outstanding common shares of the company	RiskMetrics
Managerial Tenure	Continuous	The average of tenure of executives	RiskMetrics
Alliance Purpose	Dummy	R&D alliance: 1; non R&D alliance: 0	Derived from SDC
Alliance Governance	Dummy	Joint venture: 1; non-joint venture: 0	Derived from SDC
Cross-border Alliance	Dummy	Cross-border alliance: 1; non cross-border: 0	Derived from SDC
Technological Distance	Continuous	Reverse ratio of the common technological domain with partners, divided by the number of total technological classes of the focal firm	USPTO
Geographical Distance	Continuous	Miles based on the zip codes of their headquarters	Derived from SDC
Alliance Size	Continuous	Number of partners of alliances formed at time *t*	Derived from SDC
Network Size	Continuous	Number of partners of alliances prior to time *t*	Derived from SDC
Structural Holes	Continuous	1 - the firm's constraint score	Derived from SDC
Clustering Coefficient	Continuous	Number of actual links connecting all neighbors of a focal firm with one another, divided by the number of all possible ties among those nodes	Derived from SDC
Board Size	Continuous	Number of board members	COMPUSTAT RiskMetrics
Board Independence	Continuous	Ratio of external directors to the board size	RiskMetrics
Debt Ratio	Continuous	Long-term debt divided by total assets	COMPUSTAT
R&D Intensity	Continuous	In-process R&D expenses divided by sales	COMPUSTAT
Firm Size	Continuous	Number of employees of the focal firm at time *t*	COMPUSTAT
Past Performance	Continuous	ROA at *t-1*	COMPUSTAT
Managerial Age	Continuous	The average age of executives	RiskMetrics

2.4.3 Model Specification

To predict alliance partner distance, we needed to correct for possible selection effects because firms self-select when they form an alliance. Firms that form alliances are likely to be systematically different from those that do not. Thus, we used Lee's (1983) generalization of the Heckman selection model to create a selection variable to control for alliance formation propensity in our multinomial logistic regression models.

We used the number of alliances of firms located in the same geographic area as the focal firm's headquarters as an instrumental variable (*No. of alliances in the focal firm's state*). The logic is that firms are likely to form an alliance when firms in the same geographic area form more alliances. We entered this instrumental variable into the first-stage probit regression to predict alliance formation propensity with the instrumental variable and a set of covariates that capture corporate governance (e.g., internal ownership and nonexecutive director ownership). This approach provides control variables referred to as the inverse Mills ratio (IMR), which was then entered into the second-stage network distance regression model (Heckman, 1979). We also checked to ensure that the instrumental variable was non-significant in the second stage. We clustered the data by firms in this step of analysis to take into account the non-independence of observations from firms with multiple alliances.

The second-stage regression involved running multinomial logistic models because partner network distance is a categorical variable. According to Hypothesis 1 and Hypothesis 2, the model for the relationship between corporate governance, the factors designed to resolve agency hazards, and partner choice for can be specified as follows:

$$y_{it} = \beta_0 + \beta_1 CorpGov_{it-1} + \beta_2 Alliance_{it} + \beta_3 NTWK_{it} + \beta_4 Firm_{it} + \beta_5 Perf_{it-1} + \varepsilon_1,$$

where y_{it} denotes the partner distance of firm *i* toward its partner at time *t*; $CorpGov_{it-1}$ represents the factors of corporate governance, managerial ownership, and nonexecutive ownership that firm *i* has at time *t-1*; $Alliance_{it}$ indicates the alliance objective, joint-venture, cross-border, technological distance, and geographical distance with the partner of firm *i* at time *t*; $NTWK_{it}$ indicates the alliance size, network size, structural hole, and clustering coefficient; $Firm_{it}$ indicates the focal firm's board size, board independence, debt ratio, R&D intensity, firm size, prior innovation, managerial tenure, and managerial age; and $Perf_{it-1}$ is the performance of firm *i* at time *t-1*. When the hypothesized moderators are included for Hypothesis 3, the model becomes:

$$y_{it} = \beta_0 + \beta_1 CorpGov_{it-1} + \beta_2 CorpGov_{it-1} Tenure_{it} + \beta_3 Alliance_{it} + \beta_4 NTWK_{it} + \beta_5 Firm_{it} + \beta_6 Perf_{it-1} + \varepsilon_1$$

, where $Tenure_{it}$ denotes the managerial tenure.

2.5 RESULTS

Table 2-2 presents the descriptive statistics and correlations for all key variables. The correlations are low, so multicollinearity is unlikely to be an issue. Sample firms from the pharmaceutical and biotechnological industries tend to form 5.7 alliances per firm, on average. There are 274 new distant partners (coded as 0), 23 new close partner (coded as 1), and 13 existing partner (coded as 2) in the sample. Given that new distant partners are the majority of observation, "new distant partners" is the reference category for this study.

TABLE 2-2: Descriptive Statistics (N=310)

Variables	Mean	SD	Min	Max	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
1. Partner Distance	2.87	.45	1	3	1.00																					
2. Managerial Ownership	.03	.06	0	.40	0.11	1.00																				
3.Nonexecutive Ownership	.01	.02	0	.16	0.09	0.15	1.00																			
4 Alliance Objective	.25	.44	0	1	-0.09	-0.06	-0.01	1.00																		
5. Alliance Governance	.09	.28	0	1	-0.11	0.06	0.06	-0.06	1.00																	
6. Cross-border Alliance	.08	.27	0	1	0.01	-0.01	-0.02	-0.11	-0.04	1.00																
7. Technological Distance	.96	.12	0	1	0.18	0.08	0.03	0.03	0.08	0.02	1.00															
8. Geographical Distance	1687.09	1376.95	0	16593.71	0.06	0.19	0.05	0.03	0.02	0.04	0.11	1.00														
9. Alliance Size	1.18	.70	1	8	-0.09	0.11	-0.08	-0.02	0.17	-0.04	-0.01	0.11	1.00													
10. Network Size	8.85	12.25	0	64	-0.31	-0.36	-0.24	0.03	0.07	0.03	-0.03	-0.09	0.05	1.00												
11. Structural Holes	.27	.33	0	1.13	0.17	0.45	0.21	0.03	-0.05	0.09	0.08	0.15	0.10	-0.51	1.00											
12. Clustering Coefficient	.03	.11	0	1	0.05	0.24	0.32	0.03	0.04	-0.06	0.05	0.01	-0.06	-0.16	0.14	1.00										
13. Board Size	10.50	2.70	5	19	-0.18	-0.35	-0.25	-0.02	0.05	-0.05	-0.07	-0.15	0.10	0.52	-0.38	-0.11	1.00									
14. Board Independence	.68	.17	.15	1	0.01	-0.44	0.02	0.02	0.09	-0.02	0.10	-0.07	-0.06	0.03	-0.16	-0.06	0.11	1.00								
15. Debt Ratio	.15	.32	0	8.58	0.10	0.12	0.04	0.01	-0.07	0.08	-0.05	0.07	0.04	-0.18	0.17	0.06	-0.30	-0.03	1.00							
16. R&D Intensity	-.48	11.38	-494.14	0	-0.04	-0.04	-0.00	0.02	-0.16	-0.18	-0.00	0.02	0.04	0.07	-0.00	-0.02	0.06	-0.03	-0.02	1.00						
17. Firm size	6.05	2.93	-2.58	12.27	-0.16	-0.46	-0.39	0.00	0.03	-0.01	0.01	-0.11	0.13	0.59	-0.39	-0.18	0.78	0.31	-0.22	0.04	1.00					
18. Prior Performance	-.32	1.52	-34.44	.66	-0.13	-0.14	-0.33	-0.04	-0.05	-0.01	-0.03	-0.04	0.12	0.37	-0.21	-0.24	0.44	0.19	-0.25	0.05	0.53	1.00				
19. Prior Innovation	2.05	3.62	0	42.08	-0.18	-0.24	0.03	-0.04	0.13	-0.01	-0.04	-0.12	0.07	0.56	-0.28	-0.17	0.30	0.09	-0.14	0.05	0.20	0.12	1.00			
20. Managerial Tenure	8.22	3.09	1.44	26.17	0.02	0.02	-0.06	-0.08	-0.01	0.04	0.02	0.03	0.01	-0.02	0.09	-0.07	-0.09	0.03	-0.00	0.06	0.12	0.19	-0.04	1.00		
21. Managerial Age	60.50	3.68	47.89	71.2	0.06	0.01	-0.10	-0.08	0.04	0.00	0.01	-0.06	0.06	-0.18	0.11	-0.05	0.21	0.21	-0.08	-0.00	0.25	0.32	-0.19	0.50	1.00	
22. Inverse Mills Ratio	.69	.35	.12	1.55	0.17	0.36	0.18	0.03	-0.04	-0.01	0.04	0.13	-0.08	-0.54	0.35	0.08	-0.80	-0.12	0.37	0.09	-0.87	-0.45	-0.20	-0.08	-0.29	1.00

The first-stage probit results for alliance propensity indicate that when a firm is located in an area where other firms form many alliances, the firm is significantly more likely to form an alliance, as shown in Table 2-3.

TABLE 2-3: The Effects of the Instrumental Variable on Alliance Propensity, 1996-2010, Results of First-stage Probit Analysis

	Model 1	**Model 2**
FIRM CONTROLS		
Board Size	.06 (.05)	.06 (.05)
Debt Ratio	-.42 (.35)	-.33 (.33)
R&D Intensity	-.34† (.20)	-.30 † (.18)
Firm Size	.30 ** (.09)	.30*** (.09)
Prior Performance	-.34 (.22)	-.26 (.21)
CORPORATE GOVERNANCE CONTROL		
Managerial Ownership	.89 (.90)	.99 (.95)
Nonexecutive Ownership	4.90 (3.25)	4.89 (3.05)
INSTRUMENTAL VARIABLE		
Number of Alliances in the State of the Focal Firm	-	**.00** ** **(.00)**
INTERCEPT	-2.84*** (.55)	-2.98*** (.57)
Observations	334	334
Groups	74	74
Log Pseudo likelihood	-206.86	-195.79
Wald Chi-square Test for Overall Fit	40.09	50.94
Pseudo R Squared	0.12	0.13

† p <.1 * p <.05 ** p <.01 *** p <.001
Standard errors are in parentheses.

Table 2-4 presents the results of the multinomial logit explaining the probability of a new close partner and an existing partner as compared to a new distant partner. Thus, a positive sign signifies a risk-averse behavior in alliance partner choice, that is, a higher probability of an alliance with an embedded tie (i.e., a new close partner or existing partner). Models 3-1 and 3-2 show only the control variables for new close partners and existing partners, respectively, with the baseline of new distant partners. Among the control variables, managerial tenure has a positive and significant effect on network distance across models, which is consistent with prior literature that suggests that longer-tenured executives are less likely to take risks (Johnson, Hoskisson, & Hitt, 1993; Arthurs, Hoskisson, Busenitz, & Johnson, 2008; Kor, 2006). Interestingly, board size has a positive and significant effect on network distance. Prior literature has emphasized two different roles of the board. One stream of prior research focuses on the monitoring role of the board and suggests that larger boards tend to be more involved in monitoring (Judge & Zeithaml, 1992; Raheja, 2005). The other stream suggests that board directors provide advice to top managers as an external network. The result speaks to the advising role of directors, implying that a small board size leads to a tie with a distant partner to overcome a limited external network.

When we include two mechanisms to address agency problems, we find a consistent strong effect of corporate governance on network distance. Model 4-1 indicates that managerial ownership has a statistically significant negative effect on partner distance for new close partners, compared to new distant partners, in support of Hypothesis 1 (β=-31.70, p <.05). The result suggests that less managerial incentive leads to alliances with new close partners rather than with new distant partners. Thus,

managerial incentive as manifested by management stock ownership encourages managers to seek distant partners. While some prior research suggests a nonmonotonic (i.e., an inverted-U-shaped) effect of managerial ownership on managerial risks, our results show a linear relationship. While the coefficients of the multinomial logit model allow me to assess the sign and significance of the independent variables, they do not reflect the magnitude of their effect on the probability of an alliance with a distant partner because the slope of the cumulative probability curve changes depending on the values of other observations in the sample. Following previous practice, I instead interpret the effect magnitudes based on the average marginal effect (AME) of each predictable variable. The AME is obtained by calculating the marginal effect for each observation in the sample holding all other variables at their mean values and then averaging across all observations. The average marginal effect of executive ownership on probability of alliance with distant partner is 7.2 percent over with close partner. Specifically, 0.1% increase in executive ownership causes 9.4% increase in probability of alliance with distant partner from 89.5% to 98.9%. Another 0.1% increase in executive ownership causes 0.3% increase in probability of alliance with distant partner from 99.5% to 99.8%.

As predicted in Hypothesis 2, the coefficient for nonexecutive directors' stock ownership is negative and significant on partner distance for new close partners, compared to new distant partners in Model 4-1 in Table 2-4 (β=-127.64, $p < .05$). The result suggests that less nonexecutive board directors' stock ownership leads to alliances with new close partners rather than with new distant partners. Thus, the incentive to strengthen board monitoring mechanisms, specifically ownership by nonexecutive board directors, pushes managers to form alliances with distant partners. Interestingly, the result

indicating that the control variable of board independence is not associated with partner network distance suggests that board independence is not enough by itself for effective monitoring; stock owned by nonexecutive board members is needed to strengthen the board monitoring function. The average marginal effect of nonexecutive ownership on probability of alliance with distant partner is 29.5 percent over with close partner. Specifically, 0.04% increase in executive ownership from 0%, which is 20% change of nonexecutive ownership, causes 8.7% increase in probability of alliance with distant partner from 90.9% to 99.6%. Another 0.04% increase in nonexecutive ownership causes 0.3% increase in probability of alliance with distant partner from 99.6% to 99.9%.

The moderating effect of managerial tenure on the relationship between managerial ownership and alliance partner network distance is marginally significant in Model 5-1 (see Table 2-4), marginally supporting H3a (β=-8.92, $p < .10$). The result suggests that firms go for distant partners to a greater extent when managers are long-tenured with strong managerial incentives.

The moderating effect of managerial tenure on the relationship between nonexecutive directors' stock ownership and alliance partner network distance was negative and significant in Model 5-1 as shown in Table 2-4 (β=-94.52, $p < .05$), supporting H3b. The result may imply that the effectiveness of board monitoring is affected by managerial tenure. We split the sample by managerial tenure into longer tenured managers above average of managerial tenure and younger-tenured managers below average of managerial tenure. The result suggests that firms are less like to ally with new close partners over new distant partners when both nonexecutive directors' stock ownership and managerial tenure are high. Thus, firms seek distant partners to a

greater extent when managers are long-tenured with strong board monitoring. The AME is 30.2% for younger-tenured managers, and the AME is 33.2% for older-tenured managers. The average marginal effect of nonexecutive ownership on probability of alliance with distant partner is 30.2 percent over with close partner when managers are younger-tenured whereas the average marginal effect of executive ownership on probability of alliance with distant partner is 33.2 percent over with close partner when managers are older-tenured. Older tenured managers are more likely to ally with distant partners than younger tenured managers who are under strong governance. Managerial tenure has a stronger negative effect on the probability of an alliance with a distant partner with low nonexecutive board monitoring than with high nonexecutive board monitoring. To illustrate the complex interaction effect, we draw a graph using the two categories of longer-tenured managers and younger-tenured managers and the probability of choosing a new distant partner over a new close partner in the relationship with nonexecutive ownership, as illustrated in Figure 2-3.

FIGURE 2-3: Interaction between Nonexecutive Ownership and Managerial Tenure Predicting the Probability of a Distant Partner

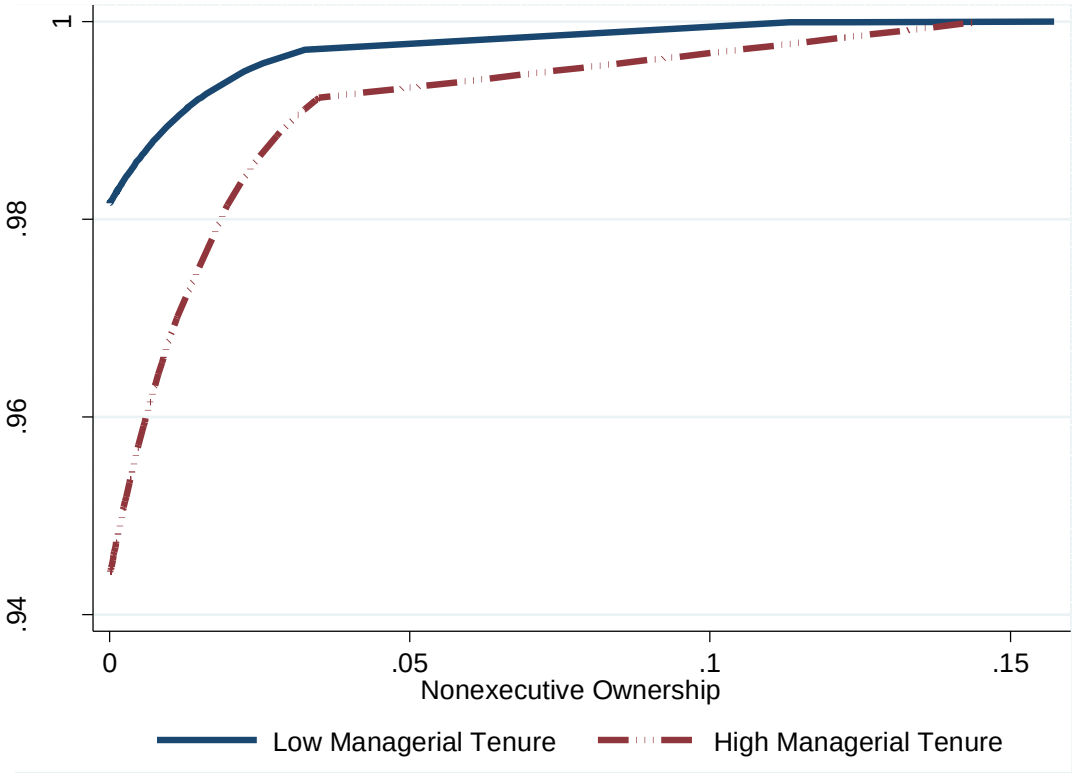


TABLE 2-4: The Effects of Corporate Governance on Partner Network Distance, 1996-2010, Results of Multinomial Logistic Regression Analysis

	Model 3-1: New Close	**Model 3-2: Existing**	**Model 4-1: New Close**	**Model 4-2: Existing**	**Model 5-1: New Close**	**Model 5-2: Existing**
Alliance Objective	1.13 *	.38	1.11 *	.36	1.05 †	.31
	(.48)	(.62)	(.53)	(.64)	(.58)	(.61)
Alliance Governance	2.10 ***	1.13	2.14 ***	1.06	2.21 ***	1.10
	(.33)	(.83)	(.37)	(.84)	(.36)	(.87)
Cross-border Alliance	1.66	-14.50 ***	1.79	-15.49 ***	1.80	-15.39 ***
	(1.27)	(.50)	(1.27)	(.56)	(1.29)	(.55)
Technological Distance	-6.43**	-7.04 ***	-5.97 **	-7.25 ***	-5.57 **	-7.42 ***
	(1.91)	(1.89)	(1.97)	(1.83)	(2.07)	(2.04)
Geographical Distance	-.00	-.00	-.00	-.00	-.00	-.00
	(.00)	(.00)	(.00)	(.00)	(.00)	(.00)
Alliance Size	1.01**	.10	1.06 ***	.10	1.10 ***	.07
	(.29)	(.64)	(.31)	(.63)	(.31)	(.61)
Network Size	.05	.05	.07	.04	.06	.04
	(.05)	(.03)	(.05)	(.03)	(.05)	(.04)
Structural Holes	-10.88 **	-14.21 *	-9.09	-17.39 †	-8.77	-17.73 †
	(4.08)	(6.62)	(6.55)	(9.00)	(6.65)	(9.90)
Clustering Coefficient	10.69 **	-3.58	21.11 **	-2.12	21.65 *	-2.72
	(3.92)	(13.11)	(7.17)	(13.73)	(8.40)	(14.64)
Board Size	.32 *	-.13	.33 **	-.14	.32 **	-.16
	(.12)	(.17)	(.12)	(.18)	(.11)	(.18)
Board Independence	-3.42	.31	-2.47	1.33	-3.50	1.75
	(2.79)	(2.64)	(3.85)	(3.03)	(3.64)	(2.65)
Debt Ratio	-7.56	-1.19	-5.20	-.32	-4.51	-.06
	(5.45)	(1.31)	(5.18)	(2.20)	(4.03)	(2.07)
R&D Intensity	13.08	1.76	6.81	2.23	8.29 *	2.26
	(10.06)	(2.70)	(4.16)	(3.16)	(3.50)	(2.96)
Firm Size	.05	-.27	-.78	-.45	-1.07	-.55
	(.63)	(.63)	(.89)	(.89)	(.71)	(.94)
Prior Performance	4.80 *	.46	6.07 *	-.20	6.98 *	-.02
	(2.43)	(3.68)	(2.68)	(4.27)	(2.81)	(4.21)
Prior Innovation Quality	-.40 *	.17	-.50 *	.20	-.56 *	.22
	(.17)	(.24)	(.21)	(.26)	(.22)	(.30)
Managerial Tenure	.23 *	-.24 *	.24 †	-.22 *	.39 *	-.20
	(.11)	(.10)	(.14)	(.11)	(.17)	(.16)
Managerial Age	-.51 **	.22	-.52 **	.22	-.54 *	.21
	(.18)	(.17)	(.20)	(.19)	(.21)	(.17)
Inverse Mills Ratio	.94	-.27	-1.35	-.98	-2.54	-1.72
	(1.94)	(2.61)	(2.72)	(2.96)	(2.47)	(3.25)
Hypotheses Effects						
Managerial Ownership	-	-	**-31.70 ***	7.58	2.48	-.12
			(13.89)	(7.86)	(1.58)	(1.33)
Nonexecutive Directors' Ownership	-	-	**-127.64 ***	-86.30	3.08 †	2.23 *
			(57.18)	(109.66)	(1.66)	(.86)
Managerial Ownership	-	-	-	-	**-8.92** †	1.35
** Managerial Tenure*					**(4.62)**	(3.21)
Nonexecutive Directors' Ownership	-	-	-	-	**-94.52 ***	-40.35
** Managerial Tenure*					**(41.40)**	(28.07)
Observations (Groups)	310 (48)		310 (48)		310 (48)	
Log pseudo likelihood	-93.91		-92.86		-91.92	
Pseudo R squared	0.30		0.31		0.32	

The comparison baseline is "New Distant Partner."

The partner industry dummy control is included.
† p <.1 * p <.05 ** p<.01 *** p<.001.
Standard errors are in parentheses.

Table 2-5 presents a summary of the empirical findings of this study. Overall, the results of the empirical analyses provide strong support for the effects of strong corporate governance on managerial risk-taking in the context of alliance partner choice.

TABLE 2-5: Summary of the Empirical Findings

Hypothesis	Prediction	Coeff. Estimate	Finding
H1	A greater proportion of top managers' stock ownership will increase the likelihood of alliance formation with distant partners by the focal firm.	31.70	Supported (p<.05)
H2	A greater proportion of nonexecutive directors' stock ownership will increase the likelihood of alliance formation with distant partners by the focal firm.	127.64	Supported (p<.05)
H3a	Managerial tenure positively moderates the positive relationship between managers' stock ownership and alliance partner network distance.	8.92	Marginally Supported (p<.10)
H3b	Managerial tenure positively moderates the positive relationship between nonexecutive directors' stock ownership and alliance partner network distance.	94.52	Supported (p<.05)

2.5.1 Robustness Tests

New distant partners were categorized as *3* when the distance was 3 and beyond, while the distances of new close partners and existing partners were categorized in the analyses as *2* and *1*, respectively. However, one may argue that even partners of a distance of 3 may be sharing social mechanisms such as peer pressure, so those partners could be regarded as new close partners. With an alternative measure of network distance that includes the distance of 3 as a new close partner, the results showed that the main effects of managerial incentive and outside board monitoring influence alliance partner network distance, which is consistent with the main story, although the interactions weakened somewhat.

Another concern could be that partners appearing for the first time, categorized as distant partners, might have distinctive characteristics from distant partners that have partners other than the focal firm. As a robustness check, we performed supplementary analyses by adding a dummy variable to take into account first-time partners. Our results remained consistent.

Some might argue that partner distance can be defined in terms of technological distance (e.g., the nature of resources), as well as social distance and that incentivized agency simply prefers technologically distant partners, regardless of the network distance. To address this concern, we controlled for technological distance in the analyses, and the results showed that managerial incentives and monitoring increase network distance, above and beyond technological distance.

Beyond the control, we examined how technological distance interacts with network distance. We examined whether strong governance increases alliance partner

technological distance and whether firms choose a distant partner, both technologically and relationally, under strong governance. We found that even with the high level of relational risk of a distant partner, firms still choose technologically distant partners. As Model 6 in Table 2-6 indicates, managerial incentives increase alliance partner technological distance (β=47.75, $p < .05$). Consistent with network distance, we have confirmed that strong governance increases managerial risks, both technologically and relationally, in the alliance partner selection context.

In addition, we demonstrated that managerial incentive and board monitoring increase the probability of an alliance with a technologically distant partner, even when the partner is already relationally distant (See model 7 in Table 2-6 (β=18.31, $p < .05$, β=22.56, $p < .10$)). The results suggest that shareholders favor access to unexplored technology domains, as well as non-redundant information from distant partners. Alliances with partners of technological relatedness may increase the redundancy of ideas, skill sets, and knowledge, which leads to a sub-additive alliance portfolio (Vassolo et al., 2004). In addition, the technological relatedness also increases the ability of partners to gain value from the focal firm. Greater technological relatedness provides the partner firm with the necessary absorptive capacity to assimilate the focal firm's knowledge and identify the alternative properties of such knowledge beyond the current alliance (Cohen & Levinthal, 1990; Dushnitsky & Lenox, 2005; Sampson, 2007). Our result implies that when two firms are not technologically similar (or technologically distant), the lack of social capital (or relationally distant) may not be a concern because of unlikely knowledge appropriation. We provide evidence that technological distance and network distance complement each other.

Finally, we ran logistic regression in Model 8-1 through Model 9-2 as another set of robustness tests, as shown in Table 2-7. Model 8-1 and Model 8-2 present the influence of corporate governance and the moderating effect of managerial tenure on the comparison between new distant partners and new close partners with the exclusion of existing partners in the model. The results are generally similar to the multinomial logit results shown in Table 2-4. A high level of managerial ownership and nonexecutive ownership increase the probability of an alliance with a new distant partner over a new close partner, supporting Hypothesis 1 and Hypothesis 2 (β=33.43, $p < .05$, β=136.17, $p < .05$). In addition, the result of the moderating effect of managerial tenure on the relationship between nonexecutive board stock ownership and network distance is consistent with the multinomial logit result in Table 2-4 in support of H3b (β=93.72, $p < .05$).

However, the results of binary logistic analysis that compares new distant partners and embedded ties (both new close partners and existing partners) are not the same as the results of the multinomial logit in Table 2-4. The results in Model 9-1 suggest that the effect of corporate governance on network distance is not significant while the moderating effect of managerial tenure on the relationship between nonexecutive board stock ownership and network distance is positive and significant (β=50.69, $p < .01$). Contrary to our expectation that the choice of existing partners may be more risk-averse than the choice of new close partners, the results imply that existing partners and new close partners are not identical in terms of partner-relational risks and benefits as we discussed above.

TABLE 2-6: The Effects of Corporate Governance on the Combined Effect of Network Distance and Technological Distance, 1996-2010

	Model 6: Technological Distance	**Model 7: Combined Effect of Network Distance and Technological Distance**
	Generalized Linear Model	**Logit**
Alliance Objective	.39 (.51)	.44 (.33)
Alliance Governance	2.01 * (.90)	1.60 (1.06)
Cross-border Alliance	.72 (.68)	.80 (.76)
Network Distance	.59 *** (.10)	-
Geographical Distance	.00 (.00)	.00 (.00)
Alliance Size	-.58 † (.33)	.08 (.56)
Network Size	.02 (.02)	-.00 (.01)
Structural Holes	.94 (.87)	2.08 ** (.64)
Clustering Coefficient	2.89 (2.62)	-.96 (2.13)
Board Size	-.16 (.13)	.15 * (.08)
Board Independence	1.19 (1.21)	1.32 (1.30)
Debt Ratio	-2.35 * (1.18)	-2.89 ** (1.08)
R&D Intensity	.74 * (.31)	.31 (.40)
Firm Size	1.08 * (.42)	.58 † (.31)
Prior Performance	.56 (1.02)	-.73 (1.44)
Prior Innovation Quality	.15 (.15)	.04 (.13)
Managerial Tenure	-.09 (.08)	.03 (.06)
Managerial Age	.04 (.06)	.08 (.05)
Inverse Mills Ratio	1.91 * (.88)	5.01 *** (1.36)
Hypotheses Effects		
Managerial Ownership	**47.75 *** **(19.10)**	**18.31 *** **(7.98)**
Nonexecutive Directors' Ownership	**35.34** **(41.06)**	**22.56** † **(13.17)**
No. of Observations	310	274
No. of Groups	48	48
Log pseudo likelihood	-22.66	-124.49
Pseudo R squared	0.31	0.21

† p <.1 * p <.05 ** p<.01 *** p<.001 Standard errors are in parentheses.
The partner industry dummy control is included. The comparison baseline for Model 7 is "New Close Partner." Note that Model 7 includes only alliances with network-distant partners.

TABLE 2-7: The Effects of Corporate Governance on Partner Network Distance, 1996-2010, Results of Logistic Regression Analysis

	Model 8-1: New Distant vs. New Close	**Model 8-2: New Distant vs. New Close**	**Model 9-1: New Distant vs. New Close & Existing**	**Model 9-2: New Distant vs. New Close & Existing**
Alliance Objective	-.96 † (.54)	-.91 (.59)	-.90 * (.37)	-.86 * (.38)
Alliance Governance	-2.10 *** (.35)	-2.16 *** (.33)	-1.68 *** (.46)	-1.71 *** (.47)
Cross-border Alliance	-1.73 (1.32)	-1.74 (1.33)	-.76 (.76)	-.83 (.78)
Technological Distance	5.54 * (2.36)	5.11 * (2.35)	5.97 *** (1.49)	5.73 *** (1.57)
Geographical Distance	.00 (.00)	.00 (.00)	.00 (.00)	.00 (.00)
Alliance Size	-1.17 ** (.38)	-1.22 ** (.39)	-.63† (.37)	-.61 † (.37)
Network Size	-.07 (.04)	-.07 (.04)	-.05 (.03)	-.04 (.03)
Structural Holes	8.59 (6.61)	8.55 (6.80)	9.24 † (4.74)	9.41 † (4.90)
Clustering Coefficient	-21.52 ** (7.53)	-22.11 * (9.66)	-7.09 * (2.92)	-7.34 * (3.21)
Board Size	-.32 ** (.11)	-.31 ** (.10)	-.14 (.10)	-.12 (.10)
Board Independence	1.82 (4.18)	3.01 (3.91)	.16 (2.65)	.20 (2.61)
Debt Ratio	4.64 (4.69)	3.98 (3.58)	3.44 (3.25)	3.06 (3.38)
R&D Intensity	-7.19 † (4.34)	-8.87 * (3.71)	-1.90 (1.69)	-2.14 (1.71)
Firm Size	.93 (.89)	1.19 (.73)	.53 (.72)	.76 (.72)
Prior Performance	-6.64 * (2.80)	-7.62 * (3.01)	-2.20 (2.91)	-2.51 (2.91)
Prior Innovation Quality	.53 * (.22)	.60 * (.24)	.12 (.20)	.11 (.21)
Managerial Tenure	-.26 * (.13)	-.42 ** (.16)	-.02 (.11)	-.10 (.12)
Managerial Age	.58 ** (.19)	.59 ** (.20)	.17 (.19)	.21 (.20)
Inverse Mills Ratio	1.91 (2.80)	2.92 (2.57)	.48 (2.10)	1.40 (2.08)
Hypotheses Effects				
Managerial Ownership	**33.43 * (14.54)**	-46.72 (29.42)	**.25 (6.28)**	-6.08 (11.65)
Nonexecutive Directors' Ownership	**136.17 * (54.44)**	-189.18 † (106.91)	**82.62 (72.47)**	-108.07 * (48.21)
*Managerial Tenure * Managerial Ownership*	-	**9.63 † (5.38)**		**1.02 (1.53)**
*Managerial Tenure * Nonexecutive Directors' Ownership*	-	**93.72 * (41.12)**		**50.69 ** (17.77)**
Observations (Groups)	297(45)		310(48)	
Log pseudo likelihood	-50.24	-49.54	-78.64	-78.14
Pseudo R squared	0.37	0.38	0.29	0.29

The comparison baseline is "New Close Partner."

The partner industry dummy control is included.
† p <.1 * p <.05 ** p<.01 *** p<.001. Standard errors are in parentheses.

2.6 CONCLUSION AND DISCUSSION

We began by relaxing the assumption of a firm making partner choices as a unitary actor and positing that choosing distant alliance partners involves relational risk on the part of managers. Consequently, agency considerations apply to making this choice. We then examined how and under what circumstances agency costs regarding partner distance might be alleviated by the design of corporate governance. Our results provide support for the idea that firms seek distant partners when their corporate governance mechanisms successfully address agency problems and encourage the firms' managers to take risks in their alliance partner choices. Firms tend to form alliances with distant partners when firms have a strong managerial incentive structure and board monitoring system, and more specifically, when top managers and nonexecutive directors have stock ownership. Our findings, therefore, support the idea that the agency problem may well extend to firms' collaborative strategies (i.e., alliance partner choices).

We contribute to the literature on partner choice by joining the conversation of what drives alliances with distant partners. Previous work has explored the controllability of uncertainty (Beckman et al., 2004), technology discontinuities (Rosenkopf & Padula, 2008), existing network structure (Sytch, Tatarynowicz, & Gulati, 2011), resources and capabilities (Diestre & Rajagopalan, 2012), and performance relative to aspirations (Baum et al., 2005) as determinants of partnering with nonlocal firms. These alternative theories offer a different prediction, which leaves room for a contribution by introducing a new lens that relies on a distinct theoretical framework. That being said, to these

explanations we add corporate governance to mitigate the agency problem as a driver of alliance partner choice. In addition, prior literature is yet to begin a discussion of how managerial opportunism affects alliance partner choices. We show that firms' decisions regarding alliance partners are sensitive to the presence of agency hazards arising from the separation of ownership and control; thus, managers may be opportunistic when it comes to alliance partner choices. More generally, prior studies view a firm as a unitary entity encompassing the interests of agents and principals when firms are involved in alliance partner choices. Previous literature on corporate strategy and finance has only examined agency theory in the context of acquisitions, diversification, and R&D investments. Our study is among the first to view the firm as an entity of fragmented interests when it comes to alliance partner choice between the agent and the principal.

More specifically, we show that many of the agency motives and payoffs associated with acquisitions, diversification, and internationalization also apply to partner choice. The literature on alliances highlights various benefits that firms achieve through alliances. Agency theory, nevertheless, raises the possibility that adverse managerial motives may partially account for alliance choices, and eventually, the outcomes. Consequently, our use of agency theory offers a distinct perspective on alliances. In addition, there has been debate on the explanatory power of agency theory. For example, the assumption in agency theory that self-interest is a motive for managerial decisions is rejected by Lane, Cannella and Lubatkin (1998, 1999). A test of whether agency problems have an impact in an alliance setting, as we perform here, contributes to exploring the boundary conditions of the theory by showing that self-interested managers might be making sub-optimal alliance partner choices.

We also extend prior literature by adding the notion of network distance of nonlocal ties relative to the prior literature, which only distinguishes between new and existing partners (Beckman et al., 2004). Beckman, Haunschild, and Phillips (2004) make a distinction between exiting and new partners. We argue that all new partners are not the same because the social mechanism available with a new close partner would be different from the social mechanism available with a new distant partner. Theoretically, the notion of network distance explains the social mechanisms that are available between two firms and the characteristics of information flowing between the two firms. These social mechanisms are like an overall network structure. If there is a mutual partner between the two firms (i.e., close partner), the relational risk is reduced (Coleman, 1988), and the novelty of information coming from an unconnected partner (i.e., distant partner) is higher than that from a connected partner (Burt, 1992). The social mechanism and information novelty are associated with the risk that managers take; thus, the investigation of network distance is relevant to agency theory.

Like all research, this study raises questions that remain unanswered. Future research could explore other aspects of corporate governance in exploring alliance partner choice, such as distinguishing between the behaviors of agent-managers vs. founder CEOs (Souder, Simsek, & Johnson, 2012). Further, while we examined the stock ownership of executives, we did not include TMT compensation (Dever et al., 2008; Beatty & Zajac, 1994) as a potential determinant of alliance partner choice; this too, might be an avenue for future research.

Moreover, our study includes only the formal relationships of alliances when it comes to building a firm's network, thus excluding informal relationships. Information

flows through information networks such as a TMT's personal network, which also affects alliance partner decisions. Future research may benefit from adding informal along with formal networks. Potentially, interlocking boards between two firms (Gulati & Westphal, 1999) can be used as an information network. Such research would be helpful in understanding whether TMT networks or board interlocks substitute or complement a firm's alliance networks. Finally, we are taking the first step to apply agency theory to alliance contexts; thus, our theory development relies on conventional agency theory. This focus provides research opportunities such as adding a behavioral agency model (Wiseman & Gomez-Mejia, 1998; Devers, Wiseman, & Holmes, 2007; Devers, McNamara, Wiseman, & Arrfelt, 2008). Consideration of behavioral views as to how individuals make choices in the context of incentives and monitoring has the potential to add complex nuances that remain undiscovered in prior agency-related research. Nevertheless, our work represents an initial step in conjoining agency theory with the alliance literature.

Chapter 3 How Does Alliance Partner Network Distance Affect a Firm's Innovation?

3.1 INTRODUCTION

In an effort to understand how relational risk and knowledge transfer challenges in an alliance affect a firm's innovation, prior literature on alliances (or any dyadic relationship) and innovation has investigated the effects of overall alliance partner composition (Phelps, 2010), alliance network structures (i.e., local clustering; Schilling & Phelps, 2007) and the strength of ties within a network (Tiwana, 2008; Hansen, 1999) as determinants of innovation.

Although research has long recognized the importance of alliance partner choice in a firm's innovation (Ahuja, 2000; Sampson, 2007; Phelps, 2010), previous research has yielded conflicting results about the influence of alliance partner choice on firm innovation between the benefits of novel and non-redundant information from an alliance partner and the benefits of social capital with an alliance partner. On one side of the debate, studies have found that novel information enhances knowledge creation (Hargadon & Sutton, 1997; McEvily & Zaheer, 1999) because it provides actors with timely access to diverse information (Burt, 1992) from the partners and increases innovation. On the other side of the debate, research has suggested that social capital, including trust, reciprocity norms, and a shared identity, improves knowledge transfer

and innovation (Ahuja, 2000; Dyer & Nobeoka, 2000; Schilling & Phelps, 2007; Hansen, 1999) because social capital increases cooperation and knowledge sharing (Coleman, 1988; Portes, 1998).

There are two reasons for the conflicting results about the benefits of novel information and social capital in a relationship with an alliance partner on innovation. First, it views an alliance only as a dyadic relationship. The network structure underlying in this dyadic relationship has not been taken into account. The network structure embedded in a dyadic relationship influences partner risk, knowledge transfer challenges, and information quality. If there is a mutual partner between two firms, relational risk is reduced (Coleman, 1988) and the novelty of information coming from unconnected partners is higher than that from connected partners (Burt, 1992). In the current research, the notion of network distance captures how two parties are connected to each other in a network configuration, along with the direct dyadic relationship. Thus, conceptually, close partners are likely to make a focal firm's network denser by creating network closure, while distant partners construct sparse networks by creating a structural hole. By linking the literature on alliances with the literature on networks with the notion of alliance partner network distance, we can see how innovation is influenced differently by diverse and timely information from distant partners and by the social mechanisms that are available between close partners.

Second, research on the relationship between network structure and innovation has only focused on a particular type of innovation, either innovation quantity (Ahuja, 2000; Guler & Nerkar, 2012) or innovation characteristics (i.e., exploratory innovation by Phelps, 2010) to investigate the effect of alliance partner choice on innovation. Without

examining the comprehensive types of innovation together, we cannot conclude that one type of alliance partner is beneficial to innovation and the other is not, since a particular type of innovation may require social capital of closure (Coleman, 1988) over novel knowledge of a structural hole (Burt, 1992) or novel knowledge over social capital.

The purpose of this paper is to investigate the effect of alliance partner network distance, which captures the network structure embedded in an alliance, on various types of innovation. I explore how knowledge coming from a distant (or close) partner contributes to a firm's innovation, and additionally, whether technological distance between a focal firm and its partner compensates for network distance. My research question is: How does alliance partner network distance affect innovation in terms of innovation quantity, exploratory innovation, and innovation quality?

I contend that an alliance with a close partner, a relationship based on trust and similarity, encourages the firm to share information and knowledge. Open and frequent knowledge transfer leads to increased innovative output. Similarity with close partners allows easier interpretation of partner knowledge, producing quick innovative output. In contrast, non-redundant knowledge from distant partners allows firms to reach an exploratory domain and to produce better-quality innovation. Firms depart from path-dependence through relationships with distant partners. The partners' novel ideas and departure from existing practices will increase exploratory and breakthrough innovations.

I test the hypotheses regarding the effects of an alliance partner network distance on innovation in the U.S. pharmaceutical and biotechnology industries with 534 R&D alliances of 189 firms from 1996 to 2009. I find that alliances with distant partners bring about exploratory innovation, while alliances with close partners increase innovation

quantity by increasing the number of patents. An alliance with a close partner is useful for patent quantity, while an alliance with a distant partner encourages exploratory innovation in terms of extended patent categories. Interestingly, an alliance with a partner, both technologically and socially distant, results in high-quality innovation.

This study is expected to offer two contributions. First, this study contributes to a longtime debate about the influence of alliance partner choice on innovation by showing that a different type of partner brings about a different kind of innovation. I maintain that not only a partner's characteristics, but also the underlying network structure of the partner (how two firms are connected in a network) both affect the firm's innovation. This study examines how two firms are connected using the concept of alliance partner network distance. The network distance in a dyad is associated with the social capital between two firms (Coleman, 1988) and the quality of information (Burt, 1992). In this research, I have shown that the social mechanism of close partners and information novelty from distant partners lead to different innovation consequences. This study reconciles the longtime debate by showing that close partners contribute to firms' innovation by increasing the number of patents (Ahuja, 2000), whereas distant partners contribute by helping firms explore new technological areas (Zaheer & Bell, 2005; Burt, 1992).

Second, I advance an operationalization of network evolution with the concept of network distance. The current research explores dynamic changes of the network structure rather than a firm's static position within a broader network of relationships by examining an additional tie formation with the notion of alliance partner network distance. Empirical research has not yet examined the impact of dynamic changes of alliance

networks on a focal firm's innovation by looking at the addition of a new alliance partner. The research on network evolution requires a simultaneous focus on both dyads and the aggregation of dyads into a larger network (Hite & Hesterly, 2001; Gulati, Sytch, & Tatarynowicz, 2012; Baum, McEvily, & Rowely, 2012). Partner selection is fundamental to network evolution, as it is a critical driver of network changes and configurations (for example, density or centrality). In particular, new tie formation and partner network distance are key components of network evolution in that the addition of a new partner to an alliance portfolio may change the ego network structure. By examining an additional tie, the current study contributes to the debate by disentangling the effect of an alliance from the aggregated network effect, which combines distant and close partners and provides a better understanding of how alliance networks and a single additional alliance can influence firm innovation.

3.2 LITERATURE REVIEW

In this literature review, I summarize the key concepts and findings from two bodies of work that are relevant to this study: alliances and innovation, and network structure and innovation. For each body of research, I summarize the primary theory, relevant empirical findings, and literature gaps that my study addresses.

3.2.1 Alliance and Innovation

Strategic alliances are a means of accessing external knowledge that a firm does not have and can be an effective medium of knowledge transfer and integration (Hamel, 1991). However, acquiring knowledge through alliances poses serious challenges during the process of detection, transfer, and assimilation of knowledge because knowledge is tacit (Polanyi, 1966) and resides in individual employees' minds or is embedded in organizational routines, experience, processes, and networks (Nonaka, 1994; Nonaka & von Krogh, 2009). A concern over unintended knowledge transfer to a partner and erosion of the value of the firm's knowledge resources may also prevent the firm from contributing to an alliance (Li, Eden, Hitt, & Ireland, 2008).

Trust is a solution to the relational risks and facilitates knowledge transfer in an alliance (Das & Teng, 1998; Zaheer, McEvily, & Perrone, 1998; Lado, Dant, & Tekleab, 2008). Trust that is available between embedded partners positively affects knowledge transfer between firms and increases absorptive capacity (McEvily & Marcus, 2005; Lane, Salk, & Lyles, 2001). Therefore, an embedded partner seems preferable for innovation over a non-embedded partner. On the other hand, prior literature has shown the benefits of non-embedded partners, such as access to diverse non-redundant novel information (Burt, 1992) and helping firms overcome their myopia of learning (Levinthal & March, 1993). However, non-embedded partners come with risks, as well. Non-redundant information is not necessarily transferred. There is often a knowledge transfer challenge for alliances with non-embedded partners.

In an effort to understand how partner risk and knowledge transfer challenges affect innovation, prior literature on alliances (or any dyadic relationship) and innovation investigates the effects of overall alliance partner composition (Phelps, 2010), alliance

network structures (i.e., local clustering; Schilling & Phelps, 2007), and the strength of ties within a network (Tiwana, 2008, Hansen, 1999) as determinants of firm innovation. A literature gap of prior literature is that it views an alliance as a dyadic relationship; however, the network structure underlying this dyadic relationship has not been explored. The network structure embedded in a dyadic relationship influences partner risk and knowledge transfer challenges. If there is a mutual partner between two firms, relational risk is reduced (Coleman, 1988) and the novelty of information coming from unconnected partners is higher than that from connected partners (Burt, 1992). By linking the literature on knowledge transfer with the literature on alliances, we can see how innovation is influenced differently with diverse and timely information from distant partners, and increased absorptive capacity based on the trust available between close partners.

3.2.2 Network Structure and Innovation

Research that examines the influence of social networks on innovation has explored how the network benefits influence knowledge creation. In particular, the configuration of an actor's set of direct ties (the actor's egocentric network structure) has received considerable attention. However, previous research has yielded conflicting results about the influence of network structures on firms' innovation. On one side of the debate, studies have found that structural holes in a firm's network enhance its knowledge creation (Hargadon & Sutton, 1997; McEvily & Zaheer, 1999) because they provide actors with timely access to diverse information (Burt, 1992) from partners not directly

connected to each other, which leads to increased innovation. On the other side of the debate, research has suggested that network closure improves knowledge transfer and innovation (Ahuja, 2000; Dyer & Nobeoka, 2000; Schilling & Phelps, 2007; Hansen, 1999) because network closure provides social capital and because such structures generate trust, reciprocity norms, and a shared identity, which increase cooperation and knowledge sharing (Coleman, 1988; Portes, 1998).

One plausible reason for these conflicting results is that a different network structure leads to a different kind of innovation. Research on the relationship between network structure and innovation only looks at a particular type of innovation, either innovation output (Ahuja, 2000; Guler & Nerkar, 2012) or innovation characteristics (i.e., exploratory innovation by Phelps, 2010). Given that a particular type of innovation may require either social capital of closure (Coleman, 1988) over novel knowledge of a structural hole (Burt, 1992) or novel knowledge over social capital, I contend that different types of innovation should be examined in network research in a study.

Another reason for the mixed results is that most studies have only focused on the influence of the structural aspect of networks and have largely overlooked the dynamic perspective. To the best of my knowledge, none of the literature on the relationship between networks and innovation has treated the network as a dynamic structure, although some of the literature regarding the network effects on firm performance applies to the dynamic perspective (i.e., Baum, McEvily, & Rowley, 2012; McEviliy, Jaffee, & Tortoriello, 2012). Prior literature has largely assumed that the outcomes of a network structure are exogenous to the structure that created them. However, it is plausible that some network advantages precede rather than follow a network position. From a dynamic

perspective on networks, I explore the effect of an additional individual alliance rather than a cumulative effect of the total alliances of a focal firm in terms of innovation. A multilevel approach that considers both the macro level (network level) and micro level (actions of an individual firm) enables us to better understand the evolution of a network and to explore the dynamic nature of the network (Gulati, Sytch, & Tatarynowicz, 2012; Baum, McEvily, & Rowely, 2012). By examining an additional tie, the current study contributes to the debate by disentangling the effect of an alliance from the aggregated network effect, which combines distant and close partners and provides a better understanding of how alliance networks and a single additional alliance can influence firm innovation.

3.3 THEORY AND HYPOTHESES

3.3.1 Alliance Partner Network Distance

The benefits and risks involved in close partner and distant partner relationships are distinctive. The risks involved in a distant partner alliance include the following. First, there is no social mechanism with a distant partner because of the lack of a mutual partner. When allying with a distant partner, firms possess limited information about their partners' capabilities, reliability, and motives or their ability to work together effectively. Alliances offer many opportunities for cheating, from stealing the partner's technology, to providing poorer-quality investments in joint projects, to not fulfilling ex-ante commitments. When a firm forms an alliance with a distant partner, the firm cannot control the partner's potential opportunism such as knowledge appropriation (Li, Eden,

Hitt, & Ireland, 2008; Baum, Calabrese, & Silverman, 2000), and the firm cannot sanction the partner's opportunism due to the lack of social mechanisms and reference for a distant partner (Gulati, 1995).

In contrast, close partners are less relationally risky than distant partners because of the social mechanism. First, when a new alliance partner shares a common third party with the focal firm, trust and reciprocity are promoted. Trust and reciprocity serve as a social control mechanism that mitigates partner opportunism and safeguards the exchanges in alliances (Dyer & Singh, 1998). Second, trust and reciprocity between the focal firm and a close partner can resolve a part of the exchange hazards and challenges to efficient knowledge transfers and inter-firm cooperation (Coleman, 1988; Gulati, Nohria, & Zaheer, 2000). Finally, interaction with a close partner tends to be more intense than one with a distant partner. The interactions improve the detection and transfer of tacit and embedded knowledge (Zander & Kogut, 1995) and lead to the creation of partner-specific knowledge sharing routines that facilitate knowledge transfers (Lane & Lubakin, 1998; Walker, Kogut, & Shan, 1997).

There are some benefits of an alliance with a distant partner over a close partner. First, alliances with distant partners help firms overcome their myopia of learning (Levinthal & March, 1993). Local searches cause firms to develop "core rigidities" (Leonard-Barton, 1995) or to fall into the "competency trap" (Levitt & March, 1988). However, an alliance with a distant partner enriches the knowledge pool by adding distinctive new variations which provide a sufficient number of choices to solve a problem (March, 1991) and to find a recombinatory search (Katila & Ahuja, 2002; Fleming & Sorenson, 2001). Second, the literature on structural holes which distant

partners build posits that firms in networks rich in structural holes are better able to access novel information and resources from a remote part of the network (Burt, 1992). It allows the focal firm to hear about the potential threats and opportunities more quickly than others and to discover possible exchange partners (Powell & Smith-Doerr, 1994). Finally, weak ties are more likely to help firms reach divergent regions of the network, leading to novel ideas (Granovetter, 1973). Below, I discuss how the benefits and challenges of distant and close partners affect firms' innovation.

3.3.2 Alliance Partner Network Distance and Innovation

Current research focuses on three aspects of innovation to examine the effect of alliance partner network distance on innovation: innovation quantity, exploratory innovation, and innovation quality.

Innovation Quantity

A relationship based on trust encourages firms to share information and helps them integrate new knowledge from the alliance partner. Levine and Prietula (2012) showed that embedded exchange, defined as involving a familiar partner, can lead to better innovative performance because the intertwinement of economic and social relations allows trustful sharing and close coordination which are absent in a market exchange (Granovetter, 1983; Uzzi, 1997). Consistent with prior literature, I argue that a firm's competence to increase innovative output improves the benefits from mutual trust and the close partner's willingness to share information.

A common context for close interactions between embedded ties such as relationally close partners also increases the likelihood of the similarity between the firms in terms of their practices and routines and increased innovation output. The commonality of organizational routines that are facilitated by proximity builds a shared knowledge base and eventually makes for easier interpretation of knowledge gained through the mechanism. Firms know how to communicate with their partners more clearly based on a shared routine. Easier communication between close partners based on information about each other also leads to the quick production of innovative quantity. As evidence, Zander and Kogut (1995) empirically showed that the speed of transfer relates to how easily capabilities are taught.

In contrast to a close partner, an alliance with a distant partner may undermine knowledge creation as a result of mounting coordination, monitoring costs, and operational challenges. First, building alliance governance to mitigate potential relational issues consumes managerial attention (Ocasio, 1997) and investments of the time and effort needed to maintain the relationship and coordinate joint activities in terms of negotiating and crafting contracts and monitoring the progress of uncertain research tasks (Williamson, 1983). Second, the distance of knowledge creates challenges in its acquisition and absorption (Fleming & Sorenson, 2001). Even when firms seek to incorporate external knowledge in their innovation process, the search processes restrict external knowledge from being utilized in familiar and proximate areas. As the firm moves away from its knowledge base, its probability of success in knowledge creation converges to the level of a start-up's liability of newness (Carroll, 1983; Freeman, Carroll, & Hannan, 1983). Finally, it is also possible that the cost of establishing and maintaining

a distant tie hinders innovation quantity. As Burt (1992) emphasized, each network tie imposes a nontrivial cost on the focal actor. Network members need to invest time and resources to build ties with network members and help them as needed (Hansen, Podolny, & Pfeffer, 2001). Since a distant partner requires continuous attention due to the lack of a social mechanism, alliances with a distant partner may become burdensome for a firm, draining the firm's innovation resources that can be used in other ways. Thus,

Hypothesis 1. Partner network distance will decrease the focal firm's subsequent innovation quantity.

Exploratory Innovation

Embedded exchanges can lead to better performance for the short-term because the intertwined economic and social relations allow trusted sharing and close coordination (Levine & Prietula, 2012). However, focusing on embedded exchanges can also harm long-term performance because it is "deep rather than wide" (Uzzi, 1997, p. 51; Gupta, Smith, & Shalley, 2006).

Long-term innovation success occurs when firms search more broadly for knowledge in a variety of technological domains (Ahuja & Lampert, 2001; Ahuja & Katila, 2004; Katila & Ahuja, 2002). First, the difference between the knowledge that resides in a far distant partner creates the potential for non-overlapping knowledge bases for the focal firm (Burt, 1992). The exposure to heterogeneous knowledge from a distant partner should improve recognition of opportunities and raise the creative potential of the

firm. Knowledge diversity from various contacts is also useful in the implementation of new ideas, particularly when the tasks are multifaceted or complex. It may help firms build a sound causal understanding of the relationships between elements in the complex system that they are proposing, and thus may help firms navigate a project to a successful outcome (McGrath, Tsai, Venkatraman, & MacMillan, 1996). This claim is consistent with prior research (Rowley, Behrens, & Krackhardt, 2000; Baum, Cowan, & Jonard, 2010) showing that firms benefit more from dense networks when innovation is incremental, and more from structural holes when innovation is disruptive. A firm with a sparse network of disconnected contacts is likely to pick up a wider array of information about current events, news, and gossip, privileged by both a greater range of information circulation in the firm and the ability to test its accuracy through independent confirmation.

Long-term innovation success also occurs when achieving the goal of developing truly radical innovation represents a clear departure from existing practices. Path-dependence learning is not helpful. Rather, novelty is critical for developing radical innovations (Rosenkopf & Almeida, 2003; Tushman & Rosenkopf, 1996). However, embedded ties may have developed a similarity of mental maps for innovation that inhibits novelty. When a firm does not have knowledge similar to that of the partner's knowledge, the context and communication from the partner is likely to be novel to the firm. Novel information is not only new to the firm, but also non-redundant. The recombinant view (Fleming, 2002; Henderson & Clark, 1990) suggests that new knowledge is created by a combination of new components or new combinations of existing components. The incorporation of knowledge from a distant partner introduces

heterogeneity and increases the opportunity set of new components that can be utilized. According to Rodan and Galunic (2004), the lack of constraint that a distant partner provides should assist in the pursuit of entrepreneurial activities by facilitating autonomous strategic behaviors. This leads to my second hypothesis:

Hypothesis 2. Partner network distance will increase the focal firm's exploratory innovation.

Innovation Quality

The current study examines the impact of innovations on the overall industry with quality innovation from novel, emerging, and pioneering technologies. A high-impact technology innovation serves as the basis for future technologies, products, and services. As an example, a breakthrough innovation enables firms to challenge the existing technological order and shape new trajectories, and allows them to engage in corporate reinvention, business growth, and new business development by taking on technological leadership (Burgleman, 1983). In developing a breakthrough or influential innovation, firms that retain technological leadership in their industry build their competence base and assets and gain greater strength in their competitive position and attractiveness (Tushman & Anderson, 1986).

A central idea about innovation quality is that external knowledge or knowledge that spans boundaries is vital for valuable innovation (Henderson & Clark, 1990; Fleming, 2001). An emerging field that threatens an existing dominant design is often supported by

many different disciplines, allowing the firm to invent more innovative knowledge. Novel technologies (in which the firm lacks prior experience) and pioneering technologies (that do not build on any existing technologies) from different disciplines lead to breakthrough innovations (Ahuja & Lampert, 2001). A search in novel areas increases the firm's inventive performance in the emerging field by increasing the number of possible combinations between the new knowledge from a different technological landscape and existing components (Fleming & Sorenson, 2001; Henderson & Clark, 1990) and exposing R&D staff to new problem-solving techniques (Ahuja & Lampert, 2001; Katila & Ahuja, 2002).

Prior literature on breakthrough innovations has focused on the technological domain as an external source of new non-redundant knowledge for breakthrough innovations (Rosenkopf & Nerkar, 2001; Phene, Fladmoe-Lindquish, & Marsh, 2006; Jiang, Tan, & Thursby, 2010). I suggest that network distance is another source of breakthrough knowledge. Distant partners increase the focal firm's search for novel knowledge through interactions with the partnering firm's inventors who introduce new insights and expertise to the focal firm. This novel knowledge helps these firms keep up with the changing field, develop new techniques, and avoid being left behind. As evidence, Jiang, Tan and Thursby (2010) showed that an alliance increases a firm's inventive performance in an emerging field when the partners are diverse in terms of technological distance.

In contrast to a distant partner, an alliance with a close partner is likely to be constrained by ossified routines and structures that hinder breakthrough innovations (Nelson & Winter, 1982). Rigid mental models and deeply embedded routines serve to

naturally limit the mature firm's foray into producing high-impact innovations. Inertia, which is a source of organizational rigidity, is a negative side of a relationship with a close partner. Strict rules from embedded relationships exacerbate creative thinking because rigid monitoring and control mechanisms reduce the potential generation of new ideas. Firms are less likely to be willing to experiment with new ways of thinking, as they increasingly rely on their customary routines. Their obligations and reciprocity may lead firms to routines with which they are already familiar with rather than to experiment with new ideas (Kaplan & Henderson, 2005). Thus,

Hypothesis 3. Partner network distance will increase innovation quality.

3.3.3 Contingent Effect of Technological Distance

Alliances with partners of technological relatedness may increase the redundancy of ideas, skills sets, and knowledge which leads to a sub-additive alliance portfolio (Vassolo et al., 2004). Additionally, technological distance between two firms decreases the probability of knowledge appropriation because of the lack of similarity in knowledge bases. Without a concern about knowledge appropriation, firms are more likely to share their knowledge based on the increased level of trust between the two firms. I propose that technological distance offsets a weak knowledge flow with a distant partner leading to a high level of innovation quantity. Thus,

Hypothesis 4a. Technological distance weakens the negative relationship between partner network distance and innovation quantity such that high technological distance and high network distance increase innovation quantity.

Although an alliance allows access to a partner's knowledge, it does not guarantee the effective detection, transfer, and assimilation of this knowledge. In particular, excessively new technologies without a deep understanding can have harmful consequences due to information overload, confusion, and diseconomies of scale (Fleming & Sorenson, 2001; Ahuja & Lampert, 2001).

Technological distance worsens this problem since a firm's absorptive capacity in relation to its partner will decline (Lane & Lubatkin, 1998). Technological relatedness between two firms facilitates knowledge flow, successful collaboration and eventually value creation. Similar knowledge bases (i.e., they possess knowledge in similar technological domains) are more likely to establish and create better performing alliances (Rothaermel & Boeker, 2008; Lane & Lubatkin, 1998; Mowery, Oxley, & Siverman, 1996). Prior studies provide evidence that partners' technological relatedness (or technological closeness) increases their ability to assimilate and utilize each other's know-how, that is, their absorptive capacity (Cohen & Levinthal, 1990), which ultimately increases the amount of value that is created through alliances. Therefore, firms face challenges to internalize and utilize non-redundant novel information from partners who are technologically and relationally distant. Thus,

Hypothesis 4b. Technological distance weakens the positive relationship between partner network distance and exploratory innovation such that high technological distance and high network distance decrease exploratory innovation.

Breakthrough innovation requires bundling heterogeneous resources and nonobvious technology components. The breadth of a portfolio's resources helps a focal firm engage in a greater degree of exploration. Exposure to partners' diverse technologies broadens the firm's perspective and increases its ability to generate quality innovations. Utilization of technologically distant knowledge that is new to the firm allows it to avoid the familiarity trap, thus providing a basis for breakthrough innovations. As evidence, knowledge from beyond the firm's technological domain leads to innovations that have a significant impact on subsequent technological developments (Ahuja & Lampert, 2001). Thus, a superior alliance partner with a diverse and unique mix of valuable resources helps a firm create breakthrough innovations. Thus,

Hypothesis 4c. Technological distance strengthens the positive relationship between partner network distance and innovation quality such that high technological distance and high network distance increase innovation quality.

3.4 METHODS

3.4.1 Sample and Data Sources

I examined the hypotheses in a longitudinal study of the pharmaceutical and biotechnology industries in the United States between 1996 and 2009. The sample was drawn from U.S. firms in these industries that were present in the Acquisitions and Alliances database of the Security Data Company (SDC) from 1996 to 2009. The pharmaceutical industry has four SIC codes: 2833 (medicinal chemicals and botanical products), 2834 (pharmaceutical preparations), 2835 (in-vitro and in-vivo diagnostic substances), and 2836 (biological products, except diagnostic substances). The biotechnology industry refers to the manipulation of genetic material through recombinant DNA technology, cell fusion, and monoclonal antibodies, and includes the codes 8731 (commercial physical and biological research), 8732 (commercial nonphysical research), 8733 (noncommercial research organizations), and 8734 (testing laboratories). These two industries are particularly suited for testing my hypotheses for two reasons. First, these industries are an appropriate context to test theories of innovation as a consequence since (1) a patent is a proxy for the firm's technology capability to combine various types of knowledge, (2) the innovation value chain in those industries, and (3) firms routinely patent their inventions (Sorensen & Stuart, 2000). Second, high technology industries such as the pharmaceutical and biotechnology industries are a good context to test the effects of distant partners since a consistent flow of new entrants may occur in these industries. Thus, they continue to experience disruptive technological changes and a combination of various technologies. Finally, alliances in these industries are prevalent because accessing another firm's capabilities is a key to success.

I used patent data to measure technological knowledge because patents are valid and robust indicators of knowledge transfer and knowledge creation (Trajtenberg, 1987). Previous research has confirmed that patents are a reliable measure of innovation. The patent data come from the United States Patent and Trademark Office (USPTO). I used the application date to assign a granted patent to a firm because this date closely captures the timing of knowledge creation (Griliches, 1990) and is the first date when the patent is available to the partner.

To construct the network distance variable, I obtained alliance information such as the date, types, and partners from the Acquisitions and Alliances database of the Security Data Company. I pulled a nearly complete network configuration to capture information about how many steps a firm is connected with a partner. I collected information on firms for control variables from Standard & Poor's Compustat. My unit of analysis is an R&D alliance. A total of 534 alliance cases of 189 firms were observed for the analysis after accounting for missing financial data from Compustat.

3.4.2 Measures

Dependent variable. My theory suggests that alliance partner distance has a distinctive impact on innovation subsequent to the alliance formation. Following prior studies that use patents to study innovation (Jaffe & Trajtenberg, 2002; Lahiri, 2010), I concentrated only on the patents granted in the United States.

Post-alliance performance has been examined with three- to five-year windows after the deal was announced. Following Sampson (2007), I used a four-year moving

window to compute the innovation measures: innovation quantity, exploratory innovation, and innovation quality. I measured the dependent variables for the three hypotheses in the following ways.

Hypothesis 1 predicts that an alliance with a close partner increases *innovation quantity*. Innovation quantity was measured as the number of patents generated by a focal firm in a given year after an alliance formation (Sorensen & Stuart, 2000; Almeida & Phene, 2004; Josh & Nerkar, 2011; Wu, 2012) controlling for technological distance and innovation quantity before the alliance.

Hypothesis 2 concerns the relationship between partner distance and *exploratory innovation*. I constructed the ratio of a new patent class entrance beyond a focal firm's existing classes for exploratory innovation. To capture the proportion of exploratory searches building on unfamiliar knowledge, I applied the *patent classes* (U.S. Class) that a focal firm entered into after an alliance formation for exploratory innovation as the first measure (Ahuja & Lampert, 2001; McGrath & Nerkar, 2004; Jiang, Tan, & Thursby, 2010). Patents are classified by the patent examiner in technology "classes" that represent different technological areas. The technology classes are used as an indicator of a firm's areas of technological expertise (Jaffe, 1986). The extent to which a firm enters new technological domains is indicative of exploration, according to the definition of exploration (Ahuja & Lampert, 2001; McGrath & Nerkar, 2004). This measure is broader than the citation-based measure, since it takes into account all technology classes in which a firm might obtain a patent. I computed this measure as the ratio of the number of new U.S. classes in which firm *i* received a patent in year *t*, classifying a technology class

as new if the firm had not received a patent in that class within the past four years over the total number of categories.

In *Hypothesis 3*, I examined how network distance affects the *innovation quality* or the *impact of a patent*. Patents vary in terms of their economic value (Trajtenberg, 1990). Certain patents may have little effect on a firm's fortune, so a simple count of patents should be distinguished from the knowledge value. I measured innovation quality with an annual citation-per-patent measure (Wu, 2011). Concerning the forward citation measure, bibliometric studies have repeatedly demonstrated that subsequent citations to a patent are associated with its technological importance and value by creating a "ripple effect" (Fleming 2001). To construct the measure, I calculated the citation counts of a firm's patents for the four-year window after an alliance and divided that number by the total number of patents during the window (Levitas & McFadyen, 2004; Josh & Nerkar, 2011).

A key difference between exploratory innovation and innovation quality is that exploratory innovation is defined from the firm's perspective, whereas the search is exploitative or exploratory in reference to a particular firm's knowledge base. In contrast, innovation quality is related to field knowledge as a whole.

Independent variables. The independent variable indicates whether a sample company chose a distant or close partner for a given year. The distance between the focal firm and its new partner was measured by an alternative minimum path length (geodesic) toward the partner from the focal firm (Podolny, 1994; Gulati & Gargiulo, 1999; Schilling & Phelps, 2007). For example, when the focal firm could reach its partner D through firm C

(indicating that there was a mutual partnership between the focal firm and its partner D) before the focal firm and its partner D formed an alliance, the distance of partner D is 2, as Figure 3-1 illustrates. If the focal firm could reach its partner through three firms in the shortest alternative path before a direct relationship between the focal firm and its partner was formed, the distance is 4[5].

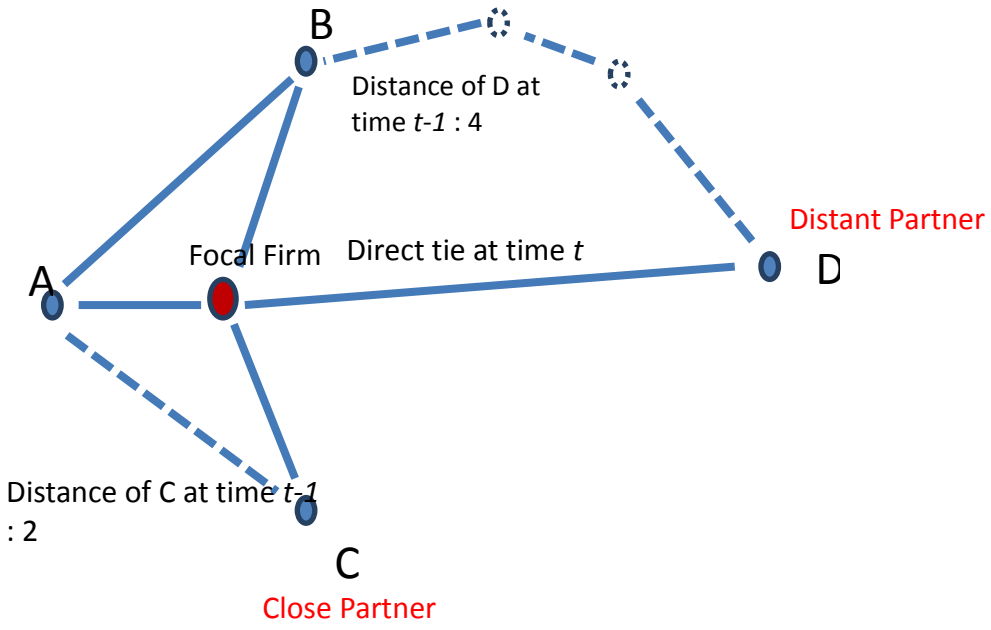
To compute the *alliance partner network distance*, this study extended ego networks into two degrees of alliances, in other words, pulling the alliance partners of the focal firms' partners. Without information on alliance termination, the network cannot be structured. Unfortunately, the termination date of an alliance is unclear, since firms typically do not declare their termination, and the SDC does not often provide a termination date[6]. As a remedy for the lack of alliance termination dates, the prior literature has used a moving window to construct network structures. Following a common practice in the alliance research (Gulati & Gargiulo, 1999; Podolny, Stuart, & Hannan, 1996), I used a four-year moving window to account for the duration of each alliance. For example, when an alliance was formed in 1998, then the alliance lasted until 2002. The adjacency matrix for a given year records alliances formed in that year and in any of the previous three years. I assigned 1 to each alliance if firms *i* and *j* entered into an alliance in a given year, or 0 otherwise (Bae & Garguilo, 2004). I also added alliances occurring up to three years prior to the sample years in order to control for possible left-censoring problems.

[5] Note that I treated the cases where there was no firm in between as infinite distance, meaning that the partner was an infinitely distant partner of distance 6. The very first alliance partner for firms was treated as 0, as the definition implies that there is no common partner.

[6] A total of 1,823 termination dates have been reported out of 127,523 alliances from 1990 to 2010, which is approximately 1.4% of the total alliance observations.

The moderator variable of technological distance indicates the extent to which partner firms patented in distinctive technology classes based on the class and subclass within the U.S. patent classification system with a four-year window. The variable was measured by a reverse ratio of the common technological domain with partners, divided by the number of total technological classes of the focal firm (Ahuja & Katila, 2001).

FIGURE 3-1: Illustration of Alliance Partner Distance



Control variables. To minimize alternative explanations and isolate the marginal effects of the explanatory variables, I controlled for several alliance-, network-, firm-, and innovation-level variables whose influence on innovation might be confounded with the explanatory variable.

*Cross-border alliance***.** International alliances may provide access to diverse knowledge (Rosenkopf & Almeida, 2003) on the one hand, and may cause greater coordination and communication problems and cultural conflicts diminishing interfirm learning, on the other hand (Lyles & Salk, 1996). The cross-border alliance is a dummy variable which coded international alliances as 1 and 0 otherwise.

*Alliance governance***.** Research suggests that an equity joint venture is a superior governance mechanism for inter-firm learning and knowledge transfer (Kogut, 1988; Mowery, Oxley, & Silverman, 1996). The alliance governance measure is a dummy variable which coded joint ventures as 1, and 0 otherwise.

Geographical distance. Geographical distance indicates the extent to which the cost of knowledge transfer increases and the frequency of personal contact that builds social relations decreases. It was measured by miles based on the zip codes of their headquarters (Rosenkopf & Almeida, 2003).

Number of structural holes. To control for network configuration, I assessed the presence or absence of structural holes in the network of the focal firms and constructed the structural holes as constraints using UCINET (Borgatti, Everett, & Freeman, 2002). I calculated the structural holes as one minus the firm's constraint score (Zaheer & Bell, 2005).

Cluster coefficient. The average clustering coefficient was measured as the number of actual links connecting all neighbors of a focal firm with one another, divided by the number of all possible ties among those nodes to distinguish small world networks from random networks to control for an alternative of network distance (Gulati, Sytch, & Tatarynowicz, 2012; Schilling & Phelps, 2007).

R&D intensity. A firm's R&D expenditure is its investment in knowledge creation (Griliches, 1990) and contributes to its ability to absorb external knowledge (Cohen & Levinthal, 1990). It was measured by dividing a firm's R&D expenses by its sales in the year of an alliance formation.

Debt ratio. Debt ratio has frequently been used in the literature on organizational slack (Bourgeois, 1981). Availability of slack resources tends to increase an exploratory search (Singh, 1986) and leads to greater innovation performance (Nohria & Gulati, 1996). Debt ratio was measured by long-term debt, divided by total assets.

Prior performance. Prior profitability affects a decision-maker's optimism (Cyert & March, 1963) and the funds available for R&D. Profitability was measured as the previous ROA, the ratio of net income to the year-end value of total assets.

Presample innovation. Prealliance innovation was added to control for a firm's propensity to file for a patent to exploit, explore, and produce better-quality patents, as well as a firm's technological capability (Silverman, 1999).

Table 3-1 provides a summary of variable operationalization.

TABLE 3-1: Variable Operationalization

Variable	Type	Operationalization	Data Sources
Innovation Quantity	Number	Number of patents generated by a focal firm during a 4-year window after alliance formation	USPTO
Exploratory Innovation	Ratio Continuous	Number of new U.S. classes in which firm *i* filed a patent in the past four years over the total number of categories.	USPTO
Innovation Quality	Ratio Continuous	Average number of citations received by those patents within four years of the applicant year	USPTO
Partner Distance	Category	Alternative minimum path length toward the partner from the focal firm at time *t-1* Average value of distances of each alliance at time *t*	Derived from SDC
Technological Distance	Continuous	Reverse ratio of the common technological domain with partners, divided by the number of total technological classes of the focal firm	USPTO
Cross-border Alliance	Dummy	Cross-border alliance: 1; non cross-border alliance: 0	Derived from SDC
Alliance Governance	Dummy	Joint venture: 1; non-joint venture: 0	Derived from SDC
Geographical Distance	Continuous	Miles based on the zip codes of the partners' headquarters	Derived from SDC
Structural Holes	Continuous	1 - the firm's constraint score	Derived from SDC
Clustering Coefficient	Continuous	Number of actual links connecting all neighbors of a focal firm with one another, divided by the number of all possible ties among those nodes	Derived from SDC
R&D Intensity	Continuous	In-process R&D expenses divided by sales	COMPUSTAT
Debt Ratio	Continuous	Long-term debt divided by total assets	COMPUSTAT
Past Performance	Continuous	ROA at *t-1*	COMPUSTAT

3.4.3 Model Specification and Estimation

Hypothesis 1 suggests that a close partner produces more patents, and the argument behind Hypotheses 2 and 3 is that forming an alliance with a distant partner leads to exploratory innovation and better quality, respectively. Hypotheses 4a, 4b, and 4c regard interaction effects between network distance and technological distance on innovation quantity, exploratory innovation, and innovation quality, respectively.

Arguably, the controls may not fully eliminate omitted-variable bias because there may still be unobserved features of a firm's network and innovation that both affect network distance and innovation. I am also concerned about the possibility of reverse causality; that is, firms choose either distant partners or close partners to increase a particular type of innovation. Both concerns may result in biased estimates due to nonrandomized assignments of observations to levels of the independent variable of interest (Holland, 1986). To address these concerns, I use the instrumental variable approach in a two-stage least squares (2SLS) estimation with a policy shock in the first stage to predict an exogenous change in the main variable (Berry & Waldfogel, 2001; Woodridge, 2002).

For alliance partner network distance, I used the Sarbanes-Oxley Act of 2002 as a policy shock. The Sarbanes-Oxley Act of 2002 was created to make top managers responsible to shareholders for management. It required that independent directors be objective, shareholder-focused monitors of management; therefore, increasing their representation on boards should uniformly improve corporate governance. Independent directors are custodians of shareholder interests, so their presence on the board helps

reduce agency problems. Increasing board monitoring and reducing agency problems lead to managers taking greater risks in alliance partner selection, resulting in allying with distant partners. The *Sarbanes-Oxley Act of 2002* captures observations occurring after the Act's enactment year, i.e., it takes the value of *1* for alliances occurring after 2002 and *0* otherwise. In the first stage of the 2SLS estimation, I predict alliance partner network distance with the instrument and control variables.

$$Disa\tan ce_{it} = \beta_0 + \beta_1 SOA_{it} + \beta_2 Alliance_{it} + \beta_3 NTWK_{it} + \beta_4 Firm_{it} + \beta_6 Perf_{it-1} + \varepsilon_1,$$

where $Distance_{it}$ denotes the partner network distance of firm *i* toward its partner at time *t*; SOA_{it} represents the dummy variable to capture observations occurring after the Sarbanes-Oxley Act of 2002; $Alliance_{it}$ indicates the joint-venture, cross-border, technological distance, and geographical distance with the partner of firm *i* at time *t*; $NTWK_{it}$ indicates the structural hole, and clustering coefficient; $Firm_{it}$ indicates the focal firm's debt ratio, and R&D intensity; and $Perf_{it-1}$ is the performance of firm *i* at time *t-1*.

By using the 2SLS command in Stata, which performs the standard variance adjustments for the coefficient in the second stage, I obtained a consistent and efficient estimate, which I used to test the hypotheses. In the second stage, I traced how the alliance partner network distance results in a change in innovation. I used a moving window dependent variable. In the second stage, I estimated the main model with the same control variables as the first stage.

$$Innovation_{it} = \beta_0 + \beta_1 predicted(Dis\tan ce)_{it} + \beta_2 Alliance_{it} + \beta_3 NTWK_{it} + \beta_4 Firm_{it} + \beta_5 Perf_{it-1} + \varepsilon_1$$

To test H4, which is an interaction effect of technological distance,

$$Innovation_{it} = \beta_0 + \beta_1 predicted(Distance)_{it} + \beta_2 predicted(Distance)_{it} * TechDis_{it} + \beta_3 Alliance_{it} + \beta_4 NTWK_{it} + \beta_5 Firm_{it} + \beta_6 Perf_{it-1} + \varepsilon_1$$

3.5 RESULTS

Table 3-2 presents the descriptive statistics for the variables and a correlation matrix for all variables used in this study. The patent quantity and pre-patent quantity are highly correlated, while the other correlations are relatively low. To confirm that multicollinearity is not a concern, the variance inflation factors for the full model are from 2.42 to 4.12, well below the commonly used threshold of 10.0 (Chatterjee & Price, 1991).

Since the focal firm's innovation may influence alliance partner choice, alliance partner network distance may be endogenous, in which case a simple OLS would yield biased coefficients. Therefore, I applied 2SLS, generating consistent coefficient estimates. This benefit must be balanced against the fact that 2SLS coefficients are subject to bias when instruments may be weak. In response, I report both 2SLS and OLS in Table 3-4 and Table 3-7, respectively, in the Results section.

Since the research model involves interactions between alliance partners' technological distance and alliance partner network distance, I require two instrumental variables: one main effect and one interaction (Wooldridge, 2002). Even if two instrumental variables may be available, the bias induced by having many instrumental variables would yield highly suspect results. Given this unavoidable limitation, I ran the models once with OLS and once using instruments for alliance partner network distance.

TABLE 3-2: Descriptive Statistics

					Correlation														
Variables	Mean	SD	Min	Max	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1. Patent Quantity	98.87	172.40	1	849	1.00															
2. Exploratory Innovation	23.03	33.01	0	100	-0.33	1.00														
3. Innovation Quality	3.15	6.49	.01	188	0.00	-0.16	1.00													
4. Network Distance	.95	.21	0	1	-0.16	0.09	-0.01	1.00												
5. Technological Distance	.96	.12	0	1	0.11	-0.04	0.01	0.07	1.00											
6. Cross-border Alliance	.07	.27	0	1	0.02	-0.03	0.01	-0.05	0.06	1.00										
7. Alliance Governance	.09	.28	0	1	0.02	-0.04	0.02	-0.04	0.02	-0.02	1.00									
8. Geographical distance	1687.09	1376.95	0	16593.7	0.09	-0.03	0.03	-0.03	0.06	0.06	-0.01	1.00								
9. Structural Holes	.27	.33	0	1.1	-0.36	0.20	0.01	0.09	-0.09	0.00	-0.07	-0.06	1.00							
10. Clustering Coefficients	.03	.11	0	1	0.01	-0.01	0.15	-0.02	-0.03	-0.01	0.01	-0.01	0.08	1.00						
11. R&D Intensity	-.48	11.38	-494.14	0	0.04	0.05	0.02	-0.01	-0.02	-0.05	0.01	-0.01	-0.05	0.01	1.00					
12. Debt Ratio	.15	.32	0	8.58	-0.09	0.09	-0.00	0.03	0.00	0.00	-0.00	-0.01	-0.03	0.01	0.03	1.00				
13. Prior Performance	-.32	1.52	-34.44	.66	0.33	-0.16	-0.04	-0.07	0.11	-0.06	0.04	0.07	-0.17	0.05	0.02	-0.06	1.00			
14. Prior Patent Quantity	109.32	199.92	1	873	0.75	-0.35	-0.09	-0.16	0.12	-0.02	0.02	0.05	-0.38	-0.02	0.04	-0.04	0.33	1.00		
15. Prior Exploratory Innovation	30.81	36.13	0	100	-0.18	0.28	0.09	0.01	0.01	0.04	0.02	-0.00	0.10	-0.07	0.04	-0.02	-0.15	-0.23	1.00	
16. Prior Quality	2.67	4.20	.02	53	-0.18	0.07	0.27	0.06	-0.02	0.03	-0.04	-0.00	0.06	-0.03	-0.02	-0.05	-0.23	-0.21	0.20	1.00

TABLE 3-3: The Effects of the Sarbanes-Oxley Act of 2002 on Network Distance 1996-2009, Results of First-stage Logit Analysis

	Model 1-1	**Model 1-2**
FIRM CONTROLS		
Cross-border Alliance	-.64†	-.46
	(.36)	(.36)
Alliance Governance	-.57	-.50
	(.37)	(.38)
Technological Distance	2.36 ***	2.25 **
	(.66)	(.66)
Geographical Distance	-.00	-.00
	(.00)	(.00)
Structural Holes	1.92 **	1.64**
	(.58)	(.57)
Cluster Coefficient	-1.47	-.88
	(1.00)	(1.05)
R&D Investment	-.02	-.02
	(.09)	(.10)
Debt Ratio	.79	.51
	(.66)	(.64)
Prior Performance	-1.11 **	-.91 *
	(.40)	(.40)
INSTRUMENTAL VARIABLE		
Sarbanes-Oxley Act of 2002		**.82 *** **
		(.23)
INTERCEPT	1.05	.85
	(.67)	(.67)
No. of Observations	1942	1942
No. of Groups	363	363
Log pseudo likelihood	-350.87	-344.31
Wald chi-square test for overall fit	56.88	58.70
Pseudo R squared	0.07	0.09

† p <.1 * p <.05 ** p <.01 *** p <.001
Standard errors are in parentheses.
The partner industry dummy is controlled.

I used the Sargan-Hansen statistics test to detect potential endogeneity in alliance partner network distance because it is more robust to heteroskedasticity than the Hausman test. The result does not indicate the presence of endogeneity in terms of over-identifying restriction. This gives me some confidence that even with the interaction terms added, the impact of endogeneity is limited.

I went through postestimation tests. First, I used Stata's *estat endogenous* procedure to test the hypothesis that the endogenous variables are actually endogenous using the Durbin and Wu-Hausman test. The variable of alliance partner network distance is endogenous since $p<0.001$. Second, I used Stata's *estat firststage* to test whether there is a weak-instrument problem. R-square is high enough to confirm that there is no weak-instrument problem (R-sq= 0.12). However, minimum eigenvalue statistic of 4.3 does not exceed the critical value of LIML estimator. It potentially implies a weak-instrument problem. Third, I used Stata's *estat overid* to test the instrument for validity. There is no overidentifying restriction.

Table 3-3 shows the results of the first-stage logit regression with the Sarbanes-Oxley Act of 2002 as an instrumental variable. The first regression indicates that I have achieved meaningful instrumentation. The impact is significant and positive on alliance partner network distance, as I predicted.

Table 3-4 presents the results of the 2SLS analysis used to test the hypotheses. Models 2-1, 3-1, and 4-1 show the results of the second-stage regression analysis. Models 2-2, 3-2, and 4-2 show results of the interaction effect of technological distance with network distance on innovation consequences.

Hypothesis 1 predicts a negative effect of network distance on the number of patents applied for after an alliance. Model 2-1 in Table 3-4 strongly supports this hypothesis (β=-383.85, $p < .05$). The marginal effect of the coefficient is -129.53. An increase in network distance would be associated with 129.53 fewer patents. The results indicate that an alliance with a close partner leads to more patents than a distant partner after an alliance, controlling for the pre-alliance number of patents. This result is consistent with prior studies that show network closure increases innovation, which is measured by the number of patents (Ahuja, 2000).

Hypothesis 2 focuses on the effect of network distance on exploratory innovation. In Hypothesis 2, I predict that network distance will increase exploratory innovation. The positive effect of distance on new patent class entrance is statistically marginal (β=77.93, $p<.10$). The marginal effect of the coefficient is 23.38. An increase in network distance would be associated with 23.38 additional patent classes. The result confirms prior research by Zaheer and Bell (2005), which indicated that access to structural holes enhances firm innovation as measured by new technology adaptation.

Hypothesis 3 addresses the effect of network distance on innovation quality. In Model 4-1 in Table 3-4, the result shows that a negative effect was evident on innovation quality, contrary to my prediction. Thus, Hypothesis 3 is not supported.

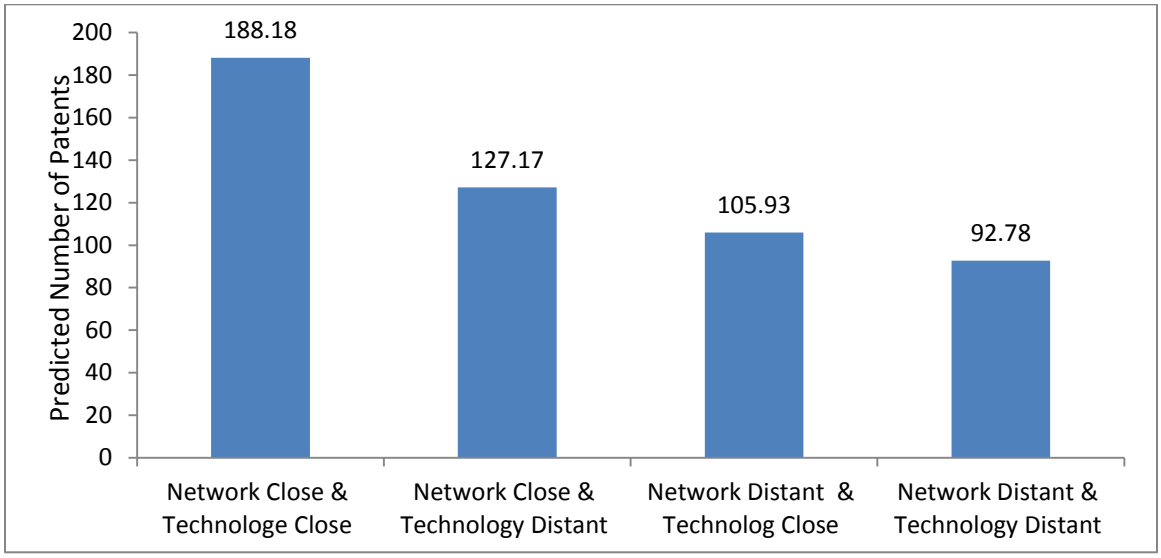
Hypotheses 4a and 4b are supported. The results signify that technological distance negatively moderates the negative relationship between network distance and innovation quantity. In addition, technological distance negatively moderates the positive relationship between network distance and exploratory innovation. Regarding Hypothesis 4c, the result signifies that technological distance negatively moderates the negative

relationship between innovation quality and network distance while I hypothesized technological distance positively moderates the positive relationship between innovation quality and network distance.

Hypothesis 4a postulates a moderating role of technological distance on the negative relationship between alliance partner network distance and innovation quantity. The coefficient estimate on the interaction term is positive and significant (β=528.32, $p<.05$) in Model 2-2, confirming support for Hypothesis 4a.

Figure 3-2 illustrates the predicted value of innovation quantity of the interaction between network distance and technological distance. For an alliance with technologically close partner, an alliance with distant partner produces 82.25 fewer patents compared to an alliance with close partner. For an alliance with technologically distant partner, an alliance with distant partner produces 34. 39 fewer patents compared to an alliance with close partner. Thus, technological distance negatively moderates the negative relationship between network distance and innovation quantity in support of Hypothesis 4a.

FIGURE 3-2: Predicted Value of Innovation Quantity by Network Distance and Technological Distance

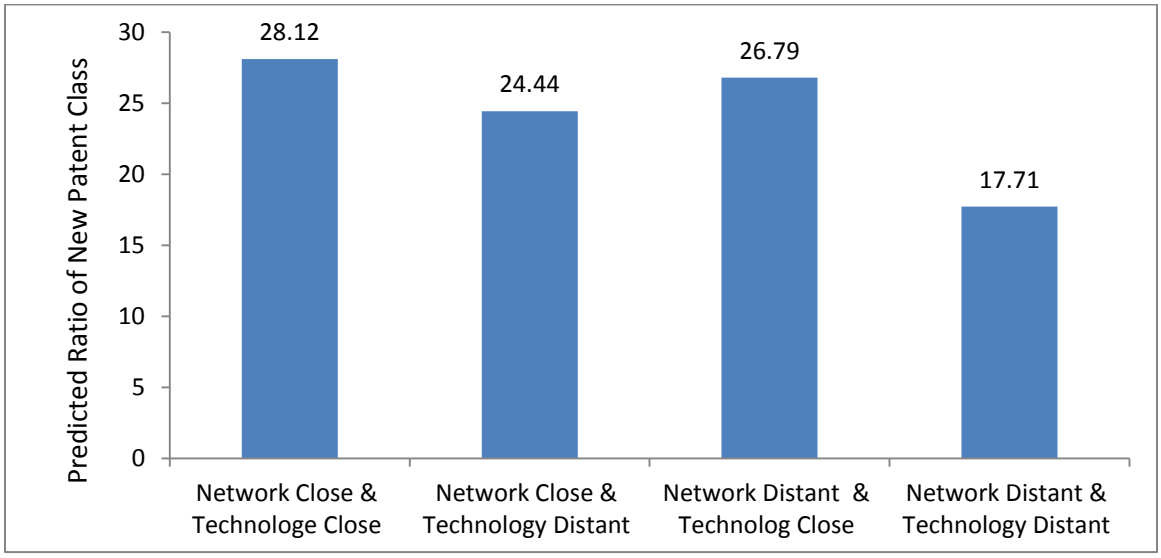


Model 3-2 introduces the interaction effect of technological distance on the positive relationship between network distance and exploratory innovation. The coefficient estimate on the interaction term is significant (β=-107.48 $p<.05$), offering support for Hypothesis 4b.

Figure 3-3 illustrates the predicted value of exploration innovation of the interaction between network distance and technological distance. For an alliance with technologically close partner, an alliance with distant partner produces 1.33 fewer new patent classes compared to an alliance with close partner. For an alliance with technologically distant partner, an alliance with distant partner produces 6.73 fewer new patents classes compared to an alliance with close partner. The result implies that an alliance with a partner that is both technologically and relationally distant leads to less exploratory innovation. Thus, technological distance negatively moderates the positive

relationship between network distance and exploratory innovation in support of Hypothesis 4b.

FIGURE 3-3: Predicted Value of Exploratory Innovation by Network Distance and Technological Distance



Model 4-2 in Table 3-5 introduces a moderating effect of technological distance on the relationship between network distance and innovation quality. The comparison across high and low technological distance is shown in Model 4-2, with the sample split by technological distance with a partner. Network distance negatively affects innovation quality with low technological distance. Hypothesis 3 is not supported, showing a negative relationship between network distance and innovation quality. However, with an interaction effect of technological distance, an alliance with a distant partner increases innovation quality both in terms of forward citation and patent generality, as Model 4-2 in Table 3-4 indicates (β=5.90, $p < .05$). The result implies that technological distance

negatively moderates the negative relationship between network distance and innovation quality.

Figure 3-4 illustrates the predicted value of innovation quality of the interaction between network distance and technological distance. For an alliance with technologically close partner, an alliance with distant partner produces 0.14 more forward citation per patent compared to an alliance with close partner. For an alliance with technologically distant partner, an alliance with distant partner produces 0.21 more forward citation per patent compared to an alliance with close partner. The result implies that an alliance with a partner that is both technologically and relationally distant leads to best quality innovation. Thus, technological distance negatively moderates the negative relationship between network distance and innovation quality.

FIGURE 3-4: Predicted Value of Innovation Quality by Network Distance and Technological Distance

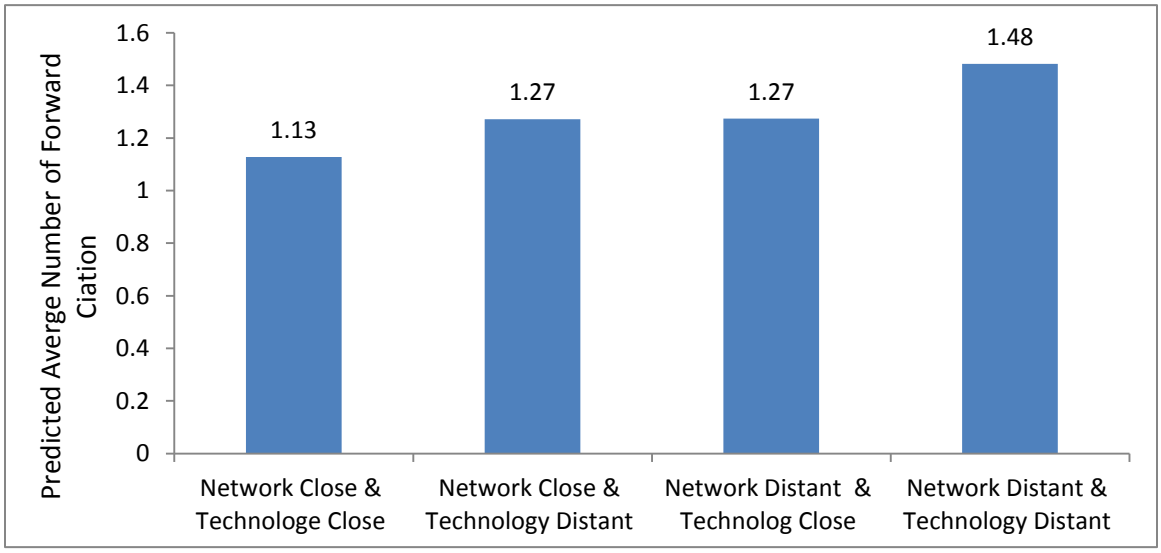


TABLE 3-4: The Effects of Alliance Partner Network Distance on Innovation, 1996-2009, Results of 2SLS Analysis

	Model2-1	**Model2-2**	**Model 3-1**	**Model 3-2**	**Model 4-1**	**Model 4-2**
	H1	**H4a**	**H2**	**H4b**	**H3**	**H4c**
	Innovation Quantity		**Exploratory Innovation**		**Innovation Quality**	
Measures	**No. of Patents**		**Patent Class**		**Forward Citation**	
	Main	Interaction	Main	Interaction	Main	Interaction
ALLIANCE CONTROL						
Cross-border Alliance	92.38 (91.00)	65.70 (91.63)	-18.75 (20.20)	-12.30 (19.36)	1.41 (1.07)	1.13 (1.13)
Alliance Governance	-97.76 (83.13)	-125.86 (94.32)	6.05 (18.47)	10.44 (19.93)	-.59 (.87)	-.93 (1.00)
Technological Distance	721.54 † (396.26)	109.58 † (59.32)	-134.18 (86.66)	-20.60 (12.58)	6.84 * (3.47)	1.14 & (.56)
Geographical Distance	.00 (.01)	-.01 (.01)	.00 (.00)	.00 (.00)	.00 (.00)	00 (.00)
NETWORK CONTROLS						
Structural Holes	38.86 (64.47)	17.46 (62.08)	-14.04 (14.35)	-8.58 (13.15)	1.42 (.87)	1.15 (.87)
Cluster Coefficients	-127.95 (192.97)	-47.51 (184.70)	33.79 (43.23)	13.31 (39.27)	.78 (2.15)	1.63 (2.23)
FIRM CONTROLS						
R&D Intensity	4.26 (16.43)	8.97 (17.57)	.25 (3.59)	-.53 (3.71)	-.07 (.19)	-.02 (.21)
Debt Ratio	49.89 (72.52)	48.55 (74.75)	-24.26 (15.97)	-23.21 (15.77)	.81 (.84)	.83 (.92)
Prior Performance	-6.38 (24.45)	.90 (24.49)	5.74 (5.53)	3.54 (5.26)	-.16 (.30)	-.07 (.31)
INNOVATION CONTROLS						
Pre-alliance Patent Stock	.15 (.24)	.22 (.23)	.06 (.05)	.05 (.05)	-	-
Pre-alliance Number of ICL Class	-	-	.33* (.13)	.25 * (.13)	-	-
Pre-alliance Innovation Quality	-	-	-	-	.26** (.08)	.27 ** (.09)
Post-alliance Exploration	-	-	-	-	-.01 (.00)	-.00 (.01)
HYPOTHESIS EFFECTS						
Network Distance	**-383.85 * (184.51)**	**-553.97 * (277.34)**	**77.93 † (41.44)**	**109.73 †**	**-3.88 ** (1.50)**	**-6.01 * (2.53)**
*Network Distance * Technological Distance*	-	**528.32 * (269.42)**	-	**-107.48 ***	-	**5.90 * (2.53)**
Observations	534	534	534	534	534	534
Groups	189	189	189	189	189	189
Wald chi-square test for overall fit	70.54	65.82	11.79	11.76	20.60	17.39
Root MSE	394.35	408.43	85.69	86.19	4.59	5.00

† p <.1 * p <.05 ** p <.01 *** p <.001
Standard errors are in parentheses.
The partner industry dummy control is included.

Table 3-5 presents a summary of the empirical findings of this study. Overall, the results of the empirical analyses provide strong support for the effects of alliance partner network distance on innovation in terms of patent quantity, exploratory patents, and patent quality, as well as a moderating effect of alliance partner technological distance.

TABLE 3-5: The Summary of the Empirical Findings of 2SLS

	Prediction	Coeff. Estimate	Finding
H1	Partner network distance will decrease the focal firm's subsequent innovation quantity.	-383.85	Supported ($p<0.05$)
H2	Partner network distance will increase the focal firm's exploratory innovation.	77.93	Marginally Supported ($p<0.1$)
H3	Partner network distance will increase innovation quality.	-3.88	Not Supported ($p<0.01$)
H4a	Technological distance negatively moderates the negative relationship between partner network distance and innovation quantity, such that high technological distance and high network distance increase innovation quantity.	528.32	Supported ($p<0.05$)
H4b	Technological distance negatively moderates the positive relationship between partner network distance and exploratory innovation, such that high technological distance and high network distance decrease exploratory innovation.	-107.48	Supported ($p<0.05$)
H4c	Technological distance positively moderates the positive relationship between partner network distance and exploratory innovation, such that high technological distance and high network distance increase innovation quality.	5.90	Not Supported ($p<0.05$)

2.5.1 Robustness Tests

Two dimensions that appear to be important for robustness purposes are alternative measures of innovation consequences and OLS models.

Alternative Measure. Alternative measures of exploratory innovation for Hypothesis 2 and innovation quality for Hypothesis 3 appear to be important for robustness purposes. A review of empirical studies on innovation used alternative measures of the self-citation ratio and the patent class of citation for exploratory innovation, and patent generality for patent quality. The results with the alternative measures are consistent with the results that are reported in Table 3-4.

For exploratory innovation, I applied an alternative measure of *non-self-citation* (Sorensen & Stuart, 2000; Benner & Tushman, 2002; Katila & Ahuja, 2002). Self-citing occurs when a patent filed by a focal firm includes in its list of citations one or more patents belonging to itself. The presence of new and unfamiliar citations indicates that the firm is building on unfamiliar knowledge rather than on its own existing or familiar knowledge, which is congruent with the definition of an exploratory search. I calculated the proportion of non-self-citations as the reverse ratio of the number of self-citations by focal firm *i* during the 4-year window after an alliance compared to total citations, where the total citations denote the total number of citations made by focal firm *i* in the time-window. The effect of an alliance with a distant partner on exploratory innovation measured with the non-self-citation is positive and significant, as Model 5-1 shows in Table 3-6 (β=274.63, $p<.05$). The result is consistent with the result of the measure of new patent class entrance. The coefficient estimate on the interaction term is negative and significant (β=-1896.72, $p<.05$) in Model 5-2, confirming support for Hypothesis 4b.

As another alternative measure for exploratory innovation, I used the *diversity of citations' patent classes* which supplements the other two measures and constructed the Herfindahl index to capture the degree of concentration across citation classes (Miller, 2004). The measure of citation diversity is the reverse ratio of the Herfindahl index, which is measured by the number of patent classes of citations and the number of total citations. Model 6-1 in Table 3-6 supports Hypotheses 2 (β=2.16, $p<.05$). An interaction effect of technological distance with network distance on exploratory innovation measured by the non-self-citation is negative and significant, in support of H4b (β=-15.07, $p<.05$). The results are consistent with the other two measures of exploratory innovation.

Another dimension of patent quality is the generality of patents, which indicates the percentage of citations received by patent *i* that belong to patent class *j*, out of n patent classes (Valentini, 2012). Therefore, if patent *i* is cited by subsequent patents that belong to a wide range of technological fields, the measure will be high, whereas if most citations are concentrated in a few fields, the measure of generality will be close to zero. A high generality score suggests that a patent had a widespread impact that influences subsequent innovation in a variety of fields. The results when measured with the forward citation for innovation quality are consistent with those of H3 and H4c.

TABLE 3-6: The Effects of Alliance Partner Network Distance on Innovation with Alternative Measures, 1996-2009, Results of 2SLS Analysis

	Model 5-1	Model 5-2	Model 6-1	Model 6-2	Model 7-1	Model 7-2
	H2	**H4b**	**H2**	**H4b**	**H3**	**H4c**
	Exploratory Innovation				**Innovation Quality**	
Measures	**Non Self-citation**		**Citation Diversity**		**Patent Generality**	
	Main	Interaction	Main	Interaction	Main	Interaction
ALLIANCE CONTROL						
Cross-border Alliance	-9.68	2.18	-.12	.01	.40	.12
	(14.05)	(14.05)	(.13)	(.12)	(.26)	(.29)
Alliance Governance	17.70	20.85	.14	.17	-.22	-.38
	(12.49)	(13.80)	(.12)	(.12)	(.21)	(.27)
Technological Distance	-105.44 *	5402.85 *	-1.01 *	42.67*	1.80*	-111.28 *
	(53.20)	(2459.29)	(.44)	(21.22)	(.86)	(46.54)
Geographical Distance	-.00	-.00	.00	-.00	.00	.00
	(.00)	(.00)	(.00)	(.00)	(.00)	(.00)
NETWORK CONTROLS						
Structural Holes	-8.53	-1.93	-.12	-.02	.22	-.02
	(10.63)	(9.64)	(.11)	(.08)	(.22)	(.19)
Cluster Coefficients	21.04	3.87	.15	.02	-.32	-.06
	(29.67)	(28.42)	(.26)	(.24)	(.53)	(.58)
FIRM CONTROLS						
R&D Intensity	-1.02	-1.04	.00	.00	-.00	.01
	(2.54)	(2.66)	(.02)	(.02)	(.05)	(.05)
Debt Ratio	-10.12	-3.00	-.03	.05	.18	.03
	(11.28)	(10.42)	(.10)	(.09)	(.21)	(.21)
Prior Performance	2.13	.32	-.02	-.05	.01	.07
	(3.89)	(3.83)	(.04)	(.03)	(.07)	(.08)
INNOVATION CONTROLS						
Pre-alliance Number of ICL Class	.13	.08	-	-	-	-
	(.09)	(.09)				
Pre-alliance Non-self-citation	.27†	.57***	-	-	-	-
	(.15)	(.08)				
Pre-alliance Citation Class	-	-	.65***	.78***	-	-
			(.09)	(.07)		
Pre-alliance Innovation Quality	-	-	-	-	.04 *	.04 †
					(.02)	(.02)
Post-alliance Exploration	-	-	-	-	.00	-.00
					(.00)	(.00)
HYPOTHESIS EFFECTS						
Network Distance	**274.63***	**1820.71 ***	**2.16***	**14.44***	**-4.98 ****	**-37.42 ***
	(113.12)	**(821.08)**	**(.99)**	**(7.08)**	**(1.73)**	**(15.54)**
*Network Distance * Technological Distance*	-	**-1896.72 ***	-	**-15.07***	-	**39.04 ***
		(862.75)		**(7.44)**		**(16.33)**
Observations	534	534	534	534	534	534
Groups	189	189	189	189	189	189
Wald chi-square test for overall fit	83.35	77.10	146.55	139.27	17.14	13.53
Root MSE	60.91	63.76	.53	.55	1.13	1.30

† p <.1 * p <.05 ** p <.01 *** p <.001
Standard errors are in parentheses.
The partner industry dummy control is included.

OLS Regression. As another set of robustness tests, I ran the OLS regression in Model 8-1 through Model 13-2. Table 3-7 presents the OLS results for innovation consequences, using six different measures, including alternative measures of innovation quantity, exploratory innovation, and innovation quality. The results are generally similar to the 2SLS results appearing in Table 3-4. An alliance with a close partner increases innovation quantity, whereas an alliance with a distant partner increases exploratory innovation. In addition, an alliance with a distant partner decreases innovation quality, thus failing to support Hypothesis 3. However, when a partner is both relationally and technologically distant, a focal firm is likely to have quality innovations. On the other hand, an alliance with both a relationally and technologically distant partner decreases exploratory innovation, as Hypothesis 4b predicted.

TABLE 3-7: The Effects of Alliance Partner Network Distance on Innovation, 1996-2009, Results of OLS Analysis

	Model8-1	Model8-2	Model 9-1	Model 9-2	Model 10-1	Model 10-2	Model 11-1	Model 11-2	Model 12-1	Model 12-2	Model 13-1	Model 13-2
	H1	**H4a**	**H2**	**H4b**	**H2**	**H4b**	**H2**	**H4b**	**H3**	**H4c**	**H3**	**H4c**
Dependent Variables	**Innovation Quantity**		**Exploratory Innovation**						**Innovation Quality**			
Measures	**No. of Patents**		**Patent Class**		**Self-citation**		**Citation Diversity**		**Forward Citation**		**Patent Generality**	
	Main	Interaction	Main	Interaction	Main	Interaction	Main	Interaction	Main	Interaction	Main	Interaction
ALLIANCE CONTROL												
Cross-border Alliance	29.16	27.74	-4.86	-5.48	-.10	-.26	-.01	-.00	.51	.50	.16†	.15†
	(24.63)	(24.63)	(6.36)	(6.35)	(4.69)	(4.70)	(.06)	(.06)	(.49)	(.49)	(.09)	(.09)
Alliance Governance	-8.85	-7.20	-13.27 *	-12.55 *	-4.31	-4.13	.04	.03	.07	.10	-.05	-.02
	(20.20)	(20.22)	(5.22)	(5.21)	(3.87)	(3.87)	(.05)	(.05)	(.40)	(.41)	(.08)	(.07)
Technological Distance	21.87	67.30	11.11	29.77†	3.29	8.30	-.27*	-.49 **	-.07	.55	-.01	.59**
	(54.09)	(63.56)	(14.09)	(16.53)	(10.28)	(12.01)	(.13)	(.15)	(1.08)	(1.24)	(.20)	(.22)
Geographical Distance	.01	.01	-.00	.00	.00	.00	-.00	-.00	.00 **	.00**	.00	.00
	(.00)	(.00)	(.00)	(.00)	(.00)	(.00)	(.00)	(.00)	(.00)	(.00)	(.00)	(.00)
NETWORK CONTROLS												
Structural Holes	-26.11	-25.26	.44	.75	-6.07 *	-5.90 *	.04	.03	-.13	-.09	-.19**	-.15**
	(15.89)	(15.89)	(4.11)	(4.10)	(2.98)	(2.99)	(.04)	(.04)	(.31)	(.31)	(.06)	(.06)
Cluster Coefficients	47.39	47.03	-7.36	-7.38	9.64	9.52	-.09	-.08	2.84 **	2.83 **	.22	.21
	(48.73)	(48.69)	(12.66)	(12.61)	(9.28)	(9.28)	(.12)	(.12)	(.97)	(.97)	(.18)	(.18)
FIRM CONTROLS												
R&D Intensity	-.97	-1.12	1.53	1.46	.16	.15	.01	.01	-.11	-.11	-.01	-.01
	(4.61)	(4.61)	(1.19)	(1.19)	(.88)	(.88)	(.01)	(.01)	(.09)	(.09)	(.02)	(.02)
Debt Ratio	-28.07	-30.37 †	-7.56†	-8.52 †	-3.91	-4.14	.10*	.11	-.33	-.36	-.12 †	-.14 *
	(17.50)	(17.57)	(4.52)	(4.52)	(3.32)	(3.34)	(.04)	(.04)	(.35)	(.35)	(.06)	(.06)
Prior Performance	7.55	7.40	1.99	1.96	1.35	1.31	-.06***	-.06***	.18	.17	.10 ***	.09***
	(6.65)	(6.64)	(1.74)	(1.74)	(1.26)	(1.26)	(.02)	(.02)	(.13)	(.13)	(.02)	(.02)
INNOVATION CONTROLS												
Pre-alliance Patent Stock	.61***	.60***	-.03***	-.03***	-	-	-	-	-	-	-	-
	(.03)	(.03)	(.01)	(.01)								

Class Average Patent Quantity	.35 † (.19)	.34† (.19)	-	-	-	-	-	-	-	-	-	-
Pre-alliance Number of ICL Class	-	-	.25*** (.04)	.25*** (.04)	-	-	-	-	-	-	-	-
Pre-alliance Self-citation	-	-	-	-	.57 *** (.03)	.56*** (.03)	-	-	-	-	-	-
Pre-alliance Citation Class	-	-	-	-	-	-	.76*** (.04)	.74 *** (.04)	-	-	-	-
Pre-alliance Innovation Quality	-	-	-	-	-	-	-	-	.21 *** (.04)	.21 *** (.04)	.03*** (.01)	.03*** (.00)
Post-alliance Exploration	-	-	-	-	-.07 * (.03)	-.07* (.03)	-	-	-.01† (.00)	-.01† (.00)	.00 (.00)	.00 (.00)
HYPOTHESIS EFFECTS												
Network Distance	**-64.36** (22.23)**	**-51.49 * (24.16)**	**-4.90 (5.73)**	**.37 (6.22)**	**-15.57*** (4.18)**	**-14.04 ** (4.59)**	**.10 * (.05)**	**.03 (.06)**	**-.21**	**.01 (.48)**	**-.26** (.08)**	**-.05**
*Network Distance * Technological Distance*	**-**	**-21.82 (16.07)**	**-**	**-8.87* (4.14)**	**-**	**-2.44 (3.02)**	**-**	**-.11 ** (.04)**	**-**	**-.31 (.31)**	**-**	**.30*****
Observations (Groups)	534	534	534	534	534	534	534	534	534	534	534	534
Groups	189	189	189	189	189	189	189	189	189	189	189	189
R-Square	.61	.62	.12	.13	.55	.55	.52	.52	.10	.10	.13	.17
Root MSE	112.08	111.99	28.92	28.82	21.32	21.33	.27	.26	2.23	2.23	.42	.40

† p <.1 * p <.05 ** p <.01 *** p <.001
Standard errors are in parentheses.
The partner industry dummy control is included.

3.6 CONCLUSION AND DISCUSSION

To contribute to prior research that has yielded mixed results regarding the relationship between alliance partner choice, alliance network configuration, and innovation, the current study extends our understanding of the relationship by adding a dynamic perspective and by exploring various aspects of innovation. This study investigates how alliance partner network distance affects firms' innovative activities: innovation quantity, exploratory innovation, and innovation quality. I found that alliances with close partners increase innovative quantity through frequent knowledge flows, whereas alliances with distant partners increase exploratory innovation. In particular, by applying multiple measures for exploratory innovation, I identified the mechanism of exploratory innovation. Firms not only broaden their technological areas, but also spread their citation classes. Although the overall level of innovation quantity may increase with alliances involving close partners, the direction of that innovation shifts away from exploratory innovation and toward an exploitative search. This shift has critical implications for the long-term viability of firms. A firm's innovative quantity increases at a cost to some of its exploratory innovation, which can have longer-term consequences. In some ways, however, the effect of the innovation search is more vital to organizational evolution than to innovative quantity. Finally, innovation quality increases when an alliance partner is both relationally and technologically distant. The results imply that exploratory innovations and breakthrough innovations are distinctive. Exploratory innovations are created by non-redundant information from relationally distant partners; however, a combined effect of network distance and technological distance lead to less exploratory innovation due to information overload, confusion, and diseconomies of scale. However, innovation

quality that may lead to a radical innovation is beyond exploratory innovation.. Exploratory innovation is simply new to a firm whereas innovation quality it is determined by market responses.

This study makes important contributions for research and practice. First, I reconcile the long-lasting theoretical debate between the benefits of structural holes and closure on innovation by examining the effects of network distance on comprehensive innovative activities. I provide a comprehensive understanding of how the trust that comes with close partners and non-redundant information from distant partners can affect subsequent innovations. The extent to which social capital exists in a firm's network of alliances can increase the firm's access to its partners' knowledge, the motivation of its partners to transfer knowledge, and the efficiency of knowledge exchange and transfer (Inkpen & Tsang, 2005), resulting in more successful innovative quantity. However, for the sake of exploration, novel ideas from alliance partners are required over trust with partners. These findings contribute to the debate over whether trust or non-redundant information leads to more innovation.

I also investigated how an additional alliance, rather than the cumulative effects of the total number of alliances, affects innovation, thus controlling for existing network structure. Given the important roles of indirect ties as channels for the flow of information and know-how, I contend that the underlying network structure in a dyad – the concept of network distance as captured in the current study – may influence innovation considering that both direct and indirect ties are theoretically significant. By linking the social mechanism and knowledge novelty from the network structure and the effect of additional direct ties, I have attempted to fill the gap in the existing literature.

These results have important practical implications regarding alliance partner choices. R&D alliances are a useful way to increase firm innovation. As prior literature on ambidexterity suggests (Tushman & O'Reilly, 1996), R&D alliances seem to contribute most to firms' innovations when they have a balance between distant and close partners in their alliance portfolio. The results imply that firms' tendency to prefer embedded ties (Walker, Kogut, & Shane, 1997; Gulati & Gargiulo, 1999; Li & Rowley, 2002) may hinder long-term innovation. Therefore, managers should make an effort to search for nonlocal ties and to build strong relationships with distant partners.

This study has limitations that future research may address. First, I suggest that partner distance is associated with trust and the quality of information that a partner brings; moreover, this study examines the innovation consequences with patents at the firm level. By nature, it is challenging to match a patent as an output of an alliance with the actual alliance. Future research may attempt to more directly relate innovation outcomes to network distance. A promising direction for future research would be to examine direct knowledge transfer occurring before and after the formation of an alliance and to confirm whether a new patent is related to the new partner's knowledge stock. Another approach to address this issue would also be innovation consequences at the patent level.

Second, three dependent variables of the study are not independent. Network distance or other variables can have a similar influence on different innovative consequences. This requires using models that accommodate potential correlation in error terms across the innovation quantity, exploratory innovation, and innovation quality equations in the study. In addition, testing hypotheses on the effect of network

distance on the different types of innovation consequences requires testing differences in the variables' coefficients across innovation type equations at the same time. To address these issues, I would employ a seemingly unrelated regression (SUR) model with robust standard errors.

Third, the impact of governance on innovation should be considered. With the use of an instrument, I rule out any direct effect of the instrument (strong corporate governance) on the dependent variables of different types of innovation consequences. However, previous literature suggests that here is some influence of corporate governance on R&D investments and innovation. In addition, postestimation tests suggest that I may have a weak-instrument problem. In a future study, I would implement another instrument that is exogenous and strongly correlated with the network distance.

Finally, I measured innovation quality with the impact dimension of quality. The impact was measured by the number of forward citations. Highly cited patents represent highly influential innovations. However, prior literature measured innovation impact with alternative measures, for example, breakthrough innovation (Ahuja & Lampert, 2001). Breakthrough patents are much more enormously valuable as foundations for firms to build upon than highly impactful patents. To capture the distinctive nature of breakthrough patents, I would incorporate the alternative measures of breakthrough patents as well as patents' general impact in future studies.

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