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Towards understanding who makes corporate venture capital investments and why

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ABSTRACT

This study examines when established firms participate in corporate venture capital (CVC). We build on the resource-based view of interfirm collaboration and emphasize the strategic flexibility of CVC relationships. We use longitudinal data on 477 firms from 1990 to 2000 to test our hypotheses. We find that firms in industries with rapid technological change, high competitive intensity and weak appropriability engage in greater CVC activity. We also show that firms that possess strong technological and marketing resources and resources developed from diverse venturing experience engage in greater CVC activity. Finally, we find that these firm resources moderate the influence of the observed industry effects in paradoxical ways.

1. Executive summary

A fundamental question in the study of organizations concerns how they adapt to changing environments. Successful adaptation typically involves learning from exploratory initiatives (March, 1991), which allows firms to transform the ways in which they compete (Guth & Ginsberg, 1990). Firms explore and pursue such strategic renewal through external initiatives such as corporate venture capital (CVC) investing, strategic alliances, and acquisitions (Keil, 2002). While acquisitions and alliances have been extensively examined, research on CVC is limited and has only recently attracted renewed interest (Dushnitsky, 2006). In this study, we examine CVC as an important mode of exploration and renewal.

CVC refers to direct minority equity investments made by established companies in privately-held entrepreneurial ventures (Gompers & Lerner, 1998). CVC relationships are exploratory initiatives because they create boundary-spanning ties with new ventures, which often pursue new technologies (Dushnitsky & Lenox 2005a; Rosenkopf & Nerkar 2001). While corporate investors may pursue both strategic and financial goals in making CVC investments, strategic objectives generally dominate[3] (Dushnitsky, 2006). CVC investing can increase investor innovation (Wadhwa & Kotha, 2006), market value (Dushnitsky & Lenox, 2006), and financial returns (Allen & Hevert, 2007). Entrepreneurs also have incentives for seeking CVC. CVC funds have been a significant source of venture financing since their inception in the mid-1960s, accounting for 12% of all U.S. VC funding in recent years (PriceWaterhouseCoopers, 2006). CVC investments also provide strategic benefits to ventures, including access to complementary assets that would be costly and time-consuming to build (Gans & Stern, 2003) and an endorsement effect that sends a positive signal of the venture's quality to other stakeholders (Stuart, Hoang, & Hybels, 1999). By providing these benefits, CVC investors can enhance new venture performance (Gompers & Lerner, 1998).

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[3] Dushnitsky (2006) summarized a variety of investor strategic objectives identified in the CVC literature. These include accessing novel technologies, recognizing and reacting to technological discontinuities, learning about potential acquisition targets, stimulating demand for core products by investing in complements, developing strategic relationships such as licenses or alliances, and exposure to entrepreneurial thinking and culture.

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Despite its potential importance to both established firms and new ventures, we know little about the antecedents of CVC relationships (Dushnitsky, 2006). In particular, our review of the extant literature suggests it is limited in at least three important respects. First, while investor strategic and financial objectives have been actively researched, only one study has examined conditions that empirically discriminate CVC investors from non-investors (i.e., Dushnitsky & Lenox, 2005a). Surprisingly, although research characterizes CVC as a means of adapting to changing environmental conditions (Keil, 2002; Maula, 2007), the influence of an incumbent's industry on its motivations to establish new CVC relationships with entrepreneurial firms is unexplored. Prior research provides little insight into how or why the competitive forces an incumbent faces affect its decision to pursue or avoid CVC investing[4]. Moreover, research on the antecedents of CVC investing primarily consists of case studies, descriptive surveys, or cross-sectional analyses, which do not support causal inferences since they do not control for unobserved heterogeneity or temporal precedence.

Second, CVC research has assumed investors are able to attract a sufficient supply of startups in which to invest. This assumption is particularly problematic because corporate investors are often viewed suspiciously by both ventures and independent venture capitalists (IVCs) due to the perception that a CVC investor's intent may be to expropriate a venture's technology (Dushnitsky & Shaver, 2009; Katila, Rosenberger, & Eisenhardt, 2008). Because corporate investors typically seek to co-invest with independent venture capitalists and rely on them for identifying quality investment opportunities (Dushnitsky, 2006), an aspiring corporate investor's opportunities to form new CVC relationships will depend on its ability to attract both IVCs and new ventures. CVC research has largely ignored the characteristics of potential investors or the industries in which they compete that increase or decrease their partnership opportunities. The broader interfirm collaboration literature shows that inducements are a necessary, but not sufficient, condition for partnership formation (Ahuja, 2000). Thus, an explanation of CVC partnership formation must consider not only what motivates incumbents to invest, but what affects their investment opportunities as well.

Finally, CVC research and the broader interfirm collaboration literature treat the sources of a firm's inducements to partner and the sources of its partnering opportunities as independent effects on partnership formation. The potential interactions between these factors have been largely unexamined. Specifically, little research has considered whether the effect of environmental inducements on a firm's formation of CVC or other interfirm ties depends on its resource endowments. Few studies have explored how a firm's resources moderate the influence of its environment on its formation of interfirm ties. This is surprising given a central tenet of strategic management is the "fit" or contingency between a firm's resources and its environment (Venkatraman & Camillus, 1984).

In sum, prior research has largely ignored whether and when an established firm's competitive environment and resources, and the interaction of the two, affect its inducements and opportunities to form minority equity relationships with startup firms. To address these limitations, we investigate the research question, *how do an incumbent's resources and competitive environment, alone and in combination, influence its motivations and opportunities to form new CVC partnerships?* In developing our theory, we build on the resource-based view of interfirm collaboration (Ahuja, 2000; Eisenhardt & Schoonhoven 1996) and emphasize the strategic flexibility inherent in CVC relationships. First, we examine industry conditions that influence incumbents' motivations to pursue CVC. We expect dynamic industries, characterized by rapid technological change, high competitive intensity and weak appropriability, will induce firms to pursue CVC. Second, we examine the resources of incumbents that influence their ability to attract, form and benefit from CVC investment opportunities. We expect incumbents with strong technological and marketing resources and diverse CVC experience will have more opportunities and incentives to pursue CVC. Finally, we derive competing hypotheses regarding the interactions between these external and internal drivers of CVC partnering activity.

We test our predictions using longitudinal data on 477 firms in 312 primary industries from the 1990 Fortune 500 list for the period 1990–2000. We find strong and robust support for our hypotheses. This study contributes to the CVC literature by addressing significant gaps in research on the antecedents of incumbents' CVC activity. Our results also have important implications for research into corporate entrepreneurship, interorganizational relationship formation, and VC syndication networks.

2. Theory and hypotheses

We adopt a resource-based view of interfirm relationships (Eisenhardt & Schoonhoven, 1996). According to this perspective, firms are bundles of tangible and intangible resources (Wernerfelt, 1984). Valuable, rare, inimitable and non-substitutable resources are sources of firm competitive advantage and economic performance (Barney, 1991). Resources are often firm-specific and heterogeneously distributed because their development consists of time-consuming, path-dependent processes (Dierickx & Cool, 1989). This makes market trading for such resources quite difficult (Chi, 1994). Firms create and appropriate value by assembling unique resources and combining them in unique ways. Interfirm relationships allow firms to overcome problems in trading firm resources by enabling partners to access and develop novel resources and efficiently exploit and retain existing resources (Das & Teng, 2000).

A primary advantage of interfirm ties is the strategic flexibility they offer. Relative to internal R&D and acquisition, interfirm ties typically involve smaller irreversible investments of organizational resources and are thus easier and cheaper to restructure or exit in the face of changing environmental conditions (Folta, 1998). Interfirm ties also provide partners with privileged information about the quality of each other's resources. This information reduces partner uncertainty, giving them an advantaged position to scale up or down the partnership activities in response to environmental changes (Kogut, 1991). Finally, interfirm ties enable

[4] While Dushnitsky and Lenox (2005a) found that aspects of a new venture's industry influenced the volume of CVC investment, they did not investigate the influence of an incumbent's industry on its CVC activity.

partners to quickly gain access to needed resources, increasing the rate of firm learning and the speed of resource recombination and development (Hamel, 1991).

CVC investments are a type of formal interfirm relationship, formed when a larger, established firm acquires a minority equity stake in a young venture. From an investor's perspective, CVC relationships are a means of quickly accessing the external resources of innovative new ventures (Keil, 2002) and a way of exploiting existing resources (Maula, 2007). CVC relationships also provide investors with substantial strategic flexibility. CVC investments are inherently exploratory and constitute relatively small resource commitments to novel, and therefore uncertain, initiatives (Li & Mahoney, 2006). Because investments are small, investors can increase the variety of novel resources to which they have access and reduce their risk by investing in a portfolio of startups (Allen & Hevert, 2007). CVC investments allow investors to reduce commitment and downside risk, while retaining their ability to gain via subsequent investment from the upside potential of good ideas. Indeed, CVC is typically used to quickly obtain windows on uncertain growth opportunities, such as new technologies, products or markets (Dushnitsky, 2006). Research suggests CVC investments provide investors with abandonment, deferral and growth options (Allen & Hevert, 2007; Hurry, Miller, & Bowman, 1992; Li & Mahoney, 2006).

The resource-based view of interfirm collaboration argues interfirm ties are formed when firms have sufficient inducements and opportunities to collaborate (Ahuja, 2000). Inducements refer to the incentives firms have to partner with other firms and result from a firm's need to access specific competitive resources that it does not possess and the costs of doing so (Ahuja, 2000). Opportunities refer to the number of firms available and motivated to partner with a focal firm and are a function of industry size and a firm's ability to know, attract and engage partners (Ahuja, 2000). Environmental conditions and firm resources influence both inducements and opportunities (Sakakibara, 2002). In particular, environmental conditions that threaten firms' competitive positions induce them to collaborate by increasing their need to access and develop novel resources (Eisenhardt & Schoonhoven, 1996). Firms with large stocks of valuable resources are attractive partners and have many collaborative opportunities (Ahuja, 2000). Such firms also tend to have efficiency advantages in pursuing partnerships, which increases the benefits they derive from collaboration and their inducements to pursue it (Ahuja, 2000).

We build on this framework in examining the conditions under which incumbent firms form new interfirm partnerships through their CVC investments (i.e., CVC partnerships). Given their inherent flexibility, we expect CVC partnerships will be particularly beneficial to incumbents competing in dynamic environments. Consequently, incumbents will be more induced to form CVC partnerships when competing in dynamic environments. We also argue the strength of a firm's technological, marketing and network resources will increase the efficiency and efficacy of its CVC investing and will increase its attractiveness to new ventures. Finally, in extending the resource-based view of interfirm collaboration, we argue the effect of environmental inducements on a firm's formation of CVC ties is contingent on its resources.

2.1. Industry conditions

The dynamism of a firm's industry will influence its incentives to form new CVC ties. Dynamic industries change rapidly and in unpredictable ways (Dess & Beard, 1984; Eisenhardt, 1989), resulting in short-lived sources of competitive advantage (D'Aveni, 1994). Because of the rapid and uncertain nature of change, incumbents need to quickly explore and develop new resources to alter their competitive positions and develop new sources of advantage (Eisenhardt & Martin, 2000). Early commitment to irreversible development initiatives in such environments can lead to sub-optimal solutions or even competency traps (Levitt & March, 1988). Thus, flexible modes of organizing are particularly valuable in dynamic environments (Ghemawat & Costa, 1993; Volberda, 1996). Because CVC ties provide incumbents with ample strategic flexibility in quickly exploring the resources of innovative new ventures, we expect such interfirm ties will be more attractive to incumbents competing in dynamic environments.

Dynamic environments exhibit rapid technological change (Dess & Beard, 1984), intense competition (Volberda, 1996) and rapid technological diffusion (Bettis & Hitt, 1995). These aspects of dynamism are associated with greater uncertainty, weakened mobility and entry barriers, and the erosion of sources of competitive advantage (Bettis & Hitt, 1995; Dess & Beard, 1984; Volberda, 1996). Thus, we argue the rate of technological change, level of competitive intensity, and the ease to which technical knowledge diffuses in an incumbent's primary industry will affect its CVC partnering activity.

2.1.1. Industry technological change

In industries with rapid technological change, existing products and technologies are rapidly rendered obsolete as new products and technologies are created (Qualls, Olshavsky, & Michaels, 1981). Firms in these industries need to continuously develop new resources as new sources of value creation and appropriation (Eisenhardt & Martin, 2000). The challenge of rapidly developing new resources is exacerbated by the inherent uncertainty of such initiatives. Outright commitment to developing particular resources is risky since rival technologies and products evolve in unforeseen directions and it is unclear ex-ante which will be valued by customers (Brown & Eisenhardt, 1997). Thus, a flexible approach to resource development is attractive (McGrath, 1997). Loosely-coupled, low commitment interfirm ties are particularly valuable in this respect (Steensma & Corley, 2000).

CVC investments allow investors to reduce risk by spreading it across multiple, low commitment external initiatives. The option value of these initiatives can be high in technologically dynamic industries because breakthrough products or technologies are often developed by new ventures (Gans & Stern, 2003). CVC investments enable firms to recognize and assimilate potentially disruptive knowledge and use it to build new products or enter new markets (Maula, Keil, & Zahra, 2003). Cooperating with young ventures allows incumbents to economize on imitative R&D necessary for catching up with these ventures (Kann, 2000). A prime motive for CVC investing is the pursuit of novel technologies relevant to the investing firm's core business (Dushnitsky, 2006).

Research also shows that CVC investing can improve investor innovation (Dushnitsky & Lenox, 2005b). Thus, we expect the rate of technological change in a firm's primary industry will increase its incentives to form new CVC partnerships.

Hypothesis 1. The rate of technological change in a firm's industry will be positively associated with the number of new CVC partnerships it enters.

2.1.2. Industry competitive intensity

Intensely competitive industries provide low returns for incumbents and threaten their survival (Barnett, 1997). Incumbents in such industries often seek to innovate to increase their margins by building new resources that help differentiate their offerings or increase their relative efficiency (Geroski, 1990), thereby achieving transient advantages (D'Aveni, 1994). Firms also often seek to develop complementary products to stimulate demand for their offerings and lock-in customers through switching costs (Garud & Kumaraswamy, 1993). In sum, the competitive intensity a firm experiences increases its incentives to alter its competitive position to compete more effectively (Porter, 1980).

Due to the frequency and unpredictably of competitive change in intensely competitive industries, incumbents have strong incentives to pursue strategically flexible, exploratory modes of organizing to achieve competitive repositioning (Ilinitch, D'Aveni, & Lewin, 1996; Volberda, 1996). Also, when competitive intensity threatens firm performance, it can increase the firm's willingness to pursue risky exploratory initiatives (March & Shapira, 1992). CVC ties are exploratory and provide strategic flexibility in responding to competitively threatening environments. Through CVC investing, firms can increase their innovativeness by quickly accessing the novel knowledge of entrepreneurial firms and thus avoid costly imitative R&D (Dushnitsky & Lenox, 2005b). CVC investments can also stimulate the development of complementary products by new ventures, increasing demand for an investor's products and differentiating them from rivals (Kann, 2000). Finally, incumbents often use CVC to nurture the development of products and technologies that will enhance their operational efficiency (Dushnitsky, 2006). Thus, industry competitive intensity should increase a firm's inducements to form CVC partnerships.

In contrast, in industries with low competitive intensity, competitive change is slow and existing resources can provide durable sources of advantage (Thomas, 1996). In stable environments, exploration initiatives such as CVC investments can compromise the efficiency of exploiting existing competences (March, 1991). For example, the pursuit of new competencies may prematurely cannibalize the returns from existing competencies (Kessler & Chakrabarti, 1996). Competitively stable environments tend to be less uncertain than highly rivalrous ones (Thomas, 1996; Volberda, 1996). This reduces the value of hedging and increases the value of commitment (Ghemawat, 1991). Thus, in industries with low competitive intensity, firms have little need to invest in flexible, exploratory initiatives (Volberda, 1996).

Hypothesis 2. The competitive intensity of a firm's industry will be positively associated with the number of new CVC partnerships it enters.

2.1.3. Industry appropriability

Appropriability refers to the extent to which the economically valuable knowledge produced by a firm can be protected from spilling over to competitors (Teece, 1986). Formal intellectual property rights (IPR), such as patents and trademarks, are a fundamental means by which firms protect their innovations from imitation (Teece, 1986). However, the efficacy of IPRs as a means of appropriability varies significantly by industry (Levin, Klevorick, Nelson, & Winter, 1987). Weaker appropriability conditions increase the rate and volume of knowledge spillovers, which increase the rate of technological change by increasing technological opportunity for all firms (Klevorick, Levin, Nelson, & Winter, 1995). Under a weak IPR regime, knowledge embodied in a firm's inventions is at risk of quickly diffusing to other firms, resulting in the rents from these assets rapidly dissipating (Teece, Pisano, & Shuen, 1997). Incumbents must innovate continuously to link together temporary profit streams and achieve persistent profitability (Roberts, 1999). Weak appropriability also increases the uncertainty of the returns from committing to long periods of resource development (Sakakibara, 2002). Thus, incumbents need to quickly and flexibly develop new resources to rapidly innovate. In industries in which the value of important firm resources, such as technological knowledge, erodes quickly, incumbents emphasize flexible, exploratory modes of organizing (Ghemawat & Costa, 1993). As the logic leading to the prior hypotheses suggests, CVC investments can increase the knowledge available to investors, enabling them to quickly and flexibly develop new resources. In contrast, stronger appropriability conditions increase a firm's incentives to commit to internally developing resources due to the greater certainty of the returns from such investments (Levin et al., 1987).

The benefits of interfirm collaboration in environments with weak appropriability are not without potential costs. A weak IPR regime can increase the risk of knowledge expropriation, reducing incentives to collaborate (Teece, 1986). However, these costs will be less relevant for CVC investors. Incumbents can compensate for weak IPRs through their use of strategic appropriability mechanisms, such as their possession of complementary assets (Gans & Stern, 2003) and their use of "firewalls" around confidential sources of information to prevent its leakage (Markham, Gentry, Hume, Ramachandran, & Kingon, 2005). These mechanisms reduce the hazards of cooperating with new ventures (Cassiman & Veugelers, 2006). The staging of financing over multiple rounds also discourages new venture opportunistic behavior (Gompers, 1995). Finally, the risk of expropriation by new ventures is mitigated by a corporate investor's credible threat of an expensive IP lawsuit. In sum, we expect that in industries with weak IPR regimes, an incumbent's incentives to form new CVC partnerships will outweigh the risks of expropriation by new ventures in these environments.

Hypothesis 3. The strength of the appropriability regime in a firm's industry will be negatively associated with the number of new CVC partnerships it enters.

2.2. Firm resources

An established firm's resources will influence both its opportunities and inducements to invest in young ventures. Opportunities for interfirm ties depend on a firm's ability to identify, attract, and engage partners, which are greatly determined by the quality of its resources (Ahuja, 2000). Corporate investors typically create portfolios of CVC investments (Allen & Hevert, 2007), co-invest with independent VCs and rely on them for quality investment opportunities (Dushnitsky, 2006). Thus, CVC investors must be able to attract entrepreneurial ventures and IVCs to ensure sufficient investment opportunities. Since IVCs also pursue these ventures, CVC investors must offer benefits beyond financial capital (Chesbrough, 2000). We argue the extent to which an incumbent has extensive technological assets, valuable marketing resources such as brand name, and social network resources developed by co-investing across diverse industries will increase its ability to attract investment opportunities.

A firm's resources will also influence its inducements for CVC investing. Research on interfirm collaboration argues the extent to which firms possess resources that have excess capacity and can be readily deployed to support new initiatives reduces the costs of undertaking such initiatives and increases their attractiveness (Dyer & Singh, 1998). Incumbents possessing such fungible resources will find it more efficient, and thus have stronger incentives, to form CVC partnerships. Firms also are more motivated to form partnerships when such ties help them retain and increase the efficient use of existing resources (Das & Teng, 2000). Thus, the strength of an incumbent's technological and marketing resources and the expertise it develops from prior CVC experience will increase its inducements to pursue CVC.

2.2.1. Technological resources

A firm's technological resources will influence its CVC investment opportunities. Potential partners seek firms that have deep technological resources to learn from their expertise (Ahuja, 2000). Access to technological resources is particularly valuable to young ventures seeking CVC investment. Though a venture is typically founded with some specialized technological expertise, it is often unable to develop this technology further due to lack of resources such as expensive equipment or skilled personnel (Mitchell & Singh, 1992). An incumbent's attractiveness to ventures seeking financing will increase if it has large stocks of technological resources such as patents, or if it signals its commitment to building such resources through investments in R&D (Stuart et al., 1999).

Technologically rich firms also have strong incentives to form CVC partnerships. A firm's technological resources enhance its "absorptive capacity" for recognizing and assimilating external knowledge (Cohen & Levinthal, 1990). A firm with deep technological resources can more accurately evaluate the option value in forming a relationship with a venture and establish processes for assimilating knowledge necessary for exercising the option (McGrath, 1997). Firms with deep technological expertise are better at evaluating a venture's knowledge (Sykes, 1986), are more capable of identifying ways in which value can be captured from cooperating with new ventures (Gans & Stern, 2003), and typically have the complementary technologies needed to derive value from technology options (McGrath, 1997).

Hypothesis 4. A firm's technological resources will be positively associated with the number of new CVC partnerships it enters.

2.2.2. Marketing resources

Firms with strong marketing resources typically have powerful brands and positive reputations (Srinivasan, Park, & Chang, 2005). A firm's brand and reputation improve its attractiveness to potential new venture VC syndicate partners because partnering with such a firm sends a positive signal about a venture's quality to interested third parties that otherwise lack information about its quality (Ernst, Witt, & Brachtendorf, 2005; Stuart et al., 1999). Corporate investors are attractive partners when their marketing resources can compensate for the marketing deficiencies of young ventures (Kelly, Schaan, & Joncas, 2000). Accessing an established firm's marketing resources, such as brand name, market knowledge or distribution channels, can increase a venture's chances of successfully commercializing its product or service (Teece, 1986), and help it develop its own marketing resources (Kelly et al., 2000).

In addition to attracting opportunities, the strength of a firm's marketing resources will increase its inducements to form CVC partnerships. Firms with ample marketing resources are more capable of identifying how new venture knowledge can be effectively commercialized (Keil, 2004), and are more effective in helping a venture commercialize its invention (Kelly et al., 2000). This increased efficacy should help corporate investors select better startups and improve their chances of success, resulting in more productive portfolios. Firms with strong marketing resources, such as well-known and respected brands, deep customer knowledge, promotional expertise and extensive distribution channels, often have excess capacity in such resources (Penrose, 1959). Given the exchange problems associated with such knowledge-based resources (Chi, 1994), incumbents can increase the efficient use and retention of these resources by renting them to startups using CVC ties. As the strength of a firm's marketing resources increase, it should find it more efficient to pursue CVC partnerships and have stronger incentives to do so.

Hypothesis 5. A firm's marketing resources will be positively associated with the number of new CVC partnerships it enters.

2.2.3. Diversity of CVC experience

In addition to internal firm resources, the social structural context in which a firm is embedded can affect its partnering opportunities (Gulati, 1999). Networks of interfirm ties influence partnering opportunities by providing information and reputation benefits, or "network resources," to well-connected firms (Gulati, 1999). The widespread use of syndicated investing by

VCs[5] results in a social network that connects investors based on their prior co-investments in the same ventures (Sorenson & Stuart, 2001). This syndication network structures the flow of information about investment opportunities and investor behavior across VC market participants (Sorenson & Stuart, 2001).

The network resources and investment opportunities available to a CVC investor will be greater when it has previously invested across diverse industries. Because IVCs tend to specialize in particular industries (Sorenson & Stuart, 2001), the VC syndication network exhibits a high degree of clustering whereby groups of investors that have invested in the same industries are densely interconnected in cliques (Kogut, Urso, & Walker, 2007). Firms that invest across diverse industries become members of numerous cliques, increasing their syndication network centrality (Everett & Borgatti, 1998). Research shows VCs that invest across more diverse sectors, and thus have more diverse investment experience, are more connected and central in the VC syndication network (Guler, 2007; Kogut et al., 2007; Milanov, Dimov, & Shepherd, 2006). CVC investors syndicate their investments more frequently than IVCs, typically co-invest with IVCs, and generally invest with larger syndicates than rounds involving only IVCs (Dushnitsky, 2006). Given their more intensive use of syndication, investing across diverse industries will tend to increase a corporate investor's centrality relative to similarly diversified IVCs[6].

Because investors that invest across diverse industries occupy more central positions in the syndication network, they accrue greater information and reputation benefits, which increase their ability to identify and attract venture investment opportunities (Bygrave, 1988; Sorenson & Stuart, 2001). Central firms have quicker access to more and better quality information about investment opportunities (Sorenson & Stuart, 2001). Central firms are attractive to new ventures and venture capital syndicate partners because they can provide timely access to valuable information that is otherwise difficult to obtain and can facilitate access to additional investors or other valuable contacts (Bygrave, 1988). Central VC firms can improve the performance of their portfolio firms by providing them with better value-added services (Hochberg, Ljungvist, & Lu, 2007). Central firms are also more prominent and visible, which enhances their attractiveness to potential partners (Gulati & Gargiulo, 1999), such as new ventures and VC syndicate partners (Dimov & Milanov, 2010). The greater availability of information from multiple sources about the capabilities and behavior of central firms increases the reliability of this information and reinforces the development of a trustworthy reputation, increasing the investor's attractiveness to both new ventures and potential syndicate partners (Raub & Weesie, 1990; Wright & Lockett, 2003).

Besides increasing opportunities, a firm's investment diversity will affect its inducements to form CVC ties. The diversity of a firm's partnering experience improves its ability to manage and benefit from interfirm partnerships and thus increases its incentives to form such ties (Powell, Koput, & Smith-Doerr, 1996). Diverse CVC experience will benefit the specialized groups that typically manage firms' CVC investing (Dushnitsky, 2006). Research suggests group member experiential diversity improves group task performance. Experientially diverse groups can draw on diverse perspectives, approaches, and information resources in performing their tasks, increasing the potential for cross-pollination of ideas and solutions (Milliken & Martins, 1996). The cognitive variety in diverse groups challenges members' extant cognitive structures and beliefs about cause–effect relationships (Lei, Hitt, & Bettis, 1996). This reduces superstitious learning and stimulates deeper understanding of cause–effect relationships (Levitt & March, 1988), fosters healthy skepticism in decision-making (Janis, 1972), improves group decision quality (Kilduff, Angelmar, & Mehra, 2000), and promotes novel insights and solutions (Page, 2007). A recent meta-analysis found task-related experiential diversity enhanced group problem-solving, creativity and decision-making (Horwitz & Horwitz, 2007).

These benefits of experiential diversity have implications for the performance of a firm's CVC activities and its incentives to invest. In evaluating investment opportunities, CVC groups with diverse industry experience will tend to have more rigorous due diligence processes, be less susceptible to being misled by opportunistic entrepreneurs, and more capable of effectively utilizing information about investment opportunities (De Clercq & Sapienza, 2005). In negotiating and approving investments, CVC groups with diverse experience will be less prone to decision biases and generate higher quality decisions (Yang et al., 2009). Yang et al. (2009) found the diversity of a CVC investor's experience increased its ability to select and appropriately value high quality ventures. In monitoring ventures, experientially diverse CVC groups will have faced a variety of contractual problems, unanticipated contingencies and other monitoring difficulties. This should enhance their ability to write contracts that minimize agency problems and maximize entrepreneurial effort and help them quickly recognize potential problems in their ventures. Finally, because of their broader social networks, deeper understanding of startup performance, and their ability to cross-pollinate ideas across sectors, experientially diverse CVC groups may be able to offer their portfolio firms better advice and coaching. Thus, controlling for the amount of experience, CVC investors that have invested across diverse industries should be better at evaluating and managing VC investments, resulting in lower uncertainty about CVC and a greater willingness form new CVC ties.

Hypothesis 6. The diversity of a firm's CVC investment experience will be positively associated with the number of new CVC partnerships it enters.

[5] During the period of this study (1990–2000), 50.8% of all venture capital investments in the U.S. were syndicated (Wright and Lockett, 2003). CVC investors syndicate the vast majority of their investments, typically with IVCs, and generally invest with larger syndicates than rounds involving only IVCs (Dushnitsky, 2006). In our data, 88% of CVC investments were syndicated, with an average syndicate size of 5.1 investors.

[6] In our data, the correlations between a CVC investor's investment diversity (defined below) and four standard measures of network centrality (i.e., degree centrality, betweenness centrality, Bonacich power centrality and eigenvector centrality) in the U.S. VC syndication network were, respectively, 0.43, 0.23, 0.33 and 0.41. The correlations between the investment diversity of all other VC investors and the same centrality measures during the same period were, respectively, 0.31, 0.24, 0.10, and 0.29. Thus, consistent with our argument, VC investors with diverse investment diversity are more central in the syndication network and investment diversity is more strongly correlated with syndication network centrality for CVCs than for IVCs. We thank Dimo Dimov for these data.

2.3. The interaction of firm resources and industry conditions

While we have examined how and why industry conditions and firm resources independently influence a firm's inducements and opportunities to form CVC partnerships, we now examine the influence of the interaction of these environmental and firm characteristics on a firm's formation of CVC ties. These interactions are largely unexplored in the CVC and broader interfirm collaboration literature. Because a firm's resource endowments influence both its inducements and opportunities to partner, we separately consider how a firm's environmental inducements to partner interact with the opportunity-generating and inducement-generating dimensions of its resources. In so doing, we derive competing hypotheses regarding the influence of the interaction of environmental dynamism and firm resources on CVC partnership formation. First, we consider how the effect of environmental inducements on a firm's formation of CVC ties depends on the partnering opportunities generated by its resource endowments. Next, we examine how the inducements generated from a firm's environment interact with the inducements generated by its resource endowments to influence its formation of CVC ties.

Prior research suggests a firm's resource endowments may either facilitate or inhibit its efforts to explore and change in responding to a dynamic environment (Kraatz & Zajac, 2001). In the context of exploratory interfirm partnerships such as CVC ties, the resource endowments of a potential corporate investor can enhance the positive influence of environmental dynamism on its formation of CVC ties by generating sufficient CVC partnering opportunities. In the absence of sufficient opportunities, inducements to partner will have little effect on the rate of partnership formation (Ahuja, 2000). In other words, although firms may have powerful incentives to partner, if they are unable to attract a sufficient supply of likewise motivated partners to meet this demand, their ability to form interfirm ties will suffer. To the extent firm technological, marketing and network resources generate CVC partnering opportunities, the ability of firms to establish CVC ties as a flexible response to dynamic environmental conditions will be constrained by the degree to which they possess such resources.

In environments characterized by rapid technological change, high competitive intensity and weak appropriability, firms have strong incentives to form CVC partnerships because they provide investors with a highly flexible means of quickly exploring the external resources of innovative new ventures. In threatening environments like these, firms with ample technological, marketing and network resources are better positioned to identify and attract young ventures as partners. These resource-rich firms will also have the necessary excess capacity, or "slack," in these resources to undertake risky, exploratory activities, such as CVC investing, which are necessary for long-term viability in dynamic environments (March, 1991). Thus, as the need arises, resource-rich incumbents will have substantial opportunities and the ability to exploit their existing resources through the formation of CVC ties. Conversely, firms lacking such resources will be less attractive partners and will not have sufficient slack in these resources to invest in necessary, yet risky exploratory relationships. These limited opportunities and ability will reduce the likelihood that resource-poor firms will invest in young ventures to adapt to dynamic environments. These arguments are consistent with the general proposition that organizational resources facilitate exploration and strategic change in the face of turbulent industrial environments (Kraatz & Zajac, 2001).

Hypothesis 7a. Increases in a firm's technological and marketing resources and investment diversity will strengthen the effects of industry technological change, competitive intensity and appropriability on the number of new CVC partnerships it enters.

In contrast to this prediction, an examination of how environmental dynamism influences the inducements of resource-rich firms suggests a competing hypothesis. Although resource-rich incumbents will have ample partnering opportunities, the motivations of such well-endowed firms to pursue exploratory activities may be significantly diminished when facing dynamic competitive environments (Kraatz & Zajac, 2001). In the absence of sufficient inducements to pursue exploratory interfirm ties, opportunities to partner will have little effect on the rate of partnership formation (Ahuja, 2000). To the extent dynamic environments diminish the incentives of resource-rich firms to pursue exploratory initiatives (Kraatz & Zajac, 2001), the influence of industrial dynamism on firm CVC partnership formation will decline as the resource endowments of potential investors increase.

Research provides at least three explanations for why increasing resource endowments diminish a firm's incentives to pursue exploratory initiatives in the face of dynamic environments (Kraatz & Zajac, 2001). First, as environmental dynamism increases and therefore becomes more threatening to a firm's economic performance, resource-rich firms often focus on increasing the efficient use of these resources in their existing technological, product and market domains rather than exploring new domains (Ghemawat & Costa, 1993; Levinthal & March, 1993; Staw, Sandelands, & Dutton, 1981). Resource-rich firms tend to have greater confidence in their own capabilities and are more likely to rely on these capabilities rather than external sources when faced with threatening environments (Levitt & March, 1988). Building on prospect theory (Kahneman & Tversky, 1979), Amason and Mooney (2008) argued that firms that have accumulated substantial slack resources have higher reference points, relative to slack-poor firms, by which they judge good versus poor performance. Consequently, as a resource-rich firm's objective competitive environment becomes more dynamic, it will tend to perceive this environment, relative to a resource-poor firm, as more threatening, leading it to focus on increasing the efficiency of its existing resources and avoiding riskier, external exploratory initiatives (Amason & Mooney, 2008; Dutton & Jackson, 1987). In contrast, resource-poor firms will have lower reference points and will be prone to frame strategic issues, such as those stemming from a dynamic environment, as opportunities to improve their performance (Amason & Mooney, 2008; Fiegenbaum, Hart, & Schendel, 1996), which increases a firm's willingness to pursue risky, exploratory initiatives (Sharma, 2000). Amason and Mooney found evidence consistent with these arguments. In sum, a firm's resource endowments shape the perceptions and judgments of its decision-makers and, paradoxically, make resource-rich firms less likely to pursue exploratory strategic initiatives as environmental turbulence increases (Julian & Ofori-Dankwa, 2008; Kraatz & Zajac, 2001).

Second, because resource-rich firms typically have slack in their resources (Penrose, 1959), their performance may be buffered from environmental threats (Kraatz & Zajac, 2001). As a result, resource-rich firms are less likely to be induced to adapt to a dynamic environment through exploratory initiatives (Dutton & Duncan, 1987; Kraatz & Zajac, 2001). In contrast, resource-poor firms will have strong incentives to access external resources in competitively threatening environments, given their inability to internally buffer such external threats (Patzelt, Shepherd, Deeds, & Bradley, 2008). Research shows the possession of slack resources reduces the positive influence of environmental dynamism on a firm's pursuit of corporate entrepreneurship initiatives (Simsek, Veiga, & Lubatkin, 2007). Voss et al. (2008) found that as firms perceived their environments to be more threatening, firms with substantial slack in their operating assets increased their pursuit of product exploitation rather than exploration. Finally, substantial resource endowments are typically associated with substantial commitments (Kraatz & Zajac, 2001). In the process of building valuable resources, firms make binding commitments to specific goals, practices, structures and routines, which constrain resource-rich firms more so than poorer firms in deploying or altering their resources (Selznick, 1957). Because of these commitments, the preservation and protection of firm resources become valued as ends in themselves, which can lead to substantial internal conflicts, politicking, strong negative emotions and outright opposition when a firm's existing resources are threatened (Selznick, 1957). Thus, as environmental dynamism increases, resource-rich firms are more likely to resist exploratory initiatives that threaten to alter their resources or redeploy them to other purposes (Kraatz & Zajac, 2001; Staw et al., 1981), while resource-poor firms have much less to lose and protect and more to gain from exploratory initiatives (Fiegenbaum et al., 1996). In contrast, in more benign or stable environments, both resource-rich and resource-poor firms will face relatively fewer threats and thus have similarly muted external inducements to explore.

Because CVC partnerships are exploratory initiatives for corporate investors, the prior arguments suggest resource-rich incumbents' incentives to form such partnerships will decline as the dynamism in their primary industries increases. Industries characterized by rapid technological change, high competitive intensity and weak appropriability are highly dynamic and represent competitively threatening environments for incumbents. Thus, as the strength of an incumbent's technological and marketing resources increase, it will be less likely to form new CVC partnerships because its personnel perceive less of a need to pursue such exploratory initiatives and because they desire to apply these resources to existing operating domains to increase their efficient utilization or minimize internal conflicts. In addition, corporate investors with highly diverse investment experience will reduce the scope and rate of their CVC partnering activity and focus it on fewer economic sectors and fewer ventures as environmental dynamism increases. Increasing environmental threats often lead firms to use slack resources as a buffer rather than a pool of discretionary resources for pursuing risky exploratory initiatives (Deephouse & Wiseman, 2000); causing discretionary corporate venturing activities to be scaled back or shuttered to conserve firm resources (Fast, 1981; Gompers, 2002). Because CVC units with more diverse partnering experience will tend to be larger and embody greater levels of commitment (Milanov et al., 2006), these groups will have strong incentives to reduce the scope and scale of their investment activity to increase the efficiency of the resources under their control and to preserve and protect these resources by actively defending their group's survival. This argument is consistent with research that shows diversified firms tend to restructure to focus on fewer businesses as environmental dynamism increases because doing so increases the efficient use of existing firm resources and protects firms from failure (Bergh & Lawless, 1998).

Hypothesis 7b. Increases in a firm's technological and marketing resources and investment diversity will diminish the effects of industry technological change, competitive intensity and appropriability on the number of new CVC partnerships it enters.

3. Methods

We constructed a panel for the period 1990–2000 using a sample of all firms in the 1990 Fortune 500 list. Because CVC investments are typically made by large, established firms (Dushnitsky, 2006), we focused our study on such firms. We chose the period 1990–2000 because the number of firms making CVC investments and the average investor's volume of CVC activity grew during this period, suggesting ample cross-sectional and within-firm variation in CVC activity (Dushnitsky & Lenox, 2005a). We chose to sample firms at the beginning of the study period to minimize survivor bias. The primary businesses of these firms operated in 312 industries (at the 4-digit SIC level) during this time period, resulting in considerable variation in our industry-level variables. Although firms were sampled based on their sales volume (i.e., membership in the Fortune 500), this selection criterion does not introduce an omitted variable bias (i.e., endogeneity) because, as we discuss below, we explicitly control for differences in firm size. We also control for unobserved differences (i.e., omitted variables) in firm CVC activity in our panel data estimation using firm and period effects. While generally large, sample firms exhibited substantial variation across all firm-level explanatory variables (see Table 1). Finally, most sample firms did not make a CVC investment, further demonstrating that we do not sample on the dependent variable.

We dropped firms missing financial data, leaving a final sample of 477 firms in 312 primary industries and 4406 firm-year observations. Our panel is unbalanced as 105 firms ceased to exist or were acquired during the sample period. Of the 477 firms in 312 industries, 83 firms from 73 industries engaged in CVC. These 83 investors made 1860 investments, worth $7.7 billion, in 1271 unique ventures.

3.1. Dependent variable

Given the motivation for our research question and our theoretical framing, our dependent variable is the formation of new CVC partnerships. We operationalize this variable as the number of new portfolio firms in which firm *i* made CVC investments in year *t*.

Table 1
Correlations and descriptive data.

	N	Mean	S.D.	Min	Max	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1. Number of CVC investments	4406	0.309	4.201	0	179	1.000																
2. Industry growth	4406	0.043	0.121	−0.554	3.504	0.213*	1.000															
3. Industry capital intensity	4406	0.037	0.028	0	0.343	0.061*	−0.025	1.000														
4. Industry advertising intensity (logged)	4406	0.462	0.291	0	1.364	−0.006	0.015	−0.160*	1.000													
5. Industry CVC involvement	4406	2.902	5.034	0	73	0.172*	0.115*	0.063*	0.110*	1.000												
6. Firm liquidity (logged)	4399	0.283	0.105	0.002	1.058	0.054*	0.054*	0.021	−0.033	0.094*	1.000											
7. Firm sales (logged)	4405	3.389	0.511	0	5.242	0.137*	0.043*	0.013	0.087*	0.102*	−0.158*	1.000										
8. Firm age	4406	75.028	33.06	3	232	−0.017	−0.010	0.001	0.038	−0.069*	−0.113*	0.140*	1.000									
9. Firm investment history	4406	0.877	6.686	0	255	0.756*	0.169*	0.040*	0.019	0.163*	0.052*	0.166*	0.016	1.000								
10. Firm diversification	4406	4.476	2.665	1	20	0.066*	0.017	−0.076*	−0.115*	−0.058*	−0.092*	0.371*	0.136*	0.087*	1.000							
11. Industry tech change (logged)	4406	0.454	0.302	0	1.533	0.084*	0.108*	0.153*	0.119*	0.531*	0.169*	0.114*	−0.140*	0.128*	−0.103*	1.000						
12. Industry competitive intensity	4406	0.427	0.256	0	0.981	0.015	0.061*	0.182*	−0.095*	0.086*	0.062*	−0.132*	−0.011	0.026	−0.034	0.059*	1.000					
13. Industry appropriability	3976	27.636	7.770	10.36	44.36	0.001	0.076*	0.206*	−0.082*	0.085*	0.026	0.126*	−0.035	0.022	0.032	0.343*	0.082*	1.000				
14. Firm tech resources (logged)	4406	1.428	0.993	0	4.230	0.122*	0.080*	0.161*	0.023	0.261*	0.038	0.541*	0.041*	0.178*	0.136*	0.498*	−0.070*	0.368*	1.000			
15. Firm mktg resources (logged)	4114	1.149	0.990	0	3.653	0.107*	0.056*	−0.159*	0.502*	0.147*	0.018	0.379*	0.096*	0.131*	0.051*	0.191*	−0.130*	−0.029	0.243*	1.000		
16. Investment diversity	4406	0.049	0.181	0	0.978	0.295*	0.079*	0.017	0.026	0.300*	0.035	0.283*	0.017	0.545*	0.119*	0.264*	0.050*	0.099*	0.314*	0.193*	1.000	
17. Firm alliances	4406	2.394	7.806	0	174	0.107*	0.048*	−0.004	0.019	0.206*	0.065*	0.397*	−0.057*	0.128*	0.013	0.285*	−0.055*	0.136*	0.352*	0.258*	0.354*	1.000
18. Firm acquisitions	4406	1.346	2.840	0	55	0.186*	0.043*	−0.041*	0.010	0.115*	0.044*	0.387*	−0.033	0.127*	0.228*	0.122*	−0.077*	0.016	0.227*	0.180*	0.184*	0.278*

* Significant at $p<0.01$.

We did not count follow-on investments in existing portfolio firms because the initial investment creates the interfirm tie. We collected data on a firm's CVC activity from the VentureXpert database. VentureXpert contains comprehensive historical data on venture funds, corporate investors, venture-backed firms, and analytic data on fund commitments, disbursements, statistics and performance. Several studies on independent and corporate venture capital have used this database (e.g., Dushnitsky & Lenox, 2005a,b; Gompers, 1995;Wadhwa & Kotha, 2006).

3.2. Independent variables

To construct industry-level variables, we followed the approach used by Sakakibara (2002). We first identified the industry(ies) in which sample firm *i* operated in year *t* and then obtained industry segment revenues using Compustat Business Segment data. We then recorded the 4-digit SIC of the segment in which it generated the largest sales volume as its primary industry for that year.

3.2.1. Industry technological change

We measure the rate of technological change in firm *i*'s primary industry in year *t* using the ratio of industry R&D expenditures to industry sales (industry R&D intensity). R&D by incumbents represents technological inputs (i.e., knowledge flows) to technical innovation within an industry and is strongly correlated with industry innovation output (Acs & Audretsch, 1988; Griliches, 1990). Industries with larger R&D ratios exhibit greater technological change (Griliches & Lichtenberg, 1983; Kortum, 1997; Thornhill, 2006). We collected these data from *R&D Ratios and Budgets*.

3.2.2. Industry competitive intensity

Following prior research (e.g., Geroski, 1990), we measure the competitive intensity in firm *i*'s primary industry in year *t* using the reverse-scaled concentration ratio of the top four selling firms in that industry. We calculated this measure as one minus the ratio of the industry sales of the top four firms to total industry revenues in year *t* (i.e., $1 - CR4$). This measure ranges between 0 and 1, with higher values indicating increasingly intense competition. These data were obtained from the *Annual Survey of Manufactures* and Compustat Business Segment data.

3.2.3. Industry appropriability

Following Sakakibara (2002), we measure the strength of the appropriability regime in firm *i*'s primary industry as the average percentage of process and product innovations in the industry that patents effectively protect from imitation. We obtained these data from the Carnegie–Mellon Survey (CMS) of industrial R&D (Cohen, Nelson, & Walsh, 2000). The CMS was administered in 1994, about the midpoint of our sample time period. Thus, this variable is time-invariant. A comparison of the CMS results with a similar survey conducted earlier (Levin et al., 1987) shows that industry appropriability conditions are relatively stable over time. The CMS was limited to manufacturing sectors. Thus, data are available for only manufacturing firms, which constituted about 90% of our sample.

3.2.4. Firm technological resources

A firm's patent stock is a good measure of its stock of technological resources (Henderson & Cockburn, 1994). We measure technological resources of firm *i* in year *t* as the number of patents it obtained in the five years prior to and including year *t*. Patents were counted in the year of application to precisely captures the timing of knowledge creation (Griliches, 1990). We used the *Delphion* database to collect firm patent data, aggregating subsidiary patents up to the parent.

3.2.5. Marketing resources

Greater advertising expenditure by a firm signifies stronger marketing resources (Chattejee & Wernerfelt, 1991). We measure firm marketing resources as the annual advertising expenditures (in millions of dollars) of firm *i* in year *t*. We obtained these data from Compustat, Compact Disclosure, 10-Ks, and *Advertising Ratios and Budgets.*

3.2.6. Investment diversity

To compute the diversity of a firm's portfolio, we use the 4-digit Venture Economics Industry Classification (VEIC) code that VentureXpert assigns to a venture's primary industry. Prior research has used VEIC codes to determine a venture's industry (Dushnitsky & Lenox 2005a). We recorded the VEIC code of each venture in which firm *i* invested in the five years prior to and including year *t*. The use of a five year window to observe interfirm ties is common in the interorganizational network literature (e.g., Gulati, 1999; Hochberg et al., 2007). Diversity was computed as a reverse-scaled Herfindahl index: $1 - \sum p_j^2$, where p_j is the proportion of firm *i*'s investments in ventures in industry *j*.

3.3. Control variables

3.3.1. Industry capital intensity, advertising intensity and growth

We control for industry conditions that affect the availability of investment opportunities (i.e., number of ventures) within an industry. These conditions, if unobserved, may be confounded with the effects of our hypothesized industry variables. The rates of entry, growth and innovativeness of new firms are negatively affected by the capital intensity of an industry (Acs & Audretsch, 1988). As an entry barrier, high capital intensity can also increase an incumbent's incentive to pursue innovation through internal

R&D (Kraft, 1989), potentially decreasing its motivation to pursue CVC. We measure the capital intensity of firm *i*'s primary industry as the ratio of industry capital expenditures to industry sales in year *t*. The rates of entry, growth and innovativeness of new firms are also negatively affected by industry advertising intensity (Acs & Audretsch, 1988). We measure the advertising intensity of firm *i*'s primary industry as the log of the ratio of industry advertising expenditures to industry sales in year *t*. Finally, the rates of entry and growth of new firms are increased by the sales growth of an industry (Mata & Portugal, 1994). While industry growth can increase the availability of investment opportunities, it can weaken an incumbent's incentive to invest in CVC. Growth reduces competitive rivalry, the need to pursue new growth opportunities, and the need to access resources from external partners (Eisenhardt & Schoonhoven, 1996). We measure the sales growth in firm *i*'s primary industry as the percentage change in industry sales in year *t* relative to the prior year.

3.3.2. Industry CVC involvement

We control for CVC activity within a firm's primary industry because a firm's use of CVC may be due to mimetic isomorphism, causing it to imitate practices of other established firms (DiMaggio & Powell, 1983). We operationalize this variable as the number of other firms in firm *i*'s industry in year *t* that have invested in CVC in the last 3 years.

3.3.3. Firm size, age, and diversification

Larger firms may make more CVC investments because they tend to have greater resources to make discretionary, uncertain investments (Singh, 1986). We measure the size of firm *i* in year *t* as its total revenues (in $ millions). Older firms are more likely to exploit established domains of competence than move into new fields of innovative activity (Sorensen & Stuart, 2000), and hence may exhibit greater inertia in exploring new sources of knowledge. We control for firm *i*'s age in year *t* as the number of years since founding. By operating many businesses, diversified firms may pursue more CVC investment opportunities and have access to more investment opportunities. We measure diversification as the number of four-digit SIC codes in which firm *i* operated in year *t*.

3.3.4. Investment history

A firm's CVC experience can increase the efficiency and efficacy of its subsequent CVC investing (Siegel, Siegel, & MacMillan, 1987), and therefore capture otherwise unobserved differences in its ability and propensity to participate in CVC. We measure firm *i*'s history in year *t* as the sum of all investments it has made in the past 5 years.

3.3.5. Liquidity

Firms with greater cash reserves have slack resources that they can devote to CVC without compromising internal operations (Dushnitsky & Lenox, 2005a). We control for firm *i*'s liquidity in year *t* through its quick ratio, an indicator of excess, uncommitted liquid resources (Singh, 1986). The quick ratio is the ratio of liquid assets to current liabilities.

3.3.6. Alliances and acquisitions

Instead of making CVC investments, firms may use alliances or acquisitions as substitute external venturing mechanisms (Villalonga & McGahan, 2005). We control for the number of acquisitions and alliances executed by firm *i* in time *t*. We collected these data using the Securities Data Company (SDC) M&A database and the SDC joint venture and alliance database.

3.4. Model specification and estimation

The dependent variable in this study is a count variable and takes on only non-negative integer values. While Poisson regression is appropriate to model count data, our data were significantly overdispersed, violating a basic assumption of the Poisson estimator (Hausman, Hall, & Griliches, 1984). We use negative binomial regression to model the count data (Hausman et al., 1984). The negative binomial panel estimator accommodates explicit control of persistent individual unobserved effects through either fixed or random effects. We include year dummies to control for unobserved systematic period effects. We also employ firm random effects to control for unobserved firm differences, such as persistent differences across firms in the structures and objectives of their CVC programs (Dushnitsky & Lenox, 2006). We used random effects for three reasons. First, the fixed effects models omit observations from firms with zero investments, leaving a sample of only investing firms, a condition we wanted to avoid. Second, our industry appropriability variable is time-invariant and thus subsumed by firm fixed effects. Finally, Hausman's (1978) tests indicated the estimates obtained using random effects were consistent with the fixed effects results. We lag all but two covariates by one year to account for the lag between opportunity identification and deal closing, to reduce concerns of reverse causality and avoid simultaneity. We do not lag firm alliances or acquisitions and observe them in the same year as the dependent variable because alliances and acquisitions are potential substitutes for CVC investments.

4. Results

Table 1 presents descriptive statistics and correlations. Our measures for industry technological change, industry advertising intensity, firm technological resources, firm marketing resources, firm liquidity and firm size are log-transformed because they are skewed and kurtotic.

We report the results of our random effects negative binomial regressions in Table 2. Model 1 is the baseline controls-only model. In Model 2, we enter industry-level variables to test Hypotheses 1–3. In Model 3 we enter firm-level variables to test

Table 2
Main effects regression results; DV: number of firm-year CVC investments.

Hypothesis	Variable	1	2	3	4	5
		RE	RE	RE	FE	RE
		NegBin	NegBin	NegBin	LFM	NegBin
	Constant	−6.430***	−7.335***	−6.545***		−2.508***
		(1.289)	(1.022)	(1.039)		(0.378)
	Industry growth	−0.032	−0.318	−0.254	1.242	−0.266
		(0.068)	(0.702)	(0.666)	(1.447)	(0.665)
	Industry capital intensity	4.818+	6.455*	1.655	4.692	2.117
		(2.679)	(2.890)	(2.927)	(6.489)	(2.920)
	Industry advert. expend. (logged)	−0.131	−0.535+	−0.680*	−0.628	−0.671*
		(0.303)	(0.326)	(0.339)	(0.028)	(0.337)
	Industry CVC involvement	0.045***	0.147***	0.105***	0.147***	0.106***
		(0.010)	(0.019)	(0.018)	(0.037)	(0.018)
	Firm liquidity (logged)	1.265	−0.304	0.167	5.537*	0.279
		(0.845)	(0.743)	(0.705)	(2.720)	(0.705)
	Firm size (logged)	1.719***	1.122***	0.487+	1.557***	0.474+
		(0.339)	(0.245)	(0.263)	(0.342)	(0.261)
	Firm age	0.002	0.003	0.001	0.011	0.000
		(0.003)	(0.003)	(0.003)	(0.007)	(0.003)
	Firm investment history	0.002+	0.002	0.002	−0.198**	0.003*
		(0.001)	(0.001)	(0.001)	(0.074)	(0.001)
	Firm diversification	0.018	0.094*	0.075*	0.177	0.074*
		(0.035)	(0.039)	(0.037)	(0.112)	(0.037)
	Firm alliances	0.032***	0.029***	0.027***	0.037	0.027***
		(0.007)	(0.007)	(0.007)	(0.044)	(0.007)
	Firm acquisitions	0.021*	0.003	−0.001	−0.224**	−0.001
		(0.009)	(0.014)	(0.014)	(0.038)	(0.014)
H1	Industry tech. change (logged)		1.309***	0.972**	1.305***	1.111**
			(0.372)	(0.367)	(0.397)	(0.383)
H2	Industry competitive intensity		0.831*	0.735*	3.314***	0.800*
			(0.451)	(0.412)	(0.848)	(0.413)
H3	Industry appropriability		−0.016+	−0.026*		−0.024*
			(0.012)	(0.012)		(0.012)
H4	Technological resources (logged)			0.258*	0.632**	0.329*
				(0.142)	(0.247)	(0.154)
H5	Marketing resources (logged)			0.280**	0.341+	0.295**
				(0.114)	(0.275)	(0.113)
H6	Investment diversity			1.990***	3.683***	2.019***
				(0.281)	(0.455)	(0.284)
H7	Interactions					
	Ind. tech. change × firm tech. res.					−0.360+
						(0.293)
	Ind. tech. change × firm mktg. res.					
	Ind. tech change × firm invest. diver.					
	Ind. comp. intensity × firm tech. res.					
	Ind. comp. intensity × firm mktg. res.					
	Ind. comp. intensity × firm invest. diver.					
	Ind. appropriability × firm tech. res.					
	Ind. appropriability × firm mktg. res.					
	Ind. appropriability × firm invest. diver.					
	Year effects included	Yes	Yes	Yes		Yes
	Observations	4399	3971	3751		3751
	Log likelihood	−973.320	−861.012	−800.415		−799.658
	Wald Chi squared	885.36***	602.47***	810.90***		800.27***
	Degrees of freedom	20	23	26		27
	LR Chi squared test (dof)		15.80 *** (3)	86.28***(6)		
	Sargan test (*p*-value)				0.179	
	First-order serial correlation (*p*-value)				0.232	
	Second-order correlation (*p*-value)				0.900	

• 1-tailed tests for hypothesized variables, 2-tailed tests for control variables.
• Robust standard errors in parentheses.
+Significant at $p<0.1$; *Significant at $p<0.05$; **Significant at $p<0.01$; ***Significant at $p<0.001$.

6	7	8	9	10	11	12	13
RE	RE	RE	RE	RE	RE	RE	RE
NegBin	NegBin	NegBin	NegBin	NegBin	NegBin	NegBin	NegBin
−2.685***	−2.579***	−2.641***	−2.502***	−2.294***	−3.062***	−2.496***	−2.568***
(0.385)	(0.371)	(0.385)	(0.375)	(0.401)	(0.374)	(0.379)	(0.379)
−0.415	−0.373	−0.816	−0.235	−0.585	−0.693	−0.259	−0.261
(0.660)	(0.659)	(0.674)	(0.670)	(0.666)	(0.666)	(0.666)	(0.659)
3.330	2.792	2.241	1.672	−0.414	5.304+	1.662	1.394
(2.906)	(2.919)	(2.854)	(2.927)	(3.095)	(2.875)	(2.928)	(2.950)
−0.813*	−0.559+	−0.585+	−0.686*	−0.659*	−0.916**	−0.681*	−0.789*
(0.337)	(0.340)	(0.341)	(0.340)	(0.339)	(0.343)	(0.339)	(0.343)
0.099***	0.097***	0.094***	0.105***	0.104***	0.076***	0.105***	0.112***
(0.018)	(0.018)	(0.018)	(0.018)	(0.019)	(0.018)	(0.019)	(0.019)
0.190	0.362	0.080	0.174	0.184	0.085	0.160	0.104
(0.695)	(0.695)	(0.711)	(0.706)	(0.716)	(0.706)	(0.708)	(0.714)
0.817**	0.501*	0.404	0.485+	0.487+	0.139	0.482+	0.483+
(0.274)	(0.259)	(0.270)	(0.263)	(0.272)	(0.268)	(0.266)	(0.263)
0.001	−0.001	0.000	0.001	0.002	−0.001	0.001	0.002
(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
0.004**	0.003*	0.004**	0.002+	0.003*	0.003*	0.002+	0.002+
(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
0.075*	0.079*	0.069+	0.075*	0.071+	0.066+	0.075+	0.071+
(0.037)	(0.036)	(0.037)	(0.037)	(0.038)	(0.037)	(0.037)	(0.037)
0.028***	0.025***	0.025***	0.027***	0.028***	0.022**	0.027***	0.027***
(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)
−0.001	0.001	−0.002	−0.001	−0.015	0.027+	−0.001	0.003
(0.014)	(0.014)	(0.014)	(0.014)	(0.015)	(0.015)	(0.014)	(0.015)
1.998***	1.513***	1.070**	0.950**	1.080**	0.992**	0.967**	0.984**
(0.416)	(0.424)	(0.367)	(0.377)	(0.369)	(0.354)	(0.369)	(0.362)
1.319**	0.781*	2.379***	0.677+	1.395**	0.212	0.732*	0.721*
(0.424)	(0.415)	(0.614)	(0.466)	(0.487)	(0.419)	(0.412)	(0.409)
−0.014+	−0.023*	−0.016+	−0.026*	−0.028*	−0.083***	−0.026*	−0.040**
(0.011)	(0.012)	(0.012)	(0.012)	(0.012)	(0.016)	(0.013)	(0.014)
0.126	0.215+	0.536**	0.256*	0.309*	0.845***	0.259*	0.247*
(0.139)	(0.141)	(0.177)	(0.142)	(0.150)	(0.190)	(0.143)	(0.143)
0.624***	0.303**	0.302**	0.279**	0.303**	0.241*	0.280**	0.277**
(0.134)	(0.113)	(0.116)	(0.114)	(0.117)	(0.112)	(0.114)	(0.114)
2.083***	2.612***	1.974***	1.992***	1.991***	1.860***	1.989***	1.935***
(0.280)	(0.367)	(0.272)	(0.281)	(0.280)	(0.266)	(0.281)	(0.284)
−1.585***							
(0.295)							
	−1.801**						
	(0.686)						
		−2.022***					
		(0.472)					
			0.094				
			(0.357)				
				−2.613**			
				(0.933)			
					0.079***		
					(0.012)		
						0.001	
						(0.010)	
							0.039*
							(0.020)
Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
3751	3751	3751	3751	3751	3751	3751	3751
−785.725	−796.989	−789.793	−800.380	−796.466	−780.008	−800.406	−798.513
780.22***	821.74***	832.35***	811.58***	785.58***	914.85***	810.09***	808.40***
27	27	27	27	27	27	27	27

Hypotheses 4–6. While not reported, all models include year dummies to control for unobserved period effects. Variance inflation factors for all variables in models 1–3 were well below 10, indicating multicollinearity is not a concern. We report the results of the interaction tests (Hypotheses 7a and 7b) in Models 5–13. We enter each interaction separately because VIF values suggested problematic multicollinearity was present when multiple interactions were entered. While not reported due to space constraints, the significance of each explanatory variable discussed below is not sensitive to the order in which it was entered into the model. We assess the robustness of these results in the following section.

4.1. Industry effects

In support of Hypothesis 1, the results in Model 2 indicate Industry Technological Change has a significantly positive effect on CVC tie formation ($\beta = 1.309$, $p < 0.001$). This result is consistent in all models. Consistent with Hypothesis 2, the results show that Competitive Intensity is positive and statistically significant ($\beta = 0.831$, $p < 0.05$). This effect remains consistent in all subsequent models. In support of Hypothesis 3, the results show industry appropriability has a significantly negative effect on firm CVC activity ($\beta = -0.016$, $p < 0.10$). This effect is statistically stronger in subsequent models.

4.2. Firm effects

We find strong and consistent support for Hypothesis 4. Model 3 results show that Firm Technological Resources is positive and significant ($\beta = .258$, $p < .05$). Hypothesis 5 predicts stronger marketing resources will positively influence firm CVC activity. Results from Model 3 provide support for this hypothesis ($\beta = 0.280$, $p < .01$). Hypothesis 6 posits that Investment Diversity will positively affect firm CVC activity. Results from Model 3 provide strong support for this prediction ($\beta = 1.990$, $p < .001$). This parameter estimate may be biased because diversity results from an endogenous dynamic in which prior investments determine current investment diversity. We address this issue in the next section below.

4.3. Interactions

We report the results of the interaction tests (Hypotheses 7a and 7b) in Models 5–13 in Table 2. We enter each interaction separately to reduce multicollinearity. To test Hypotheses 7a and 7b, we constructed nine multiplicative interactions by pairing each hypothesized industry variable with each hypothesized firm-level variable. Hypothesis 7a indicates that we expect positive signs on the coefficients for the interactions involving industry technological change and competitive intensity and negative signs for the interactions involving industry appropriability. Hypothesis 7b implies the opposite expectations. The results in Table 2 show the signs on all interactions are in the directions predicted by Hypotheses 7b and that seven of the nine interactions are significant. Two interaction terms were not statistically significant: firm marketing resources and industry competitive intensity and firm marketing resources and industry appropriability. Thus, we claim substantial support for Hypothesis 7b.

5. Alternative explanations and robustness checks

Although the results are consistent with our theory, we considered alternative explanations and assessed the robustness of the results. While we found a firm's CVC investment diversity was positively related to its subsequent CVC tie formation, the estimated effect of this variable may be biased by endogeneity. The diversity variable can only take on positive values if a firm invested in the past. Thus, diversity will be correlated with lagged values of the dependent variable and may capture a firm's unobserved propensity to make CVC investments. Investment history is essentially a lagged dependent variable and is therefore endogenous. Because of its correlation with investment history ($r = 0.55$), investment diversity is potentially endogenous. To address this concern and obtain consistent estimates on investment history and diversity, we specified a linear feedback model for dynamic count panel data and estimated this model using the nonlinear GMM method implemented by Windmeijer (2002).

Table 2, Model 4 presents the results of this analysis for the full main effects model. In estimating this model, we specified a one year lag of the dependent variable as the linear feedback term and treated investment diversity as endogenous. We use two years of lagged values to instrument for the lagged dependent variable (i.e., y_{it-2}, y_{it-3}) and two years of lagged values to instrument for investment diversity. Thus, observations from the first two years drop out of the sample. Lagged values of endogenous variables are exogenous because they are given (i.e., predetermined) constants in determining the current period's values of the endogenous variables (Kennedy, 1996). We estimated model 4 using firm and year fixed effects. Thus, we cannot include industry appropriability in the model. The Poisson fixed effects model does not allow a constant. We report robust standard errors. Consistent with model 3 results, investment history is not significant while investment diversity is positive and significant. The results for the other hypothesized variables are also consistent. The Sargan test suggests the moment conditions (i.e., the instruments) are valid and tests for first- and second-order serial correlation are not significant, suggesting a correctly specified model. Thus, our inference about investment diversity does not change.

Next, we explored the possibility that parameter estimates for other explanatory variables were biased by endogeneity. We did so using Windmeijer's (2002) estimation approach described above. Initially, we estimated the full main effects model treating all five time-varying explanatory variables (i.e., excluding industry appropriability) as endogenous. We instrumented for each variable using its lagged values for the previous two years. Although the results were qualitatively consistent with those reported in Model 3 of Table 2, the Sargan test results indicated the moment conditions were invalid. The likelihood of a significant Sargan test increases with the number of

instrumented variables (Windmeijer, 2002). Thus, we estimated the model four separate times, each time treating investment diversity and another explanatory variable as endogenous. For each model, the Sargan test indicated the moment conditions were valid and tests for first and second-order serial correlation were insignificant, suggesting correctly specified models. The results from each of these models were consistent with those reported in Model 3 of Table 2, which suggests our results in Table 2 are not substantively influenced by endogeneity.

We performed several additional unreported robustness checks. First, although our use of a one year lag between independent and dependent variables reduces the potential of reverse causality, we empirically investigated this possibility using a common econometric approach inspired by Granger (1969). Following Sims's (1972) "Granger causality" method, we estimated our main effects model, excluding industry appropriability since it was time-invariant, with one and two years lags and a one year lead (i.e., $t+1$) of our explanatory variables, and our existing control variables. We estimated this model using a negative binomial random effects panel estimator. We found the lagged explanatory variables were significant in the predicted directions, but that none of the explanatory variables observed one year in the future were significant. Thus, we did not find evidence of reverse causality[7]. Because reverse causality is a type of simultaneity bias, and thus a source of endogeneity (Wooldridge, 2002), this test provides added evidence that our results are not unduly influenced by endogeneity.

Second, the distribution of the dependent variable contains a large number of zeros — nearly 84% of sample firms did not make a CVC investment during the study period. This suggests our data may contain excess zeros relative to that generated by a standard negative binomial process. Failure to account for these extra zeros may result in biased parameter estimates (Lambert, 1992). Accordingly, we estimated models 3 and 5–13 using a zero inflated negative binomial (ZINB) model. The ZINB model assumes the population is characterized by two regimes: one where members are "not at risk" and thus always have zero counts, and one where members are "at risk" and thus have zero or positive counts (Greene, 2000). The likelihood of being in either regime is estimated using a logit specification, while the counts in the second regime are estimated using a negative binomial specification. Because we could not find a panel data version of the ZINB model in the econometrics literature, we employed a standard ZINB estimator and computed standard errors that are robust to both clustering within firms and heterosckedasticity. We specified the inflation model, which estimates the likelihood firms never make CVC investments during the study period, and the negative binomial model with all explanatory and control variables and year dummies. The results of this estimation were consistent with those reported in Table 2.

Third, we estimated all models using firm fixed effects and found very similar results. Indeed, Hausman tests (1978) indicated the estimates from the random effects models were consistent with those obtained using fixed effects. Fourth, we estimated models 2–3 using annual R&D expenditures as the measure of firm technological resources instead of the patent stock measure. Fifth, we estimated models 2–3 using R&D intensity (R&D expenditures/firm sales) and advertising intensity (advertising expenses/firm sales). Sixth, we ran models 2–3 excluding industry appropriability. This provided us with a larger sample since data on industry appropriability were unavailable for over 400 observations. Sixth, we estimated the full main effects model (Table 2, Model 3) using multilevel mixed-effects Poisson regression (using the *xtmepoisson* procedure in Stata 10). We specified a nested data structure in which firms were nested in their respective primary industries. We assigned random effects to both firms and industries, allowing us to control for unobserved heterogeneity at both levels. We did so because some sample firms switched primary industries during the course of our study. In these cases, firm effects do not subsume unobserved industry effects that may cause endogeneity. Finally, we used two alternative dependent variables. We constructed a dichotomous dependent variable that indicated whether a firm made any CVC investments in year t and estimated these models using random effects panel logistic regression. We also operationalized the dependent variable as the U.S. dollar value of the new CVC investments made by firm i in year t. Because this variable is bounded at zero, we estimated the models using a random effects panel Tobit estimator. The results from each of these analyses were consistent with those reported in Table 2.

In sum, we utilized a variety of estimation techniques, alternative explanatory and dependent variables and alternative model specifications to address alternative explanations for our results. In each of these robustness checks, our main results reported in Table 2 were confirmed.

6. Discussion

This study was motivated by three important limitations of existing research on CVC and interfirm collaboration. First, although research characterizes CVC as a means of adapting to changing environmental conditions (Keil, 2002), the influence of an incumbent's industry on its motivations to pursue CVC is largely unexplored. Second, while the specific objectives firms pursue in their CVC investing have been examined, research has largely ignored how firm resources influence the availability of investment opportunities. Third, despite the strategy literature's axiomatic notion of fit between firms and their environments (Andrews, 1971), few studies on interfirm relationship formation have explored the contingencies between a firm's environment and its resources. In addressing these limitations, the results of this study make several contributions.

The results of this study suggest that incumbents are induced to pursue CVC investing when they operate in dynamic environments. We found that firms in industries with rapid technological change, high competitive intensity and weak appropriability engage in greater CVC activity. To our knowledge, this is the first study to examine the influence of an incumbent's primary industry on its degree of CVC activity. The results also suggest that firms are able to attract viable investment opportunities and benefit from them when they possess strong resource profiles. We found the strength of an incumbent's technological and marketing resources and the diversity of its prior CVC

[7] Sims (1972: 544) argued, "…if causality runs from *X* to *Y* only, future values of *X* in the regression should have coefficients insignificantly different from zero as a group."

experience increased its CVC activity. The result for firm technological resources reinforces a similar finding by Dushnitsky and Lenox (2005a). We also found evidence of a paradox in examining the interactions of industry conditions and firm resources. Although dynamic environments stimulate firms to use flexible modes of exploration to adapt and resource-rich firms are in a better position than resource-poor firms to pursue such flexible, exploratory initiatives, our results suggest resource-rich firms actually undertake fewer rather than more CVC partnerships when facing dynamic environments. This study is the first to consider both inducements and opportunities, and how environmental inducements interact with the opportunities and incentives generated by an incumbent's resources, in explaining its formation of CVC partnerships. These results are robust to the use of several time-varying controls, fixed and random firm effects, random industry effects, efforts to control for endogeneity, alternative estimation techniques, and alternative measures of the dependent variable.

Our results suggest the influence of a firm's competitive environment and its resource on its CVC partnering activity is complex and paradoxical. Our main effects results indicate that while environmental factors induce firms to explore via CVC investing, their inducements and opportunities to pursue CVC are constrained by the resources they can exploit in the process. These effects results suggest venturing programs can simultaneously pursue the development of new resources and the leveraging of existing firm resources (Maula, 2007). This insight reinforces arguments made in the organizational ambidexterity and dynamic capabilities literatures that simultaneous exploration and exploitation are at the heart of strategic renewal (O'Reilly & Tushman, 2007; Eisenhardt & Martin, 2000). However, our interaction results suggest the pursuit of ambidexterity and effective adaptation are characterized by a paradox: although resource-rich firms can attract and pursue sufficient exploratory partnering opportunities, their incentives to do so are dampened in the very environments that necessitate such exploration. This finding reinforces a key result from Kraatz and Zajac (2001), who found that organizations possessing greater stocks of historically valuable resources were less likely to engage in adaptive change when they faced a turbulent competitive environment. Moreover, this result reinforces Hedberg et al. 's (1976) exhortation that the key to success over time is, paradoxically, less commitment to the resources that provide success in the present. The results of this study expand our understanding of the antecedents of CVC and also have substantive implications for research in corporate entrepreneurship, interfirm relationship formation, and VC syndication networks.

By focusing on the characteristics of *investors* rather than aspects of the ventures in which they invest, we complement work by Dushnitsky and Lenox (2005a) and Li and Mahoney (2006). When considered together, our industry-level results and those of Dushnitsky and Lenox (2005a) suggest a set of "push–pull" inducements for incumbent CVC activity. Our results indicate that the conditions in a firm's primary industry exert pressure on it (i.e., "push" it) to participate in CVC. However, we did not explore in which ventures incumbents invest. Dushnitsky and Lenox's (2005a) findings suggest incumbents are motivated to invest in ventures that compete in industries with high technological opportunity and weak appropriability because these ventures may yield higher marginal returns to knowledge production than internal R&D. In short, the attractiveness of these ventures "pulls" incumbents to invest in them.

While we focused on a particular type of interfirm relationship, this study contributes to the broader interorganizational collaboration literature. Although prior research has employed an inducements–opportunities framework in explaining interfirm relationship formation (Ahuja, 2000; Eisenhardt & Schoonhoven, 1996), this research has largely ignored the potential interactions between the sources of a firm's inducements and the sources of its opportunities. We move beyond one of the few studies that have explored this issue (Park, Chen, & Gallagher, 2002) by answering these authors' call to examine how a firm's resources moderate technological, competitive and institutional environmental effects on its formation of interfirm ties. To our knowledge, the interactions we test in this study have not been examined in either the CVC or broader interfirm collaboration literatures. Moreover, our interaction results are counter-intuitive in that they show resource-rich firms form fewer, rather than more, exploratory partnerships as the dynamism in their competitive environments increases.

Finally, our results have implications for research on venture capital syndication networks. The syndication of venture investing can increase both independent venture fund performance (Hochberg et al., 2007) and CVC fund performance (Birkinshaw & Hill, 2003). Hochberg et al. (2007) found that IVC funds whose parent firms occupied more central positions in the syndication network realized better fund performance. This result suggests it is important for venture investors to be well-connected to other VC firms (Bygrave, 1988). However, established VCs dominate the syndication network and strongly favor co-investing with other incumbent VCs they directly know (through prior syndication relationships) and trust (Kogut et al., 2007). The necessity, yet difficulty of being well-connected in the VC syndication network raises the question of how new entrants become networked in the first place.

The results of this study help answer this question. We observed the formation of new ties between corporate investors and young ventures. Consistent with prior research (Dushnitsky, 2006), our sample CVC investors syndicated 88% of their investments. Most investors were new entrants into the VC market during the sample period. Given that we observe new investments by new entrants into the VC syndication network, our study suggests the admission ticket for a new CVC investor to the VC syndication network is the possession of substantial technological, marketing and reputation resources. These resources also lead to increasing network embeddedness over time. Firms endowed with these valuable resources will be attractive partners for both entrepreneurial firms and other VC investors. Our results imply that established firms will be significantly constrained in becoming active participants in the VC syndication network by the investment opportunities their resources generate.

6.1. Limitations and future research

This study focused on the characteristics of investors rather than the features of investment opportunities (i.e., new ventures) as antecedents to CVC. We did not evaluate the characteristics of new ventures that might influence CVC investment. However, this

unobserved heterogeneity did not appear to bias our results. Prior research shows the industry in which a new venture operates influences its attractiveness as a target of CVC investment (Dushnitsky & Lenox, 2005a) and the degree to which it will seek CVC investment (Katila et al., 2008). Future research should explore characteristics of the investor–new venture dyad that influence the formation of a CVC relationship. This would allow an explicit examination of who partners with whom. Work by Dushnitsky and Shaver (2009) showing that a CVC relationship is more likely to occur when the products of the partners are complements rather than substitutes is a step in this direction (see also Katila et al., 2008).

An additional limitation concerns the generalizability of the findings. While we found empirical support for our theory, the results may be limited to the time period studied or the sampled firms. Historically, CVC investing has been cyclical, with three different waves of activity beginning in the mid-1960s (Dushnitsky, 2006). Our sample period covers only one of these waves. Thus, whether our results hold for the other periods is an empirical question. Next, we use a purposive sample rather than a random sample. While the Fortune 500 list represents a sample frame that is independent of CVC activity and is widely used in strategy research, we acknowledge our results may not generalize to the population of established companies that are at risk of CVC investing. Finally, because our measure of industry appropriability was limited to manufacturing industries, which comprised about 90% of our sample, our results related to this variable may not generalize to non-manufacturing industries. Additional evidence using data from different time periods and samples is needed to externally validate our findings.

6.2. Implications for managerial practice

Given the need for flexible exploration in highly dynamic environments, managers of firms in such environments should carefully consider CVC as a viable mode of exploration and renewal. In so doing, managers should assess whether their firms possess the necessary competences to benefit from CVC investments. While the dynamism of a firm's environment can encourage the use of CVC, this motivation must be tempered by a rigorous assessment of whether the firm has sufficient quality and fungibility in its resources to benefit from CVC. Finally, a firm must be able to make these resources available for use by the unit responsible for its investing activities if it is to benefit from CVC. CVC units realize higher performance when they can effectively leverage their parents' valuable resources in pursuing their exploratory missions (Hill & Birkinshaw, 2006).

A related implication pertains to a firm's investment opportunities. Our findings suggest a firm's CVC investment opportunities are a function of the strength of its network, technological, and marketing resources. The possession of low quality resources may reduce an investor's bargaining power, leading it to pay a premium for an equity stake in a new venture. This may help explain Gompers & Lerner's (1998) finding that corporate investors tend to pay a premium for a venture's equity relative to independent VCs. Thus, incumbents that lack the requisite types and quality of resources may end up paying more for a CVC investment and benefiting less.

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