Friends, Acquaintances or Strangers? Partner Selection in R&D Alliances

Lorraine Eden
Texas A&M University

DRAFT WORKING PAPER
2007

Bush School Working Paper # 589
FRIENDS, ACQUAINTANCES OR STRANGERS?

PARTNER SELECTION IN R&D ALLIANCES

Dan Li*
Kelley School of Business
Indiana University
Bloomington, IN 47405-1701
Phone: 812-855-5967
Email: lid@indiana.edu

Lorraine Eden
Mays Business School
Texas A&M University
College Station, TX 77843-4221
Phone: 979-862-4053
Email: leden@tamu.edu

Michael A. Hitt
Mays Business School
Texas A&M University
College Station, TX 77843-4221
Phone: 979-458-3393
Email: mhitt@mays.tamu.edu

R. Duane Ireland
Mays Business School
Texas A&M University
College Station, TX 77843-4221
Phone: 979-862-3963
Email: direland@mays.tamu.edu

* Please address correspondence to this author.

April 2007

Forthcoming in the Academy of Management Journal

Acknowledgements: Earlier versions of this paper were presented at the 2005 Academy of Management annual meetings and faculty workshops at Texas A&M University, Indiana University, The City University of New York, and University of Texas at El Paso. We thank Jeff Reuer, Harry Barkema, Sri Zaheer, Manuel P. Ferreira, Jamie Collins, the conference and workshop participants for their insightful comments and suggestions. We also want to thank Editor Sara L. Rynes and three anonymous reviewers for their helpful suggestions.
FRIENDS, ACQUAINTANCES OR STRANGERS?
PARTNER SELECTION IN R&D ALLIANCES

ABSTRACT

Previous research has advanced two primary solutions for safeguarding firms’ valuable technologies in R&D alliances - a protective governance structure and a narrow alliance scope. However, there are circumstances in which even the most protective governance structure (e.g., an equity joint venture) and the most restrictive alliance scope (e.g., a “pure” R&D project) can fail to reduce firms’ leakage concerns sufficiently to ensure an appropriate level of knowledge sharing. In these instances, we suggest partner selection as an alternative solution. We categorize potential alliance partners into three types: Friends, Acquaintances and Strangers, depending on their previous alliance experience. Results from our analysis of 1159 R&D alliances indicate that the more radical the innovation goals of the alliance, the more likely it is that partnerships will be formed between Friends than Strangers. However, Strangers are preferred to Acquaintances, suggesting that firms’ partner selection preferences are not transitive. Moreover, our results suggest that partner selection, governance structure and alliance scope are used as substitute mechanisms to protect valuable technological assets from being appropriated in R&D alliances.

Keywords: partner selection, R&D alliances, knowledge protection, trust, innovation, alliance scope, governance structure.
While enjoying access to their partners’ technological assets, firms in research and development (R&D) alliances place their own valuable technological assets at risk of appropriation. Previous researchers have suggested two solutions to this appropriation risk. Transaction cost economics (TCE) theorists argue that equity-based governance structures can more effectively promote knowledge sharing and protect core technologies from appropriation by opportunistic partners than non-equity-based structures (Oxley, 1999; Pisano, 1989). Narrowing the scope of R&D alliances can also reduce opportunism by limiting points of contact between alliance partners (Khanna, 1998; Oxley & Sampson, 2004).

However, in certain circumstances, even the most protective governance structure and the most restricted alliance scope can fail to reduce knowledge leakage concerns. For example, although equity-based alliances exist and are even encouraged by host governments, many companies, particularly medium- and small-sized enterprises, hesitate to enter emerging markets such as China and India because of knowledge leakage concerns. Restricted alliance scope can also fail as an effective governance mechanism. A classic example occurred during the development of the Apple Macintosh in 1982-1984. Apple engaged Microsoft to develop spreadsheet, database, and graphical applications for the Mac. As a result, Microsoft acquired critical knowledge about Apple’s Graphical User Interface products that enabled its development of the Windows operating system. Eventually, Apple recognized the appropriation of its distinctive advantage and filed a lawsuit against Microsoft. The lawsuit failed, and Microsoft was later awarded a registered trademark for the name “Windows.”

When determining how to protect valuable knowledge from leakage in a R&D alliance, the extant literature has largely focused on selecting a secure governance structure and, more recently, on narrowing the alliance activity scope. The selection of partners has been treated as
exogenous. Moreover, very little scholarly attention has been paid to partner selection, despite work emphasizing that partner selection is one of the critical decisions when forming an alliance (see, for example, Brouthers, Brouthers, & Wilkinson, 1995; Geringer, 1991; Hitt, Tyler, Hardee, & Park, 1995; Ireland, Hitt, & Vaidyanath, 2002; Koot, 1988).

We argue that partner selection is a third, alternative mechanism whereby firms in a R&D alliance can control the threat of knowledge leakage and retain their core proprietary assets. Partner selection involves firms evaluating three important types of potential alliance partners based on their prior interactions: Friends and Acquaintances (which we define as Prior Partners) and Strangers. Supporting this argument is the precedence in the alliance literature for equating prior ties with trust (Dyer & Singh, 1998; Gulati, 1995a). Because the focal firm’s degree of trust in new partners is typically less than in its prior partners, under conditions where knowledge leakage costs are high, one might expect a priori that prior partners would be preferable to new partners. Preference transitivity in partner selection would therefore imply that Friends (F) are preferable to Acquaintances (A), who are preferred to Strangers (S); that is, F > A > S.

However, hypothesizing preference transitivity in partner selection may be too simplistic in that a prior partnership has two effects on partner selection: increasing trust and decreasing information asymmetry between partners. Both effects can generate greater rewards for the firm in terms of generating innovations. Yet, decreasing information asymmetry also has a confounding effect because it can generate higher risk of opportunistic behavior by the partner firm. The tension between the risks and rewards of prior partnerships is at the core of our explanation for the focal firm’s potentially non-transitive decision making about partner selection in R&D alliances. That is, when knowledge leakage costs are high, the focal firm might prefer a new partner (a Stranger) to a Prior Partner.
We argue that the hazards of knowledge sharing are most salient when the innovations to be developed are radical and/or the external protection of intellectual properties is weak. While the external protection of intellectual properties is the typical protection mechanism offered by the market, the radicality of the alliance’s innovation goals determines the degree to which valuable intellectual assets will be revealed and shared in an alliance. Both circumstances prompt firms to carefully consider partner selection as a mechanism to safeguard intellectual assets. We investigate the (in)transitivity of partner selection in R&D alliances under such circumstances. In addition, we explore the dynamic relationships among three protection mechanisms (partner selection, governance structure and alliance scope), building on Oxley and Sampson’s (2004) earlier analysis of alliance scope and governance.

Organizational learning and transaction cost economics are the theoretical foundations for the issues we examine. At its core, organizational learning is a process through which firms develop new knowledge or insights (Tippins & Sohi, 2003). Historically, organizational learning research has focused on various processes (Crossan & Berdrow, 2003) that firms can use to develop knowledge that enhances organizational performance. Some argue that organizational learning is essentially a rational process within the decision-making and choice domain (Cohen & Sproull, 1996). Our work is framed within the context of partner selection as an important dimension of the decisions and choices firms make when forming strategic alliances. Transaction cost economics theory informs our work in that partner selection is a transactional feature of strategic alliances (Reuer, Zollo, & Singh, 2002).

Figure 1 illustrates our study’s conceptual framework. The left half of Figure 1 illustrates how innovation radicality and intellectual property protection affect the transitivity in partner selection; the right half of the graph represents the dynamic relationships among alternative
methods for protecting valuable technology in R&D alliances: partner selection, governance structure and alliance scope. We first examine the partner selection decision (the left half of Figure 1), ignoring the governance and scope alternatives. We define different types of Prior Partners, examine the theoretical benefits and risks of Prior Partners, and analyze the conditions under which firms make choices among Friends, Acquaintances and Strangers. We hypothesize that innovation radicality and intellectual property protection (IPR) affect the transitivity of partner selection decision-making in predictable ways. We then examine partner selection, and the roles played by innovation radicality and IPR protection, within a dynamic system that includes alliance governance and alliance scope (the right half of Figure 1). Our empirical analysis tests our arguments on a sample of 1159 R&D alliances involving companies in high-technology industries over the ten-year period 1994-2003. The paper closes with a discussion of implications for theory, research and practice, limitations, and suggestions for future research.

[Insert Figure 1 about here]

THEORY DEVELOPMENT

Friends, Acquaintances, and Strangers

A firm can choose from among three types of potential alliance partners – Friends, Acquaintances and Strangers. The common definition of a friend is someone you know, like and trust. Therefore, in an alliance context, we define Friends as potential alliance partners, with whom the firm has developed strong-form trust through multiple previous interactions. With strong-form trust, partners are trustworthy, independent of whether or not exchange vulnerabilities or governance mechanisms exist (Barney & Hansen, 1994).

The common definition of an acquaintance is someone you know and about whom you have some but limited knowledge. We define Acquaintances as potential partner firms that know
each other through a limited number of prior interactions; trust between them is semi-strong or weak. The limited prior interaction is highly unlikely to yield strong-form trust. Lastly, a stranger is someone who is unknown to you; we define *Strangers* as potential alliance partners that are unknown to each other. Therefore, the form of trust between Strangers is weak.

We argue that the three archetypal categories – Friends, Acquaintances and Strangers – are useful for expository purposes, although we recognize that the underlying relationships are likely to be continuous. This is analogous to the use of “High” and “Low” when the underlying relationship is linear. It helps to identify, explain and examine differences that occur, perhaps more modestly in degrees, as one progresses along a continuum.

**The Benefits of Prior Partnerships**

Several advantages of forming R&D alliances with Prior Partners have been recognized in the literature. One advantage is that alliances with Prior Partners ease knowledge transfer. A common theme in previous work on absorptive capacity is that prior interactions between partner firms can reduce the causal ambiguity surrounding knowledge transfer and therefore facilitate more efficient and effective flows of technology from one party to the other (e.g., Cohen & Levinthal, 1990; Kale, Singh, & Permutter, 2000; Kogut & Zander, 1992; Mowery, Oxley, & Silverman, 1998; Szulanski, 1996; von Hippel, 1994; Zahra & George, 2002). Hoetker (2005) also reports that, as technological uncertainty increases, prior relationships take on greater positive significance relative to the importance of technical capabilities, as methods for facilitating smooth collaboration. That is, the transfer of technologies between alliance partners can be eased by decreasing the information asymmetry between partner firms.

Additionally, alliance experience can generate trust between partner firms (Gulati, 1995a), and trust can reduce transaction costs and uncertainties involved in information sharing
and transfer (Barney & Hansen, 1994; Beckman, Haunschild, & Phillips, 2004; Dyer & Chu, 2003; McEvily, Perrone, & Zaheer, 2003; Parkhe, 2003). For instance, Hitt, Bierman, Uhlenbruck and Shimizu (2006) found that more interaction over time is positively related to larger contracts in monetary terms. These results strongly suggest that more interactions over time lead to higher trust (willingness to present larger monetary contracts to partners).

In the context of technology protection, the major concern for firms entering R&D alliances is the predictability of partners’ behavior. Behavioral codes defining the core activities for each party are difficult to specify, typically incomplete, and costly to enforce (Contractor & Wonchan, 2002; Johnson, 1970). Therefore, trust is necessary for the parties to make a good-faith effort toward achieving mutual goals and not to take excessive and unilateral advantage of each other, even when the opportunity to do so is available (Sabel, 1993). Moreover, trust increases the likelihood that organizational actors will exchange information and ideas because current exchanges are the most likely to be positively reciprocated at a future time (Collins & Smith, 2006).

**The Risks of Prior Partnerships**

There are also disadvantages of forming R&D alliances with Prior Partners. For example, concerns about search costs can prevent firms from looking beyond their own existing pool of social relationships (Ellis, 2000). When this happens, firms become locked into established relationships (Gulati, 1995b).

Moreover, path-dependent learning may prevent the collaboration between Prior Partners from achieving the goal of developing truly radical innovations that represent a clear departure from existing practices. Novelty is critical for developing radical innovations (Dewar & Dutton, 1986; Hart & Christensen, 2002; Sheremata, 2004; Tushman & Rosenkopf, 1996). However,
partner firms that have had multiple interactions may have developed similar mental maps for innovation that inhibit novelty. Beckman et al. (2004), for example, argue that new partners can bring more new information to an alliance than prior partners and therefore may be preferred when a firm faces firm-specific uncertainties such as new market entry.

Finally, and perhaps more importantly, while reduced information asymmetry can ease technology transfer between alliance partners, it can also place the firms in vulnerable positions. When information asymmetry exists between partner firms, appropriation by Strangers can be avoided or delayed by informal methods (e.g., lead time, learning curves) that afford intellectual property protection. However, given their earlier interactions, Prior Partners are more likely to understand each other’s know-how, operating routines, and managerial practices. Armed with this knowledge, they can more easily overcome the informal methods of intellectual property protection (Arrow, 1974; Heiman & Nickerson, 2002, 2004). If they choose to behave opportunistically, it is therefore easier for Prior Partners than for Strangers to appropriate a partner firm’s core technologies.

Weighing the Benefits against the Risks of Prior Partners

We argued above that firms forming R&D alliances with Prior Partners benefit from the smoothness of technology transfer, which comes from both reduced information asymmetry and increased trust. The smooth technology transfer and reduced partner opportunism together suggest that the focal firm’s partner selection decision should be transitive; that is, Friends should be preferred to Acquaintances, and Acquaintances to Strangers (F > A > S). However, the repeated interactions also generate vulnerabilities for partner firms. Because Prior Partners understand each other’s know-how, operating routines, and managerial practices through earlier interactions, they can appropriate the partner firm’s core technologies quickly and effectively if
they choose to do so. As a result, the increasing risks may offset the benefits from Prior Partners to the focal firm, creating non-transitive partner selection preferences.

We suggest that information asymmetry between partners can be reduced quickly, particularly where knowledge assets are public in nature; however, it may take multiple close collaborations to build strong-form trust between partner firms (Barney & Hansen, 1994). This suggests that, as the number of prior relationships increases between two firms, the rewards from innovation generation, which are based on both the slow development of strong-form trust and the faster reduction in information asymmetry, should grow slowly over time. At the same time, as the number of prior relationships increases, the faster reduction in information asymmetry increases the risk of innovation appropriation. This suggests that the rewards to the focal firm should increase more slowly than the risks, as the number of prior partnerships increases.

We therefore conclude that Prior Partners carry both risks and rewards for the focal firm. Our arguments suggest that Friends are characterized by low levels of information asymmetry and strong-form trust, Strangers by high levels of information asymmetry and weak-form trust, and Acquaintances by relatively low levels of information asymmetry and semi-strong or weak trust. Partnering with Acquaintances creates a serious situation for firms concerned about opportunism because it is likely that Acquaintances can succeed in stealing their partners’ core technologies if they choose to do so. Therefore, appropriation concerns should be more salient for Acquaintances than for Strangers or Friends. We illustrate our arguments in Figure 2, which relates the number of prior partnerships to the risks and rewards of those partnerships.

[Insert Figure 2 about here]

The innovation benefits curve in Figure 2 shows that increasing the number of prior partnerships generates positive benefits for the focal firm, but at a decreasing rate. The slow
build-up of strong-form trust and the faster reduction in information asymmetry between the partner firms smooth the development and transfer of knowledge between the partner firms.

More specifically, as the number of prior relationships increases, the synergies that exist due to complementarities in information asymmetry also decrease and eventually are exhausted. Eventually, the prior partners share full knowledge about each other, the alliance is successfully complete and the needs’ gap no longer exists, in that the two partners no longer have any relevant information that may be applicable for future alliances. Thus, the stock of new knowledge that can be gained from a Prior Partner is eventually exhausted. We especially expect this to be the case when radical innovations are desired because Prior Partners may not have what the firm needs in order to undertake the radical innovation.¹

The reduction in information asymmetry also increases the focal firm’s vulnerability to opportunistic behavior by the Prior Partner, raising opportunism risk for the focal firm. We show two different risk curves in Figure 2. First, the line 0AB represents the assumption that opportunism risk increases rapidly with the number of prior partnerships. This is the situation where knowledge has the characteristics of a public good (Johnson, 1970). When information asymmetry reaches its minimum (when the prior partner has enough knowledge to capture/absorb much or all of the focal firm’s knowledge base related to the R&D alliance), maximum risk is reached (point A). The line 0AB becomes level at point A because increasing the number of prior partnerships beyond point A does not increase the focal firm’s vulnerability.

The firm chooses the optimal number of prior partnerships by maximizing the difference between its total rewards and total risks from partner selection; that is, by equating the firm’s marginal benefit to its marginal risk from an additional prior partnership. Graphically, this occurs where the slopes of the innovation benefit curve 0CD and the opportunism risk curve 0AB are
the same for a particular number of prior partnerships.

Examining the curves in Figure 2, one can see that the optimal number of prior partnerships is potentially intransitive because the risk and reward curves intersect in two places: points C and D. To the left of C, innovation benefits exceed opportunism risk, which encourages the focal firm to undertake another alliance with this firm. To the right of C, up to D, the reverse is the case: total risk exceeds total rewards, discouraging selection of prior partners. After D, reward again exceeds risk, encouraging further alliance relationships with prior partners. Depending on where points C and D occur, the focal firm may or may not choose a Prior Partner over a Stranger. In Figure 2, the optimal number of prior partners occurs first before point C where the number of prior partnerships is zero (Stranger), and then again after point D where a Friend is selected. In this case, Friends are preferred to Strangers, who are preferred to Acquaintances, thereby providing an example of intransitivity (F > S > A).

On the other hand, the line 0EB represents the assumption that opportunism risk increases slowly with the increase of prior partnerships. This could be because the focal firm’s knowledge base is highly tacit. As a result, information asymmetry persists for much longer, vulnerability increases much more slowly, and opportunism risk rises slowly. As a result, the line 0EB never intersects the innovation rewards curve. In this situation, reward always dominates risk, and transitive preferences exist as F > A > S.

In sum, previous research has shown that the firm’s partner selection preference could be transitive or intransitive. We explore below the factors that can affect information asymmetry, the degree of vulnerability, and the focal firm’s partner selection choice.

**Partner Selection and Technology Protection**

How well technological assets can be protected is based partly on the degree of
technological exposure in a R&D alliance. R&D projects can be of different types, ranging from incremental modifications of existing technology to ambitious projects seeking to make radical changes in technology to develop the “next generation” of products. Therefore, the level of partner firms’ exposure of their valuable knowledge varies in R&D alliances depending on the type of innovations desired. We should expect more protection from opportunism when there is extensive exposure of partner firms’ core technologies.

**Innovation Radicality**

There are at least two types of innovations that R&D alliances can develop – radical and incremental (Dewar & Dutton, 1986; Sheremata, 2004). In general, radical innovations are based on new design concepts that break existing paradigms, whereas incremental innovations are based on minor changes or improvements in the current technology. Firms committed to developing radical innovations seek to locate entrepreneurial opportunities that can shift the basis of competition in the industry (Ireland, Hitt, & Sirmon, 2003). In contrast, incremental innovations help incumbent firms derive maximum value from their current capabilities by providing customers with similar products or services that are marginally improved or provided at a lower cost and/or with easier accessibility (Sheremata, 2004).

R&D alliances focused on developing radical innovations produce more risks of technology leakage than those targeting incremental innovations. The preexistence of a product or process technology enables parties to delineate property rights at the origin of an alliance with far less ambiguity, as in the case of incremental innovations, than if the relevant technology does not exist, as in the case of radical innovations (Pisano, 1989). As a result, cooperation to develop radical innovations entails higher risk of technology leakage, and greater efforts are needed to reduce opportunistic behavior.
Previous work has suggested that forming alliances between Prior Partners can reduce the potential for opportunism (Gulati, 1995a; Sabel, 1993). This is the case for partners that are Friends; however, the conditions are different when partners are Acquaintances. In contrast to Strangers, Acquaintances are more familiar with their partner firms’ technological assets and are thus able to appropriate their valuable knowledge more easily. Therefore, firms are highly vulnerable in such situations and may intentionally avoid Acquaintances to protect their technological and other operation-related assets from potential opportunistic behaviors.

In terms of Figure 2, we show that high radicality of innovation causes high vulnerability, as in curve 0AB, and non-transitivity in the focal firm’s preferences: Friends are preferable to Strangers (point D) but Strangers are preferred to Acquaintances (point C), so that F > S > A. On the other hand, low radicality implies low vulnerability, as in curve 0EB, and thus transitivity of preferences occurs where F > A > S. This suggests the following hypothesis:

**Hypothesis 1.** All else equal, the more radical the innovation goals of the R&D alliance, the more likely that partner selection will be intransitive: Friends are preferred to Strangers and Strangers are preferred to Acquaintances.

**Intellectual Property Rights (IPR) Protection**

Partner firms in a R&D alliance also rely on formal protection of their proprietary assets such as patents and copyrights. For instance, Beckman et al. (2004) posit that when the market uncertainty is high (in our context, formal IPR protection is weak), firms are more likely to form new alliances with their existing partners to reinforce their networks. However, in some situations formal protection may be ineffective or less effective than desired, leaving firms to manage the residual opportunism by carefully selecting partners.

Ineffective market protection occurs for at least two reasons. First, firms seeking protection of technology transferred across national borders often encounter a variety of
complicated legal rules and procedures (Oxley, 1999). For example, although member countries of the Paris Convention for Protection of Industrial Property agree to grant foreign firms the same intellectual property protection as domestic firms, the Convention does not specify the standards of protection required. Consequently, IPR protection levels vary significantly across countries² (Oxley, 1999).

Second, fundamental shifts in technology are rapidly making the current system of IPR protection ineffective. “It is clear that the invention of a new gene cannot be handled in the same way as the invention of a new gearbox” (Thurow, 1997: 98). Current knowledge-intensive industries, and the nature of the patents flowing from firms competing in them, pose far more complex challenges. The changes in the nature of technology shift the responsibility (and the costs) from the market to partner firms for protecting their technological assets.

Compared to firms operating in markets where intellectual properties are well protected, organizations operating in environments with weak intellectual property protection are more vulnerable and therefore have concerns about the safety of their technological assets in R&D alliances. Consistent with the literature, we argue that under such situations Friends are the preferred alliance partners because strong-form trust ensures that they will not appropriate each other’s valuable technologies even if opportunities are present to do so.

However, Acquaintances must be considered differently. Because of fewer information asymmetries between Acquaintances, partner firms are even more vulnerable in an environment where their intellectual properties cannot be effectively protected because strong-form trust has not yet been developed. Therefore, Acquaintances represent a worst-case scenario in a market where intellectual properties are not well protected; that is, in cases of relatively low information asymmetry and semi-strong or weak trust. In contrast, opportunistic behaviors by Strangers can
be delayed by informal learning barriers stemming from technologies per se.

As shown in Figure 2, we therefore argue that weak IPR protection implies high vulnerability (curve 0AB), causing intransitive preferences; that is, Friends are preferable to Strangers, who are preferable to Acquaintances (F > S > A). This suggests the following hypothesis:

**Hypothesis 2.** All else equal, the weaker the intellectual property rights protection, the more likely that partner selection will be intransitive: Friends are preferred to Strangers and Strangers are preferred to Acquaintances.

**Dynamic Aspects of Alliance Formation**

We now bring together the left and right halves of Figure 1 by examining the three decisions (partner selection, governance structure and alliance scope) as a dynamic and endogenous system. Firms must make three decisions when forming a R&D alliance: with *whom* to ally (partner selection), *how* to allocate responsibilities and authority between partners (governance structure), and *what* activities to perform (alliance scope). These three sets of decision alternatives are interrelated in that each decision is likely to affect the other two. Additionally, all three decisions are important mechanisms used by firms to protect their technological assets. Thus, although our focus is on the partner selection decision, we believe that all three decisions are important; we do not argue that one is greater relative importance.

In this section, we restrict our discussion to Friends rather than Prior Partners in general. This is because the assumption of strong-form trust between Friends is consistent with prior research; whereas we assume that semi-strong or weak trust exists between Acquaintances.

Cooperation often has a social dimension as well as an economic dimension (Blau, 1964). Transaction cost theorists treat transactions as independent from each other. For instance, Williamson (1975) claims that “legal ordering” incentives, such as shared ownership of specific
investments, can be used to restrain opportunism, thereby safeguarding future profits yielded by cooperation (Axelrod, 1984; Heide & Miner, 1992). Hennart (1982; 1991) and Teece (1986) suggest that equity joint ventures offer “mutual hostage” positions that can guarantee performance as part of the internationalization process to avoid opportunistic behavior. Recent research by Heiman and Nickerson (2002; 2004) also found that equity-based governance is typically adopted to deal with the potential opportunistic behaviors resulting from knowledge management practices that are designed to facilitate the transfer of tacit knowledge between partners. However, according to Murakami and Rohlen, “[T]he value of the relationship itself is typically ignored and the impersonality of the transaction is assumed” (1992: 70). To govern a cooperative relationship, both economic and social mechanisms matter.

Different from hierarchical arrangements such as shared ownership, trust can be used to maintain good working relationships between business partners (Barber, 1983; Killing, 1988; Lorenz, 1988; Palay, 1984). Prior interactions provide information about a partner’s behavior, creating expectations of future behavioral patterns. The ability to predict behavior (e.g., abiding by the informal agreement or contract between partners in an alliance) affords the focal firm an opportunity to trust prior partners. As such, firms with prior interactions are likely to rely on trust rather than expensive equity joint ventures or large shares of equity ownership to govern their cooperative relationship (Buckley & Casson, 1988; Gulati, 1995a; Inkpen & Currall, 2004).

Additionally, the benefits of relying on trust have been found to be more significant when the equity-based governance is absent (Zollo, Reuer & Singh, 2002). Hence, weak protection of intellectual property in the market or significant exposure of a firm’s core technology in the cooperative arrangement (required by the goal of the alliance such as developing radical innovations) is likely to motivate partners to select either equity-based governance for the
alliance or trustworthy partners (Friends) as alliance partners to eliminate or reduce opportunism. These arguments suggest a substitution effect between governance modes and partner selection (equity joint venture versus trust), leading to the following paired hypotheses:

**Hypothesis 3a.** *All else equal, when the R&D alliance is structured as an equity joint venture, there is a lower likelihood that the alliance partners are Friends.*

**Hypothesis 3b.** *All else equal, when the R&D alliance is between Friends, there is a lower likelihood that the alliance governance structure is an equity joint venture.*

When firms consider a R&D alliance, they must decide on its scope. A R&D alliance can focus exclusively on R&D activities. An increase in the vertical scope of the alliance integrates R&D with other activities, such as manufacturing and/or marketing. In such cases, the extent of knowledge sharing and coordination inevitably increases (Reuer et al., 2002), resulting in a concomitant reduction in control over information flows across the relevant organizational boundaries (Teece, 1992). Moreover, operational routines exhibit substantial inseparability, and that knowledge gained in the course of manufacturing and marketing efforts within the alliance likely has important effects on other areas of partner firms’ operations. As a result, it is almost impossible to effectively manage mixed activity R&D alliances without extensive sharing of tacit knowledge that is embedded in operational routines (Reuer et al., 2002).

Because an enlarged alliance scope creates greater potential for exposure of partner firms’ core technologies to each other, protection of technological assets is more challenging. Firms are often reluctant to accept such a high level of exposure of their valuable technologies in the absence of strong-form trust with their partners. Therefore, when an expanded alliance scope is necessary, firms are more likely to pursue Friends as alliance partners. Alternatively, when firms are confident that their Friend partners will not behave opportunistically, they are more likely to extend their collaboration to other activities in order to achieve a higher level of
synergy. These arguments suggest a substitution effect between governance and alliance scope, leading to the following paired hypotheses:

**Hypothesis 4a.** All else equal, when the alliance scope is narrow, there is a lower likelihood that the alliance partners are Friends.

**Hypothesis 4b.** All else equal, when the R&D alliance is between Friends, there is a lower likelihood that the alliance scope is narrow.

**METHODS**

**Sample**

Our sample consists of R&D alliances among firms in high-technology industries. Our definition of a high-technology industry comes from the AeA, the largest association of high-tech companies in the United States. AeA classifies the industry into high-tech manufacturing (SIC codes: 357, 365, 366, 367, 381, 382, 384, and 386) and high-tech services which include communications services (SIC codes: 481, 482, 484, and 489) and software and computer-related services (SIC code: 737). Firms in these industries are ideal for research on R&D collaborations because survival and profitability are critically dependent on a firm’s ability to create and commercialize innovations quickly and efficiently. In recent years, firms have been establishing R&D alliances at an unprecedented rate as a way to spread the risk and cost of technological development.

We collected information about alliances from the Securities Data Corporation (SDC) Database on Alliances and Joint Ventures, supplemented by information from the Lexis-Nexis database and the RDS Business Reference Suite. The information included in the SDC Database is compiled from publicly available sources such as SEC filings and their international counterparts, trade publications, wires, and news sources.

Our sample consists of 1159 R&D alliances involving firms in the high-technology
industries during the period of 1994-2003, as reported in the SDC database. In this study, we only include R&D alliances formed between two firms (which represents the overwhelming majority of the alliances formed).\textsuperscript{4}

**Measures**

*Dependent Variables*

We have three dependent variables. The first dependent variable is PARTNER, a categorical variable capturing the relationship between alliance partners. We employ the number of prior alliances as the proxy to categorize Friends, Acquaintances and Strangers. PARTNER was set to 1 when the alliance partners are Strangers (i.e., partner firms have had no alliance during the past five years\textsuperscript{5}), 2 when the alliance partners are Acquaintances (i.e., partner firms have had one alliance during the past five years\textsuperscript{6}), and 3 when the alliance partners are Friends (i.e., partner firms have had two or more alliances during the past five years). We also created a dummy variable, FRIEND, for our analysis of the dynamic aspects of alliance formation decisions. FRIEND equals to 1 when a R&D alliance is formed between Friends and 0 otherwise.

The second dependent variable is designed to capture alliance governance mode. EQUITY is set to 1 when the R&D alliance was organized as an equity-based joint venture and 0 when it was organized as a non-equity-based contract.

The third dependent variable, SCOPE, captures the vertical scope of alliance activities. SCOPE is set to 1 when the alliance involves R&D activities exclusively. Such alliances are more narrow in scope than alliances including manufacturing and/or marketing in addition to collaborative R&D, for which SCOPE equals 0 (Oxley & Sampson, 2004).

*Independent Variables*
The key independent variables are radicality of innovation and strength of intellectual property rights protection. RADICALITY, the measure of innovation radicality, was coded from synopses of alliance activities provided by the SDC database, the Lexis-Nexis Database and the RDS Business Reference Suite, with a scale from 1 (very incremental) to 7 (very radical). The synopses of alliance activities were coded by two independent coders. There was an initial 78 percent agreement among the raters and Cohen’s Kappa is 0.83, which is well above the satisfactory level of 0.70. Disagreements were discussed and resolved by the two raters. Resolved scores were used in the analyses. To eliminate the time bias in the coding, we standardized the coding of RADICALITY by year.

Our annual measure of IPR protection in the market, PROTECTION, is taken from the World Competitiveness Yearbook (WCY) published by the International Institute for Management Development. This organization conducts executive surveys annually to quantify issues such as intellectual property protection that are not easily measured. This variable was centered to reduce multicollinearity problems.

Control Variables

We control for the effects of firm size and age of both alliance partners. Firm size is measured by the total number of employees. Firm age is the number of years between the incorporation year and the year of alliance formation. Missing values were replaced by the overall means.

Because firms with frequent alliance activities may be more experienced with alliances in general, we control for the effects of general alliance experience of both partner firms. The proxy used is the total number of alliances (independent of current partner) that the partner firm has had during the five years prior to the sample alliance announcement, in logged format.
We also include a variable, PRIOR COOPERATION COMPLEXITY, to control for the complexity of prior collaboration between partners. We first generated a factor based on items regarding whether the prior cooperation was “vertical vs. horizontal,” “equity-based vs. non-equity-based” and “R&D vs. non-R&D alliance.” Cronbach’s Alpha for the composite factor is 0.698. We then multiplied the composite factor with the number of prior alliances formed between these partner firms over the past five years. This measure captures both the number of prior interactions between the partners and the diversity of their previous collaborations.

We also control for the TECHNOLOGY OVERLAP between partners. The measure we use is based on the distribution of firms’ patents in different patent classes (Oxley & Sampson, 2004). Patent information was collected from the patent documents published by the U.S. Patent and Trademark Office (USPTO). We generate each partner firm’s technological portfolio by measuring the distribution across patent classifications of the patents for which the firm applied during the four years prior to alliance formation. There are 403 classifications identified for our sample partner firms. A multidimensional vector is then structured to capture the distribution of the firm’s technological portfolio, $F_i = (F_i^1 \ldots F_i^s \ldots F_i^{403})$ where $F_i^s$ represents the number of patent applications by partner firm $i$ in the patent class $s$. We computed the technology overlap between partner firm $i$ and $j$ ($i \neq j$) as $FiFj' / \sqrt{(FiFi')(FjFj')}$. The value of technology overlap varies from zero to one with zero indicating no overlap in partner firms’ technological expertise and one indicating complete overlap.

We included a set of dummy variables for the industries of the focal firms. The focal firm of an alliance is the partner that carries the major equity share (>50%), or is specified as the central organizer of the collaboration. When these two criteria were not applicable, the name of the company that was listed first in the alliance’s name published in the alliance announcement
was specified as the focal firm. We generated twelve dummy variables for 3-digit SIC codes with the value of 1 representing the codes of 357, 365, 366, 367, 381, 382, 384, 386, 481, 484, 737 and other (482 and 489) respectively, and 0 otherwise. We grouped SIC code 482 and 489 into one category because of the limited observations in these two industries (N=3 and N=11, respectively). We used SIC 357 as the comparison baseline and therefore included eleven dummies in the analyses.

The dataset includes R&D alliances for a ten-year period, creating the possibility that firms and industries change over time (e.g., concerns and preferences for alliance partners). Thus, we include nine dummy variables to control for the ten years in the analyses.

Lastly, EQUITY and SCOPE are included as control variables in the regression models analyzing alliance partner selection.

**RESULTS**

Descriptive statistics and an intercorrelation matrix for all variables used in the study are presented in Table 1. We carefully explored the potential for multicollinearity. The variance inflation factor (VIF) for each individual variable is below 5, and the average VIF for each regression model is below 2. Therefore, we concluded multicollinearity did not threaten the coefficient estimates.

[Insert Table 1 about here]

We first estimated partner selection as a function of the variables included in the hypotheses (Hypotheses 1 and 2), along with the relevant control variables described above. Because partner selection is a categorical variable, we use multinomial logistic regression analysis for this estimation. The first set of results is shown in Table 2. Models 1 and 2 include only control variables. Models 3 and 4 add the independent variables.
The results showed that, as predicted, RADICALITY has a statistically significant negative coefficient when comparing Acquaintance against Strangers (Model 3 in Table 2: $\beta = -0.96, p<0.05$). When comparing Friends against Strangers, RADICALITY has a statistically significant positive coefficient (Model 4 in Table 2: $\beta = 0.15, p<0.01$). The results show that when innovation radicality is high, R&D alliances are more likely to be formed between Friends than Strangers, but less likely to be formed between Acquaintances than Strangers (that is, partner selection is intransitive, $F > S > A$). Therefore, strong support is found for Hypothesis 1 regarding the effects of innovation radicality.

Contrary to expectations, neither of the coefficients for PROTECTION was statistically significant in Models 3 and 4 in Table 2. Thus, the results provide no support for Hypothesis 2 regarding the effects of intellectual property protection in the local market.

To test the hypotheses on the dynamic aspects of alliance formation decision (Hypothesis 3a - Hypothesis 4b), we examine the interdependencies among the three decision variables. We do so by employing a three-stage least squares (3SLS) analysis. Unlike ordinary least squares analysis (OLS), estimation by 3SLS recognizes the endogeneity of partner selection, governance structure and alliance scope in a simultaneous equation framework and therefore provides consistent estimates of the parameters. In addition, 3SLS is preferable to two-stage least squares (2SLS) because, unlike 2SLS, 3SLS is a full-information estimation technique which estimates all parameters simultaneously. Thus, because 3SLS incorporates the cross-equation correlations, it produces parameter estimates that are asymptotically more efficient than those of 2SLS. A Hausman test was conducted and the Chi Square was 83.30 ($p<0.001$), indicating the existence of endogeneity. As shown in Table 3, these three decision variables are closely and inextricably
interwoven.

[Insert Table 3 about here]

As predicted in Hypotheses 3a and 3b, the coefficient for EQUITY is negative and statistically significant in the FRIEND equation ($\beta = -0.13, p<0.001$) and the coefficient for FRIENDS is negative and statistically significant in the EQUITY equation ($\beta = -0.14, p<0.001$). Thus, when alliance scope is organized in a protective governance structure, the need to select partners with strong-form trust is reduced. And, vice versa, when the alliance is organized between trustworthy partners, firms are less likely to adopt an expensive governance structure such as an equity-based joint venture. Therefore, these findings suggest a substitution effect between governance and the selection of Friends, providing support for Hypotheses 3a and 3b.

As suggested by Hypotheses 4a and 4b, the coefficient for SCOPE is negative and statistically significant in the FRIEND equation ($\beta = -0.16, p<0.001$) and the coefficient for FRIENDS is negative and statistically significant in the SCOPE equation ($\beta = -0.34, p<0.001$). These results suggest that when alliance scope is more focused, there is less need to select partners with strong-form trust to protect against knowledge leakage. Conversely, when the alliance is organized between trustworthy partners, firms are more willing to engage in activities of broader scope. Thus, the substitution effect between alliance scope and selection of Friends is clearly evident, supporting Hypotheses 4a and 4b.

Also, consistent with the literature, we detect the substitution effect between governance and alliance scope. The coefficient for EQUITY is negative and statistically significant in the SCOPE equation ($\beta = -0.21, p<0.001$) and the coefficient for SCOPE is negative and statistically significant in the EQUITY equation ($\beta = -0.11, p<0.001$). The substitution effect between governance and alliance scope is also evident, supporting Oxley and Sampson (2004).
The overall results also provide a possible explanation for the lack of support found for Hypothesis 2. We proposed in this hypothesis that the weaker the intellectual property rights protection, the more likely it would be that Friends would be preferred to Strangers and Strangers preferred to Acquaintances. Thus, Friends should be the dominant choice. What may explain this lack of significant results is that RADICALITY and PROTECTION appear to be addressed by different decisions. In Table 3, the coefficient for RADICALITY is positive and statistically significant in the FRIEND equation \((\beta = 0.09, p<0.001)\), but it is not statistically significant in the EQUITY equations. The coefficient for PROTECTION is negative and statistically significant in the EQUITY equation, but it is not statistically significant in the FRIEND equation \((\beta = -0.11, p<0.001)\). These results suggest that firms use different decision foci to address separate issues in protecting their technological assets. Our results suggest that firms use governance design to handle ineffective/inefficient property protection, but partner selection to deal with knowledge exposure when developing radical innovations.

**DISCUSSION**

Partner selection is a critical component of alliance management. Prior research has emphasized that firms select alliance partners because of the resources they hold (e.g., Hitt, Dacin, Levitas, Arregle, & Borza, 2000). Our research suggests that firms also select partners that allow them to hold onto (i.e., to protect) their valuable resources.

**Implications for Theory, Research and Practice**

This research extends our knowledge regarding the application of organizational learning and transaction cost economics to partner selection decisions when firms form alliances. A great deal of previous work has emphasized the importance and value of organizational learning in a variety of contexts. A key reason for this focus in research is that learning is the pathway to
creating new knowledge that in turn positively contributes to firms’ efforts to innovate and outperform their rivals (Collins & Smith, 2006). Our results provide support for prior arguments, but with a contextual caveat. Some knowledge that is gained through limited prior contacts may actually be harmful. The knowledge gained from a prior alliance helps partners learn about the firm’s routines along with some information regarding its core technology. As a result, it would be easier for the partner to act opportunistically by using this knowledge than if the partner were a stranger with no prior knowledge. The prior knowledge of partners increases the risk of exposing a firm’s core knowledge on which its competitive advantage is based if the previous relationships were inadequate to establish strong-form trust between the partners. Thus, our work contributes to an emerging research stream aimed at understanding the relationship between strategy and efficient economic organizational forms including alliances (Crossan & Berdrow, 2003). Firms that are able to benefit from R&D collaborations while simultaneously protecting their own valuable knowledge increase the likelihood of maintaining their competitive advantage as the foundation for success in the marketplace. However, our results regarding decisions about alliance formation support the contention that the learning process in alliances can be difficult and fragile (Inkpen, 2000).

This study has implications for the debates about informal governance (termed as trust, relational capital, or social capital in various studies) and formal governance (defined as formal contracts or equity-based joint ventures in different studies) functioning as complements or substitutes. Many scholars have argued that formal governance (such as contracts) can enhance trust (e.g., Lorenz, 1999; Mayer & Argyres, 2004; Poppo & Zenger, 2002; Stikin, 1992). This perspective posits that contracts improve trust because the contracting process helps to clarify each party’s roles and responsibilities, promotes expectations of cooperation and generates
commitment to the relationship. Other scholars argue that, to the contrary, informal and formal governance are substitutes for one another (e.g., Dyer & Singh, 1998; Gulati & Singh, 1998; Malhotra & Murnighan, 2002; Larson, 1992, Reuer, Arino, & Mellewigt, 2006; Uzzi, 1997). The second view posits that the presence of trust is expected to obviate the need for formal governance because each partner can expect the other will fulfill her promises. The introduction of formal governance can be taken as a signal of lack of trust by partners. Our findings are consistent with this second perspective and show that the equity-based governance structure is adopted only when other protective mechanisms (such as trust) are absent or inapplicable.

Further, we are able to show that the substitutive relationships exist among three, rather than two, knowledge-protection mechanisms in R&D alliances. Our study suggests that partner selection is a third, alternative mechanism to achieve the same knowledge protection goals as governance structure and alliance scope. Although partner selection has long been considered an alternative by some, it has rarely been included in prior empirical work. Indeed, in most prior research, partners have been treated as a given. We argue that the three decisions represent a dynamic and endogenous system. Our results suggest a problem with traditional models in which simultaneous consideration of all three decision variables is not specified. Thus, this work extends empirical tests of transaction cost theory. While the results reported herein are should not be considered as definitive, they do suggest an important avenue for future research on alliance management.

This research also enhances our understanding of trust between alliance partners. Previous work has employed prior interaction as a proxy of trust. However, we argue that there is a clear distinction between Acquaintances and Friends, at least in the context of technology protection in R&D alliances. To protect their valuable technological assets, firms tend to select
Friends as partners for new R&D alliances while trying to avoid Acquaintances on which they do not have adequate information to predict future behavior or in which prior behaviors caused concerns. Such a conclusion calls for a caveat to the usual assertion that prior partners are more trustworthy and therefore preferable to new partners.

Moreover, our study adds to a growing literature in economics and strategic management on matching models. Matching models attempt to address the issue of why partners (in different contexts from dating to M&A activity) choose each other. For instance, in the context of M&As, scholars have reported that matching between the acquirer and target along dimensions such as industry is likely to involve larger investments (e.g., Kenney, Payne & Whitehead, 2002) and deliver higher levels of productivity (e.g., Estrella, 2001). It has also been argued from the real options perspective that prior cooperation experience between firms can accelerate the matching process of merger/acquisition (e.g., Reuer, 2005). However, the difficulty of evaluating partners still exists. Our research contributes to this literature by providing in-depth examination of three types of possible targets for strategic alliances that could also be used for M&As.

In terms of implications for managerial practice, our analysis suggests that managers can and do pay attention to the competitive implications of the potential for losing control of technological assets in R&D alliances. These considerations play a role in designing R&D alliances. For example, firms can adjust their partner selection decisions to protect their technological assets. By focusing on the processes rather than the outcome, we examined why firms select Prior Partners for the purpose of protecting their proprietary assets in R&D alliances. Our results support the arguments presented. Moreover, our analysis adds to the behavioral literature on management, by providing both an argument and evidence for intransitivity of partner selection when the goals of the alliance are to develop radical innovation.
Limitations

The present study has several limitations. The measures of Friends and Acquaintances are coarse grained. We empirically defined Acquaintances as Prior Partners with whom a firm has had one alliance during the past 5 years, while Friends are Prior Partners with whom the firm has had more than one alliance during the past 5 years. It is possible for one prior relationship to build strong trust between partners while three or four unimportant collaborations may be unable to convince partner firms to trust each other. Also, the time duration of prior relationships is assumed in the present study. While some alliances barely survive the honeymoon stage, others may last over many years (Levinthal & Fichman, 1988). The success or failure of prior relationships can have significant implications to partner selection for future alliances. For instance, one failed alliance may lead the firm to identify its partner as the “devil you know.” However, companies typically do not report negative news such as alliance “divorce” unless lawsuits are involved. A lack of adequate data prevented more fine-grained measurements of Acquaintances and Friends and further categorization of different types of Acquaintances. Nonetheless, the current measures do represent the first effort to specify important relationships using these variables.

We took the alliance project selection (in our context, the innovation decision) as given in the current study. That is, we made the assumption that alliance project decision has been made before the firm considers and decides on alliance partners, governance structure and alliance scope. However, it is possible that project selection is considered simultaneously with the three alliance formation decisions examined in our paper. Additionally, the different types of alliance motives that firms have had in prior alliances are likely to affect the current alliance goal (such as the goal of developing a radical innovation). In our study, we focused on how the current
alliance goal can affect partner selection while taking the goal as given and treating the radicality of innovation as exogenous. The consideration of project decisions\textsuperscript{14} may add another challenge to alliance formation and management and thus warrants future research.

Another limitation of our paper is that we focused on partner firms’ ability to behave opportunistically while taking their willingness to perform such behaviors as a given. A qualification to our argument must be made once we recognize that both parties can potentially learn from each other; that is, because each partner has reduced information asymmetry about the other partner, reduced information asymmetry on both sides may serve as a check on opportunistic behavior by both parties. In other words, the focal firm (firm A) worries that reduced information asymmetry generated by working together in a R&D alliance might cause a potential partner (firm B) to behave opportunistically. That firm B has the ability to behave opportunistically due to reduced information asymmetry does not necessarily imply that B also has the willingness to do so. Vulnerability is only important for focal firm A when its partner firm B has both the ability and the willingness to behave opportunistically.

That willingness, as we know from game theory, depends on whether there are repeated games. Agents are much less likely to engage in opportunism if the game will have additional rounds. In addition, the ability of the other firm to retaliate will also check opportunistic behavior. This suggests that B is less likely to engage in opportunism if (1) B expects there are more opportunities for profitable alliances with A, or (2) B recognizes that the reduced information asymmetry occurs for both parties, and that A can retaliate by behaving opportunistically against B (engaging in a “tit for tat” strategy). Note that intellectual property rights also reduce the willingness of B to engage in opportunism by creating punishments for violating IPR agreements. However, we believe it is difficult, and sometimes impossible, for the
focal firm to detect whether a potential partner firm will or will not be motivated to take advantage of the focal firm’s vulnerabilities during the collaboration. Since the focal firm knows that its partner has the ability to do so, and is not sure about the willingness, we argue that the focal firm will resort to safeguards such as trust to protect its valuable technologies at the beginning of alliance formation.

There are also limitations associated with the transfer of technologies. First, in R&D alliances, there is the distinction between uni- and bi-directional high tech relationships. In uni-directional relationships, the factors influencing partner selection may differ when the focal firm plays different roles – the source vs. the recipient. In bi-directional relationships, the firm may be particularly cautious because of the frequent exchange of information and knowledge with its partners. We could not account for these different relationships in the current study because of the difficulty in identifying them. Perhaps they can be examined by follow-up studies specifically targeting the different relationships.

Second, we did not consider the depletion of the knowledge stocks by partner firms. While the literature has focused on the learning side of knowledge transfer in alliances, there are a few studies examining the depletion effects of the “learned” knowledge. Our study is not an exception to this common practice in that we too focused on the learning side of knowledge transfer in alliances. The knowledge “learned” from alliance partners may be depleted over time because technology employees involved in the alliance leave the company, because the partner further advances the knowledge shared in an alliance (when the partner is the main knowledge supplier in the relationship), or because the knowledge supplied or developed jointly becomes out-of-date in the rapidly changing competitive landscape. Regardless of the cause of knowledge depletion, the consequence is a changed technological combination between alliance partners.
Such a change may alter a firm’s decision on with whom to partner for the next alliance.

**Future Research**

Important findings from this study identify several avenues for future research. First, we found that different mechanisms are used to manage separate knowledge leakage concerns. Governance design was used to deal with ineffective external protection mechanisms, while partner selection was used to manage the internal contacts with partners required by the objective of R&D collaborations. These findings are important because they add partner selection to the mix of governance decisions made in managing alliances. The extent to which the two mechanisms are used as pure substitutes versus complementary mechanisms should be an important focus in future alliance management research.

Second, our study represents an initial effort to identify, differentiate and measure Acquaintances and Friends. However, the coarse-grained nature of our measures calls for additional work. While one good prior relationship may be much better than the sum of several failed alliances, the current measures were not able to capture such differences. More in-depth examination of the characteristics of prior alliances (such as activities involved, time duration of alliances) holds promise for future insightful conclusions. A related future research suggestion concerns the need for a detailed examination of Acquaintance firms. For example, how do Acquaintances with unpleasant experiences consider each other as potential partners for new R&D alliances? What about Acquaintances involved in serious lawsuits, a situation in which Acquaintances may become enemies?

Third, although our focus is on the comparison among Friends, Acquaintances and Strangers, we also call for research on the choice between Strangers. One challenge for many alliances is the ability to choose between different types of Strangers instead of among Friends,
Acquaintances and Strangers, in light of the distribution of resources to be accessed versus the limited number of alliances already formed by many companies. This issue deserves attention as an important dimension of partner selection.

Fourth, investigating the role of general alliance experience on partner selection is a promising avenue for future research. Although we included the partner firms’ alliance experience, independent of partner and alliance type, future work might be completed to examine how general alliance experience may moderate the causalities investigated in this study. Will the firm’s alliance experience in general promote its selection of Strangers to capture technological novelty? If so, how will the variation in firms’ general alliance experience affect their considerations of different types of partners?

Fifth, the number of international R&D alliances has increased during the past decade because they have become a major means of developing and/or acquiring technological assets (Narula & Duysters, 2004). The complexities of the global business environment and the lack of familiarity between alliance partners from different countries together produce a higher perceived risk of opportunism than in domestic alliances (McCutchen, Swamidass, & Teng, 2004). As a result, alliance partners are likely to be more concerned about knowledge leakage in international alliances compared to domestic ones. Such concerns may be reflected by cautious selection of alliance partners. Therefore, research on partner selection for international R&D alliances, as a mechanism to protect alliance participants’ technological assets, is needed.

A sixth research avenue focuses on multi-partner R&D alliances. These alliances have gradually emerged in many industries to cope with the tremendous resource requirements and/or risks involved in large-scale R&D projects. While multilateral alliances have the same value creation logic as bilateral R&D alliances, the involvement of more than two participants
complicates alliance design and governance (Doz & Hamel, 1998). With more partners and the lack of direct reciprocity among partner firms, knowledge protection becomes an even more difficult task in multilateral than bilateral R&D alliances. Hence, further exploration of R&D alliances with multiple partners and how each partner’s core competencies can be protected from being appropriated is warranted.

Seventh, the comparison between alliances and acquisitions is worth noting. If information asymmetry is low between prior partners, the firm might complete an acquisition instead of forming an alliance, thereby avoiding some of the hazards typically associated with alliances. There are various considerations that justify the choice between an alliance and an acquisition, even if the adverse selection problem is resolved for a particular transaction. Hence, a comparison between alliances and acquisitions for R&D purposes should be fruitful in offering both theoretical and practical implications.

A final meaningful research avenue is to examine the dynamics of alliance management. For instance, investments in co-specialized assets during R&D collaboration may require adjustment of knowledge protection mechanisms (such as re-configuration of ownership structure, inviting new partners into the joint project) and thus renegotiation may come into play. Investigating how these protection mechanisms will be amended as the R&D collaboration evolves deserves more scholarly attention.

In sum, the research presented herein suggests that partner selection can be used as an alternative mechanism to secure firms’ technological assets in R&D collaborations. This mechanism can substitute for other means of protection such as governance structure and alliance scope. Our results suggest that this line of inquiry has potentially important implications for the theory and management of inter-firm alliances.
ENDNOTES

1 We are indebted to a reviewer for this observation.

2 For example, the effective duration of patent protection ranges from 5 years in several Latin American countries to almost 20 years in most European countries.

3 AeA website: http://www.aeanet.org/Publications/IDMK_definition.asp

4 Although we emphasize two-partner R&D alliances in this study, we acknowledge that the analysis of R&D alliances among three or more partners is a useful direction for future research. However, such an analysis is beyond the scope of this paper.

5 The same coding was repeated with seven years and similar results were generated.

6 In our empirical work, we test for the robustness of this assumption by redefining Acquaintances as having two or more prior alliances, and Friends as three or more prior alliances. We also replicate the analyses by adopting a continuous dependent variable (the number of prior relationships).

7 We also employ a dummy variable, RADICALITY2, to measure innovation radicality. The variable takes on the value of one when the innovative goal of a R&D alliance is to develop radical innovations. An innovation is categorized as radical when the alliance synopsis suggests that the primary activity is to pursue next generation technologies. This would include, for example, the alliance between Hitachi and Asahi Optical to develop a next-generation optical head that increases DVD storage capacity to 100GB. The omitted category of alliances involves incremental innovation when the synopsis suggests that alliance activities are focused on development of new products or processes based on existing technologies. An example would be the R&D alliance between Texas Instruments and Sharp to provide research and development services for camera-equipped cellular phones. Sharp agreed to supply camera lenses while Texas
Instrument to make the semiconductor; both activities are based on the firms’ existing technologies. Similar results were observed using RADICALITY and RADICALITY2. Tables are available upon request.

8 The two independent coders are two individuals with engineering degrees and experience (with eleven and seven years of professional experience, respectively). The same set of thirty synopses was first given to each of the coders who coded; the codings were then compared to ensure consistency. Thereafter, the coders were asked to code all of the remaining synopses.

9 A random sample of 50 of the codings was re-examined by a patent officer; analysis showed that his coding was correlated with the independent coders’ coding at the level of 0.91.

10 Cohen’s Kappa is used to assess inter-rater reliability and is considered to be an improvement over using % agreement to evaluate this type of reliability. Kappa has a range from 0 ~ 1.00, with larger values indicating better reliability.

11 We also measure the intellectual property protection using the number of years since the country signed the Paris Convention for Protection of Industrial Property. We log and center this variable; similar regression results were observed.

12 We replicated the analyses by using the proxy of total intangible assets as firm size. Similar results were observed.

13 The same coding was repeated with seven years; the analysis yielded similar results.

14 We gratefully acknowledge an anonymous reviewer for pointing this out to us.
REFERENCES

Gulati, R., & Singh, H. 1998. The architecture of cooperation: Managing coordination costs and


Note: Broken arrows represent causalities previously tested in the literature.
FIGURE 2
TRANSITIVITY OF PARTNER SELECTION DECISIONS

Risk & Return (in $)

Innovation Benefits from Greater Trust & Reduced Information Asymmetry

Opportunism Risk (Low Vulnerability)

Opportunism Risk (High Vulnerability)

Stranger Acquaintance Friend

Number of Prior Partnerships
### TABLE 1

**DESCRIPTIVE STATISTICS**

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>S.D.</th>
<th>Min</th>
<th>Max</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
<th>12</th>
<th>13</th>
<th>14</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Partner</td>
<td>1.47</td>
<td>0.78</td>
<td>1</td>
<td>3</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Friend</td>
<td>0.18</td>
<td>0.37</td>
<td>0</td>
<td>1</td>
<td>0.92</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Firm Size: Partner 1</td>
<td>3.10</td>
<td>1.58</td>
<td>-4.07</td>
<td>6.61</td>
<td>0.04</td>
<td>0.05</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Firm Size: Partner 2</td>
<td>2.16</td>
<td>1.14</td>
<td>-4.96</td>
<td>4.88</td>
<td>0.08</td>
<td>0.08</td>
<td>-0.01</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Firm Age: Partner 1</td>
<td>3.40</td>
<td>0.64</td>
<td>0</td>
<td>4.71</td>
<td>0.00</td>
<td>0.01</td>
<td>0.42</td>
<td>-0.03</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Firm Age: Partner 2</td>
<td>2.58</td>
<td>0.37</td>
<td>0</td>
<td>4.73</td>
<td>-0.05</td>
<td>-0.04</td>
<td>0.00</td>
<td>0.16</td>
<td>0.05</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>General Alliance Experience: Partner 1</td>
<td>1.35</td>
<td>1.67</td>
<td>0</td>
<td>6.46</td>
<td>0.13</td>
<td>0.11</td>
<td>0.05</td>
<td>-0.02</td>
<td>0.08</td>
<td>-0.01</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>General Alliance Experience: Partner 2</td>
<td>1.45</td>
<td>1.77</td>
<td>0</td>
<td>6.46</td>
<td>0.23</td>
<td>0.18</td>
<td>-0.02</td>
<td>0.13</td>
<td>0.00</td>
<td>0.02</td>
<td>0.13</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Prior Cooperation Complexity</td>
<td>0.76</td>
<td>2.51</td>
<td>0</td>
<td>34.49</td>
<td>0.50</td>
<td>0.45</td>
<td>0.04</td>
<td>0.05</td>
<td>0.06</td>
<td>-0.01</td>
<td>0.26</td>
<td>0.28</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Technology Overlap</td>
<td>0.04</td>
<td>0.15</td>
<td>0</td>
<td>1</td>
<td>0.12</td>
<td>0.11</td>
<td>0.03</td>
<td>0.03</td>
<td>-0.05</td>
<td>0.00</td>
<td>0.19</td>
<td>0.04</td>
<td>0.18</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Equity</td>
<td>0.15</td>
<td>0.36</td>
<td>0</td>
<td>1</td>
<td>-0.04</td>
<td>-0.07</td>
<td>0.11</td>
<td>0.07</td>
<td>0.09</td>
<td>0.04</td>
<td>-0.05</td>
<td>-0.07</td>
<td>-0.03</td>
<td>0.00</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>Scope</td>
<td>0.59</td>
<td>0.49</td>
<td>0</td>
<td>1</td>
<td>-0.10</td>
<td>-0.08</td>
<td>0.01</td>
<td>0.02</td>
<td>-0.02</td>
<td>0.03</td>
<td>0.00</td>
<td>0.04</td>
<td>-0.01</td>
<td>0.01</td>
<td>-0.06</td>
<td></td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>Radicality</td>
<td>0.00</td>
<td>1.00</td>
<td>-2.53</td>
<td>2.39</td>
<td>0.18</td>
<td>0.24</td>
<td>0.02</td>
<td>0.01</td>
<td>0.04</td>
<td>0.07</td>
<td>0.04</td>
<td>0.01</td>
<td>0.07</td>
<td>-0.02</td>
<td>-0.02</td>
<td>0.13</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>Protection</td>
<td>0.00</td>
<td>0.68</td>
<td>-4.95</td>
<td>1.06</td>
<td>0.04</td>
<td>0.03</td>
<td>-0.12</td>
<td>-0.04</td>
<td>-0.08</td>
<td>-0.02</td>
<td>0.02</td>
<td>0.02</td>
<td>-0.04</td>
<td>0.00</td>
<td>-0.16</td>
<td>-0.07</td>
<td>0.01</td>
</tr>
<tr>
<td>15</td>
<td>Year</td>
<td>1995.90</td>
<td>2.37</td>
<td>1994</td>
<td>2003</td>
<td>-0.04</td>
<td>-0.05</td>
<td>0.09</td>
<td>0.02</td>
<td>0.07</td>
<td>0.06</td>
<td>-0.12</td>
<td>-0.07</td>
<td>0.06</td>
<td>-0.03</td>
<td>0.07</td>
<td>0.08</td>
<td>0.00</td>
</tr>
</tbody>
</table>

Notes: N=1159; * p<.05
### TABLE 2
MULTINOMIAL LOGISTIC REGRESSION

<table>
<thead>
<tr>
<th>Control variables</th>
<th>Model 1 (ACQ)</th>
<th>Model 2 (FRD)</th>
<th>Model 3 (ACQ)</th>
<th>Model 4 (FRD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Firm Size: Partner 1</td>
<td>-0.26</td>
<td>-0.09</td>
<td>-0.28</td>
<td>-0.23</td>
</tr>
<tr>
<td>Firm Size: Partner 2</td>
<td>0.16</td>
<td>0.51</td>
<td>0.19</td>
<td>0.52</td>
</tr>
<tr>
<td>Firm Age: Partner 1</td>
<td>1.26</td>
<td>1.12</td>
<td>1.30</td>
<td>1.26</td>
</tr>
<tr>
<td>Firm Age: Partner 2</td>
<td>-2.11</td>
<td>-2.07</td>
<td>-2.06</td>
<td>-2.25</td>
</tr>
<tr>
<td>General Alliance Experience: Partner 1</td>
<td>0.30</td>
<td>0.21</td>
<td>0.34</td>
<td>0.24</td>
</tr>
<tr>
<td>General Alliance Experience: Partner 2</td>
<td>1.07 *</td>
<td>0.96 *</td>
<td>1.09 †</td>
<td>1.21 †</td>
</tr>
<tr>
<td>Prior Cooperation Complexity</td>
<td>34.56</td>
<td>34.76</td>
<td>34.51</td>
<td>34.73</td>
</tr>
<tr>
<td>Equity</td>
<td>4.89 *</td>
<td>3.85 *</td>
<td>4.52 *</td>
<td>3.92 †</td>
</tr>
<tr>
<td>Scope</td>
<td>-0.21</td>
<td>-0.40</td>
<td>-0.16</td>
<td>-0.44</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Independent variables</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Radicalsity</td>
<td>-</td>
<td>-</td>
<td>-0.96 *</td>
<td>0.15 **</td>
</tr>
<tr>
<td>Protection</td>
<td>-</td>
<td>-</td>
<td>-0.47</td>
<td>-0.17</td>
</tr>
<tr>
<td>Intercept</td>
<td>-8.03</td>
<td>-8.07</td>
<td>-8.68</td>
<td>-6.22</td>
</tr>
</tbody>
</table>

| N                                      | 1159          | 1159          |               |               |
| Log likelihood                         | -207.83       | -180.06       |               |               |
| LR-Chi²                                | 1412.46***    | 1468.02***    |               |               |

Notes:
1. ACQ = Acquaintance. FRD = Friend. The comparison baseline is Stranger.
2. Two-tailed t statistics where † p < .10, * p < .05, ** p < .01, *** p < .001.
3. Because of space limitations, we did not include individual coefficients on dummy variables for year and industry in this table.
TABLE 3
THREE-STAGE LEAST SQUARES REGRESSION

<table>
<thead>
<tr>
<th>3SLS with FRIEND, EQUITY, and SCOPE as exogenous variables</th>
<th>FRIEND</th>
<th>EQUITY</th>
<th>SCOPE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Friend</td>
<td>-0.14 ***</td>
<td>-0.34 ***</td>
<td></td>
</tr>
<tr>
<td>Equity</td>
<td>-0.13 ***</td>
<td>-0.21 ***</td>
<td></td>
</tr>
<tr>
<td>Scope</td>
<td>-0.16 ***</td>
<td>-0.11 ***</td>
<td></td>
</tr>
<tr>
<td>Firm Size: Partner 1</td>
<td>0.01 †</td>
<td>0.02 *</td>
<td>0.01</td>
</tr>
<tr>
<td>Firm Size: Partner 2</td>
<td>0.03 **</td>
<td>0.02 **</td>
<td>0.01</td>
</tr>
<tr>
<td>Firm Age: Partner 1</td>
<td>-0.02</td>
<td>0.02</td>
<td>-0.00</td>
</tr>
<tr>
<td>Firm Age: Partner 2</td>
<td>-0.04 †</td>
<td>0.02</td>
<td>0.02</td>
</tr>
<tr>
<td>General Alliance Experience: Partner 1</td>
<td>-0.01</td>
<td>-0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>General Alliance Experience: Partner 2</td>
<td>0.01</td>
<td>-0.01</td>
<td>0.02 *</td>
</tr>
<tr>
<td>Prior Cooperation Complexity</td>
<td>0.06 ***</td>
<td>0.00</td>
<td>0.01 †</td>
</tr>
<tr>
<td>Technology Overlap</td>
<td>0.11</td>
<td>0.06</td>
<td>0.11</td>
</tr>
<tr>
<td>Radicality</td>
<td>0.09 ***</td>
<td>0.01</td>
<td>0.09 ***</td>
</tr>
<tr>
<td>Protection</td>
<td>0.01</td>
<td>-0.11 ***</td>
<td>-0.06 *</td>
</tr>
</tbody>
</table>

*Intercept*        0.34 *** | -0.04 | 0.58 *** |

N                      1159 | 1159 | 1159 |

Chi2                    527.61*** | 172.58*** | 160.04*** |

F-value                 17.02*** | 5.58*** | 5.16*** |

Notes:
1. Two-tailed t statistics where † p< .10, * p< .05, ** p< .01, *** p< .001.
2. Because of space limitations, we did not include individual coefficients on dummy variables for year and industry in this table.
Dan Li (lid@indiana.edu) is an assistant professor of international business at the Kelley School of Business, Indiana University. She received her Ph.D. from Texas A&M University. Her research interests include the management of multinational enterprises, particularly in the areas of international strategic alliances.

Lorraine Eden (leden@tamu.edu) is a Professor of Management at Texas A&M University. Her current research focuses on strategies of multinationals in corrupt economies and tax havens, MNE responses to liability of foreignness and regional integration, and transfer price manipulation. Professor Eden is incoming Editor in Chief of the Journal of International Business Studies and a Fellow of the Academy of International Business.

Michael A. Hitt (mhitt@cgsb.tamu.edu) is a distinguished professor of management and holds the Joe B. Foster Chair in Business Leadership and the Dorothy Conn Chair in New Ventures at Texas A&M University. He received his Ph.D. from the University of Colorado. His research interests include managing resources in organizations, international strategy, corporate governance, and strategic entrepreneurship.

R. Duane Ireland (direland@mays.tamu.edu) holds the Foreman R. and Ruby S. Bennett Chair in Business at Texas A&M University. He is a fellow of the Academy of Management. Strategic alliances, managing organizational resources, and strategic entrepreneurship are current research interests.