J PROD INNOV MANAG 2013;30(5):916–936

DOI: 10.1111/jpim.12037

Exploration and Resource Commitments in Unequal Partnerships: An Examination of Corporate Venture Capital Investments*

Anu Wadhwa and Sandip Basu

While established firms' relationships with external ventures may have significant strategic benefits, the realization of such benefits is fraught with considerable uncertainty. The real options and interorganizational learning literatures present an interesting trade-off for established firms regarding commitment of resources in a partnership. This study seeks to enhance our understanding of how firms manage these trade-offs when committing resources to external venturing initiatives. We examine the magnitude of resources initially committed by an established firm to an external venturing partnership in the context of corporate venture capital (CVC) investments. While a real options approach suggests that resource commitments should be lowered in the presence of uncertainty regarding realization of benefits, the interorganizational literature emphasizes that resource commitments may be essential for building quality relationships that expedite learning. Corporate investors, who invest in new ventures in order to gain strategic benefits, face higher uncertainty when their investment objectives involve greater exploration. However, greater exploration also increases investors' need to learn from their portfolio ventures. We, therefore, predicted that the degree of exploration would have a U-shaped relationship with the investor's resource commitment in a venture. We also expected that factors that serve to decrease the investor's uncertainty, i.e., investor experience diversity and venture affiliation to prominent venture capitalists, would moderate the U-shaped relationship between exploration and resource commitment. The predictions of the study are tested on a sample of 248 initial investments in private ventures made by incumbent firms in the computer, semiconductor, and telecommunications industries between 1996 and 2000. We find some support for our hypotheses. This study contributes to the external venturing literature on CVC investments by examining the determinants of the magnitude of resource commitment to new ventures, and integrates real options perspective, which advocates low resource commitments under uncertainty, with the organizational learning literature, which argues for greater resource commitment to secure partner cooperation. The results of this study reveal interesting insights into how CVC investors manage individual investments to generate strategic benefits.

To remain competitive in technologically intensive industries, incumbent firms need to continuously identify ways to start new businesses, develop new technologies and products, enter new markets, and adopt new organizational forms (Ahuja and Lampert, 2001; Teng, 2007). Entrepreneurial approaches to implement such initiatives within a corporate context are collectively described as corporate entrepreneurship (Covin and Slevin, 1991; Sharma and Chrisman, 1999). An important aspect of established firms' corporate entrepreneurship efforts is external venturing, which involves searching for new ideas and learning from knowledge sources outside firm boundaries, typically by partnering with young entrepreneurial ventures (Keil, 2002; Keil, Maula, Schildt, and Zahra, 2008). External venturing helps established firms learn about new technologies, new markets, or new business models, and thereby recognize and respond to emerging environmental opportunities and threats (Schildt, Maula, and Keil, 2005).

While established firms' relationships with external ventures may have significant strategic benefits, the realization of such benefits is fraught with considerable uncertainty. The inherent uncertainty associated with learning from smaller partners presents a dilemma for established firms about the level of resources that they should commit toward building a relationship. Different streams of literature that examine the costs and benefits of committing resources to a partnership tend to focus on

Address correspondence to: Anu Wadhwa, Ecole Polytechnique Fédérale de Lausanne, Odyssea, Station 5, Lausanne, Switzerland. E-mail: anu.wadhwa@epfl.ch. Tel: +41-21-693-0030.

* We would like to thank Suresh Kotha, V. K. Narayanan, Christopher Tucci, participants at the Corporate Entrepreneurship Conference at Rensselaer Polytechnic Institute (2010), Guest Co-Editor Jeffrey Covin, and two anonymous referees at JPIM for their helpful comments and suggestions on earlier drafts of this paper.

very different aspects of this dilemma, and thus provide very different solutions. On the one hand, real options logic focuses on the costs of committing resources and suggests that in the presence of high uncertainty, extensive resource commitments are undesirable until the uncertainty is resolved (Folta, 1998; McGrath, 1997). While the focus on uncertainty is important, this approach does not entertain the possibility that firms might lose any learning benefits by committing cautiously. On the other hand, the literature on learning in partnerships underscores the benefits of making larger, unilateral resource commitments to align partner incentives (Santoro and McGill, 2005), develop trust (Young-Ybarra and Wiersema, 1999), secure partner commitment (Kang, Mahoney, and Tan, 2009), and signal commitment (Parkhe, 1993). Thus, the real options and interorganizational learning literatures present an interesting trade-off for established firms regarding commitment of resources in a partnership. There is a tension between the need to make higher resource commitments to ensure successful learning outcomes from external relationships and the propensity to reduce resource commitments to initiatives with uncertain outcomes. We seek to enhance our understanding of how firms manage these trade-offs when committing resources to external venturing initiatives. The research question of this study is: What factors influence the extent of initial resource commitment of a firm to its external venturing initiatives?

To address this question, we study a specific type of external venturing initiative undertaken by established firms: corporate venture capital (CVC) investments. CVC investments are direct, minority investments made by large established firms in private, entrepreneurial ventures (Dushnitsky and Lenox, 2005b; Wadhwa and Kotha, 2006), and they provide an appropriate context to examine our research question for several reasons. First, CVC investment is an important approach to external venturing for established firms (Dushnitsky, 2006; Keil et al., 2008). Through CVC investments, corporate investors establish boundary-spanning relationships with young ventures pursuing novel technologies and emerging markets (Dushnitsky and Lenox, 2005b; Keil, 2004). Second, learning is an important aspect of CVC investments from the perspective of the corporate investor (Dushnitsky, 2006). While CVC investors seek an internally acceptable rate of financial return on their investments, the primary objective of most investors is strategic, i.e., to access and learn about the knowledge possessed by their portfolio companies in the form of novel technologies or unfamiliar markets (Dushnitsky and Lenox, 2005a). Harnessing potential learning from CVC relationships is therefore paramount for corporate investors to achieve their objectives and realize important firm-level outcomes (Keil, 2004).[1] Third, the resource commitment made by the corporate investor to the new venture is unilateral, with the expectation that these resource commitments will yield both financial returns and strategic benefits for the corporate investor in the long run. Because the venture is not contractually obliged to provide access to its knowledge, the corporate investor has to decide how to structure the relationship to realize the envisioned, but uncertain, benefits.

We argue that CVC investments of corporate investors involve varying degrees of search and experimentation with external knowledge. On the one hand, corporate investors may use CVC investments to undertake *exploration*, i.e., the search for, and experimentation with, novel knowledge outside their domains of competence (March, 1991). On the other hand, investors' CVC

BIOGRAPHICAL SKETCHES

Dr. Anu Wadhwa is Assistant Professor of Management of Technology at the Ecole Polytechnique Fédérale de Lausanne in Switzerland. She received her Ph.D. in Management from the Foster Business School at the University of Washington. Dr. Wadhwa's primary interests focus on corporate entrepreneurship and innovation, interorganizational relationships, and venture funding and financing. Her work has been published or is forthcoming in journals such as *Academy of Management Journal*, *Journal of Management*, *Frontiers of Entrepreneurship Research*, and *Proceedings of the Academy of Management*.

Dr. Sandip Basu is Assistant Professor of Management at the Zicklin School of Business, Baruch College, City University of New York. He received his Ph.D. in Management from the Foster Business School at the University of Washington, Seattle, and has previously taught at the California State University, East Bay, in Hayward, California. Dr. Basu's primary interests are in the areas of entrepreneurship and innovation, strategic change, organizational capabilities, and new venture creation. He has published articles in *Journal of Business Venturing*, *Strategic Entrepreneurship Journal*, *Frontiers of Entrepreneurship Research*, and *Proceedings of the Academy of Management*.

[1] Effectiveness of CVC investments has been highlighted in the extant literature, which suggests that CVC investments can help corporations achieve some important firm-level outcomes. First, CVC investments often help investors innovate more effectively by enhancing their capabilities to create new knowledge (Dushnitsky and Lenox, 2005b; Schildt et al., 2005; Wadhwa and Kotha, 2006); recognizing new, disruptive technologies (Maula, Keil, and Zahra, 2003; Rice et al., 2000); and creating a balance between exploration and exploitation (Hill and Birkinshaw, 2006; Keil et al., 2008; Maula et al., 2003; Rice et al., 2000). Second, CVC investments enhance investors' ability to execute other strategic initiatives, such as alliances (Wadhwa and Phelps, 2009), acquisitions (Benson and Ziedonis, 2009), and entry into new businesses (Birkinshaw and Hill, 2003). By generating these strategic benefits in addition to financial returns, CVC programs can, directly or indirectly, lead to the enhanced financial performance of corporate investors (Dushnitsky and Lenox, 2006; Dushnitsky and Shapira, 2010; Hill and Birkinshaw, 2006).

investment goals may involve *exploitation*, i.e., refinement and deployment of existing internal competencies along known technological and/or market trajectories (Benner and Tushman, 2002; March, 1991; Merton, 1957; Rosenkopf and Nerkar, 2001). Thus, a corporate investor's objectives for making CVC investments may be characterized along a continuum, measured by the extent to which corporate investors seek to learn about new technologies and markets by investing in start-ups. The greater (lower) the novelty and unfamiliarity of knowledge, the higher the exploration (exploitation). The degree of exploration sought through a CVC investment influences two types of uncertainty about realization of strategic benefits, as perceived by the investor. First, with greater exploration, the investor is more uncertain about the venture's capabilities to deliver the long-term benefits sought. Second, the investor is also more uncertain of its *own* capabilities to learn from the venture and realize strategic benefits. Whereas uncertainty regarding venture capabilities could be reduced by initially making a lower resource commitment to a venture, uncertainty regarding one's own capabilities can only be mitigated by making higher resource commitments that would allow the investor to learn more effectively from the venture. We argue that an investor experiences each type of uncertainty differentially based on the degree of exploration involved, and accordingly predict a U-shaped relationship between degree of exploration pursued through an investment and the resources committed to a portfolio company. We also argue that certain factors, other than the resources committed, also help corporate investors mitigate these two types of uncertainties. One such factor is a strong learning capability built over time by making CVC investments that are more diverse. The other is an evaluation of the venture's capabilities based on the other partners that are affiliated with it. These factors are expected to moderate the U-shaped relationship between the extent of exploration and initial resource commitment.

We empirically test our hypotheses on a sample of 248 initial investments in private ventures made by incumbent firms in the computer, semiconductor, and telecommunications industries between 1996 and 2000. Our study makes three important contributions. First, it examines the extent of resource commitment by a larger partner in an unequal partnership. This is an important managerial decision with implications for the benefits realized by the larger partner (Young-Ybarra and Wiersema, 1999). Second, by taking a closer look at the heterogeneity present in corporate investors' strategic objectives, this study offers a more fine-grained picture of how these objectives could involve different degrees of exploration and uncertainty associated with them. Third, by integrating perspectives from the interorganizational learning literature (which highlights the benefits of making resource commitments) and real options literature (which describes the costs of large resource commitments under uncertainty), we develop a unique theoretical explanation for corporate investors' decisions regarding resource commitments in portfolio companies. We discuss these implications in more detail in the discussion section.

Theory and Hypotheses

Exploration by an organization involves searching for and experimenting with novel knowledge outside its domains of competence (March, 1991). Exploration is particularly critical for incumbent firms in dynamic industries experiencing frequent and rapid changes so that they can anticipate and respond to subsequent opportunities and threats (Teng, 2007). An important dimension of a firm's exploratory activity is *technological* exploration. This form of exploration involves spanning of a firm's technological boundaries and pursuing unfamiliar, often emerging technologies (Belderbos, Faems, Leten, and Looy, 2010; Lee, Lee, and Lee, 2003; Rosenkopf and Nerkar, 2001). By engaging in technological exploration, a firm typically seeks to learn about or develop new technologies that can be subsequently incorporated into products, processes, and business models (Lee et al., 2003; Zhou and Wu, 2010). Technological exploration is therefore a powerful driver of innovation that improves the firm's long-term adaptability (Rosenkopf and Nerkar, 2001). Another distinct dimension of firm exploratory activity is *market-related* exploration (Anand, Mesquita, and Vassolo, 2009; Mascarenhas, 1992). While engaging in this form of exploration, a firm seeks to learn about new and unfamiliar markets that it can potentially enter (Anand et al., 2009; King and Tucci, 2002). Market-related exploration is therefore necessary to find profitable opportunities in new environments and build capabilities to address these (Anand et al., 2009; Madhok, 1997). Technology- and market-related explorations could be complementary but are often independent, for instance, when a firm intends to leverage its existing technologies into new markets (Madhok, 1997). Thus, organizations can pursue exploration along dual and often orthogonal dimensions of technology and markets (Gupta, Smith, and Shalley, 2006; Smith and Tushman, 2005).

A commonly advocated approach for established firms to sustain exploration is to use external knowledge as the source of exploratory ideas and initiatives (Holmqvist,

2004). Firms can integrate the new knowledge from external partners to complement internally developed knowledge and enhance the available opportunities for exploration (Ahuja, 2000; Nagarajan and Mitchell, 1998). In particular, the knowledge developed by small entrepreneurial ventures is often breakthrough and revolutionary in nature and likely to be complementary to established firms' internal knowledge (Henderson and Clark, 1990). External venturing, i.e., the approach of developing knowledge collaboratively with young entrepreneurial firms, is therefore vital to established firms' exploration (Covin and Slevin, 1991; Keil, 2004).

Uncertainty in External Venturing

Uncertainty about whether to pursue an activity exists when the outcomes of this activity cannot be intuitively or statistically evaluated using past experiences (Knight, 1921). Because explorative activities involve learning about unfamiliar technologies and markets and developing new competencies related to these areas, there is usually high uncertainty regarding successful outcomes of such activities (March, 1991). In particular, when firms employ an external venturing approach to exploration (Zahra, 1996), the literature suggests that two sources of uncertainty become highly salient. Whereas the first source of uncertainty relates to the capabilities of the venture, the second relates to the capabilities of the larger partner itself.

Uncertainty regarding venture capabilities. This source of uncertainty for the venturing firm arises from concerns regarding the ability of the smaller partner to develop valuable knowledge of potential strategic value. When a firm is developing novel knowledge, it is difficult to predict how external activities outside the control of the firm (e.g., market demand for a product in which this knowledge is embodied, or the emergence of competing and complementary knowledge) may affect the commercialization, integration, and diffusion of such new knowledge (Anderson and Tushman, 1990). Moreover, small ventures are usually subject to the "liability of newness" (Stinchcombe, 1965; Stuart, Hoang, and Hybels, 1999) and may lack critical resources to further develop and exploit their knowledge. Hence, although the venturing firm recognizes early promise in the technology- and market-related capabilities of its smaller partners, it might still perceive significant uncertainty about whether the smaller partners can build on their early initiatives and ultimately succeed in developing valuable knowledge. This type of uncertainty has been characterized in the literature as being relatively *exogenous* in nature because it is largely unaffected by corporate investor actions and typically resolves over time (Folta, 1998). For example, the corporate investor can only recognize over time whether a portfolio company has developed adequate capabilities to generate the strategic benefits initially sought through the investment.

Uncertainty regarding own capabilities. Another distinct type of uncertainty involves the ability of the *venturing firm* to learn from or absorb its smaller partner's knowledge (Cohen and Levinthal, 1990; Lane and Lubatkin, 1998). This is distinct from the first source of uncertainty. For example, the smaller partner may develop knowledge with strategic value for the larger partner but the larger partner may not be able to adequately transfer such knowledge. The larger firm's relative unfamiliarity with the venture's knowledge inhibits its learning (Lane and Lubatkin, 1998). Such obstacles are magnified because the smaller partner is not contractually or hierarchically bound to cooperate in knowledge sharing (Dushnitsky and Shaver, 2009). Therefore, in addition to uncertainty regarding venture capabilities, the venturing firm also faces uncertainty about its own ability to absorb the external venture's knowledge. This type of uncertainty is relatively *endogenous* to the corporate investor. Endogenous uncertainty can be resolved by an investor's actions that allow the firm to "act as an agent of endogenous change" by attempting to "shape the contingencies in its favor" (Folta, 1998, p. 977; McGrath, 1997). Therefore, corporate investors are likely to take actions to increase the extent to which they can learn from their portfolio companies when they perceive such endogenous uncertainty.

Corporate investors often make CVC investments with the objective of technological exploration. Access to portfolio company technologies through CVC helps fill gaps in internal technological development (Kann, 2000), provide a window on emerging technologies (Chesbrough, 2002), or develop new standards jointly (Rice et al., 2000). When a corporate investor's investment in a venture involves technological exploration, there is likely to be greater exogenous uncertainty about the venture's capabilities to develop valuable technologies. The technologies of portfolio companies are typically still in the development stage, and their future usefulness and commercialization potential is unknown. Moreover, at the time of the initial investment by the corporate investor, the potential link to the investor's core technologies and knowledge is tenuous, and the recombinant potential is not well understood (Fleming and

Sorenson, 2001). At the same time, there is also likely to be endogenous uncertainty about the investor's capabilities to learn from its portfolio company. The extent of learning required to absorb these new technologies may exceed the limits of the investor's absorptive capacity (Cohen and Levinthal, 1990), i.e., the extent to which it can screen, value, and utilize external technologies. Further, the portfolio company may be unwilling to divulge valuable intellectual property, thereby resulting in greater imperfections in knowledge transfer. Thus, for a corporate investor, both sources of uncertainty regarding favorable outcomes are likely to be present when an investment involves technological exploration.

CVC investments can also be used for market-related exploration to find new applications for the investor's products, seek new geographical markets, or create network externalities for the firm's core products (Chesbrough, 2002; Dushnitsky, 2006; Winters and Murfin, 1988). When the investor's investment involves market-related exploration, the investor's uncertainty regarding venture capabilities is likely to increase. The best practices and routines of conducting research and innovation tend to be similar across the similar knowledge bases of firms operating in related industries and markets (Kogut and Zander, 1992; Spender and Grant, 1996). Therefore, it is harder for the investor to evaluate venture capabilities in relatively unfamiliar industries and markets. Besides, the uncertainty regarding its own capabilities to learn from a portfolio company in an unfamiliar industry also increases. Common skills, shared language, and similar technical structures allow more efficient knowledge transfers (Katila and Ahuja, 2002). Attempting to evaluate or integrate elements of a dissimilar knowledge base challenges the cognitive structures and assumptions about cause–effect relationships, which may result in costly, excessive, and inconclusive experimentation (Ahuja and Lampert, 2001) and require greater effort to understand and integrate (Cohen and Levinthal, 1990). Cognitive constraints and lack of experience with knowledge elements from dissimilar market domains limit the extent to which firms can comprehend increasingly complex interactions among those elements and combine them effectively with existing knowledge (Fleming and Sorenson, 2001). Further, integrating knowledge from dissimilar sources requires changing patterns of communication, language, best practices, and mental models (Kogut and Zander, 1992). Therefore, for a corporate investor, both sources of uncertainty regarding favorable outcomes are likely to be present when an investment involves exploration in unfamiliar industries and markets.

Resource Commitments in External Venturing

Real options reasoning and resource commitment. Real options theory provides some insights into how managers in the venturing firm confront and mitigate uncertainty in technology- and market-related exploration. The real options framework has been used to conceptualize managerial decision-making in a variety of settings, including joint ventures (Kogut, 1991), acquisitions (Bowman and Hurry, 1993), research and development (R&D) projects (McGrath and Nerkar, 2004), capital projects (Kogut and Kulatilaka, 2001), vertical integration (Leiblein and Miller, 2003), and market entry (Folta and O'Brien, 2004). A real option confers the right, but not the obligation, to participate in a future strategic opportunity requiring greater investment (Dixit and Pindyck, 1994). Real options are attractive because they allow irreversible investments in uncertain opportunities to be deferred, thereby reducing commitment and preserving flexibility (Folta, 1998). By allowing uncertainty to resolve over time, an investor can determine whether the opportunity is valuable before exercising the option. Thus, the real options perspective argues that a low-cost option that preserves access to future strategic investments is attractive under conditions of uncertainty. Creating an option, instead of making more irreversible and extensive resource commitments, reduces the potential negative effect on a firm when valuable strategic opportunities do not accrue. Extensive resource commitments that do not yield benefits may negatively influence the firm's profitability as well as impose significant opportunity costs that preclude it from investing in other strategic initiatives. Creating a real option allows the firm to increase its investment in certain opportunities later, when it is more confident about generating strategic benefits.

External venturing initiatives provide an appropriate context for employing a real options approach to resolve exogenous uncertainty relating to the smaller partner's capabilities (Allen and Hevert, 2007; Folta, 1998; Hurry, Miller, and Bowman, 1992). When a firm perceives greater uncertainty in the smaller partner's capabilities, it is likely to reduce initial resource commitments to the smaller partner thereby retaining the option to invest more at a later time should the opportunity seem valuable in the future. For example, a CVC investor that perceives greater uncertainty about capabilities of the portfolio company (at the time the investor makes the first investment in that venture) will invest a lower proportion of its resources in that venture relative to the total resources allocated for CVC activity. Such a real options approach

will ensure continuance of its CVC program even when strategic benefits from particular investments are not realized. Further, this approach will allow parallel investments to be made in a greater number of ventures from the parent resources allocated to CVC. As noted earlier, exogenous uncertainty in venture capabilities increases when the investor is pursuing exploration, either technological or market-related, through the investment. We therefore expect that investors would reduce their initial commitments to ventures from which they seek knowledge about new technologies or markets.

Interorganizational learning and resource commitment. While real options theory primarily suggests making lower initial resource commitments to reduce exposure to exogenous uncertainty, it also recognizes that there are important advantages to making higher commitments toward an initiative by reducing existing endogenous uncertainty. Higher resource commitments by the investor might expedite greater learning of a new set of growth opportunities, creating a chain of subsequent options (Bowman and Hurry, 1993; Folta, 1998; Folta and O'Brien, 2004). Effective external venturing typically requires interorganizational learning, an interdependent process requiring collaboration, and cooperation among the parties involved (Holmqvist, 2004; Zollo, Reuer, and Singh, 2002). To generate cooperative behavior among smaller partners and to eventually learn from them, it is essential for the external venturing firm to also display a degree of commitment to meet the resource needs of these partners (Hamel, 1991; Kale and Puranam, 2004). Therefore, to reduce the endogenous uncertainty about an investor's own capabilities to absorb and integrate an external venture's knowledge, a corporate investor may have to commit relatively more resources to the relationship.

Prior research has pointed out several mechanisms through which greater resource commitments to external venturing partnerships enable firms to learn more from these partnerships. First, the commitment of resources to a partnership makes the smaller partner more inclined to share its existing knowledge. Young ventures are often concerned about opportunistic behavior by an established collaborator that might use its asymmetric power to misappropriate the venture's intellectual property or compete for the same customers (Dushnitsky and Shaver, 2009). These concerns make young ventures hesitant and cautious about revealing and sharing valuable knowledge with larger partners. Committing resources to a partnership helps the venturing firm alleviate such concerns of opportunistic behavior and secure the trust of the smaller partner (Mesquita, Anand, and Brush, 2008; Parkhe, 1993).[2] Second, commitment of resources by the established firm to the partnership with a venture creates incentives for the venture to develop new knowledge of value to the established firm. When the larger partner makes more resources available to realize common collaborative goals, the smaller partner is more inclined to make corresponding investments to develop relation-specific knowledge (Kale and Puranam, 2004; Kang et al., 2009). Third, the commitment of resources helps create a long-term mutually beneficial partnership by increasing the dependence of the smaller partner on the larger collaborator. Because young ventures are particularly constrained in terms of the resources they need for growth and development (Stinchcombe, 1965; Stuart et al., 1999), their initial dependence on providers of such resources prevents them from ending these relationships prematurely (Young-Ybarra and Wiersema, 1999). When a corporate investor makes a high initial resource commitment, the venture is likely to be amenable to extending the initial CVC tie into other types of relationships that allow adequate time for knowledge transfers to happen in mutually beneficial ways.

As noted earlier, uncertainty regarding one's own capabilities to learn from a portfolio company increases when either technological or market-related exploration is involved. Such uncertainty is expected to increase considerably given the high learning needs from a portfolio company when the investment involves exploration that is *both* technology- and market-related in nature. Exploration that combines these dimensions requires learning about new technologies and markets. Such a high degree of exploration would be ineffective in stimulating investor adaptation and renewal if the investor was not able to learn through collaboration and cooperation with concerned portfolio companies (Keil, 2004; Wadhwa and Kotha, 2006). Therefore, initial resource commitments by the investor are often instrumental in getting the required cooperation from smaller partners and eventually learning from relationships characterized by a high

[2] The threat of opportunistic behavior by the investor is low in this context for four reasons. First, corporate investors care about their reputation in the investing community because it is a source of deal flow for them. Any evidence of misuse of their power can adversely affect their reputation as a reliable investor and negatively impact future opportunities to invest in ventures. Second, ventures have the power to refuse investments that they perceive could compromise their interests, such as investments from investors with unreliable reputations (Katila, Rosenberger, and Eisenhardt, 2008). Third, other VCs that have invested in the venture also look out for their own interests in the venture and are not likely to allow any expropriation by the corporate investor. Finally, more often than not, investors follow the initial investments by committing to future tangible and intangible resources in the form of more investment and joint development agreements, respectively.

degree of exploration that involves both technology- and market-related dimensions.

The insights provided by the real options and interorganizational learning literatures, when integrated, suggest a curvilinear relationship between the corporate investor's degree of exploration in a CVC relationship and the resources it commits initially to the portfolio company. At very low levels of technology- and market-related exploration, the investor has relatively little uncertainty about generating positive outcomes from the relationship, which induces the investor to commit more initial resources. This is in line with real options theory, which suggests that under low uncertainty, greater resource commitment is beneficial for ensuring faster strategic benefits (Folta, 1998; Folta and Miller, 2002). A high initial commitment is also beneficial for investor learning, which may be needed even at low levels of exploration. Although the corporate investor is relatively sure of his or her ability to absorb knowledge from the venture, this investor still needs to learn quickly from the venture to obtain the strategic benefits sought. Thus, at low levels of exploration, there is no trade-off between the prescriptions of real options and organizational learning. At moderate levels of exploration, i.e., when either technology- or market-related exploration are undertaken, the investor perceives more uncertainty in the capabilities of the venture to produce valuable knowledge. However, the investor's endogenous uncertainty about his or her own learning capabilities does not increase proportionately at this stage. Investors' learning needs are still moderate, requiring learning about either new technology or a new market but not both. When exogenous uncertainty increases more rapidly than endogenous uncertainty, the investor will be induced to commit a lower level of resources than if it sought low exploration.

Finally, when corporate investors make investments to pursue *both* technology- and market-related exploration, such as trying to learn about new technologies from ventures in unfamiliar industries, the degree of exploration associated with such investments is very high. While the exogenous uncertainty perceived by the investor regarding venture capabilities continues to be high, it is not significantly greater than a case involving either technology- or market-related exploration. In contrast, the uncertainty about its own ability to learn from the venture increases much more significantly. The learning required from such investments is now considerable in that the investor not only has to understand a new technology but do this from an unfamiliar industry. Learning from the portfolio company is essential for the investor to overcome its high endogenous uncertainty and benefit from the highly explorative initiative. Such learning can be achieved by committing higher levels of resources to the portfolio company with the objective of gaining its cooperation. Therefore, when the need to learn increases significantly from moderate to high exploration, it is more critical for the corporate investor to reduce the uncertainty in its own capabilities to learn by making higher levels of commitment than to reduce uncertainty in the venture's capabilities by making lower levels of commitment. Thus, we hypothesize:

> *H1: The degree of exploration pursued by a corporate investor in a CVC investment relationship has a U-shaped association with the initial resource commitment by the corporate investor to the venture such that resource commitment is greater at very low and very high degrees of exploration.*

So far, it was argued that the extent to which a partner commits resources to the partnership depends on the level of exogenous and endogenous uncertainty it perceives in the relationship, which in turn influences the importance the investor assigns to learning in the partnership. The exogenous and endogenous uncertainty in an investment is not dependent merely on the degree of exploration involved but also depends on the investor's perceptions of his or her own capabilities and the venture's capabilities. For example, corporate investors may be heterogeneous in the evaluation of their own capabilities to learn from portfolio companies. Moreover, investors may receive heterogeneous signals of ventures' capabilities to generate valuable knowledge. Therefore, investors could experience varying levels of exogenous and endogenous uncertainty even for investments involving similar degrees of exploration. This study examines the corporate investor's prior CVC investment experience and the prominence of venture capitalists in the syndicate it invests with, as moderators of the relationship between its degree of exploration and resource commitment.

Prior experience and resource commitment. An investor's experience with making CVC investments could influence his or her endogenous uncertainty about being able to access and transfer a portfolio venture's knowledge. Experience with a specific activity increases efficiency when performing this activity through learning-by-doing (Argote, Beckman, and Epple, 1990). Research on external venturing shows that firms learn from their experience with external venturing initiatives and become more proficient in those activities (Gulati, 1999; Keil, 2004). Inexperienced CVC investors are

likely to lack well-developed approaches for monitoring their investments and ensuring realization of strategic objectives. Moreover, they have also not had a chance to build a reputation in the entrepreneurial community as a trustworthy investor. The primary means through which such investors can obtain leverage with the venture is by making a higher level of investment. As an investor acquires greater CVC experience, it is likely to develop alternative ways to manage its relationships with ventures without relying solely on high levels of investment.[3] An experienced investor is also more embedded in VC networks and has a reputation as a reliable investor. It can therefore elicit cooperation from portfolio ventures who view it as an attractive partner (Basu, Phelps, and Kotha, 2011).

However, more than just cumulative experience of a repetitive nature, the diversity of such experience can result in greater learning about the cause–effect relationships. Experientially, diverse teams draw on diverse perspectives, approaches, and information resources when performing their tasks, increasing the potential for cross-pollination of ideas and solutions (Milliken and Martins, 1996). CVC units with more diverse experience have experienced a range of contractual problems, unanticipated contingencies, and other monitoring difficulties. These units will be more likely to minimize agency problems and recognize potential problems in their ventures (Clercq and Sapienza, 2005). Finally, thanks to broader social networks and deeper understanding of start-up performance (Gulati, 1999), such CVC units can offer portfolio ventures better technological advice and access to market opportunities, which in turn allows these CVC units to build a stronger reputation in the entrepreneurial community. Because of their enhanced reputation, extensive social networks, and ability to monitor venture activities, CVC units with more diverse experience have lower uncertainty regarding their ability to learn from portfolio companies. They can learn from portfolio companies without being overly dependent on their resource commitments. Because endogenous uncertainty is less salient than exogenous uncertainty for investors with more diverse CVC experience, they are likely to reduce resource commitments more significantly at lower levels of exploration and less likely to increase resource commitments at higher levels of exploration compared with investors who do not have such experience. Hence, we posit:

> *H2: CVC experience diversity of the investor will moderate the U-shaped relationship between the degree of exploration pursued by the corporate investor and the initial resource commitment to a portfolio company such that the negative effect of exploration on initial resource commitment at lower levels of exploration will be more negative, and the positive effect of exploration on commitment at higher levels of exploration will be less positive, for investors with greater CVC experience diversity.*

Partner affiliations and resource commitment. An implication of real options reasoning is that investors need to actively examine external signals to mitigate uncertainty in an initiative. If an investor can mitigate its exogenous uncertainty by alternative means, it may be worthwhile to increase initial resource commitments to the initiative to mitigate endogenous uncertainty and realize greater strategic benefits (Folta and Miller, 2002). Because low resource commitments may have negative consequences for the learning a corporate investor derives from its portfolio companies, investors are likely to increase resource commitments in higher quality ventures. However, it is often difficult to interpret underlying quality of young ventures from observable performance indicators such as revenues and profits. In the absence of reliable codified information regarding young venture quality, investors often evaluate their portfolio companies from the affiliations these companies have with prominent stakeholders (Stuart et al., 1999).

Among the most important affiliations that young ventures can have are their associations with prominent venture capitalists. Investors often coinvest jointly with other partners to share the risks in a particular investment (Dimov and Milanov, 2010; Lockett and Wright, 2001). Therefore, a corporate investor is usually part of a "syndicate" of investors that have invested in the same portfolio companies. When a corporate investor's syndicate includes prominent VCs that have a reputation for selecting and nurturing portfolio companies, this helps mitigate its uncertainty about the relationship in multiple ways. First, besides sharing the capital needed by a start-up venture, prominent investment partners also provide the venture with valuable intangible resources, such as endorsement, managerial attention, technological expertise, and network connections, all of which increase the chances of venture success (Brander, Amit, and Antweiler, 2002; De Clercq and Dimov, 2008). Second,

[3] As part of a larger project, we conducted semistructured interviews with managers of 21 CVC units/programs. Our interviews revealed that experienced investors were effective at monitoring venture activities through informal interactions rather than by relying on formal means of control. Among the informal interactions that corporate investors typically have with ventures are: phone calls and visits to ventures' plants/offices, meetings during the due diligence phase, postinvestment meetings if the investor takes a board seat or an observer seat on the board of the venture, and discussions with venture engineers prior to further commitment via co-development or licensing agreements.

the due diligence measures undertaken by prominent investment partners provide further validation of the venture's value (Bygrave, 1987; Lerner, 1994). Third, associations with prominent investors build mutually beneficial relationships and generate access to increased deal flow, thereby increasing the benefits of making the investment (Manigart et al., 2006; Sorensen and Stuart, 2000). Fourth, the presence of prominent investors with common goals and values ensures cooperative behavior of the venture (Sapienza, Manigart, and Vermier, 1996).

The expertise that prominent VCs have in conducting preinvestment due diligence, the complementary resources that these VCs offer to a venture, and the greater legitimacy they have in the entrepreneurial community will contribute toward making the corporate investor less uncertain about the venture's capabilities to generate valuable knowledge. Because of reduced exogenous uncertainty, the corporate investor will not reduce its resource commitments at lower levels of exploration as much as an investor who does not invest with similarly prominent VCs. On the contrary, these corporate investors will be inclined to increase their resource commitments at higher levels of exploration to gain resultant knowledge transfer benefits and thereby exploit the relationship more effectively. Therefore, we hypothesize:

H3: The portfolio company's affiliations to prominent VCs will moderate the U-shaped relationship between the degree of exploration pursued by the corporate investor and the initial resource commitment to a portfolio company such that the negative effect of exploration on initial resource commitment at lower levels of exploration will be less negative, and the positive effect of exploration on commitment at higher levels of exploration will be more positive, for investors that invest in portfolio companies with more affiliations with prominent VCs.

Methods

Sample and Data

The sample for this study was drawn from all corporate investors belonging to the telecommunications, semiconductor, and computer industries that made CVC investments at any point from 1996 to 2000. These industries were chosen because they are inherently technology-intensive and have witnessed rapid changes over the last decade. Incumbent firms in these industries are likely to engage in external venturing to adapt to their dynamic environments. In fact, firms in these and related industries made over 50% of all CVC investments from 1996 to 2000 (Thomson Venture Economics Data). The 1996–2000 period was chosen to observe corporate investors' investment activity because corporations played an important funding role in start-ups during these years. CVC activity is inherently cyclical (Gompers and Lerner, 1998), and this period represents one of the highest crests of such a cycle (Dushnitsky, 2006). This allowed us to sample a greater number of investors investing with greater variability of resource commitments, in a higher number of start-ups, and with considerable variation in investment experience and investment objectives.

The list of all corporate funds that invested venture capital during our observation period was obtained from Thomson Financial's VentureXpert database.[4] To construct the sample, we identified the firms associated with these CVC funds using LexisNexis and Factiva databases. From this list, we identified all public firms in the above three industries based on their Standard Industry Classification (SIC) codes of primary industries from the Compustat tapes. Detailed data were collected for all CVC investments made by our sample firms during the period of study using the VentureXpert database. For each investment in the sample, we searched the LexisNexis and Factiva databases to locate press releases and documents to determine the specific objective for which the corporate investor made each investment. In our original sample of CVC investments, those observations for which we were unable to determine the corporate investor objective were dropped. The final sample comprised 248 distinct dyads representing investments by 43 corporate investors in 228 new portfolio ventures.

Dependent Variable

The primary dependent variable was the corporate investor's initial resource commitment in an entrepreneurial venture. We were able to observe the dollars invested in a portfolio company by a focal investor in the first round of participation, which is an objective and reliable measure of financial resources committed at the start of the partnership. Financial resources are the primary tangible resources committed by a corporate investor and are a strong indicator of the extent to which other intangible resources are invested (Allen and Hevert, 2007). The amount invested in a portfolio company as a proportion of the investor's overall annual CVC activity rather than the absolute amount of money initially invested in a portfolio

[4] VentureXpert has been used extensively for research on venture capital (Gompers, 1995) and corporate venture capital (Basu et al., 2011; Dushnitsky and Lenox, 2005a, 2005b, 2006; Dushnitsky and Shaver, 2009; Gompers and Lerner, 1998; Keil et al., 2008; Maula et al., 2003; Wadhwa and Kotha, 2006).

company is a more accurate indicator of resource commitment. If an investor spends a large proportion of its funds intended for CVC activity on a single venture, this investor may be unable to significantly diversify his/her portfolio and will rely heavily on the focal portfolio company to derive strategic benefits from its program. On the other hand, even if an investor invests large absolute volumes in a particular company, its commitment from the perspective of its overall program is low if this is a small proportion of its concurrent investments in other companies. We are interested in the conditions under which the corporate investor will commit a higher or lower proportion of its investment funds in any given venture. Accordingly, for each investor–venture dyad in our sample, the amount invested (in dollars) by the corporate investor when it first funded the venture was divided by the annual CVC investments made (in dollars) by the investor in that particular year. The primary source of data was VentureXpert, which was supplemented using LexisNexis and Factiva databases.

Independent and Moderator Variables

Degree of exploration. Exploration involves the external search for new and unfamiliar knowledge that might be technology- or market-related, or both (Anand et al., 2009; Rosenkopf and Nerkar, 2001). Therefore, the measure of the degree of exploration encompasses the extent to which the investments in the sample involved exploration of new technologies and the extent to which funded ventures operated in unfamiliar markets. To determine whether an investment involved exploration of new technology, we searched LexisNexis and Factiva databases and used investor and venture names as key words to find archival announcements and articles related to each investment. All articles pertaining not only to the focal investment but also to any relationships between the concerned actors within one year prior to and one year following the investment were included in the analysis. To enable systematic analysis, we put together a list of corporate investor intentions, activities, and/or expectations related to the investment that would indicate whether the corporate investor sought new technology developed by the venture. Both authors independently analyzed the content of press releases to determine whether the investor had sought new technology from the venture. At the end of the independent coding process, the interrater agreement regarding whether the investments involved technology sourcing or not was found to be 91%. In cases of disagreement, the reasons for awarding the respective scores were discussed until an agreement about the score was reached. If any disagreement persisted, the observation was dropped (approximately 2% of observations were dropped for this reason). The methodology followed in the above content analysis has been applied in prior research (Mishina, Pollock, and Porac, 2004).

To determine whether an investment involved exploration in an unfamiliar market, we followed extensive prior research (Dushnitsky and Shaver, 2009; Farjoun, 1998; Montgomery, 1982) that uses SIC codes to measure the extent to which the markets of firms are related or unrelated.[5] When ventures operate in industries that are unrelated to the core industry of the corporate investor, the corporate investor will be less familiar with the products and services offered by the venture's industry, the customers and suppliers of the industry, the technologies used by the firms in the industry, and the business processes and business logic used in the industry. While there are some inconsistencies with the hierarchical classification of SIC codes (Montgomery, 1982), measures employing this classification are more replicable and objective compared with other alternatives (Farjoun, 1998; Hoskisson, Hitt, Johnson, and Moesel, 1993; Palepu, 1985). The ventures' SIC codes were obtained from VentureXpert and corporate investors' SIC codes from Compustat tapes. The measure of market unfamiliarity takes on a value of 1 if the SIC codes of the corporate investor and portfolio venture are completely different, .75 if only the first digits of the two SIC codes are the same, .50 if the first two digits are the same, .25 if the first three digits are the same, and 0 if all four digits of the SIC codes are the same (Wang and Zajac, 2007). Thus, the measure for market unfamiliarity ranges between 0 and 1, with 1 denoting an investment in a completely unfamiliar market for the corporate investor and 0 denoting an investment in an extremely familiar market for the corporate investor.

Finally, to create a composite measure of the degree of exploration in an investment, both dimensions of technology- and market-related exploration were considered. The measure of the degree of exploration in an investment is the sum of the standardized z-scores obtained on the technological exploration and market-related exploration measures. A smaller value of this

[5] The portfolio ventures receiving CVC investments are private firms and have not been assigned SIC codes. Based on the business descriptions of ventures, the VentureXpert database assigns each venture a VentureXpert industry classification code (VEIC). VentureXpert also provides a concordance between VEIC and SIC codes. To ensure consistency in assignment of industry codes, we chose to use SIC codes for both corporate investors and ventures.

variable represents a low degree of exploration while a larger value suggests a high degree of exploration.

CVC experience diversity. To operationalize diversity of an investor's CVC experience, we first collected data from VentureXpert on the primary business sectors of all the portfolio companies of the investor. A Herfindahl index (Palepu, 1985) was computed based on the business sectors of all ventures in which the corporate investor had invested in the past five years. A value of 0 indicated no diversity of investing experience while a value close to 1 indicated high diversity.

Prominent VCs. A firm's prominence depends on its visibility and influence over concerned stakeholders in key operational areas (Rindova, Petkova, and Kotha, 2007). Because investing in young ventures is the primary operational activity for VCs, their prominence would be reflected in their past performance. One of the most visible and direct indicators of VC performance is the number of companies that a VC has taken public (Gompers, Kovner, and Lerner, 2009; Hochberg, Ljungqvist, and Lu, 2007). VCs that have taken many of their portfolio companies public build a reputation for being attractive investors that contribute valuable expertise and connections to their portfolio companies (Rindova et al., 2007). Therefore, we first collected data from VentureXpert on the entire universe of VCs that invested during our observation period, and for these VCs we collected data on the number of initial public offerings (IPOs) that they undertook five years prior to and during the observation period of the study. Using this data, the top 50 VCs were identified based on number of IPOs undertaken in the five years prior to each year within the selected period. These VCs were considered as prominent VCs for that year. For all the corporate investor–venture dyads in our sample, a list was compiled of the VCs that had invested in the venture prior to, as well as in the same round as, the initial investment by the corporate investor. The extent to which a venture had affiliations to prominent VCs was operationalized as the number of prominent VCs that had invested in the venture by the time of the first investment made by the focal corporate investor.

Control Variables

We controlled for various aspects of the focal investment round, the venture, the corporate investor, and industry and time effects that could have an effect on the level of resource commitment by the particular investor in the portfolio company.

Funding round size and prior funds received by venture. A larger funding round might automatically result in larger shares to all participants in the round. Therefore, we controlled for funding round size, measured as the amount raised by the venture in the focal round of investment. We also controlled for funding received by the venture prior to the focal round of funding (prior funds received) in millions of dollars, because past commitments to the venture can influence present levels of investment of a new investor.

Industry and unobserved time effects. The investor's *industry growth* and *industry sales* were controlled for in the study. To control for unobserved industry effects, industry dummy variables were used to indicate whether the investing firm belonged to the telecommunications, computer, or semiconductor industry (the computer industry was the omitted dummy variable). Additionally, to control for unobserved time effects, dummy variables were included for the year the focal investment was made, ranging from 1996 to 1999 (the year 2000 was the omitted dummy variable).

Investor size, R&D intensity, employees, and unit structure. Because larger firms are likely to have the resources to make higher levels of investment in individual ventures, we controlled for the corporate investor size using both its annual revenue and number of employees in the year the focal investment was made (*investor size, investor employees*). The investor's internal R&D programs may influence the uncertainties perceived in external investments (Cohen and Levinthal, 1990) and therefore the extent of resources committed. Thus, a control variable for *investor R&D intensity* (R&D expenditure as a proportion of total revenue) was included for the year the focal investment was made. A binary control variable (*dedicated CVC unit*) was used to indicate whether the investment was made through an independent subsidiary of the corporate investor or through a mainstream corporate department. Independent subsidiaries may not be driven by the same uncertainties (Dushnitsky and Shaver, 2009), and therefore have different metrics for making decisions regarding the level of investment.

Venture patents, age and stage, and size of syndicate. The technological resources possessed by the venture may influence the uncertainty perceived by the investor in the investment. Data were collected on the number of patents filed by the venture at the time of the investment that were subsequently granted. These

data were taken from the United States Patent and Trademark Office (USPTO) patent database. This variable, *venture patents*, was operationalized as the number of patents filed by the target at the time of investment. The age of the venture (*venture age*) was controlled for because ventures' resource needs usually increase as they mature, which might influence how much individual investors invest. We controlled for stage of venture development (*venture stage*) at the time of the focal investment, as this is closely tied to the investments that a venture receives. In the case of technology ventures, investors typically make every round of funding contingent upon achievement of technical milestones (Gompers, 1995). Moreover, at an earlier stage, the concerned corporate investor is likely to be one of the lead investors and therefore obliged to commit greater resources. The VentureXpert database identifies the stage of each venture at every financing round and classifies them into three stages: early and seed, expansion, and mature. This variable was coded on a scale from 1 to 3, with 1 representing early and seed stage and 3 representing the mature stage. We also controlled for the number of coinvestors participating before the focal round, which is likely to influence the amount of the contribution of each investor (*size of syndicate*).

Analysis

The dependent variable is a proportion and cannot take values less than zero or greater than 1. Therefore, the dependent variable can be treated as a censored continuous variable bounded by 0 from below and 1 from above. Tobit regression models with robust errors were used to analyze the data. *Round size* and *prior funding received* were transformed into their natural logarithms to improve the skewness and kurtosis of their distributions. Starting from a baseline control model, all independent and moderator variables were entered in a stepwise manner. All significant tests reported in the models represent more conservative two-tailed tests, even though one-tailed tests would have been statistically adequate because of the directionality of our hypotheses (Neter, Kutner, Nachtsheim, and Wasserman, 1996).

Results

The descriptive statistics and the pairwise correlation matrix of the variables of interest are presented in Tables 1 and 2, respectively. As expected, the *degree of exploration* correlated negatively with the dependent variable, *initial resource commitment*. Some variables exhibit high correlations with each other. For example,

Table 1. Descriptive Statistics ($n = 248$)

Variables	Mean	SD	Min	Max
(1) Initial resource commitment	.226	.313	.001	1
(2) Funding round size ($ Mn)	9.705	1.08	6.792	13.218
(3) Prior funds received ($ Mn)	1.843	1.373	0	5.66
(4) Industry growth	9.341	10.708	−14.707	39.474
(5) Industry sales	15.514	8.741	2.5	38.1
(6) Year 1996	.072	.259	0	1
(7) Year 1997	.048	.215	0	1
(8) Year 1998	.076	.266	0	1
(9) Year 1999	.221	.416	0	1
(10) Industry—Hardware	.486	.501	0	1
(11) Industry—Semiconductor	.245	.431	0	1
(12) Investor size ($ Mn)	17,289.511	15,419.706	58.957	75,483.047
(13) Investor R&D intensity	.119	.074	.011	.417
(14) Investor employees	51.194	54.102	.136	337.911
(15) Dedicated CVC unit	.49	.501	0	1
(16) Venture patents	2.578	7.302	0	72
(17) Venture age	3.007	2.846	0	16.6
(18) Venture development stage	1.904	.665	1	3
(19) Size of syndicate	3.072	3.039	0	16
(20) CVC experience diversity	.532	.286	0	.813
(21) Prominent VCs	.855	1.216	0	6
(22) Degree of exploration	0	1.269	−3.519	1.964

Table 2. Pairwise Correlations ($n = 248$)

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)
(1) Initial resource commitment	1																					
(2) Funding round size ($ Mn)	−.094	1																				
(3) Prior funds received ($ Mn)	−.034	.465	1																			
(4) Industry growth	.071	−.15	−.111	1																		
(5) Industry sales	.208	−.125	−.175	.151	1																	
(6) Year 1996	.144	−.193	−.066	.317	−.082	1																
(7) Year 1997	.093	−.197	−.126	.055	−.096	−.063	1															
(8) Year 1998	.214	−.158	.015	.269	.075	−.08	−.065	1														
(9) Year 1999	.051	−.006	.067	−.478	−.02	−.149	−.12	−.153	1													
(10) Industry—Hardware	−.155	.126	.195	−.013	−.619	.101	.006	−.007	−.014	1												
(11) Industry—Semiconductor	.072	−.015	−.074	−.08	−.019	−.015	.003	−.058	.147	−.554	1											
(12) Investor size ($ Mn)	−.435	.091	−.038	−.163	−.271	−.153	−.066	−.082	−.062	.166	−.134	1										
(13) Investor R&D intensity	.178	.071	.067	.207	.232	−.042	−.083	.047	.097	−.152	.257	−.486	1									
(14) Investor employees	−.255	−.022	−.112	−.07	.02	−.124	.018	−.031	−.101	−.07	−.14	.852	−.341	1								
(15) Dedicated CVC unit	−.311	−.011	−.197	−.144	.104	−.212	−.033	−.13	−.038	−.39	.17	.425	−.369	.379	1							
(16) Venture patents	.068	.123	.092	−.097	−.034	−.041	−.044	−.023	.144	−.023	.121	−.024	.148	−.036	−.121	1						
(17) Venture age	−.022	.038	.102	−.125	−.126	.141	−.033	−.085	.098	.212	−.103	.086	−.096	.037	−.079	.244	1					
(18) Venture development stage	.078	.412	.561	−.154	−.179	−.076	.004	.019	.121	.19	−.058	.036	−.064	−.006	−.172	.116	.172	1				
(19) Size of syndicate	−.035	.291	.784	−.145	−.201	−.053	−.098	−.037	.163	.154	.014	−.043	.064	−.076	−.206	.029	.136	.43	1			
(20) CVC experience diversity	−.649	.145	−.006	−.125	−.175	−.131	−.044	−.147	−.084	.094	−.043	.427	−.224	.262	.476	−.14	−.025	−.064	−.023	1		
(21) Prominent VCs	−.199	.352	.334	−.102	−.22	−.082	−.097	−.128	.135	.076	.152	.045	.027	−.074	.011	−.096	−.035	.172	.4	.11	1	
(22) Degree of exploration	−.209	.026	.118	.113	−.055	.134	.007	.08	−.061	.273	−.198	.07	−.012	.036	−.105	−.051	.049	.034	.079	.143	.001	1

the variables *prominent VCs*, *venture stage,* and *venture prior funding* correlated with each other and with *size of syndicate*. *CVC experience diversity* correlated positively with *dedicated CVC unit* and *investor size*, suggesting that experienced corporate investors are usually large firms that also formalize their CVC investments through special structures. In order to alleviate concerns about multicollinearity, we checked the variance inflation factors (VIFs) for all variables. The individual VIFs of all but three variables are less than 2.63, well below the cut off point of 10 (Neter et al., 1996). Even among the higher values, the VIFs of *investor size, investor employees,* and the dummy for the *hardware industry* are 8.7, 6.54, and 5.47, respectively. The overall variance inflation value is 2.89. Thus, we can be confident that multicollinearity is not a problem in our data.

The results of Tobit regressions are reported in Table 3 where model 1 is the baseline model with control variables. Models 2 and 3 introduce *degree of exploration* and its squared term. To test the moderating effect of *CVC experience diversity* and *prominent VCs*, each moderator variable was set to interact with the linear term of *degree of exploration*. Models 4 and 5 sequentially introduce the interaction of *CVC experience diversity* with *degree of exploration* and its squared term. In models 6 and 7, the interactions with *CVC experience diversity* were removed and the interaction of *prominent VCs* with *degree of exploration*, and its squared term were added. Model 8 is the full model with all interaction terms. To compute the higher order terms for the interactions, the lower order terms were mean-centered to reduce multicollinearity (Aiken and West, 1991). The Log likelihood and Wald tests indicated improvement in model fit relative to the baseline model and overall model fit, respectively.

H1 predicted that the *degree of exploration* will have a U-shaped relationship with *initial resource commitment* by the corporate investor. The *degree of exploration* was consistently negative and significant at the .01 (or higher) levels in models 2–8. The square of *degree of exploration* was positive and significant at .05 (or higher) levels in models 3–8. Thus, the results support H1—the resources committed first tended to decrease and eventually increase with increasing investor uncertainty. We also computed the value of uncertainty at which the resource commitment reaches its minimum value. Taking partial derivatives, the inflection point of the estimated U-shaped curve was found to be well within the range of our data.

H2 predicted that investor's CVC experience diversity will moderate the relationship between degree of exploration and initial resource commitment. We found some support for H2 that the interaction between degree of exploration and investor's CVC experience diversity was consistently negative and significant at the .05 level in all models in which it was included. However, the interaction between the degree of exploration squared and investor's CVC experience diversity was negative but not significant in models 5 and 8. Thus, we found only a linear moderating effect as hypothesized in the first part of H2 but did not find a curvilinear moderating effect as hypothesized in the second part. A linear moderating effect suggests that CVC experience diversity primarily impacts the negative effect of exploration on initial resource commitment when the investor objectives entail low level of exploration, but does not impact the positive relationship between CVC investor diversity and exploration when the investor seeks a high level of exploration.

In H3, we predicted that prominent VCs will positively moderate the relationship between degree of exploration and initial resource commitment. We also found some support for this hypothesis. While the interaction of the linear variables was not significant, the curvilinear interaction term, i.e., degree of exploration squared X prominent VCs, was positive and significant at the .05 level in models 7 and 8. This suggests that varying levels of prominent VCs will impact the curvilinear effect of degree of exploration on initial resource commitment.

Further Analyses

We confirmed our results using different regression models. First, we estimated the different models using ordinary least squares (OLS) regression—results from OLS regression are expected to be similar to the results from Tobit regression because our dependent variable does not have many values that are equal to either 0 or 1 (Long, 1997). The Huber/White/Sandwich covariance estimator was used in all OLS regression models to correct for heteroscedasticity in the data. Second, a fractional logit regression, which has been proposed as an appropriate estimation method for fractional response variables (Papke and Wooldridge, 1996), was estimated. The results of the OLS as well as fractional logit regression were consistent with the Tobit analysis and are available from the authors.

For ease of interpretation, the equation and estimates available in model 8 (Table 3) were used to plot the U-shaped curve and the moderation effects (Figures 1 and 2). In both figures, specific values of the relevant moderator variable (at the mean, mean ± standard deviation), and values of the independent variable (at the mean, mean ± standard deviation, mean ± 2.0 standard

Table 3. Tobit Regression Results (DV = Initial Resource Commitment)

Variables	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
Constant	−.103	−.160	−.210	−.196	−.195	−.205	−.204	−.206
	[.177]	[.175]	[.175]	[.173]	[.173]	[.179]	[.178]	[.175]
Funding round size ($ Mn)	.035*	.035*	.035*	.030+	.030+	.035*	.034*	.030+
	[.017]	[.017]	[.016]	[.016]	[.016]	[.017]	[.017]	[.016]
Prior funds received ($ Mn)	−.015	−.011	−.013	−.009	−.009	−.013	−.012	−.008
	[.019]	[.019]	[.019]	[.019]	[.019]	[.019]	[.019]	[.019]
Industry growth	−.003+	−.003+	−.003+	−.003*	−.003*	−.003+	−.003+	−.003*
	[.002]	[.002]	[.002]	[.002]	[.002]	[.002]	[.002]	[.002]
Industry sales	.001	.003	.003	.004	.004	.003	.004	.005+
	[.003]	[.003]	[.003]	[.003]	[.003]	[.003]	[.003]	[.003]
Year 1996	.152*	.180**	.180**	.175**	.174**	.179**	.181**	.180**
	[.064]	[.064]	[.063]	[.062]	[.062]	[.064]	[.063]	[.062]
Year 1997	.110	.126+	.113	.105	.105	.113	.116+	.108
	[.071]	[.070]	[.070]	[.069]	[.069]	[.070]	[.069]	[.069]
Year 1998	.199***	.217***	.224***	.221***	.221***	.224***	.223***	.222***
	[.058]	[.057]	[.056]	[.056]	[.056]	[.057]	[.056]	[.055]
Year 1999	.020	.023	.014	.007	.007	.014	.017	.009
	[.041]	[.040]	[.040]	[.039]	[.040]	[.040]	[.040]	[.039]
Industry—Hardware	.014	.053	.071	.075	.075	.071	.080	.085
	[.061]	[.061]	[.061]	[.060]	[.061]	[.061]	[.061]	[.061]
Industry—Semiconductor	.036	.043	.056	.062	.062	.055	.064	.071
	[.053]	[.052]	[.052]	[.051]	[.052]	[.052]	[.052]	[.052]
Investor size ($ Mn)	−.000**	−.000**	−.000**	−.000**	−.000**	−.000**	−.000**	−.000**
	[.000]	[.000]	[.000]	[.000]	[.000]	[.000]	[.000]	[.000]
Investor R&D intensity	−.148	−.134	−.165	−.087	−.085	−.168	−.247	−.150
	[.260]	[.256]	[.253]	[.252]	[.253]	[.255]	[.257]	[.256]
Investor employees	.001	.001	.001+	.001	.001	.001+	.001+	.001+
	[.001]	[.001]	[.001]	[.001]	[.001]	[.001]	[.001]	[.001]
Dedicated CVC unit	.033	.032	.038	.028	.029	.037	.037	.031
	[.043]	[.042]	[.042]	[.042]	[.042]	[.043]	[.042]	[.042]
Venture patents	−.001	−.001	−.001	−.001	−.001	−.001	−.001	−.002
	[.002]	[.002]	[.002]	[.002]	[.002]	[.002]	[.002]	[.002]
Venture age	−.003	−.004	−.005	−.006	−.006	−.005	−.005	−.005
	[.005]	[.005]	[.005]	[.005]	[.005]	[.005]	[.005]	[.005]
Venture development stage	.034	.031	.035	.040	.040	.035	.029	.033
	[.027]	[.027]	[.026]	[.026]	[.026]	[.026]	[.026]	[.026]
Size of syndicate	.001	.001	.001	.000	.000	.002	.003	.001
	[.008]	[.008]	[.008]	[.008]	[.008]	[.008]	[.008]	[.008]
CVC experience diversity	−.577***	−.547***	−.535***	−.548***	−.545***	−.534***	−.538***	−.545***
	[.062]	[.061]	[.061]	[.060]	[.068]	[.061]	[.061]	[.068]
Prominent VCs	−.032*	−.032*	−.028*	−.026*	−.026*	−.028*	−.043**	−.042**
	[.014]	[.013]	[.013]	[.013]	[.013]	[.013]	[.015]	[.015]
Degree of exploration		−.036**	−.035**	−.043***	−.042***	−.036**	−.047***	−.053***
		[.012]	[.011]	[.012]	[.012]	[.012]	[.013]	[.014]
Degree of exploration squared			.035*	.046**	.046**	.035*	.058**	.068**
			[.015]	[.016]	[.017]	[.016]	[.020]	[.020]
Exploration X CVC exp. diversity				−.090*	−.090*			−.097*
				[.037]	[.037]			[.037]
Exploration sq. X CVC exp. diversity					−.004			−.018
					[.049]			[.049]
Exploration X prominent VC						−.001	−.014	−.009
						[.012]	[.014]	[.014]
Exploration sq. X prominent VC							.044*	.046*
							[.023]	[.023]
Number of observations	248	248	248	248	248	248	248	248
Degrees of freedom	20	21	22	23	24	23	24	26
LR Chi^2	179.85	189.20	194.27	200.20	200.21	194.28	197.84	204.40
Log likelihood	28.82	33.49	36.03	38.99	39.00	36.03	37.81	41.10
-2 log likelihood test		9.35	14.42	20.35	20.36	14.43	17.99	24.56

Standard errors in brackets; *** $p < .001$, ** $p < .01$, * $p < .05$, + $p < .1$; two-tailed t-tests for all variables.

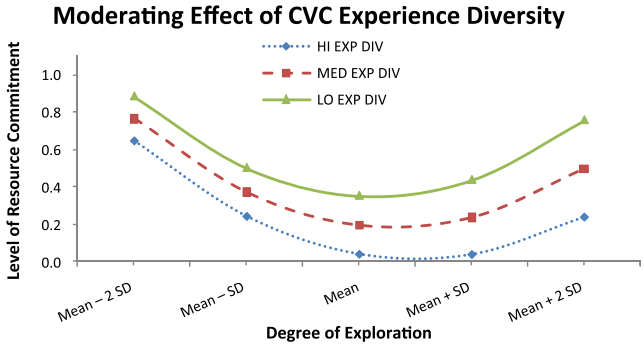

Figure 1. Moderating Effect of Investor Experience Diversity

deviation) were used in the equation, while keeping all other models of the variable equal to their sample mean values (Wiersema and Bowen, 2009). Both Figures 1 and 2 are in line with H1, showing a U-shaped relationship between degree of exploration and level of resource commitment. In Figure 1, the U-shaped curve shifts downwards with higher degrees of investor CVC experience diversity. The three curves, depicting the relationship between exploration and resource commitment at three different values of investor experience diversity, are not parallel to each other but retain the U shape. This is consistent with the results shown in Table 3, which confirm that the investor experience diversity has a linear moderating effect and does not affect the curvature of the relationship between exploration and resource commitment (Aiken and West, 1991). Figure 2 shows the moderating effect of prominent VCs on the U-shaped relationship between exploration and resource commitment. As Figure 2 reveals, resource commitments in ventures affiliated with prominent VCs rose more steeply at higher levels of exploration compared with resource commitments in ventures that do not have such affiliations. However, contrary to our expectations, the *fall* in resource commitments in ventures with prominent VC

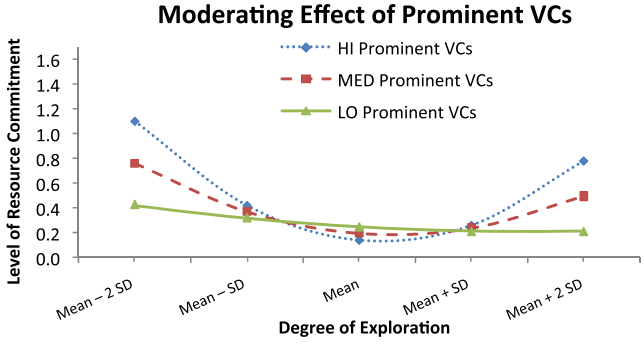

Figure 2. Moderating Effect of Prominent VCs in Investor Syndicate

affiliations was also steeper at lower levels of exploration. Thus we do not see support for a linear moderating effect.

Discussion and Conclusion

This study, which examined determinants of the extent of resources that an established firm initially commits to an external venturing partnership, was motivated by an interesting tension in the alliances and external venturing literatures. While a real options approach to engaging in external venturing suggests that initial resource commitments should be lowered when considerable uncertainty exists regarding realization of benefits, the interorganizational literature emphasizes that committing resources may be essential to building more high-quality relationships that expedite learning from smaller partners. Given this tension, we were intrigued by how firms that engage in CVC investment in order to pursue exploration overcome different types of uncertainty and learn from these external venturing relationships. In other words, how do they decide on unilateral resource commitments made to their smaller partners in order to mitigate uncertainty as well as maintain the potential for learning from these partners?

The results of the study revealed a U-shaped relationship between the degree of exploration pursued by firms and their initial resource commitments to smaller partners. For CVC investors, increasing the degree of exploration (and the resulting exogenous uncertainty about venture capabilities) is associated with lower initial commitment of resources to the portfolio companies, which is in line with the real options approach. However, a very high degree of exploration increases the imperative to learn from the portfolio companies and results in corporate investors increasing the level of resource commitment.

We find some interesting results for the factors that were hypothesized to moderate this relationship. First, for investors that have made more diverse CVC investments in the past, resource commitments appear to decrease faster as the degree of exploration in investor objectives increases from low to moderate levels. This suggests that at low levels of exploration, experienced investors manage the increasing uncertainty in line with real options reasoning and hedge their bets to resolve this uncertainty. At higher levels of exploration, we observe that experienced managers do not increase their resource commitments at the same rate as inexperienced managers do to enhance their learning from their portfolio companies. One implication of this result may be that experienced investors may also be more confident in their

ability to learn from their portfolio firms and may not perceive the need to use resource commitments to overcome learning-related uncertainty. However, we make this claim cautiously because at high levels of uncertainty the result is not significant. Second, when investors are part of a syndicate with many prominent VCs, their resource commitments at very low and very high degrees of exploration are greater compared with other investors. Because our result is significant only for high levels of exploration, it would suggest that the validation by prominent VCs is not perceived to reduce exogenous uncertainty for investors when investor objectives entail low level of exploration. Perhaps corporate investors seeking low exploration do not perceive VCs as adding much value in ways that will enable these ventures to realize the investors' investment objectives. That the moderating effects of experienced investors and those with prominent VCs in their syndicate are manifested only for certain levels of uncertainty are interesting findings that should be probed further.

Contributions

This study makes substantive contributions to the literature on external venturing, specifically to the CVC literature. First, there is limited recognition and examination of the important managerial decisions pertaining to individual venturing partnerships. While scholars have examined when firms are more likely to engage in external venturing (Basu et al., 2011), which partners they are likely to select (Dushnitsky and Shaver, 2009), and when they are likely to benefit from external venturing (Wadhwa and Kotha, 2006), research is yet to explore the choices available to managers regarding how to structure their partnerships and the decision-making processes for making these choices (McEvily, Eisenhardt, and Prescott, 2004). In this study, we examined determinants of the extent of resource commitment to a partnership, which we argue is an important element of the structure of these collaborative relationships.

Second, different streams of literature describe the costs and benefits of committing resources to a partnership. However, little work has been done on integrating these perspectives. For example, research on interorganizational learning discusses the benefits of resource commitments to securing the cooperation of a smaller partner (Kale and Puranam, 2004; Kang et al., 2009; Mesquita et al., 2008); however, it does not address the issues of greater exposure to uncertainty in making large research commitments. In contrast, research employing real options theory argues that lower initial resource commitments can mitigate the uncertainties involved in external venturing (Folta, 1998; Folta and Miller, 2002) but does not explicitly discuss learning opportunities foregone by employing this approach. Moreover, research from a real options perspective focuses on alternative governance modes (involving high and low commitment) and conditions under which each would be more attractive. Research using this perspective has not considered that similar external venturing initiatives could have differing option values based on the initial investment made in each. Our conceptualization of CVC investments as real options suggests that at low levels of resource commitment, CVC investments are more valuable as options to defer commitment. However, at high levels of resource commitment, they are no longer as valuable as deferral options but may create consequent growth options by facilitating learning from portfolio companies. Thus, we shed light on an interesting paradox: the different resource implications of real options logic and the interorganizational learning literature.[6]

Third, the limited work on resource commitments in partnerships has examined commitments from a purely dyadic view. The relation-specific investments of a firm are examined individually, without regard to its investments in other partnerships or the resources available for similar initiatives. In contrast, our unique dependent variable tracks a firm's resource commitments to a particular partner relative to its overall venturing activity.

Our research reveals interesting insights into how CVC investors manage individual investments to generate strategic benefits. Prior research and anecdotal evidence has often suggested that corporate investors are invited to invest at a later stage, their investments are perceived as "dumb money" with higher premiums, and that they lack the bargaining power of prominent VCs (Siegel, Siegel, and MacMillan, 1988). We demonstrated that despite having certain disadvantages as compared with traditional VCs, CVC investors use their resource commitments as a lever to alleviate their concerns about achieving strategic benefits from their CVC investments. However, the challenge for corporate investors is to expedite knowledge transfer without compromising the long-term viability of the investment program. Therefore, managers of corporate investment programs should commit resources to the extent that mitigates inherent uncertainties without compromising learning benefits. In the event that a CVC unit manager cannot make the desired degree of commitment because of internal or venture-imposed constraints, she could consider opting

[6] We are thankful to an anonymous reviewer for the succinct description of the paradox.

out of the particular investment. The opportunity costs of making suboptimal resource commitments to a portfolio company are high, because the firm may be constrained from making more optimal commitments to other new ventures. CVC managers should also consider if they really need to make high resource commitments to facilitate learning. If their units' investing experience offers them unique advantages in generating such learning, they could focus on reducing commitments to mitigate uncertainty in ventures' capabilities.

Another implication is that not all practices followed by traditional VCs work well when managing a CVC investment. Reducing financial risks through syndication and staging almost always makes sense for traditional VCs (Gompers, 1995) but may not always be optimal for corporate VCs, especially when they seek strong learning benefits. In general, corporate investors should evaluate and try to balance the types of uncertainty that confront them based on their strategic objectives. The nature of uncertainty they experience in an investment may be different compared with the uncertainty experienced by a traditional VC that does not have similar strategic objectives for the investment.

Finally, this study also extends the discussion of investor objectives beyond the broad category of "strategic" objectives. We observed varying degrees of exploration pursued by corporate investors in their CVC investments and demonstrated a connection between the technology- and market-related exploration pursued by corporate investors and the level of resources they commit to their CVC investments.

Limitations and Future Research

The limitations of this study could potentially suggest interesting avenues for future research. Although this study examined the trade-offs made by investors when deciding on an adequate level of investment, it did not determine whether the "right" level of investment would lead to favorable performance for both CVC units. The extent to which the alignment between concerns and governance choices leads to positive outcomes for corporate investors and ventures is a question that future research should attempt to answer.

Our sources of data were primarily archival and probably introduced some noise that is inherent in such data into our measures. Other methodologies, such as surveys and field studies, could replicate and extend the findings of this study. In addition, because the industries included in our sample are high-technology industries that are subject to rapid and continuous change, our hypotheses and assumptions about uncertainty were more germane to these industries. Whether our hypotheses would translate to other, less dynamic industries remains an open question that researchers should explore.

While our context, CVC investments, allowed us to accurately operationalize our dependent variable as *financial* resource commitments, we realize that our measure does not capture the different types of resources which can be committed by firms. This does not imply either that financial investments are the only form of resources committed by the investor to a portfolio company, or that committing financial resources is the only approach to make the venture reciprocate to the corporate investor. However, we argue that even though the venture may turn to the corporate investor at a later stage for nonfinancial resources, a financial commitment is the primary resource the corporate investor commits to form the *initial* CVC tie with a venture. Thus, the first investment becomes an important means of securing potential future cooperation, other things being equal. The measure of resource commitment used in this study therefore provides a conservative test of the predicted hypotheses. It would be promising for future research to examine conditions under which corporate investors commit more nonfinancial resources to portfolio ventures and the outcomes of doing so.

This study also focused on the initial investment made by a corporate investor in a portfolio firm. Because of the nature of our research question, we therefore examined corporate investor decisions at one point of time in a relationship with a portfolio company. An interesting research question might be whether the objectives of corporate investors change over the life cycle of a young venture. In addition, future research could explore the effect of this change on the continuity of investments made by the investor. This question also lends itself to dynamic approaches, such as panel design or field study.

In conclusion, we set out to examine the determinants of resource commitments that external venturing firms make to their smaller partners. We examined initial investments made by CVC investors in portfolio companies. Using insights from the real options and interorganizational learning literatures, we predicted a U-shaped relationship between the degree of exploration that the investor seeks from a CVC investment and the resource commitments it initially makes. We also predicted that the diversity of the investor's prior investments and the affiliations to prominent VCs of the portfolio company moderates this relationship. We hope that our study will motivate further research regarding the

importance of various elements of external venturing partnerships and the decision to incorporate these elements in a particular partnership.

References

Ahuja, G. 2000. The duality of collaboration: Inducements and opportunities in the formation of interfirm linkages. *Strategic Management Journal* 21 (3): 317–43.

Ahuja, G., and C. M. Lampert. 2001. Entrepreneurship in the large corporation: A longitudinal study of how established firms create breakthrough inventions. *Strategic Management Journal* 22 (6-7): 521–43.

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

Allen, S. A., and K. T. Hevert. 2007. Venture capital investing by information technology companies: Did it pay? *Journal of Business Venturing* 22 (2): 262–82.

Anand, J., L. Mesquita, and R. S. Vassolo. 2009. The dynamics of multimarket competition in exploration and exploitation activities. *The Academy of Management Journal* 52 (4): 802–21.

Anderson, P., and M. L. Tushman. 1990. Technological discontinuities and dominant designs: A cyclical model of technological change. *Administrative Science Quarterly* 35: 604–33.

Argote, L., S. Beckman, and D. Epple. 1990. The persistence and transfer of learning in industrial settings. *Management Science* 36: 140–54.

Basu, S., C. Phelps, and S. Kotha. 2011. Towards understanding who makes corporate venture capital investments and why. *Journal of Business Venturing* 26: 153–71.

Belderbos, R., D. Faems, B. Leten, and B. V. Looy. 2010. Technological activities and their impact on the financial performance of the firm: Exploitation and exploration within and between firms. *Journal of Product Innovation Management* 27 (6): 869–82.

Benner, M., and M. L. Tushman. 2002. Process management and technological innovation: A longitudinal study of the paint and photography industries. *Administrative Science Quarterly* 47: 92–1724.

Benson, D., and R. H. Ziedonis. 2009. Corporate venture capital as a window on new technologies: Implications for the performance of corporate investors when acquiring startups. *Organization Science* 20 (2): 329–51.

Birkinshaw, J., and S. A. Hill. 2003. Corporate venturing performance: An investigation into the applicability of venture capital models. In *Academy of management best paper proceedings*, ed. K. M. Weaver. B1–6. Seattle: BPS.

Bowman, E. H., and D. Hurry. 1993. Strategy through the options lens: An integrated view of resource investments and the incremental choice decision. *Academy of Management Review* 18 (4): 760–82.

Brander, J. A., R. Amit, and W. Antweiler. 2002. Venture-capital syndication: Improved venture selection vs. the value-added hypothesis. *Journal of Economics & Management Strategy* 11 (3): 423–52.

Bygrave, W. D. 1987. Syndicated investments by venture capital firms: A. Networking perspective. *Journal of Business Venturing* 2: 139–54.

Chesbrough, H. W. 2002. Making sense of corporate venture capital. *Harvard Business Review* 80 (3): 4–11.

Clercq, D. D., and H. J. Sapienza. 2005. When do venture capital firms learn from their portfolio companies? *Entrepreneurship Theory and Practice* 29 (4): 517–35.

Cohen, W. M., and D. A. Levinthal. 1990. Absorptive capacity: A new perspective on learning and innovation. *Administrative Science Quarterly* 35 (1): 128–52.

Covin, J. G., and D. Slevin. 1991. A conceptual model of entrepreneurship as firm behavior. *Entrepreneurial Theory and Practice* 16: 7–25.

De Clercq, D., and D. Dimov. 2008. Internal knowledge development and external knowledge access in venture capital investment performance. *Journal of Management Studies* 45 (3): 585–612.

Dimov, D., and H. Milanov. 2010. The interplay of need and opportunity in venture capital investment syndication. *Journal of Business Venturing* 25 (4): 331–48.

Dixit, A. R., and R. S. Pindyck. 1994. *Investment under uncertainty*. Princeton, NJ: Princeton University Press.

Dushnitsky, G. 2006. Corporate venture capital: Past evidence and future directions. In *Oxford handbook of entrepreneurship*, ed. M. Casson, B. Yeung, A. Basu, N. Wadeson. 387–431. New York: Oxford University Press.

Dushnitsky, G., and M. J. Lenox. 2005a. When do firms undertake R&D by investing in new ventures? *Strategic Management Journal* 26 (10): 947–65.

Dushnitsky, G., and M. J. Lenox. 2005b. When do incumbents learn from entrepreneurial ventures? Corporate venture capital and investing firm innovation rates. *Research Policy* 34 (5): 615–39.

Dushnitsky, G., and M. J. Lenox. 2006. When does corporate venture capital investment create firm value? *Journal of Business Venturing* 21: 753–72.

Dushnitsky, G., and Z. Shapira. 2010. Entrepreneurial finance meets organizational reality: Comparing investment practices and performance of corporate and independent venture capitalists. *Strategic Management Journal* 39 (9): 990–1017.

Dushnitsky, G., and J. M. Shaver. 2009. Limitations to interorganizational knowledge acquisition: The paradox of corporate venture capital. *Strategic Management Journal* 30 (10): 1045–64.

Farjoun, M. 1998. The independent and joint effects of the skill and physical bases of relatedness in diversification. *Strategic Management Journal* 19: 611–30.

Fleming, L., and O. Sorenson. 2001. Technology as a complex adaptive system: Evidence from patent data. *Research Policy* 30 (7): 1019–39.

Folta, T. B. 1998. Governance and uncertainty: The trade-off between administrative control and commitment. *Strategic Management Journal* 19 (11): 1007–28.

Folta, T. B., and K. D. Miller. 2002. Real options in equity partnerships. *Strategic Management Journal* 23 (1): 77–88.

Folta, T. B., and J. P. O'Brien. 2004. Entry in the presence of duelling options. *Strategic Management Journal* 25 (2): 121–38.

Gompers, P., A. Kovner, and J. Lerner. 2009. Specialization and success: Evidence from venture capital. *Journal of Economics & Management Strategy* 18 (3): 817–44.

Gompers, P. A. 1995. Optimal investment, monitoring, and the staging of venture capital. *Journal of Finance* 50: 1461–89.

Gompers, P. A., and J. Lerner. 1998. The determinants of corporate venture capital successes: Organizational structure, incentives, and complementarities. Working Paper 6725, National Bureau of Economic Research.

Gulati, R. 1999. Network location and learning: The influence of network resources and firm capabilities on alliance formation. *Strategic Management Journal* 20 (5): 397–420.

Gupta, A. K., K. G. Smith, and C. Shalley. 2006. The interplay between exploration and exploitation. *Academy of Management Journal* 49: 693–706.

Hamel, G. 1991. Competition for competence and interpartner learning within international strategic alliances. *Strategic Management Journal* 12: 83–103.

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

Hill, S. A., and J. Birkinshaw. 2006. Ambidexterity in corporate venturing: Simultaneously using existing capabilities and building new capabilities. In *Academy of management best paper proceedings*, ed. K. M. Weaver. C1–6. Atlanta: Academy of Management.

Hochberg, Y. V., A. Ljungqvist, and Y. Lu. 2007. Whom you know matters: Venture capital networks and investment performance. *The Journal of Finance* 62 (1): 251–301.

Holmqvist, M. 2004. Experiential learning processes of exploitation and exploration within and between organizations: An empirical study of product development. *Organization Science* 15 (1): 70–81.

Hoskisson, R. E., M. A. Hitt, R. A. Johnson, and D. D. Moesel. 1993. Construct validity of an objective (entropy) categorical measure of diversification strategy. *Strategic Management Journal* 14: 215–35.

Hurry, D., A. T. Miller, and E. H. Bowman. 1992. Calls on high-technology: Japanese exploration of venture capital investments in the united states. *Strategic Management Journal* 13 (2): 85–101.

Kale, P., and P. Puranam. 2004. Choosing equity stakes in technology-sourcing relationships: An integrative framework. *California Management Review* 46 (3): 77–99.

Kang, M. P., J. T. Mahoney, and D. Tan. 2009. Why firms make unilateral investments specific to other firms: The case of OEM suppliers. *Strategic Management Journal* 30 (2): 117–35.

Kann, A. 2000. Strategic venture capital investing by corporations: A framework for structuring and valuing corporate venture programs. PhD thesis, Department of Management Science and Engineering, Stanford University.

Katila, R., and G. Ahuja. 2002. Something old, something new: A longitudinal study of search behavior and new product introduction. *Academy of Management Journal* 45 (6): 1183–94.

Katila, R., J. D. Rosenberger, and K. M. Eisenhardt. 2008. Swimming with sharks: Technology ventures, defense mechanisms and corporate relationships. *Administrative Science Quarterly* 53 (2): 295–332.

Keil, T. 2002. *External corporate venturing: Strategic renewal in rapidly changing industries*. Westport, CT: Quorum Books.

Keil, T. 2004. Building external corporate venturing capability: Initial conditions, learning processes and knowledge management. *Journal of Management Studies* 41 (5): 799–825.

Keil, T., M. V. J. Maula, H. A. Schildt, and S. A. Zahra. 2008. The effect of governance modes and relatedness of external business development activities on innovative performance. *Strategic Management Journal* 29 (8): 895–907.

King, A. A., and C. L. Tucci. 2002. Incumbent entry into new market niches: The role of experience and managerial choice in the creation of dynamic capabilities. *Management Science* 48 (2): 171–86.

Knight, F. 1921. *Risk, uncertainty and profit*. New York: Houghton Mifflin Co.

Kogut, B. 1991. Joint ventures and the option to expand and acquire. *Management Science* 37 (1): 19–33.

Kogut, B., and N. Kulatilaka. 2001. Capabilities as real options. *Organization Science* 12 (6): 744–58.

Kogut, B., and U. Zander. 1992. Knowledge of the firm, combinative capabilities, and the replication of technology. *Organization Science* 3: 383–97.

Lane, P. J., and M. Lubatkin. 1998. Relative absorptive capacity and inter-organizational learning. *Strategic Management Journal* 19 (5): 461–77.

Lee, J., J. Lee, and H. Lee. 2003. Exploration and exploitation in the presence of network externalities. *Management Science* 49 (4): 553–70.

Leiblein, M. J., and D. J. Miller. 2003. An empirical examination of transaction- and firm-level influences on the vertical boundaries of the firm. *Strategic Management Journal* 24 (9): 839–59.

Lerner, J. 1994. The importance of patent scope: An empirical analysis. *Rand Journal of Economics* 25 (2): 319–33.

Lockett, A., and M. Wright. 2001. The syndication of venture capital investments. *Omega: The International Journal of Management Science* 29: 375–90.

Long, J. S. 1997. *Regression models for categorical and limited dependent variables*. Thousand Oaks, CA: Sage Publications.

Madhok, A. 1997. Cost, value and foreign market entry mode: The transaction and the firm. *Strategic Management Journal* 18 (1): 39–61.

Manigart, S., A. Lockett, M. Meuleman, M. Wright, H. Landström, H. Bruining, P. Desbrières, and U. Hommel. 2006. Venture capitalists' decision to syndicate. *Entrepreneurship Theory and Practice* 30 (2): 131–53.

March, J. G. 1991. Exploration and exploitation in organizational learning. *Organization Science* 2 (1): 71–87.

Mascarenhas, B. 1992. Order of entry and performance in international markets. *Strategic Management Journal* 13 (7): 499–510.

Maula, M. V. J., T. Keil, and S. A. Zahra. 2003. Corporate venture capital and the recognition of technological discontinuities. Academy of Management Conference, Seattle.

McEvily, S. K., K. M. Eisenhardt, and J. E. Prescott. 2004. The Global Acquisition, Leverage, and Protection of Technological Competencies. *Strategic Management Journal* 25 (8–9): 713–22.

McGrath, R. G. 1997. A real options logic for initiating technology positioning investments. *Academy of Management Review* 22 (4): 974–96.

McGrath, R. G., and A. Nerkar. 2004. Real options reasoning and a new look at the R&D investment strategies of pharmaceutical firms. *Strategic Management Journal* 25 (1): 1–21.

Merton, R. K. 1957. *Social theory and social structure*. New York: The Free Press.

Mesquita, L. F., J. Anand, and T. F. Brush. 2008. Comparing the resource-based and relational views: Knowledge transfer and spillover in vertical alliances. *Strategic Management Journal* 29 (9): 913–41.

Milliken, F. J., and L. L. Martins. 1996. Searching for common threads: Understanding the multiple effects of diversity in organizational groups. *The Academy of Management Review* 21 (2): 402–33.

Mishina, Y., T. G. Pollock, and J. F. Porac. 2004. Are more resources always better for growth? Resource stickiness in market and product expansion. *Strategic Management Journal* 25 (12): 1179–97.

Montgomery, C. A. 1982. the measurement of firm diversification: Some new empirical evidence. *Academy of Management Journal* 25: 299–307.

Nagarajan, A., and W. Mitchell. 1998. Evolutionary diffusion: Internal and external methods used to acquire encompassing, complementary, and incremental technological changes in the lithotripsy industry. *Strategic Management Journal* 19 (11): 1063–77.

Neter, J., M. H. Kutner, C. J. Nachtsheim, and W. Wasserman. 1996. *Applied linear statistical models* (4th ed.). Homewood, IL: Irwin.

Palepu, K. 1985. Diversification strategy, profit performance and the entropy measure. *Strategic Management Journal* 6 (3): 239–55.

Papke, L. E., and J. M. Wooldridge. 1996. Econometric methods for fractional response variables with an application to 401(K) plan participation rates. *Journal of Applied Econometrics* 11 (6): 619–32.

Parkhe, A. 1993. Strategic alliance structuring: A game theoretic and transaction cost examination of interfirm cooperation. *Academy of Management Journal* 36: 794–829.

Rice, M. P., G. C. O'Connor, R. Leifer, C. M. McDermott, and T. Standish-Kuon. 2000. Corporate venture capital models for promoting radical innovation. *Journal of Marketing Theory and Practice* 8: 1–9.

Rindova, V. P., A. Petkova, and S. B. Kotha. 2007. Standing out: How new firms in emerging markets build reputation. *Strategic Organization* 5: 31–70.

Rosenkopf, L., and A. Nerkar. 2001. Beyond local search: Boundary-spanning, exploration, and impact in the optical disk industry. *Strategic Management Journal* 22 (4): 287–306.

Santoro, M. D., and J. McGill. 2005. The effect of uncertainty and asset co-specialization on governance in biotechnology alliances. *Strategic Management Journal* 26 (13): 1261–69.

Sapienza, H. J., S. Manigart, and W. Vermier. 1996. Venture capitalist governance and value added in four countries. *Journal of Business Venturing* 11 (6): 439–69.

Schildt, H., M. V. J. Maula, and T. Keil. 2005. Explorative and exploitative learning from external corporate ventures. *Entrepreneurship Theory and Practice* 29 (4): 493–515.

Sharma, P., and J. J. Chrisman. 1999. Toward a reconciliation of the definitional issues in the field of corporate entrepreneurship. *Entrepreneurship Theory and Practice* 23 (3): 11–27.

Siegel, R., E. Siegel, and I. C. MacMillan. 1988. Corporate venture capitalists: Autonomy, obstacles, and performance. *Journal of Business Venturing* 3 (3): 233–47.

Smith, W. K., and M. L. Tushman. 2005. Managing strategic contradictions: A top management model for managing innovation streams. *Organization Science* 16 (5): 522–36.

Sorensen, J. B., and T. E. Stuart. 2000. Aging, obsolescence, and organizational innovation. *Administrative Science Quarterly* 45 (1): 81–112.

Spender, J. C., and R. M. Grant. 1996. Knowledge and the firm: Overview (to special edition). *Strategic Management Journal* 17 (Winter Special Issue): 5–9.

Stinchcombe, A. L. 1965. Social structure and organizations. In *Handbook of organizations*, ed. J. G. March. 142–93. Chicago: Rand-McNally.

Stuart, T. E., H. Hoang, and R. C. Hybels. 1999. Interorganizational endorsements and the performance of entrepreneurial ventures. *Administrative Science Quarterly* 44 (2): 315–49.

Teng, B. 2007. Corporate entrepreneurship activities through strategic alliances: A resource-based approach toward competitive advantage. *Journal of Management Studies* 44 (1): 119–42.

Wadhwa, A., and S. B. Kotha. 2006. Knowledge creation through external venturing: Evidence from the telecommunications equipment manufacturing industry. *Academy of Management Journal* 49: 819–35.

Wadhwa, A., and C. Phelps. 2009. An option to partner: A dyadic analysis of CVC relationships. Paper presented at the Academy of Management Best Paper Proceedings, Chicago.

Wang, L., and E. J. Zajac. 2007. Alliance or acquisition? A dyadic perspective on interfirm resource combinations. *Strategic Management Journal* 28 (13): 1291–317.

Wiersema, M. F., and H. Bowen. 2009. The use of limited dependent variable techniques in strategy research: Issues and methods. *Strategic Management Journal* 30: 679–92.

Winters, T. E., and D. L. Murfin. 1988. Venture capital investing for corporate development objectives. *Journal of Business Venturing* 3: 207–22.

Young-Ybarra, C., and M. Wiersema. 1999. Strategic flexibility in information technology alliances: The influence of transaction cost economics and social exchange theory. *Organization Science* 10: 439–59.

Zahra, S. A. 1996. Technology strategy and new venture performance: A study of corporate-sponsored and independent biotechnology ventures. *Journal of Business Venturing* 11 (4): 289–321.

Zhou, K. Z., and F. Wu. 2010. Technological capability, strategic flexibility, and product innovation. *Strategic Management Journal* 31 (5): 547–61.

Zollo, M., J. J. Reuer, and H. Singh. 2002. Interorganizational routines and performance in strategic alliances. *Organization Science* 13 (6): 701–13.