The Knowledge Spillover Theory of Entrepreneurship in Alliances

Chengli Shu
Cuijuan Liu
Shanxing Gao
Mark Shanley

We develop and examine a framework for the knowledge spillover theory of entrepreneurship in alliances. Our framework regards entrepreneurial opportunity as endogenous, and entrepreneurial firms as heterogeneous. The empirical findings show that partners' knowledge protection, which is regarded as a knowledge filter, can increase knowledge spillovers in an alliance. Moreover, this relationship is contingent on the strength of a focal firm's entrepreneurial orientation and on alliance type (equity joint venture versus nonequity joint venture). Results also reveal that knowledge spillovers in an alliance enhance alliance performance more significantly than they enhance firm performance.

Introduction

The study of entrepreneurship is a science of opportunities. The knowledge spillover theory of entrepreneurship (KSTE) explicates one important source of entrepreneurial opportunities, namely those that are generated by entrepreneurs through utilizing commercially valuable but underexploited knowledge created by others (Acs, Braunerhjelm, Audretsch, & Carlsson, 2009; Agarwal, Audretsch, & Sarkar, 2007, 2010; Audretsch & Keilbach, 2007, 2008; Audretsch & Lehmann, 2005; Braunerhjelm, Acs, Audretsch, & Carlsson, 2010). The KSTE rests on two premises: (1) the presence of knowledge filters in knowledge-creating firms, and (2) knowledge spillovers. *Knowledge filters* are barriers that can prevent firm knowledge from being fully converted into economic knowledge (Arrow, 1962; Braunerhjelm et al.; Mueller, 2006). The presence of a knowledge filter raises the gap between the useful knowledge created by knowledge-creating firms and the actual knowledge that firms eventually commercialize. The failure of knowledge-creating

firms to fully exploit their knowledge exposes them to knowledge exploitation by others through knowledge spillovers. *Knowledge spillovers* are "the external benefits from knowledge creation that is enjoyed by parties other than the party investing in the creation" (Agarwal et al., p. 272). According to the KSTE, labor mobility, namely the movement of human capital from knowledge-creating firms to entrepreneurial firms, allows knowledge created by the former to be commercialized by the latter without full compensation. The KSTE hinges, thus, on the presence of knowledge filters that prevent knowledge from being fully exploited in knowledge-creating firms, as well as on knowledge spillovers through which the knowledge is commercialized by entrepreneurial firms.

Although the entrepreneurial opportunities explicated by the KSTE are realized through interfirm knowledge spillovers, our understanding of how the KSTE works at the interfirm level remains limited. First, the current literature has inadequately addressed the existence of the two premises of the KSTE at the interfirm level. As Agarwal et al. (2010, p. 272) posit, "the presence of knowledge spillovers poses a conundrum at the micro level." Second, to the best of our knowledge, the theoretical and empirical bases for the KSTE at the interfirm level are still missing, and these voids make the KSTE at the interfirm level a mystery. At the national and regional levels, endogenous growth models (Lucas, 1988; Romer, 1990) are used to study the existence of knowledge filters and the possible results from knowledge spillovers (e.g., Audretsch & Keilbach, 2007; Braunerhjelm et al., 2010). But national and regional economic growth can be attributed to numerous factors, while the previous KSTE studies can infer only an indirect link of knowledge filters—knowledge spillovers—entrepreneurial behaviors. Third, due to its theoretical origin, the KSTE circumscribes itself from incorporating important entrepreneurial or firm-level characteristics into its framework. While addressing the limitation entailed in viewing entrepreneurial opportunities as exogenous in traditional entrepreneurship research, previous KSTE studies replace this assumption by assuming the homogeneity of entrepreneurs: "this paper instead assumes the individual characteristics to be constant" (Audretsch & Keilbach, p. 1243).

The earlier mentioned knowledge gaps clearly demonstrate the need to establish a more viable framework for the KSTE at the interfirm level, which therefore constitutes the primary purpose of this study. We aim in particular to answer the following research questions: Do knowledge filters and knowledge spillovers, the two premises of the KSTE, exist in the interfirm context? If so, does the focal proposition in the KSTE—the positive relationship between knowledge filters and knowledge spillovers—hold in such a context? How can a particular firm-level entrepreneurial characteristic—the focal firm's entrepreneurial orientation—and the interfirm context be integrated into the KSTE framework, and what are their roles in the focal relationship? How can knowledge spillovers influence firm performance as well as the performance of cooperative interfirm relationships?

To answer these research questions, we first posit that alliances, which form an important class of interfirm relationships, provide a viable context for the occurrence of knowledge spillovers and knowledge filters. Since the KSTE rests on knowledge filters and knowledge spillovers, the possibility of establishing a framework for the KSTE in alliances is first determined by the existence of these two premises in such a context. When partnering, firms tend to employ knowledge-protection activities that are most likely to prevent the protected knowledge from being completely exploited. We suggest, therefore, that partners' knowledge protection is a particular knowledge filter in the alliance context. Second, we underpin our framework for the KSTE in alliances with the interorganizational learning theory. Although alliance practices make knowledge spillovers and knowledge filters possible, it is interorganizational learning that enables partnering firms to penetrate knowledge filters and actualize knowledge spillovers. Third,

Table 1

The Comparison Between the Traditional Knowledge Spillover Theory of Entrepreneurship (KSTE) Framework and the KSTE in Alliances

	Traditional KSTE framework	KSTE in alliances
Empirical existence	National level	Interfirm level (alliances)
	Regional level	
Theoretical bases	Knowledge characteristics	Interorganizational learning theory
	Endogenous growth models	
Antecedents/contextual factors	National and regional factors	Firm entrepreneurial orientation
		Alliance type
Knowledge filters	Divergent valuation of the knowledge between the knowledge creator and decision maker to use that knowledge	Knowledge protection
	Institutions (risk aversion, legal restrictions, bureaucratic constraints, labor market rigidities, taxes, and lack of social acceptance)	
Knowledge spillovers	Labor mobility	Knowledge spillovers in the alliance
Examination of the relationship between knowledge filters and spillovers	Indirect	Direct
Consequences	Entrepreneurial activities at the national level (the share of self-employed in the labor force)	Firm performance
	Regional start-up rate	Alliance performance

we propose that knowledge spillovers in an alliance are greatly influenced by a focal firm's entrepreneurial orientation (EO). At the same time, the focal firm's EO and alliance type serve in the KSTE in alliances as the boundary conditions for the focal relationship. Moreover, we suggest that knowledge spillovers in an alliance can further influence firm performance and alliance performance differently. An EO reflects a firm's posture and predisposition to be proactive, innovative, risk taking, and aggressive in competition (Lumpkin & Dess, 1996). Thus, an EO can motivate firms in identifying, pursuing, and materializing entrepreneurial opportunities generated by knowledge spillovers. With respect to alliance type, equity joint ventures (EJVs) and nonequity joint ventures (non-EJVs) are distinct governance mechanisms that can alter the outcomes of partnerships (Hennart, 1988; Kogut, 1988; Rothaermel & Deeds, 2006). Table 1 compares the previous KSTE framework with the framework of the KSTE in alliances developed in this research.

Knowledge Filters and Knowledge Spillovers in Alliances

An alliance is a partnership between two or more relatively independent organizations that are united to pursue some ongoing activity or process (Hennart, 1988; Williamson, 1985). Alliances, as an important class of interfirm partnership, have been employed by a wide variety of firms and almost every step in the production process can be executed through some type of interfirm cooperation (Powell, Koput, & Smith-Doerr, 1996). Once firms form alliances with others, they may gain and materialize entrepreneurial opportunities that are created by the benefits of such external connections, such as informational, timing, referral, and control benefits (Burt, 1992). Sarkar, Echambadi, and Harrison

(2001) find that alliance proactiveness, a firm's tendency to form alliances, contributes significantly to superior firm market performance. Since entrepreneurial activities demand extra resources, strategic alliances provide an appropriate conduit though which firms can access and utilize such resources that lie beyond their boundaries (Rothaermel & Deeds, 2006; Teng, 2007). An alliance is also a learning mechanism through which knowledge flows from one partner to another or others (Hamel, 1991). In what follows we discuss the existence of knowledge filters and knowledge spillovers, two premises of the KSTE, in the alliance context.

Knowledge Filters

In contrast to physical materials, knowledge can be transmitted only through interpersonal communication or organizational documentation. Yet early research shows that the likelihood that an individual passes information along is closely related to the consequences of the information transmission: Information conducive to an individual's success will be emphasized while problems will be minimized (Argyris, 1953; Simon, 1957). In other words, information is often distorted, modified, or even omitted while moving from one individual to others within an organization. Factors related to organizational communication such as the direction of information flow, individual factors such as personal values and cognitive bases, and social factors such as trust between senders and receivers can significantly influence information filtration (Huber, 1982; O'Reilly & Roberts, 1974). Such knowledge filters are also critical for firm-level entrepreneurial activities. Henderson and Clark (1990) find that established firms tend to rely on knowledge filters in their existing knowledge architecture to separate relevant information from irrelevant information from external sources, which makes them vulnerable to architectural innovations.

Knowledge filters can also hamper firms from utilizing their own internal knowledge. Based on Arrow (1962), a knowledge filter is defined for endogenous growth models as an obstacle that prevents existing knowledge from being completely converted into economic knowledge (Braunerhjelm et al., 2010). Knowledge filters under the KSTE exist when relevant parties, such as the knowledge creator and knowledge users, hold distinctive views on the same piece of knowledge. Since the knowledge creator by nature has advantages over knowledge users in evaluating the focal knowledge, these two parties may differ greatly in their attitudes toward commercializing such knowledge. When the resulting discrepancy is great enough, the knowledge creator may choose to leave the knowledge-creating firm and open an independent enterprise to commercialize the knowledge. From a broader perspective, organizational capabilities, routines, strategic orientations, culture, and even governance policies can serve as knowledge filters (Agarwal et al., 2007; Braunerhjelm et al.). However, existing KSTE studies focus primarily on knowledge filters within individual firms, while we present the evidence resulting from our study to establish the existence of knowledge filters in the alliance context. We offer three considerations related to knowledge filters in the alliance context.

First, a firm's knowledge filters continue to exist when the firm is partnering with others. Although a firm can learn from partners through alliances, it is unlikely and sometimes impossible for its organizational culture, routines, or strategic orientation to change immediately and sufficiently. For example, it took General Motors more than two decades to learn lean manufacturing techniques from Toyota through their New United Motor Manufacturing, Inc. (NUMMI) alliance (Inkpen, 2008).

Second, separate partnering firms within an alliance may evaluate the same piece of knowledge differently due to their distinct strategic postures, capabilities, and cognitions

(Das & Teng, 2000; Hamel, 1991; Harrison, Hitt, Hoskisson, & Ireland, 2001). According to the KSTE, the divergent valuation of a particular piece of knowledge by separate parties is an important source of knowledge filtering (Agarwal et al., 2007, 2010; Audretsch & Keilbach, 2007, 2008).

Third, and more importantly, knowledge protection is widely employed by partnering firms in alliances. When partnering with others a firm must first open its knowledge boundary for learning to occur, but at the same time the firm will be inevitably learned by its partners (Hamel, 1991; Khanna, Gulati, & Nohria, 1998). Under this situation, partnering firms have to use knowledge protection to prevent their knowledge from being misappropriated by their partners (Kale, Singh, & Perlmutter, 2000; Norman, 2001; Oxley & Sampson, 2004). *Knowledge protection* is "a conscientious and intended state of information filtering" (Simonin, 1999, p. 600). In alliances firms can employ mechanisms such as human resources, the legal structure of alliance agreements and contracts, and alliance processes to protect their proprietary knowledge (Norman; Oxley & Sampson; Simonin). This study focuses on alliance processes, such as actions, procedures, and mechanisms, which occur in the course of an ongoing partnership (Baughn, Denekamp, Stevens, & Osborn, 1997; Norman, 2002). On the one hand, knowledge protection can prevent alliance partners from using a focal firm's proprietary knowledge. On the other hand, the protected knowledge may never be fully commercialized by the protecting firm. According to the KSTE, such protected but undercommercialized or uncommercialized knowledge can embed entrepreneurial opportunities. Seen in this way, knowledge protection can be regarded as a particular knowledge filter in the alliance context. Although previous KSTE studies have examined several knowledge filters at the national and regional levels, this study focuses particularly on knowledge protection and its effect on knowledge spillovers in an alliance.

Knowledge Spillovers

Knowledge spillovers originate from the positive externality of a piece of knowledge due to its nonexcludability and nonexhaustibility (Arrow, 1962; Grossman & Helpman, 1991; Romer, 1990); that is, one party's use of a piece of knowledge neither precludes others from using the same piece of knowledge nor extinguishes the value of the knowledge. Since the 1980s, scholars have acknowledged the positive externality of research and development (R&D) activities (Audretsch & Feldman, 1996; Griliches, 1991). The phenomena of knowledge spillovers can happen at the interorganizational, regional, and even international level (Grossman & Helpman; Jaffe, Trajtenberg, & Henderson, 1993; Krugman, 1991). Through spillovers, individuals and organizations other than the knowledge creator can take advantage of the knowledge while providing inadequate or no compensation to the creator.

According to the KSTE, it is important to distinguish knowledge spillovers from knowledge transfer. Although both knowledge spillovers and knowledge transfer are knowledge flows, they differ greatly under the KSTE (Agarwal et al., 2010, pp. 272–273):

> While knowledge transfer involves the cross-party compensation of the value of the knowledge flowing between individuals or organizational units in a market-like transaction, knowledge spillovers relates to knowledge flows that are un- or undercompensated. That is, the recipient of the knowledge spillover is able to access the knowledge without completely paying for the value of the knowledge. Further, knowledge transfer may also (though not always) connote rivalness of use, while knowledge spillovers entails that the knowledge is simultaneously available to both parties.

Although previous KSTE studies have evidenced the effects of knowledge spillovers at the regional or national level, knowledge spillovers in the alliance context have not been adequately investigated. The present study, however, finds clear evidence of the existence of knowledge spillovers in the alliance context. First, in alliances, learning can take place in two forms: learning within an alliance and learning from an alliance (Hamel, 1991; Khanna et al., 1998; Zhang, Shu, Jiang, & Malter, 2010). While studies of the former type of learning examine how collective learning affects alliance-based performance, studies of the latter type explicate how individual firms internalize knowledge generated by alliance activities to enhance their own performance. Learning from alliances is a critical channel for knowledge spillovers because firms can exploit the acquired knowledge for self-interested purposes without fully compensating the knowledge owners. Firms, for instance, can combine acquired knowledge with internal knowledge to create new knowledge that they can use to promote their own interests (Nonaka, 1994; Shu, Page, Gao, & Jiang, 2012). As Hamel and Khanna et al. show, every partner in an alliance learns from that alliance in a unique way. The uneven outcomes of interorganizational learning indicate that knowledge spills over asymmetrically: Knowledge exchange between partners typically favors one over the other (or some over others when there are more than two partners). Since an alliance is an interfirm relationship (Hennart, 1988), partners can utilize knowledge spilled over to them directly with no need for labor mobility. In this way, an alliance provides a viable conduit through which firms can exploit partners' underexploited or unexploited knowledge.

Second, in alliances knowledge spillovers can be intended or unintended. Intended spillovers occur when the focal firm in an alliance accepts some spillovers to partners if it can count on an appropriate amount of knowledge spill-ins from those partners (Dyer & Singh, 1998). Unintended knowledge spillovers occur not only when firms learn more than expected from intended alliance activities, but also when they go beyond the boundaries of routine alliance activities to learn other capabilities from partners (Easterby-Smith, Lyles, & Tsang, 2008). In this way unintended knowledge spillovers allow partners to obtain additional knowledge at reduced or no cost (Feinberg & Gupta, 2004; Jaffe et al., 1993). Because of the incompleteness of typical cooperative contracts and the high costs of enforcing them, firms are motivated to exploit their partners' knowledge beyond what might have been specified in such contracts.

In sum, knowledge filters exist in alliances in the form of partners' knowledge protection, and alliances provide conduits through which knowledge spillovers can occur more conveniently. These considerations seem to confirm that the two premises of the KSTE hold true in the alliance context, which allows us to pursue a framework for the KSTE in alliances.

Conceptual Framework and Research Hypotheses

Partners' Knowledge Protection and Knowledge Spillovers in an Alliance

The interorganizational learning theory depicts a learning dilemma known as the "boundary paradox" in the alliance context (Kale et al., 2000; Norman, 2001; Oxley & Sampson, 2004; Quintas, Lefrere, & Jones, 1997). The paradox works as follows. In order to learn, firms in an alliance must first open their own knowledge boundaries and share their knowledge with their partners. A reasonable overlap of partnering firms' knowledge and skills makes interorganizational learning possible. But when firms open their knowledge boundaries, their proprietary knowledge will be more likely to be misappropriated by the partners. As a consequence, firms usually exercise knowledge protection when

partnering with others. As mentioned earlier, knowledge protection serves as a knowledge filter in the alliance context. Thus, the interorganizational learning theory becomes the theoretical underpinning for positing the coexistence of knowledge filters and knowledge spillovers in alliances.

The dilemma of learning in alliances suggests that the primary purpose of knowledge protection is to mitigate knowledge misappropriation by alliance partners. The theoretical assumption supporting knowledge protection as a strategy is the occurrence of partner opportunism in knowledge acquisition (Kale et al., 2000; Madhok & Tallman, 1998; Oxley & Sampson, 2004). Knowledge protection therefore serves as a safeguard against opportunistic behaviors. However, more recent empirical findings fail to support this idea. For example, Simonin (1999) finds that partner protectiveness does not significantly influence knowledge ambiguity, which is found to decrease knowledge transfer in alliances. Norman (2004) finds that a focal firm's knowledge protection does not significantly influence its knowledge acquisition from an alliance but can significantly enhance its knowledge loss to the alliance.

The earlier contradiction between theory and empirical findings provides two important implications for our current study. First, a dyadic perspective should be employed when investigating the role of knowledge protection in alliances. Since knowledge protection means preventing those who do not own the knowledge from using it, its effects can be assessed more accurately by knowledge seekers than by knowledge owners. Although the primary purpose of knowledge protection is, from the knowledge owner's perspective, decreasing unintended knowledge flows, knowledge protection can actually send strong signals to knowledge seekers and induce them to seek the protected knowledge more aggressively. In this case, the existing contradiction between theory and empirical findings may be due to the contrasting perspectives employed. Second, such unexpected findings from previous studies actually open the door to alternative interpretations of the role of knowledge protection in alliances. Based on these two implications, this research posits three reasons that a focal firm's perception of its partners' knowledge protection could have a positive effect on knowledge spillovers in an alliance.

First, partners' knowledge protection can restrict the availability of the protected knowledge. As the knowledge valuation perspective in the interorganizational learning theory suggests (Menon & Pfeffer, 2003; Zhang et al., 2010), the more restricted the availability of a certain piece of knowledge is, the greater is the possibility that the knowledge will be subject to overvaluation, "in part because it requires greater expenditures of time, effort, and financial resources to obtain" (Menon & Pfeffer, p. 500). If a piece of knowledge is highly valued, it is more likely to be pursued.

Second, related to the first reason, partners' knowledge protection sends a strong signal that the protected knowledge is valuable and thus rare. Firms are more likely to protect those resources that are rare, valuable, not perfectly substitutable, and inimitable. If a focal firm perceives that its partners place great emphasis on protecting some of their knowledge, the focal firm will naturally believe that the protected knowledge is valuable and thus is more worthy of learning. In this case, the restricted availability and enhanced rarity of the partners' knowledge make the focal firm more aggressively penetrate the partners' knowledge protection.

Third, knowledge protection will leave the protected knowledge incompletely commercialized, which gives rise to entrepreneurial opportunities through knowledge spillovers. Knowledge protection undertaken in the course of alliance-related processes aims to limit knowledge outflows (Norman, 2001, 2002; Quintas et al., 1997). Contrary to traditional tangible goods, knowledge is not subject to rivalry insofar as one party can use the knowledge without interfering with its usage by others (Arrow, 1962; Romer, 1990).

In the context of knowledge spillovers, Grossman and Helpman (1991, p. 518, italics in the original) argue that "Knowledge is *non-rival*; that is, the same idea can be used in different applications and in different locations at the same time." Even if a piece of knowledge has spilled over to others, the owner can still use the knowledge for its own sake. Because of the nonrival nature of a piece of knowledge, the more broadly the knowledge is used, the greater its value will be. If firms in alliances protect their knowledge, the potential value of the protected knowledge is diminished, leaving the protected knowledge underexploited or even unexploited. According to the KSTE, such underexploited or unexploited knowledge gives rise to entrepreneurial opportunities through knowledge spillovers. Indeed, a recent empirical study by Norman (2004) shows that a focal firm's knowledge protection can actually increase its knowledge loss to an alliance. The earlier discussion reasonably leads to the following hypothesis.

> **Hypothesis 1:** In an alliance, a focal firm's perception of its partners' knowledge protection is positively related to knowledge spillovers in the alliance.

Knowledge Spillovers in an Alliance and Performance

In the course of partnering, firms may simultaneously pursue both common and private benefits (Khanna et al., 1998). These benefits consist of anticipated firm performance as well as alliance performance. Knowledge spillovers in an alliance may influence the focal firm's performance as well as the alliance performance, but the relative importance of knowledge spillovers to these two types of performance is unclear. Therefore, this study aims to simultaneously examine the influences of knowledge spillovers on both a focal firm's performance and alliance performance. While firm performance consists in the private benefits that a focal firm can accrue from a partnership as well as the benefits generated entirely through its internal resources and operations, alliance performance reflects the collaborative outcomes of the contributions made by all partnering firms (Khanna et al.).

Knowledge spillovers can allow a focal firm to combine knowledge from partners with its internal knowledge, thereby restructuring its knowledge portfolios and achieving important synergies from the external and internal knowledge (Galunic & Rodan, 1998). Knowledge assimilation, combination, reconfiguration, and transformation can assist a focal firm in realizing the potential value embedded in its external and internal knowledge (Zahra & George, 2002). Specifically, these knowledge-management processes can broaden the focal firm's view of understanding, sharpen its problem-solving skills, and further enhance its performance (Zhang et al., 2010). More importantly, knowledge spillovers can grant the focal firm these benefits at extremely low or no costs.

Knowledge spillovers can also enhance alliance performance. Alliance performance can include financial performance, operational performance, and organizational effectiveness (Arino, 2003; Lunnan & Haugland, 2008). While alliance performance varies in the perceptions of alliance partners and changes over time, an alliance's organizational effectiveness is the most commonly used and comprehensive measure of alliance performance. Organizational effectiveness in alliance performance is the fulfillment of goals, such as financial and market achievements (Arino). Knowledge spillovers can enhance the goal fulfillment of an alliance because they can provide abundant opportunities for learning.

In the alliance context, bidirectional or multidirectional rather than unidirectional knowledge spillovers are most likely to occur (Knott, Posen, & Wu, 2009). The common interests pursued in such a cooperative relationship are promoted through opportunities

for knowledge spillovers. In a recent study, Yang, Phelps, and Steensma (2010) find that knowledge creators can learn from imitators when the latter use the former's knowledge to create new knowledge through knowledge combination. In this case, there is a "spillover knowledge pool" that can enhance innovation in both innovating firms and followers. In the alliance context, there also is a spillover knowledge pool that is constituted by knowledge spillovers contributed by all partners and that also can benefit an alliance as a whole. The more knowledge spillovers there are, the bigger is the spillover knowledge pool and the greater the possibility that an alliance as a common community can achieve higher financial and market objectives.

Since knowledge spillovers in alliances are most often multidirectional, partnering firms are both recipients of and contributors to knowledge spillovers (Knott et al., 2009). According to the KSTE, when there are knowledge spillovers and spill-ins, the community experiences a process of "creative construction" (Agarwal et al., 2007, 2010; Kotha, 2010). During the process of creative construction, two types of firm will be better off: One is the incumbent firm and the other is the new ventures that are opened by exploiting knowledge created but undercommercialized or uncommercialized in the incumbent firm. That is, alliance performance can be improved through both spillovers and spill-ins. We suggest that, during the process of creative construction, an alliance can actually benefit to a greater extent than a focal firm can because both knowledge spillovers and spill-ins can contribute to the size of the alliance's spillover knowledge pool.

Hypothesis 2a, b: Knowledge spillovers in an alliance are positively related to (a) the focal firm's performance and (b) alliance performance.

Hypothesis 3: Knowledge spillovers in an alliance have a stronger positive relationship with alliance performance than with the focal firm's performance.

The EO and Knowledge Spillovers in an Alliance

An EO comprises a firm's strategic postures, especially the processes, structures, and behaviors that enable them to be innovative, proactive, aggressive, and risk taking (Covin & Slevin, 1989; Lumpkin & Dess, 1996). While an EO traditionally has three dimensions—innovativeness, proactiveness, and risk taking—Lumpkin and Dess add two additional dimensions—competitive aggressiveness and autonomy. We consider competitive aggressiveness to be more important than autonomy in the alliance context. Because autonomy is "the independent action of an individual or a team in bringing forth an idea or a vision and carrying it through to completion" (Lumpkin & Dess, p. 140), it is incongruent to some extent with the primary objective of alliances, namely cooperation. This paper, echoed by other research (e.g., Wang, 2008), focuses on four core dimensions of an EO: innovativeness, proactiveness, risk taking, and competitive aggressiveness. With respect to the KSTE in alliances, an EO reflects alliance partners' entrepreneurial posture in the pursuit and exploitation of knowledge spillovers.

Several studies have found that alliance proactiveness on the part of partner firms can positively influence performance (Sarkar, Aulakh, & Madhok, 2009; Sarkar et al., 2001), but the relationship between a focal firm's EO and knowledge spillovers in an alliance has not been examined. In prior KSTE studies, knowledge spillovers are said to happen only when employees in a knowledge-creating firm can penetrate the firm's knowledge filters, for example by leaving the firm (Acs, Braunerhjelm, et al., 2009; Audretsch & Aldridge, 2009). In the alliance context, although knowledge spillovers do not necessitate labor mobility, firms do need both motivation and capabilities to pursue these opportunities.

First, firms with a stronger EO have greater motivation to seek opportunities for knowledge spillovers in an alliance. An EO reflects a firm's strategic posture and describes the extent to which the firm departs from established practices to champion new ideas. Firms with a strong EO attempt to beat their competitors by exploiting market opportunities and tolerating the risks involved in new products, services, and markets. As a consequence, from the knowledge valuation perspective in the interorganizational learning theory, a focal firm with a stronger EO tends, when cooperating with others, to value external knowledge highly while disregarding its own internal knowledge (Menon & Pfeffer, 2003; Menon, Thompson, & Choi, 2006; Zhang et al., 2010). Such unequal treatment of internal and external knowledge by firms with a strong EO will intensify knowledge-seeking activities and thus generate greater knowledge spillovers in the alliance.

Second, firms with a strong EO tend to emphasize organizational learning and internal knowledge creation. The entrepreneurial style of operations enhances a firm's capabilities for knowledge acquisition and utilization (Keh, Nguyen, & Ng, 2007). Atuahene-Gima and Ko (2001) suggest that a firm's EO can be regarded as a learning and selection mechanism for screening opportunities. Wang (2008) argues that adopting an EO can broaden the scope of organizational learning, while Anderson, Covin, and Slevin (2009) find that an EO can upgrade a firm's strategic learning capability. High levels of organizational learning capability can further broaden the extent of communication and knowledge flows in alliances. By providing a focal firm with necessary capabilities and strong motivation, an EO can generate more knowledge spillovers in an alliance.

Hypothesis 4: A focal firm's EO is positively related to knowledge spillovers in an alliance.

The EO and Alliance Type as Moderators

In the previous discussion, it is proposed that a focal firm's EO positively influences knowledge spillovers in an alliance, while it can impact the relationship between partners' knowledge protection and knowledge spillovers in an alliance as well. First, adopting an EO can drive firms to value partners' knowledge and increase gaps in knowledge valuation between alliance partners. Because a focal firm with a strong EO has the propensity to act proactively, innovatively, and aggressively, and to accept underlying risks, it will use novel perspectives to examine partners' knowledge, which can exaggerate the role of knowledge protection with respect to knowledge spillovers. Second, even when knowledge filters are weak, a focal firm with a stronger EO is better able to exploit novel, aggressive, and risky opportunities for knowledge spillovers in an alliance. Knowledge protection practiced by partners may dissuade firms with a weaker EO from pursuing knowledge spillovers, but for firms with a strong EO, knowledge protection will be appreciated and lead to more aggressive learning since knowledge protection can increase the rarity and restrict the availability of the protected knowledge.

Hypothesis 5: The positive relationship between partners' knowledge protection and knowledge spillovers in an alliance will be stronger when the focal firm's entrepreneurial orientation is relatively high.

Since an alliance is a hybrid governance structure that can be distinguished from a market or a hierarchy (Williamson, 1985), alliance partners must establish governance structures in advance and reinforce these structures in practice to facilitate cooperation (Khanna et al., 1998). Regarding initial governance arrangements, alliance type (EJV or non-EJV)

is the major variable (Das & Teng, 2000; Hennart, 1988; Rothaermel & Deeds, 2006; Sampson, 2007). The key distinction between EJVs and non-EJVs is that the former, but not the latter, are legal organizations that are relatively independent of their parent firms. Researchers have identified several advantages of EJVs over non-EJVs from the transaction cost economics and strategic position perspectives (Kogut, 1988). Because EJVs can provide, inherently, mutual hostage (Williamson), they can better align disparate partner motives, and alliances based on such equity are more stable. Moreover, partners in EJVs tend to exhibit higher levels of mutual trust, which makes them less likely to take advantage of others' weaknesses (Das & Teng, 1998; Gulati, 1995).[1] Even when a focal firm notices that its partners' knowledge protection could create knowledge spillovers, it may not actually exploit these opportunities because of mutual trust, and because in EJVs such exploitative activities are more visible. Once alliance partners detect that a focal firm has taken advantage of their knowledge filters, they may employ countermoves to discourage or prevent these activities. Thus, firms in EJVs are less likely to exploit opportunities for knowledge spillovers that are embedded in partners' knowledge protection.

> **Hypothesis 6:** The positive relationship between partners' knowledge protection and knowledge spillovers in an alliance is weaker in EJVs than it is in non-EJVs.

So far, we have hypothesized that a focal firm's EO and alliance type exert opposing moderation effects on the relationship between knowledge protection and knowledge spillovers in an alliance. We expect that these two moderators can simultaneously influence the focal link between knowledge protection and spillovers. Given a certain level of knowledge protection and alliance type, a focal firm with a strong EO may still want to take advantage of its partners' knowledge protection. Because adopting an EO can equip firms with motivation and capabilities to pursue external knowledge proactively, innovatively, and aggressively, and accept the corresponding risks, a focal firm's EO can enhance the level of knowledge spillovers in an alliance even when the level of knowledge protection and alliance type are given. In this case, we propose a three-way interaction effect of partners' knowledge protection, alliance type, and a focal firm's EO on knowledge spillovers in an alliance.

> **Hypothesis 7:** When a focal firm's EO is relatively high, the negative moderation effect of alliance type (EJV or non-EJV) on the relationship between partners' knowledge protection and knowledge spillovers in the alliance becomes stronger (more negative).

Methods

Sampling and Data Collection

We obtained our data from a cross-sectional survey of 219 alliances that were located in 21 provinces of mainland China in 2007. China was chosen as the site for the research because data collected from there provide two advantages. First, China is experiencing an economic and social transition to market-based arrangements, and as a result alliance activities are numerous and varied (Li & Zhong, 2003). Second, transitional Chinese society is often characterized as having a weak infrastructure regarding intellectual

---

1. We thank one of the reviewers for suggesting this point.

property rights and knowledge protection (Kumar & Ellingson, 2007). We thus have strong expectations that alliance partners devote much attention to knowledge protection and knowledge spillover opportunities. Moreover, existing studies employing China also provide interesting findings in entrepreneurship research (e.g., Tang, Tang, Marino, Zhang, & Li, 2008; Wright, Liu, Buck, & Filatotchev, 2008).

We followed Hoskisson, Eden, Lau, and Wright's (2000) recommendation to employ local researchers and use face-to-face interviews in emerging economies to maximize the reliability and validity of the data. The firms were randomly selected from the *China Business Yellow Pages* to represent companies in a range of industries, regions (coastal, middle, and northwestern provinces), and ownership structures (state-owned and private-owned enterprises). The list consisted of 2,100 companies. We placed phone calls to identify the most senior executive in charge of the most recent alliance activities in each firm and solicited that individual's cooperation. A small gift (a pen with the logo of the university) and a summary report of findings were offered as incentives for participation. The executives held titles such as chief executive officer, chief technology officer, or vice president. Of the contacted firms, 530 agreed to participate, constituting the sampling frame. To create Chinese versions of the questionnaire, we employed the translation and back-translation technique (Kreiser, Marino, & Weaver, 2002), and the translated questionnaire was independently reviewed by two bilingual researchers for content and face validity. We conducted personal interviews with 10 senior managers to refine the measures. We asked the respondents not only to answer all the questionnaire items, but also to provide feedback about the design and wording of the instrument. On the basis of these interviews, we further refined the questionnaire and finalized the survey.

For the final survey, we used professional researchers to carry out face-to-face interviews with the selected executives. A total of 308 interviews were completed, of which 89 were removed due to missing data or no alliance activities. Gulati and Singh (1998) suggest that the hierarchical governance structures of alliances fall along a continuum, with joint ventures at one extreme and simple relational contract at the other. In this research, we employed a broad conceptualization of an alliance as any partnership, whether equity based or nonequity based, between or among organizations (Hennart, 1988). Based on this definition of alliances, the effective response rate was 41.3% (219 retained surveys out of 530). Potential nonresponse bias was assessed with Armstrong and Overton's (1977) procedure. We performed *t*-tests comparing responding versus nonresponding firms in terms of industry, number of employees, and sales growth. Results indicated that there were no significant differences ($p < .05$) in the levels of variables. This suggests that nonresponse bias was not a problem.

Measures

Established multiple-item scales were used, and scale items were randomly ordered to minimize survey method biases. Each scale item used a 7-point Likert-type response format ranging from 1, "strongly disagree," to 7, "strongly agree." All scales after purification, except control variables, are listed in Appendix 1.

Entrepreneurial Orientation (Cronbach's $\alpha = .832$): We adopted the EO scale used by Wang (2008), and this scale is based on the widely used Miller/Covin and Slevin scale (Brown, Davidsson, & Wiklund, 2001; Covin & Slevin, 1989). Kreiser et al. (2002) and Runyan, Ge, Dong, and Swinney (2012) also support the usage of the EO scale in a cross-cultural context. Nine items measuring firm proactiveness, competitive aggressiveness, risk taking, and innovativeness were retained after factor purification.

Knowledge Spillovers in an Alliance (Cronbach's α = .761): Traditional research on spillovers relies on analyzing patent citation as a proxy for assessing the direction and extent of actual spillovers (e.g., Griliches, 1991; Jaffe et al., 1993). Jaffe, Trajtenberg, and Fogarty (2000) developed four survey questions to examine knowledge spillovers. Based on their work and the KSTE, this research adapted these questions to our context to measure knowledge spillovers in an alliance and emphasize the nature of undercompensation or noncompensation of knowledge flows. Three items were retained after factor purification.

Partners' Knowledge Protection (Cronbach's α = .718) was measured by two items that were adapted from Simonin (1999), reflecting the extent to which partners protect their technical and process knowledge as perceived by a focal firm.

Alliance Type was measured by a dummy variable that was coded as 1 if an alliance is an EJV and as 0 if it is a non-EJV.

Focal Firm Performance (Cronbach's α = .770) was measured by four items adopted from Dess, Lumpkin, and Covin (1997), reflecting a focal firm's financial and market performance.

Alliance Performance (Cronbach's α = .821) was measured by four items adopted from Saxton (1997), Krishnan, Martin, and Noorderhaven (2006), and Lunnan and Haugland (2008), reflecting both financial and market-based alliance outcomes.

Control Variables. We controlled for several factors that might influence our key relationships. *Firm age* was measured by the natural logarithm of operating years to 2007. *Firm size* was measured as the natural logarithm of the number of employees in 2007. *Firm ownership* was operationalized by a dummy variable, coded as 1 for state-owned enterprises, including wholly state-owned enterprises and state-controlled enterprises, and as 0 otherwise. We used two measures to control for the influence of a firm's R&D intensity in this research. *R&D intensity I* was measured by the ratio of R&D investment to total sales in 2006, while *R&D intensity II* was measured by the number of R&D personnel divided by the total number of employees. *Industry* was measured by three variables, including service industry versus nonservice industry, high-tech industry versus nonhigh-tech industry, and the development stage of the industry (introductory, developing, mature, or declining). *Alliance scope* was measured by counting an alliance's functions, such as R&D, manufacturing, and marketing. *Alliance duration* was assessed by counting the years that an alliance existed prior to 2007. Finally, *alliance membership size* was measured by the number of partnering firms within an alliance.

Measurement Validation

We conducted a confirmatory factor analysis through structural equation modeling (SEM) implemented by AMOS. First, we regard the EO as a second-order construct while treating its four dimensions—proactiveness, innovativeness, competitive aggressiveness, and risk taking—as first-order constructs (Covin & Wales, 2012; Wang, 2008). The EO measurement model indicated good fitness to the empirical data: The ratio of χ^2 to degrees of freedom (χ^2/df) was 2.017, goodness-of-fit index (GFI) = .955, comparative fit index (CFI) = .961, standardized root mean squared residual (SRMR) = .043, root mean squared error of approximation (RMSEA) = .068, and Akaike information criterion (AIC) = 90.418 (Hu & Bentler, 1999). We then added the other four reflective measures: knowledge spillovers in an alliance, partners' knowledge protection, firm performance, and alliance performance. Again, the larger measurement model fit well with the data

($\chi^2/df = 1.855$; GFI = .883; CFI = .903; SRMR = .058; RMSEA = .063; AIC = 436.611). In these two measurement models, the scale items were significantly loaded on their hypothetical variables (the smallest critical value was 3.076; $p < .01$).

Composite reliability was operationalized using the internal consistency method that is estimated by using Cronbach's alpha. Typically, reliability coefficients of .70 or higher are considered adequate (Nunnally, 1978). As shown in our Measures section and Appendix 1, all values of Cronbach's alpha exceeded .70, indicating good measurement reliability. We checked construct validity, including convergent and discriminant validity, by examining the component items for each scale. Convergent validity was assessed through factor loadings. In Appendix 1, we show that all items were neatly loaded on their hypothetical factor, and all the factor loadings were greater than .60 (Hinkin, 1998). Because these measures are widely used in the literature, we believe that the measures in this study satisfy the demands of convergent validity.

In addition, we employed two methods to confirm the discriminant validity of the measures. First, as Table 2 shows, each measure's square root of average variance extracted was higher than the coefficient for any pair of two latent variables (Fornell & Larcker, 1981). Second, we conducted a series of pairwise chi-square tests by comparing the factor correlations in constrained versus unconstrained models. All tests were significant (with the smallest resulting in $\Delta\chi^2(1) = 6.586$; $p < .05$), a second indication of discrimination.

Since we relied on a cross-sectional survey and a single respondent from each firm, the results might have been contaminated by common method bias (CMB; Podsakoff, MacKenzie, Lee, & Podsakoff, 2003). To assess CMB, we conducted two tests. In the first test, we performed an exploratory factor analysis, and the results showed that there were six discrete factors rather than one, and together the six factors explained a substantial amount of variance (65.31%; Hinkin, 1998). We compared this six-factor model with a one-factor model (Anderson & Gerbing, 1988). The former model exhibited significantly better fitness with the data than the latter ($\Delta\chi^2[df = 14] = 636.367$; $p < .001$; $\Delta AIC = 608.367$). In the second test, we examined the effects of adding one common method variance (CMV) variable to the measurement model (Podsakoff et al.). While this larger model exhibited better fitness compared with the hypothesized measurement model ($\Delta\chi^2[df = 16] = 47.045$; $p < .001$; $\Delta AIC = 15.045$), the variance extracted by the CMV variable was .029, falling below the .500 cutoff value, thereby indicating the presence of a latent factor (Hair, Anderson, Tatham, & Black, 1998). In sum, the two tests indicated that CMB was not serious, permitting us to begin hypotheses testing.

Hypotheses Testing

We used moderated hierarchical linear regression models to test the research hypotheses, a method suitable for separating out the effects of independent variables and examining moderation effects. Prior to testing, we examined scatter plot analyses and found no violations of regression assumptions (i.e., normality, linearity, and homoscedasticity). Moreover, we examined variance inflation factors (VIFs) to assess multicollinearity. To reduce potential multicollinearity, we mean-centered all the variables in the interaction terms (Aiken & West, 1991). Three sets of regressions were performed. The first set was run on predictors of knowledge spillovers, the second on predictors of firm performance, and the third on predictors of alliance performance. With respect to testing hypothesis 3, we used pairwise chi-square tests in SEM.

Table 2

Descriptive Statistics[†]

	Mean	SD	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1. Firm ownership (state vs. nonstate owned)	.470	.500	—																
2. Firm size (natural log)	2.876	.890	.240**	—															
3. Firm age (natural log)	1.166	.371	.415**	.455**	—														
4. Industry: service versus nonservice	.230	.411	−.192**	−.193**	−.222**	—													
5. Industry: high tech versus nonhigh tech	.228	.421	−.246**	.171*	.028	.228**	—												
6. Industry: development stage	2.505	.630	.037	.166*	.278**	−.028	.204**	—											
7. R&D intensity I	.155	.178	−.124	−.128	−.101	.272**	.282**	.025	—										
8. R&D intensity II	.110	.184	−.059	−.196**	−.112	.044	−.082	−.045	.001	—									
9. Alliance scope	1.269	.838	−.104	.152*	.015	−.092	.189**	.054	.014	.074	—								
10. Alliance duration	2.650	.901	.224**	.108	.341**	−.170*	−.016	.072	−.033	−.016	.113	—							
11. Alliance membership size	3.900	1.408	−.014	.128	.041	.013	.014	−.047	.082	−.061	.069	.296**	—						
12. Partners' knowledge protection	4.326	1.194	.020	.081	−.036	−.048	.116	.052	−.161*	−.043	.032	.139*	.059	**.793**					
13. Entrepreneurial orientation	4.560	.810	−.007	.209**	.009	.020	.048	−.134*	.098	−.121	.029	.125	.152*	.142*	**.618**				
14. Alliance type (EJVs vs. non-EJVs)	.320	.445	.009	.124	.045	−.196**	−.089	−.049	−.203**	.003	−.027	.046	−.064	.153*	−.030	—			
15. Knowledge spillovers in the alliance	3.783	1.255	.032	.063	.029	.006	.042	−.083	−.010	.001	−.073	.154*	.035	.331**	.157*	.124	**.804**		
16. Firm performance	4.771	.990	−.011	.046	.100	.090	.087	−.083	.162*	−.102	.007	.121	.068	.033	.294**	−.051	.145*	**.728**	
17. Alliance performance	4.773	.983	.016	.076	.045	.012	.099	−.099	.052	−.047	.077	.213**	.085	.190**	.318**	.085	.191**	.363**	**.700**

$* p < .05$; $** p < .01$ (two-tailed)

[†] n = 219. Diagonal elements (in bold) are square roots of the AVE values. Off-diagonal elements are the correlations of the variables of interest to the study.
R&D, research and development; EJV, equity joint venture; AVE, average variance extracted.

Results

Table 2 shows the correlation coefficients between every pair of variables. For three independent variables, the largest coefficient, between alliance type and partners' knowledge protection, was .168 ($p < .05$), which is moderately low. Among the control variables, firm ownership, firm size, and firm age were significantly correlated. Except for the control variables, the largest correlation coefficient, between firm performance and alliance performance, was .363 ($p < .01$) followed by .331 ($p < .01$), the coefficient between partners' knowledge protection and knowledge spillovers in an alliance.

In Table 3, Models 1, 4, and 6 were baseline models that included only control variables. Other models were used to test all the research hypotheses except for hypothesis 3. The F-tests for regressions and R-square changes in Models 2, 3, and 7 were significant, indicating that sequentially added variables explained significant amounts of variance in knowledge spillovers and alliance performance. All VIF values were lower than 10 (the highest was 1.96), suggesting that there was no serious multicollinearity (O'Brien, 2007).

Consistent with hypothesis 1, the results suggest that partners' knowledge protection is positively associated with knowledge spillovers in an alliance ($\beta = .32$; $p < .001$). The results for Models 5 and 7 supported hypothesis 2b ($\beta = .15$; $p < .05$) but not hypothesis 2a ($\beta = .12$; $p < .10$), suggesting that knowledge spillovers were positively related to alliance performance but not to firm performance. Hypothesis 3 suggests that knowledge spillovers in an alliance contribute greater value to alliance performance than to a focal firm's performance. Although the comparisons of the regression coefficients and significance levels showed support, we additionally used pairwise chi-square tests in SEM to further statistically examine this hypothesis. We first let the structural model estimate the regression weights without constraint. The results showed that knowledge spillovers in an alliance is significantly related to alliance performance ($\gamma = .23$; $p < .001$) but not to firm performance ($\gamma = .13$; $p > .05$). Then we constrained these two coefficients to be equal ($\gamma = .13$), to examine whether the constrained model was significantly different from the unconstrained model (Savalei & Kolenikov, 2008). The results were consistent with our prediction ($\Delta\chi^2[df = 2] = 6.875$; $p < .05$; $\Delta AIC = 20.125$). Therefore, hypothesis 3 was supported. Hypothesis 4 was supported also since the regression coefficient was significant and in the expected direction in Model 2 ($\beta = .15$; $p < .05$). The results in Model 3 were used to test the hypotheses pertaining to interaction effects. Hypotheses 5 and 7 were supported since the regression coefficients were significant and in the hypothesized direction ($\beta = .20$; $p < .05$; and $\beta = -.21$; $p < .05$, respectively). However, hypothesis 6 was not supported because the regression coefficient was not significant, although it ran in the hypothesized direction ($\beta = -.04$; $p > .10$). We address the potential reasons for the lack of support for this hypothesis in the Discussion section. In sum, most of the hypothesized relationships were supported by the empirical data.

Moreover, the control variables revealed some important findings. First, alliance duration was found to be significantly related to knowledge spillovers in an alliance and alliance performance. This indicated that it takes time for knowledge to spill over to an alliance from partnering firms. In particular, tacit knowledge requires trust, face-to-face communication, observation, and mentoring to be successfully internalized and exploited (Nonaka, 1994; Winter, 1987). Second, firms in the more mature industries tended to exhibit a relatively lower level of firm performance and alliance performance. Third, firms with a higher ratio of R&D personnel to all employees tended to exhibit better performance.

Table 3

Results of Hierarchical Regression Analysis (n = 219)

Variables	Knowledge spillovers			Firm performance		Alliance performance	
	Model 1 β	Model 2 β	Model 3 β	Model 4 β	Model 5 β	Model 6 β	Model 7 β
Controls							
Firm ownership (state vs. nonstate owned)	−.003	−.017	.014	−.057	−.057	−.003	−.002
Firm size (natural log)	.095	.054	.015	.020	.009	.067	.053
Firm age (natural log)	−.042	.027	.017	.139	.144	−.019	−.013
Industry: service versus nonservice	.020	.025	.024	.086	.084	.029	.026
Industry: high tech versus nonhigh tech	.076	.019	.036	.028	.019	.094	.083
Industry: development stage	−.110	−.113	−.097	−.142*	−.129	−.144*	−.127
R&D intensity I	−.016	.041	.061	.147*	.149*	.034	.037
R&D intensity II	.025	.039	.054	−.092	−.095	−.036	−.040
Alliance scope	−.115	−.106	−.110	−.002	.011	.036	.053
Alliance duration	.192*	.128	.122	.113	.090	.228**	.200*
Alliance membership size	−.028	−.042	−.024	.000	.003	−.007	−.002
Main effects							
Partners' knowledge protection		.318*** (H1)[†]	.322***				
Entrepreneurial orientation (EO)		.149* (H4)	.102				
Alliance type (EJVs vs. non-EJVs)			.113				
Knowledge spillovers					.118 (H2a)		.147* (H2b)
Interactions							
Partners' knowledge protection * EO			.195* (H5)				
Partners' knowledge protection * Alliance type			−.037 (H6)				
EO * Alliance type			.188*				
Partners' knowledge protection * Alliance type * EO			−.208* (H7)				
R^2	.054	.158	.207	.084	.097	.082	.103
Adjust R^2	.004	.105	.136	.036	.045	.034	.051
R^2 change	.054	.104	.049	.084	.013	.082	.021
F	1.083	12.476***	2.543*	1.731	3.014	1.691	4.711*
Largest VIF	1.691	1.737	1.961	1.691	1.693	1.691	1.693

* $p < .05$; ** $p < .01$; *** $p < .001$
[†] Hypotheses in bold are supported.
R&D, research and development; EJV, equity joint venture; VIF, variance inflation factor; H, hypothesis.

Robustness Checks

We ran several tests to check the robustness of our findings. First, we checked the correlation between alliance performance and focal firm performance since alliance performance tends to be confounded with partners' firms performance (Lavie, 2007). As shown in Table 2, the correlation between alliance performance and firm performance was .36, a moderate level, suggesting that these two performance measures did have independent variance to be explained by independent variables. Second, we conducted a *post hoc* analysis of the EO–spillovers link by considering a curvilinear relationship because researchers have found that the EO–performance link tends to be curvilinear in the Chinese context (e.g., Tang et al., 2008). We added a squared term of EO into the regression model, but both the F-test of the regression model and the regression coefficient between EO squared and knowledge spillovers in an alliance were not significant ($F = .75$; $p > .10$; $\beta = .07$; $p > .10$). These results suggested that the relationship between a focal firm's EO and knowledge spillovers in an alliance was more likely to be linear than curvilinear. Finally, we tested another rival model in which partners' knowledge protection had a curvilinear effect on knowledge spillovers in an alliance. The results showed no support for this rival model ($F = .45$, $p > .10$; $\beta = -.04$; $p > .10$).

Discussion

The KSTE in Alliances

The primary theoretical contribution of this study is the development of the KSTE in alliances. We first examined the existence of knowledge filters and knowledge spillovers—the two premises of the KSTE framework—in the alliance context. Based on the interorganizational learning theory, we found clear evidence that knowledge filters and knowledge spillovers exist in the alliance context, which answers our first research question. The existence of these two premises legitimizes our framework for the KSTE in alliances. Second, we conceptually established and empirically validated a framework for the KSTE in alliances. Our framework not only includes the focal relationship that is posited in traditional KSTE studies, that is, the link between partners' knowledge protection and knowledge spillovers in an alliance, but it also contains an important antecedent (the focal firm's EO), two consequences (the focal firm's performance and alliance performance), and two boundary conditions (the focal firm's EO and alliance type) of such a relationship. By directly elaborating on particular knowledge-management practices as envisioned by the KSTE, the KSTE in alliances specifies how the KSTE works at the interfirm level. Our framework goes beyond traditional entrepreneurship models and previous KSTE frameworks by regarding entrepreneurial opportunities as endogenous when positing the heterogeneity of entrepreneurial firms. Table 1 shows the differences between our framework and those employed in previous KSTE studies. Combining the framework of the KSTE in alliances with the empirical findings enables us to answer our research questions and make several contributions to theory.

First, regarding the KSTE, this research confirmed and extended the focal relationship to the alliance context. One of the theoretical propositions in the KSTE suggests a positive link between knowledge filters and knowledge spillovers in a certain region or society (Acs, Braunerhjelm et al., 2009; Agarwal et al., 2007; Audretsch & Keilbach, 2007; Braunerhjelm et al., 2010). While organizational capabilities, traditions, strategic orientation, culture, legal restrictions, bureaucratic constraints, and labor market rigidities,

among other things, can be knowledge filters (Acs, Plummer, & Sutter, 2009; Agarwal et al.), our study is one of the first that examines a particular knowledge filter in the alliance context—partners' knowledge protection—and its direct effect on knowledge spillovers. By putting the KSTE down to the interfirm level, our framework can be underpinned by strong theoretical lenses and can more accurately reflect the relationship between knowledge filters and knowledge spillovers, since these two premises of the KSTE are more easily traceable and directly assessable in the alliance context.
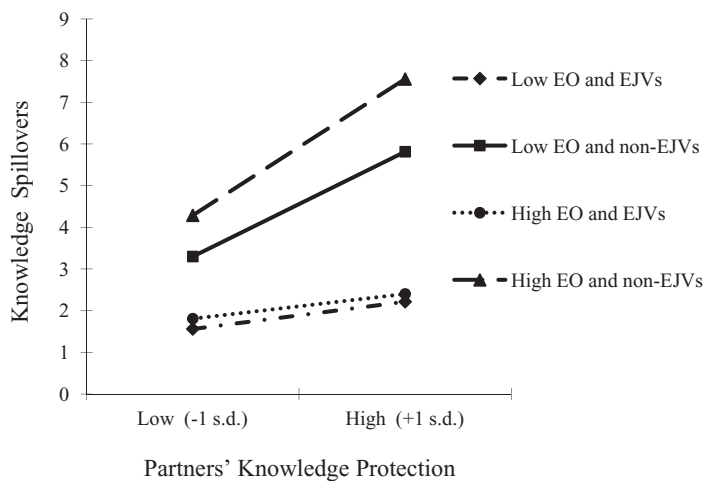
Second, our study provides a fresh perspective to address the boundary paradox identified in the interorganizational learning theory. Differing from most previous studies on the boundary paradox in alliances, we posit that the effect of knowledge protection can be assessed more accurately by knowledge seekers than by knowledge owners. From the knowledge owner's perspective, the primary purpose of knowledge protection is to prevent knowledge seekers from misappropriating that knowledge. At the same time, however, knowledge protection can signal the rarity while limiting the availability of the protected knowledge to knowledge seekers who, under this situation, will become more aggressive in pursuing such knowledge. In this case, knowledge protection may not necessarily preclude knowledge sharing in alliances as explicated by the boundary paradox (Norman, 2001; Quintas et al., 1997). Our results, together with those of Norman (2004), show that knowledge protection can actually enhance knowledge flows in an alliance. Therefore, the proposed competing elements within the boundary paradox may not preclude each other; instead, they may mutually enhance one another.

Third, we found a process of creative construction as envisioned by the KSTE. Creative construction occurs when knowledge spillovers and knowledge spill-ins occur simultaneously in a community, and as a result all community members become better off (Agarwal et al., 2007, 2010). Our study shows that alliances could be an empirical site of such a community since the findings confirmed that alliance performance can be enhanced to a greater extent than firm performance by knowledge spillovers in an alliance. Additional data analysis showed that alliance performance actually mediated the link between knowledge spillovers in an alliance and firm performance (Sobel test = 1.992; $p < .05$, two-tailed). A focal firm can actually benefit from knowledge spillovers through what it can gain from the cooperative relationship.

Fourth, this research complements KSTE studies by incorporating strategic entrepreneurship in the framework. The previous KSTE framework fails to examine the specific characteristics of knowledge creators or scientists that drive them to venture out to engage with other firms or actors. In other words, the assumption of the exogeneity of entrepreneurial opportunities in the traditional entrepreneurship models was replaced by the previous KSTE framework by assuming that entrepreneurs and entrepreneurial firms are homogeneous in their abilities, resource endowment, cultures, and so on. But we suggest that both of these assumptions should be relaxed to better understand entrepreneurship. As Kotha (2010, p. 304) suggests, strategic entrepreneurship should be employed in the dynamics between knowledge spillovers and spill-ins to motivate individuals and organizations to seize and exploit the opportunities embedded in these knowledge flows. Our study posits and empirically validates the idea that a focal firm's EO, the organization's most important entrepreneurial characteristic, has evident effects on knowledge spillovers as well as on the focal relationship in the KSTE framework. Our framework for the KSTE in alliances goes beyond not only traditional entrepreneurship research in examining the source of entrepreneurial opportunities, but also beyond the previous KSTE framework by addressing the important roles of entrepreneurial firms in materializing these opportunities. In other words, our framework for the

Figure 1

Three-Way Interaction Effect of Partners' Knowledge Protection, the Focal Firm's Entrepreneurial EO, and Alliance Type on Knowledge Spillovers in the Alliance

KSTE in alliances considers the heterogeneity of entrepreneurial firms and the endogeneity of entrepreneurial opportunities. This contribution is further enhanced by the prominent role of the focal firm's EO in the focal relationship based on the KSTE in alliances approach, as discussed later.

Lastly, the KSTE in alliances identifies two important boundary conditions for the focal relationship between partners' knowledge protection and knowledge spillovers. We proposed that, in EJVs as opposed to non-EJVs, the relationship between partners' knowledge protection and knowledge spillovers in an alliance is weaker. The findings failed to support this hypothesis, indicating that, even in EJVs, knowledge spillovers may be abundant. On the contrary, our results supported a positive moderation effect of a focal firm's EO on the focal relationship according to the KSTE in alliances. We found that, given the same level of knowledge filters, a focal firm with a stronger EO is more likely to penetrate the knowledge filters and trigger a higher level of knowledge spillovers in an alliance. A three-way interaction effect of partners' knowledge protection, a focal firm's EO, and alliance type on knowledge spillovers in an alliance also reveals the prominent role played by the EO in the KSTE in alliances. As shown in Figure 1, the highest level of knowledge spillovers in an alliance occurred when, in non-EJVs, partners' knowledge protection and a focal firm's EO were both strong; the lowest level of knowledge spillovers took place when, in EJVs, partners' knowledge protection and a focal firm's EO were both weak. On the other hand, these findings supported hypothesis 6, which suggests that, in EJVs rather than in non-EJVs, the positive relationship between partners' knowledge protection and knowledge spillovers weakens. Figure 1 shows that, irrespective of the levels of partners' knowledge protection and a focal firm's EO, knowledge spillovers are greater in non-EJVs than in EJVs. In addition, the moderating effect of an EO is greater in non-EJVs than in EJVs. Because there is less mutual trust and hostage taking among partners in non-EJVs than in EJVs, and because

non-EJVs tend to be short lived and firm-level activities are less visible, even partnering firms with a weak EO tend to take advantage of any opportunities available, including knowledge filters.

Our research does not, however, find support for a significant relationship between knowledge spillovers and a focal firm's performance, although the relationship ran in the hypothesized direction and was mediated by alliance performance. One reasonable explanation for this finding is that, because of a focal firm's own knowledge filters, even when partners' knowledge spills over to the focal firm, the focal firm still finds it difficult to fully commercialize the knowledge. Future research is needed to examine the role of knowledge filters in the process of knowledge internalization. Another possible reason that this hypothesis was not supported is that internalizing knowledge requires time, facilities, and resources, since knowledge created by other organizations features unfamiliar structures and complexity (Galunic & Rodan, 1998; Nonaka, 1994).

Managerial Implications

This research should help managers make two important decisions about joining an alliance: with whom to partner and under which governance structure. Sarkar et al. (2001) suggest that proactiveness on the part of firms engaging in alliance activities can help them identify potential partnering opportunities and further improve their market performance. However, firms that partner with others that have a strong EO may be afraid of losing their valuable knowledge. Our research findings indicate that partnering with firms with a strong EO may not necessarily hurt a focal firm's performance. A focal firm can benefit from partners with a strong EO through knowledge spillovers that can induce strong alliance performance. This study also shows that firms seeking to promote knowledge flows within an alliance should employ the non-EJV governance structure.

This research also suggests that firms should be cautious when they decide to employ knowledge protection within an alliance. Because knowledge protection can leave protected knowledge undercommercialized or uncommercialized, partner firms tend to take advantage of the associated knowledge filters. Moreover, since knowledge protection can increase the rarity and restrict the availability of protected knowledge, partners may use whatever methods are available to access and exploit the knowledge.

Limitations and Future Research Directions

Among the limitations of this research, we first acknowledge that we relied on subjective measures and collected data unilaterally from alliance partners. Future research is needed to examine the KSTE in alliances through secondary data or combining secondary with survey data. Information regarding alliance performance and firm performance is available for some public firms, such as in COMPUSTAT, and knowledge spillovers could be assessed by patent citations from, for example, the U.S. Patent and Trademark Office. Future research could connect the data from these secondary sources and subjective survey data to replicate or extend the framework developed for the KSTE in alliances.

This study also employed a cross-sectional survey research design and focused on a particular transitional economy, which could make it difficult to assess causality and generalize our findings. Although Rindfleisch, Malter, Ganesan, and Moorman (2008) suggest that cross-sectional data can ensure research reliability, more research based on

longitudinal or qualitative and multisociety designs would help to further validate our results. Since this study employed empirical data collected from a particular emerging economy, the generalizability of the findings may be limited. But because we developed the research framework based on well-developed theoretical lenses taken from the EO and interorganizational learning literatures, and because we took great care in data collection and data analysis (applying robustness checks), we believe that the empirical findings from this study can be generalized to other contexts.

Although the KSTE identifies potential sources of entrepreneurial opportunities, it provides limited capacity to trace knowledge spillovers and detect the entrepreneurial activities triggered by these spillovers. How should potential entrepreneurs exploit these opportunities, and what are the important parameters involved in the process of commercializing such knowledge? Knowledge workers in incumbent firms may be experts in creating knowledge, but they may not be entrepreneurs. It is possible for knowledge workers to cooperate with internal or external entrepreneurs to realize potential opportunities. If that is so, then more empirical research that explores the application of the KSTE to cooperative behavior would be a promising direction for future study. Kotha (2010) proposes a predator-prey model to reflect cooperative entrepreneurship, but his research is based primarily on that specific mathematical model, which also warrants empirical examination.

Future research is also needed to examine the effects of knowledge protection undertaken by multiple alliance partners. Since a focal firm and its partners can employ knowledge protection simultaneously, knowledge protection may individually and jointly influence knowledge spillovers in an alliance. Research based on pairwise analysis of knowledge protection and data collection from bilateral or multilateral alliance partners should be conducted. Moreover, this study investigated only one particular type of knowledge filter, knowledge protection, in alliances. Since China currently provides relatively weak enforcement of intellectual property rights laws (Kumar & Ellingson, 2007), firms tend to be conservative in knowledge sharing when partnering with other organizations. Knowledge protection in alliance activities in more developed countries may not, however, represent as strong a knowledge filter as it does in China. Therefore, future research is needed to investigate the effects of other types of knowledge filters (e.g., organizational culture and rigidity) on knowledge spillovers in alliances or to extend our framework to other cultures.

Conclusion

This study develops and empirically examines a framework for the KSTE in alliances. Relying on the interorganizational learning theory, we found clear evidence of the existence of knowledge filters and knowledge spillovers in the alliance context. Consistent with previous KSTE studies, we found the focal relationship in the KSTE in alliances, that is, the link between partners' knowledge protection and knowledge spillovers in the alliance, to be positive. This finding also helps address the boundary paradox in the interorganizational learning theory. In addition, our framework for the KSTE in alliances is more comprehensive than those of previous studies in that it examines the antecedent, consequences, and boundary conditions for such a focal relationship. Therefore, our framework for the KSTE in alliances simultaneously relaxes the theoretical assumption of the exogeneity of entrepreneurial opportunities in traditional entrepreneurship research, as well as that of the homogeneity of entrepreneurial firms in previous KSTE studies.

Appendix 1. Measurement Scales

To what extent do your agree with the following statements? (1 = strongly disagree; 7 = strongly agree)	Factor loadings
Entrepreneurial orientation (adopted from Wang [2008]) (Cronbach's α = .832)	
Market proactiveness	
In general our firm favors a strong emphasis on research and development, technological leadership, and innovations.	.686
In the past 3 years, our firm has marketed a large variety of new lines of products or services.	.733
In the past 3 years, changes in our products or service lines have been mostly great.	.705
Competitive aggressiveness	
In dealing with competitors, our firm often leads the competition, initiating actions to which our competitors have to respond.	.778
In dealing with competitors, our firm typically adopts a very competitive posture aiming at overtaking the competitors.	.604
Risk taking[†]	
In general, the top managers of my organization have a strong propensity to take on high-risk projects (with chances of very high return).	.642
When there is uncertainty, our firm typically adopts a "wait-and-see" posture in order to minimize the probability of making costly decisions. (reverse coded)	.755
Innovativeness	
Management actively responds to the adoption of "new ways of doing things" by main competitors.	.745
We are willing to try new ways of doing things and seek unusual, novel solutions.	.712
Knowledge spillovers in the alliance (adopted from Jaffe et al. [2000]) (Cronbach's α = .761)	
We obtain partners' technology/process know-how without completely compensating them.	.891
Uncompensated flows of technology/process know-how are abundant in the alliance.	.713
We have learned a lot of technology/process know-how from our partners without completely compensating them.	.819
Partners' knowledge protection (adopted from Simonin [1999]) (Cronbach's α = .718)	
Your partners have procedures, routines, and policies designed to restrict the sharing of relevant technology/process know-how.	.781
Your partners are using procedures, routines, and policies to protect their technology/process know-how.	.859
Firm performance (adopted from Dess et al. [1997]) (Cronbach's α = .770)	
Compared with our major competitors, our return on investments increased greatly.	.803
Compared with our major competitors, our sales grew greatly.	.803
Compared with our major competitors, our market share increased greatly.	.711
Compared with our major competitors, our net profit increased greatly.	.792
Alliance performance (adopted from Saxton [1997], Krishnan et al. [2006], and Lunnan and Haugland [2008]) (Cronbach's α = .821)	
The collaborative relationship achieved the objective of return on investments.	.697
The collaborative relationship achieved the objective of sales growth.	.814
The collaborative relationship achieved the objective of market share increase.	.807
The collaborative relationship achieved the objective of net profits.	.661

[†] In the exploratory factor analysis, the entrepreneurial orientation items were loaded on two factors: two items measuring risk taking were loaded together and other items were loaded together.

REFERENCES

Acs, Z.J., Braunerhjelm, P., Audretsch, D.B., & Carlsson, B. (2009). The knowledge spillover theory of entrepreneurship. *Small Business Economics*, *32*(1), 15–30.

Acs, Z.J., Plummer, L.A., & Sutter, R. (2009). Penetrating the knowledge filter in "rust belt" economies. *The Annals of Regional Science*, *43*(4), 989–1012.

Agarwal, R., Audretsch, D., & Sarkar, M.B. (2007). The process of creative construction: Knowledge spillovers, entrepreneurship, and economic growth. *Strategic Entrepreneurship Journal*, *1*(2), 263–286.

Agarwal, R., Audretsch, D., & Sarkar, M.B. (2010). Knowledge spillovers and strategic entrepreneurship. *Strategic Entrepreneurship Journal*, *4*(4), 271–283.

Aiken, L.S. & West, S.G. (1991). *Multiple regression: Testing and interpreting interactions*. Newbury Park, CA: Sage Publications.

Anderson, B.S., Covin, J.G., & Slevin, D.P. (2009). Understanding the relationship between entrepreneurial orientation and strategic learning capability: An empirical investigation. *Strategic Entrepreneurship Journal*, *3*(3), 218–240.

Anderson, J.C. & Gerbing, D.W. (1988). Structural equation modeling in practice: A review and recommended two-step approach. *Psychological Bulletin*, *103*(3), 411–423.

Argyris, C. (1953). *Executive leadership*. New York: Harper.

Arino, A. (2003). Measure of strategic alliance performance: An analysis of construct validity. *Journal of International Business Studies*, *34*(1), 66–79.

Armstrong, J.S. & Overton, T.S. (1977). Estimating nonresponse bias in mail surveys. *Journal of Marketing Research*, *14*(3), 396–402.

Arrow, K. (1962). Economic welfare and the allocation of resources for invention. In R. Nelson (Ed.), *The rate and direction of inventive activity* (pp. 609–626). Princeton, NJ: Princeton University Press.

Atuahene-Gima, K. & Ko, A. (2001). An empirical investigation of the effect of market orientation and entrepreneurship orientation alignment on product innovation. *Organization Science*, *12*(1), 54–74.

Audretsch, D.B. & Aldridge, T.T. (2009). Scientist commercialization as conduit of knowledge spillovers. *The Annals of Regional Science*, *43*(4), 897–905.

Audretsch, D.B. & Feldman, M.P. (1996). R&D spillovers and the geography of innovation and production. *The American Economic Review*, *86*(3), 630–640.

Audretsch, D.B. & Keilbach, M. (2007). The theory of knowledge spillover entrepreneurship. *Journal of Management Studies*, *44*(7), 1242–1254.

Audretsch, D.B. & Keilbach, M. (2008). Resolving the knowledge paradox: Knowledge-spillover entrepreneurship and economic growth. *Research Policy*, *37*(10), 1697–1705.

Audretsch, D.B. & Lehmann, E.E. (2005). Does the knowledge spillover theory of entrepreneurship hold for regions? *Research Policy*, *34*(8), 1191–1202.

Baughn, C.C., Denekamp, J.G., Stevens, J.H., & Osborn, R.N. (1997). Protecting intellectual capital in international alliances. *Journal of World Business*, *32*(2), 103–117.

Braunerhjelm, P., Acs, Z.J., Audretsch, D.B., & Carlsson, B. (2010). The missing link: Knowledge diffusion and entrepreneurship in endogenous growth. *Small Business Economics*, *34*(2), 105–125.

Brown, T.E., Davidsson, P., & Wiklund, J. (2001). An operationalization of Stevenson's conceptualization of entrepreneurship as opportunity-based firm behavior. *Strategic Management Journal*, *22*(10), 953–968.

Burt, R.S. (1992). *Structural holes*. Cambridge, MA: Harvard University Press.

Covin, J.G. & Slevin, D.P. (1989). Strategic management of small firms in hostile and benign environments. *Strategic Management Journal*, *10*(1), 75–87.

Covin, J.G. & Wales, W.J. (2012). The measurement of entrepreneurial orientation. *Entrepreneurship Theory and Practice*, *36*(4), 677–702.

Das, T.K. & Teng, B.-S. (1998). Between trust and control: Developing confidence in partner cooperation in alliances. *Academy of Management Review*, *23*(3), 491–512.

Das, T.K. & Teng, B.-S. (2000). A resource-based theory of strategic alliances. *Journal of Management*, *26*(1), 31–61.

Dess, G.G., Lumpkin, G.T., & Covin, J.G. (1997). Entrepreneurial strategy making and firm performance: Tests of contingency and configurational models. *Strategic Management Journal*, *18*(9), 677–695.

Dyer, J.H. & Singh, H. (1998). The relational view: Cooperative strategy and sources of interorganizational competitive advantage. *Academy of Management Review*, *23*(4), 660–679.

Easterby-Smith, M., Lyles, M.A., & Tsang, E.W.K. (2008). Inter-organizational knowledge transfer: Current themes and future prospects. *Journal of Management Studies*, *45*(4), 677–690.

Feinberg, S.E. & Gupta, A.K. (2004). Knowledge spillovers and the assignment of R&D responsibilities to foreign subsidiaries. *Strategic Management Journal*, *25*(8/9), 823–845.

Fornell, C. & Larcker, D. (1981). Evaluating structural equation models with unobservable variables and measurement error. *Journal of Marketing Research*, *18*(1), 39–50.

Galunic, D.C. & Rodan, S. (1998). Resource recombinations in the firm: Knowledge structures and the potential for Schumpeterian innovation. *Strategic Management Journal*, *19*(12), 1193–1201.

Griliches, Z. (1991). The search for R&D spillovers. *The Scandinavian Journal of Economics*, *94*(Suppl.), 29–47.

Grossman, G.M. & Helpman, E. (1991). Trade, knowledge spillovers, and growth. *European Economic Review*, *35*(2–3), 517–526.

Gulati, R. (1995). Does familiarity breed trust? The implications of repeated ties for contractual choice in alliances. *Academy of Management Journal*, *38*(1), 85–112.

Gulati, R. & Singh, H. (1998). The architecture of cooperation: Managing coordination costs and appropriation concerns in strategic alliance. *Administrative Science Quarterly*, *43*(4), 781–814.

Hair, J.F., Anderson, R.E., Tatham, R.L., & Black, W.C. (1998). *Multivariate data analysis*. Upper Saddle River, NJ: Prentice Hall.

Hamel, G. (1991). Competition for competence and inter-partner learning within international strategic alliances. *Strategic Management Journal*, *12*(Summer Special Issue), 83–103.

Harrison, J.S., Hitt, M.A., Hoskisson, R.E., & Ireland, R.D. (2001). Resource complementary in business combinations: Extending the logic to organizational alliances. *Journal of Management*, *27*(6), 679–690.

Henderson, R.M. & Clark, K.B. (1990). Architectural innovation: The reconfiguration of existing product technologies and the failure of established firms. *Administrative Science Quarterly*, *35*(1), 9–30.

Hennart, J.-F. (1988). A transaction costs theory of equity joint ventures. *Strategic Management Journal*, *9*(4), 361–374.

Hinkin, T.R. (1998). A brief tutorial on the development of measures for use in survey questionnaires. *Organizational Research Methods*, *1*(1), 104–121.

Hoskisson, R.E., Eden, L., Lau, C.M., & Wright, M. (2000). Strategy in emerging economies. *Academy of Management Journal*, *43*(3), 249–267.

Hu, L.T. & Bentler, P.M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling*, *6*(1), 1–55.

Huber, G. (1982). Organizational information systems: Determinants of their performance and behavior. *Management Science*, *28*(2), 138–155.

Inkpen, A.C. (2008). Knowledge transfer and international joint ventures: The case of NUMMI and General Motors. *Strategic Management Journal*, *29*(4), 447–453.

Jaffe, A.B., Trajtenberg, M., & Fogarty, M.S. (2000). Knowledge spillovers and patent citations: Evidence from a survey of inventors. *The American Economic Review*, *90*(2), 215–218.

Jaffe, A.B., Trajtenberg, M., & Henderson, R. (1993). Geographic localization of knowledge spillovers as evidenced by patent citations. *The Quarterly Journal of Economics*, *108*(3), 577–598.

Kale, P., Singh, H., & Perlmutter, H. (2000). Learning and protection of proprietary assets in strategic alliances: Building relational capital. *Strategic Management Journal*, *21*(3), 217–237.

Keh, H.T., Nguyen, T.T.M., & Ng, H.P. (2007). The effects of entrepreneurial orientation and marketing information on the performance of SMEs. *Journal of Business Venturing*, *22*(4), 592–611.

Khanna, T., Gulati, R., & Nohria, N. (1998). The dynamics of learning alliances: Competition, cooperation and relative scope. *Strategic Management Journal*, *19*(3), 193–210.

Knott, A.M., Posen, H.E., & Wu, B. (2009). Spillover asymmetry and why it matters. *Management Science*, *55*(3), 373–388.

Kogut, B. (1988). Joint ventures: Theoretical and empirical perspectives. *Strategic Management Journal*, *9*(4), 319–332.

Kotha, S. (2010). Spillovers, spill-ins, and strategic entrepreneurship: America's first commercial jet airplane and Boeing's ascendancy in commercial aviation. *Strategic Entrepreneurship Journal*, *4*(4), 284–306.

Kreiser, P.M., Marino, L.D., & Weaver, K.M. (2002). Assessing the psychometric properties of the entrepreneurial orientation scale: A multi-country analysis. *Entrepreneurship Theory and Practice*, *26*(4), 71–94.

Krishnan, R., Martin, X., & Noorderhaven, N.G. (2006). When does trust matter to alliance performance? *Academy of Management Journal*, *49*(5), 894–917.

Krugman, P. (1991). *Geography and trade*. Cambridge, MA: MIT Press.

Kumar, S. & Ellingson, J. (2007). Adaptive IP strategies in China: A tactical analysis. *Journal of Intellectual Capital*, *8*(1), 139–158.

Lavie, D. (2007). Alliance portfolios and firm performance: A study of value creation and appropriation in the U.S. software industry. *Strategic Management Journal*, *28*(12), 1187–1212.

Li, J. & Zhong, J. (2003). Explaining the growth of international R&D alliances in China. *Managerial and Decision Economics*, *24*(2/3), 101–115.

Lucas, R.E. (1988). On the mechanics of economic growth. *Journal of Monetary Economics*, *22*(1), 3–42.

Lumpkin, G.T. & Dess, G.G. (1996). Clarifying the entrepreneurial orientation construct and linking it to performance. *Academy of Management Review*, *21*(1), 135–172.

Lunnan, R. & Haugland, S.A. (2008). Predicting and measuring alliance performance: A multidimensional analysis. *Strategic Management Journal*, *29*(5), 545–556.

Madhok, A. & Tallman, S.B. (1998). Resources, transactions and rents: Managing value through interfirm collaborative relationships. *Organization Science*, *9*(3), 326–339.

Menon, T. & Pfeffer, J. (2003). Valuing internal vs. external knowledge: Explaining the preference for outsiders. *Management Science*, *49*(4), 497–513.

Menon, T., Thompson, L., & Choi, H.-S. (2006). Tainted knowledge vs. tempting knowledge: People avoid knowledge from internal rivals and seek knowledge from external rivals. *Management Science*, *52*(8), 1129–1144.

Mueller, P. (2006). Exploring the knowledge filter: How entrepreneurship and university-industry relationships drive economic growth. *Research Policy*, *35*(10), 1499–1508.

Nonaka, I. (1994). A dynamic theory of organizational knowledge creation. *Organization Science*, *5*(1), 14–37.

Norman, P.M. (2001). Are your secrets safe? Knowledge protection in strategic alliances. *Business Horizons*, *44*(6), 51–60.

Norman, P.M. (2002). Protecting knowledge in strategic alliances: Resource and relational characteristics. *Journal of High Technology Management Research*, *13*(2), 177–202.

Norman, P.M. (2004). Knowledge acquisition, knowledge loss, and satisfaction in high technology alliances. *Journal of Business Research*, *57*(6), 610–619.

Nunnally, J.C. (1978). *Psychometric theory*. New York: McGraw-Hill.

O'Brien, R.M. (2007). A caution regarding rules of thumb for variance inflation factors. *Quality and Quantity*, *41*(5), 673–690.

O'Reilly, C.A., III & Roberts, K.H. (1974). Information filtration in organizations: Three experiments. *Organizational Behavior and Human Performance*, *11*(2), 253–265.

Oxley, J.E. & Sampson, R.C. (2004). The scope and governance of international R&D alliances. *Strategic Management Journal*, *25*(8–9), 723–749.

Podsakoff, P.M., MacKenzie, S.B., Lee, J., & Podsakoff, N.P. (2003). Common method biases in behavioral research: A critical review of the literature and recommended remedies. *The Journal of Applied Psychology*, *88*(5), 879–903.

Powell, W.W., Koput, K.W., & Smith-Doerr, L. (1996). Interorganizational collaboration and the locus of innovation: Networks of learning in biotechnology. *Administrative Science Quarterly*, *41*(1), 116–145.

Quintas, P., Lefrere, P., & Jones, G. (1997). Knowledge management: A strategic agenda. *Long Range Planning*, *30*(3), 385–391.

Rindfleisch, A., Malter, A.J., Ganesan, S., & Moorman, C. (2008). Cross-sectional versus longitudinal survey research: Concepts, findings, and guidelines. *Journal of Marketing Research*, *45*(3), 261–279.

Romer, P. (1990). Endogenous technical change. *The Journal of Political Economy*, *98*(5), S71–S102.

Rothaermel, F.T. & Deeds, D.L. (2006). Alliance type, alliance experience and alliance management capability in high-technology ventures. *Journal of Business Venturing*, *21*(4), 429–460.

Runyan, R.C., Ge, B., Dong, B., & Swinney, J.L. (2012). Entrepreneurial orientation in cross-cultural research: Assessing measurement invariance in the construct. *Entrepreneurship Theory and Practice*, *36*(4), 819–836.

Sampson, R.C. (2007). R&D alliances and firm performance: The impact of technological diversity and alliance organization on innovation. *Academy of Management Journal*, *50*(2), 364–386.

Sarkar, M.B., Aulakh, P.S., & Madhok, A. (2009). Process capabilities and value generation in alliance portfolios. *Organization Science*, *20*(3), 583–600.

Sarkar, M.B., Echambadi, R., & Harrison, J.S. (2001). Alliance entrepreneurship and firm market performance. *Strategic Management Journal*, *22*(6/7), 701–711.

Savalei, V. & Kolenikov, S. (2008). Constrained versus unconstrained estimation in structural equation modeling. *Psychological Methods*, *13*(2), 150–170.

Saxton, T. (1997). The effects of partner and relationship characteristics on alliance outcomes. *Academy of Management Journal*, *40*(2), 443–461.

Shu, C., Page, A.L., Gao, S., & Jiang, X. (2012). Managerial ties and firm innovation: Is knowledge creation a missing link? *Journal of Product Innovation Management*, *29*(1), 125–143.

Simon, H. (1957). *Administrative behavior*. New York: Free Press.

Simonin, B.L. (1999). Ambiguity and the process of knowledge transfer in strategic alliance. *Strategic Management Journal*, *20*(7), 595–623.

Tang, J., Tang, Z., Marino, L.D., Zhang, Y., & Li, Q. (2008). Exploring an inverted U-shape relationship between entrepreneurial orientation and performance in Chinese ventures. *Entrepreneurship Theory and Practice*, *32*(1), 219–239.

Teng, B.-S. (2007). Corporate entrepreneurship activities through strategic alliances: A resource-based approach toward competitive advantage. *Journal of Management Studies*, *44*(1), 119–142.

Wang, C.L. (2008). Entrepreneurial orientation, learning orientation, and firm performance. *Entrepreneurship Theory and Practice*, *32*(4), 635–657.

Williamson, O.E. (1985). *The economic institutions of capitalism*. New York: Free Press.

Winter, S. (1987). Knowledge and competence as strategic assets. In D. Teece (Ed.), *The competitive challenge* (pp. 159–184). Cambridge, MA: Ballinger.

Wright, M., Liu, X., Buck, T., & Filatotchev, I. (2008). Returnee entrepreneurs, science park location choice and performance: An analysis of high-technology SMEs in China. *Entrepreneurship Theory and Practice*, *32*(1), 131–155.

Yang, H., Phelps, C., & Steensma, H.K. (2010). Learning from what others have learned from you: The effects of knowledge spillovers on original firms. *Academy of Management Journal*, *53*(2), 371–389.

Zahra, S.A. & George, G. (2002). Absorptive capacity: A review, reconceptualization, and extension. *Academy of Management Review*, *27*(2), 185–203.

Zhang, H., Shu, C., Jiang, X., & Malter, A.J. (2010). Managing knowledge for innovation: The role of cooperation, competition, and alliance nationality. *Journal of International Marketing*, *18*(4), 74–94.

Chengli Shu is an Assistant Professor in the School of Management at the Xi'an Jiaotong University, 28 West Xianning Road, Xi'an, Shaanxi 710049, China.

Cuijuan Liu is an Associate Professor of Psychology in the Department of Psychology at the Xi'an Physical Education University, 65 North Hanguang Road, Xi'an, Shaanxi 710068, China.

Shanxing Gao is a Professor of Management in the School of Management at the Xi'an Jiaotong University, 28 West Xianning Road, Xi'an, Shaanxi 710049, China.

Mark Shanley is a Professor of Strategy in the College of Business Administration at the University of Illinois in Chicago, 601 S Morgan M/C 243, Chicago, IL 60607, USA.