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HOW ALLIANCE FORMATION SHAPES CORPORATE VENTURE CAPITAL INVESTMENT IN THE SOFTWARE INDUSTRY: A RESOURCE-BASED PERSPECTIVE

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Corporate venture capital (CVC) investments serve as interfirm relationships that enable established firms to tap into emerging technology markets. Nevertheless, firms may also leverage their strategic alliances to this end. Does alliance formation reinforce or attenuate a firm's tendency to invest in entrepreneurial ventures? We introduce a resource-based perspective whereby resource complementarity and network resource visibility prompt a reinforcing association between CVC investment and alliance formation. In turn, external resource redundancy and internal resource allocation constraints yield an attenuating effect of alliance formation on CVC investment. Analyzing the alliances and CVC investments of 372 software firms during the 1990s, we reconcile these opposing arguments by revealing an inverted U-shaped association between CVC investment and alliance formation. Accordingly, the number of CVC investments first increases, but then decreases, with the number of alliances formed. Moreover, the positive association between CVC investment and alliance formation diminishes as firms invest in their internal resource stocks, mature, and accumulate experience with prior CVC investments. We advance strategic entrepreneurship research by elucidating the tendency of established firms to engage in CVC investment and by unpacking the complex association between different types of interfirm relationships that these firms leverage.

INTRODUCTION

Established firms often invest in external entrepreneurial ventures as a means of sourcing innovative ideas and sponsoring emerging technologies (Alvarez and Barney, 2001; Dushnitsky, 2006; Hill and Birkinshaw, 2008; Hill *et al.*, 2009; Zahra, 1996). Commonly referred to as *corporate venture capital* (CVC), these sponsorships involve minority equity investment by the established firm in an entrepreneurial venture that seeks capital for growing its operations (Gompers and Lerner, 1998; Dushnitsky, 2006; Hill *et al.*, 2009). In the year 2000 alone, nearly $16 billion was invested by more than 300 firms—representing 15 percent of the entire venture capital market. Despite the recent economic downturn and subsequent reduction in CVC investment, many firms have maintained a steady commitment to their venturing programs (Chesbrough, 2002; Ernst and Young, 2008).

Extant research sheds light on the practice of CVC, which became pervasive during the 1990s

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(Dushnitsky, 2006). CVC activity facilitates innovation as well as access to new markets and complementary technologies (Dushnitsky and Lenox, 2005a, 2005b; Hill *et al.*, 2009; Siegel, Siegel, and MacMillan, 1988; Zahra, 1996; Zahra and Covin, 1995). Thus, CVC investing firms can enhance innovation (Dushnitsky and Lenox, 2005b; Wadhwa and Kotha, 2006) and financial performance (Dushnitsky and Lenox, 2006; Gompers and Lerner, 1998). Nevertheless, little is known about firms' inclinations to engage in CVC activity and what drives a firm's tendency to invest in entrepreneurial ventures. In the current study, we focus on the role of strategic alliances in shaping a firm's CVC investment policy. Prior research has examined the merits of CVC activity relative to other types of interfirm relationships, such as strategic alliances (Keil *et al.*, 2008; Nicholls-Nixon and Woo, 2003; Powell, Koput, and Smith-Doerr, 1996). However, we know very little about the nature of interdependence between CVC activity and alliance formation. We conjecture that a firm's propensity to form alliances can influence its CVC investment policy. Moreover, the nature of this influence is contingent on a variety of firm-specific characteristics. Hence, we advance entrepreneurship and strategy research by uncovering the role of alliance formation in guiding firms' CVC decisions.

Corporate venture capital and strategic alliances represent two prominent and distinct types of interfirm relationships. Since the early 1980s, scholars have observed the proliferation of alliances (Gulati, Nohria, and Zaheer, 2000; Hagedoorn, 1995; Kale, Dyer, and Singh, 2002; Lavie, 2007; Rosenkopf and Schilling, 2007). An alliance refers to an enduring relationship between firms that share resources and coordinate value chain activities (Gulati, 1998). Such alliances include, for instance, cooperative marketing agreements, joint R&D projects, and long-term supplier contracts.

Both alliances and CVC programs enable firms to tap into emerging technology markets, yet they are not without differences. Alliance partners mutually commit resources and expect joint gains from that relationship, while CVC investment enables one firm to provide funding to another in expectation for technology access and return on such investment. Managers view alliances and CVC investments as distinct activities and manage them via separate corporate units. Accordingly, prior research has often studied alliances and CVC separately, as distinct types of interfirm relationships (Keil *et al.*, 2008; Nicholls-Nixon and Woo, 2003; Powell *et al.*, 1996; Roberts and Berry, 1985; Robinson and Stuart, 2007; Stringer, 2000), disregarding the possible trade-offs between the two.

We seek to bridge this gap in the literature by studying how alliance formation shapes the tendencies of established firms to engage in CVC investment.[1] On the one hand, alliance formation may reinforce CVC activity since alliances grant access to distinct (yet complementary) resources and extend firms' investment opportunities by making them more visible to potential users of their funding. On the other hand, firms' tendencies to form alliances may undermine CVC activity in the presence of binding internal resource allocation constraints and potential redundancies in the external resources that can be channeled through both types of relationships. Hence, we develop a resource-based theory (Barney, 1991; Eisenhardt and Schoonhoven, 1996; Lavie, 2006; Peteraf, 1993; Wernerfelt, 1984) to reconcile these opposing perspectives on the association between CVC activity and alliance formation.

We explicate the complex association between a firm's CVC activity and alliance formation by showing how this association changes with the frequency of alliance formation. We expect alliance formation to initially reinforce CVC activity until a threshold is reached, following which trade-offs dominate, resulting in an inverted U-shaped association between CVC activity and alliance formation. We also expect that increases in a firm's internal resource stock, age, and CVC investment experience attenuate the reinforcing effect of alliance formation on CVC activity. We test our hypotheses with longitudinal data on the alliances and CVC investments of 372 U.S. software firms from 1990 to 1999.

Our findings suggest that the configuration of internally owned resources and external resources shapes the association between CVC activity and alliance formation. Hence, this study offers a coherent framework for studying the tendency of firms to engage in CVC investments. It further elucidates how different types of interfirm relationships, namely CVC investments and strategic alliances, coevolve. By explicitly relating firms' CVC investment and alliance formation decisions, we overcome some empirical and conceptual deficiencies of prior research, which considered alternative types of

[1] In this study, we focus exclusively on the perspective of the firm making the investment, rather than on the recipient of the corporate venture capital investment.

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interfirm relationships independently without paying attention to their possible interdependence. We identify the boundary conditions for the interdependence between CVC investment and alliance formation and call for a more proactive coordination of firms' multiple types of interfirm relationships.

THEORETICAL BACKGROUND

In technology-intensive industries, firms have traditionally pursued both CVC and alliances. However, the corresponding research streams on these two types of interfirm relationships have evolved independently. With respect to CVC, established corporations are the second largest source of funding for entrepreneurial activities after traditional venture capital (VC) funds (Timmons, 1994; Keil, 2002; Dushnitsky, 2006; Maula, 2007). From the investing firm's perspective, CVC is a viable strategy for enhancing innovation and for accessing new markets and emerging technologies that may reside outside its boundaries (Dushnitsky and Lenox, 2005a, 2005b; Zahra, 1996; Zahra and Covin, 1995). CVC may also improve the attractiveness of the investing firm by enhancing its visibility (Birkinshaw, van Basten Batenburg, and Murray, 2002; Keil, 2004).[2] Prior research has indicated that investing firms may become alliance partners of their funded ventures (McNally, 1997; Sykes, 1990). Still, this research has not uncovered the considerations behind firms' decisions to engage in either alliances or CVC, nor did it study the interplay between these two types of interfirm relationships.

Interfirm alliances have traditionally been studied as a governance mode that offers an alternative to internalization or arm's-length transactions (Williamson, 1991). Alliances economize on transaction costs by relying on the efficiency of informal safeguards and provide benefits such as flexibility, cost sharing, and economies of scale and scope. Consequently, a firm's portfolio of alliances can enhance its corporate performance (e.g., Ahuja, 2000; Baum, Calabrese, and Silverman, 2000; Lavie, 2007; Stuart, 2000). In addition to alliance outcomes, scholars have studied the formation, evolution, and operations of alliances (Gulati, 1998; Koza and Lewin, 1998). In particular, alliance formation has been related to innovation efforts in turbulent markets wherein alliances emerge to enable rapid adjustment to changing conditions and reduce time to market (Alter and Hage, 1992; Harrigan, 1988; Kogut and Kulatilaka, 1993). Alliances also assist in bridging national boundaries and accessing emerging markets (Kogut and Kulatilaka, 1993; Ohmae, 1989). Additionally, alliances may be formed in response to competitors' alliances (Gimeno, 2005) or to enhance industry coordination and reduce market uncertainty (Eisenhardt and Schoonhoven, 1996). In this sense, scholars have followed real options reasoning to suggest that an alliance can mitigate market uncertainty and uncertainty concerning the behavior of a prospective exchange partner, leading to an acquisition or termination once the uncertainty is resolved (Chi and McGuire, 1996; Tong, Reuer, and Peng, 2008). Moreover, a firm may engage in alliances in order to explore external opportunities and generate new knowledge, or alternatively, to exploit complementary assets and leverage existing knowledge (Koza and Lewin, 1998; Lavie and Rosenkopf, 2006; Rothaermel and Deeds, 2004). Alliance formation may also be driven by path dependence whereby prior partners generate opportunities and provide referrals to new partners (Chung, Singh, and Lee, 2000; Gulati, 1995b). Nevertheless, this literature has not focused on alternative types of relationships and, by and large, neglected the undertaking of CVC as a viable alternative or complementary type of relationship for accessing external resources.

Alliances and CVC serve as mechanisms for accessing external resources, but they inherently differ with respect to the nature of the relationship and its organization (see Table 1). Alliances imply mutual dependence and reciprocal resource commitments of otherwise independent firms that engage in interactive coordination of various value chain activities, such as joint R&D and marketing initiatives. In alliances, both partners strive toward shared goals and seek to appropriate financial gains from their collaboration. In contrast, CVC investment entails disparity between an investor and the consumer of monetary funds, specifying a unidirectional flow of financial resources and appropriation claims from the investor to the funded venture that independently performs its value chain activities. Alliances have specific objectives that are negotiated and then pursued by both parties, whereas CVC agreements pertain to the operations of the funded venture. In contrast, the scope of alliance operations is narrowly

[2] Besides funding, CVC programs are believed to provide funded ventures with complementary resources and reputational benefits (Block and MacMillan, 1993; Dushnitsky, 2006; Maula, 2007).

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Table 1. A comparison of CVC and alliances

	CVC	Alliances
Definition	• A minority equity investment by an established firm in an entrepreneurial venture that seeks capital for growing its operations	• A voluntary arrangement between independent firms that share and exchange resources in the codevelopment or provision of products, services, or technologies
Main objectives	• Sponsoring an emerging or complementary technology	• Cost sharing, joint development, resource access, and market entry, among others
Scope	• The agreement covers the whole operation of the funded venture and none of the established firm's operations	• The agreement covers joint operations whose specific scope is limited relative to the partners' independent operations
Activities	• The funded venture performs value chain activities on a stand-alone basis	• Value chain activities are performed interactively by both partners
Funding	• Only the established firm makes the financial investment	• Both partners may make financial investments
Ownership	• The established firm buys a minority equity stake in the funded venture and may exert influence on its corporate decisions	• Most alliances do not involve equity, with joint ventures drawing major equity stakes from the partners that directly influence the operations of the new venture
Timing	• The relationship is established during specific investment rounds, often early in the life cycle of the privately held funded venture	• The relationship can be initiated throughout the life cycles of both partners
Setting	• The established firm is typically joined by independent VC funds that also invest in the funded venture as part of the syndication	• Most alliances are dyadic and do not involve independent VC funds
Role asymmetry	• A clear distinction between the investor and the recipient of funds	• Both partners invest resources and expect monetary returns on their investments
Governance	• The established firm manages CVC via a dedicated VC arm or a corporate business development unit	• Alliances are managed by a dedicated alliance function or by business units of the respective partners

defined, even when involving an equity stake position (Robinson and Stuart, 2007).[3] Moreover, many firms manage alliances and CVC through separate units aimed either at alliance management (Dyer, Kale, and Singh, 2001) or venture capital investment (Chesbrough, 2002; Dushnitsky, 2004). This organizational divide reflects managers' views of alliances and CVC as distinct activities, in accordance with prior research. Hence, scholars have distinguished agreements with alliance partners from capital investments in technology-intensive ventures (e.g., Robinson and Stuart, 2007). In doing so, however, extant work has often overlooked the interplay between CVC and alliances by assuming away possible associations between these two types of relationships. Furthermore, prior research has typically assumed the perspective of the entrepreneurial venture, rather than accounting for firm-level tendencies to make CVC investments.

We investigate the simultaneous tendencies to form different types of interfirm relationships from the perspective of the investing firm. We focus on the question of why a firm would engage in CVC investment, rather than on why a pair of firms would partake in an equity investment. This is not to imply that a dyadic approach is without merit. Indeed, anecdotal evidence suggests that an alliance may evolve into a

[3] Robinson and Stuart (2007: 561–562) observe several additional differences: 'there are critical differences between alliance agreements and VC contracts. These differences stem from the fact that while VCs fund the growth of firms as a whole, clients in strategic alliances sponsor projects inside firms. Thus, unlike what we see in VC deals, the client often does not receive board seats or other explicit, firm-level control rights in conjunction with its equity stake in the target. Instead, contracts uniformly put project-level control provisions into place.' In this sense, specialized VC funds operate much like the CVC arm of an investing firm (e.g., Gompers and Lerner, 1998; Dushnitsky, 2006; Maula, 2007).

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CVC investment (e.g., 'How do VC deals come about at Visa? They often start as strategic alliances and then evolve into a venture capital investment,' The Daily Deal, 2002); or vice versa ('. . . several portfolio companies have entered into development and other strategic relationships with BD subsequent to BD Ventures' investment,' Becton Dickinson). Our objective, however, is to investigate how alliance formation affects CVC investment at the firm level. By developing firm-level theory, we accommodate a comprehensive set of considerations of which dyadic mechanisms are viewed as a special case.

How do an established firm's alliance formation activities influence its CVC investment practices? In the absence of a clear indication in prior research, we consider opposing perspectives on the potential reinforcing versus attenuating association between these interfirm relationships. We then seek to reconcile these seemingly contradictory perspectives by introducing a contingency perspective that derives from resource-based theory and its extension to the context of interfirm relationships (Barney, 1991; Eisenhardt and Schoonhoven, 1996; Lavie, 2006).

The reinforcing effect of alliance formation on CVC investment

An established firm's tendency to invest CVC may be reinforced by its inclination to form alliances because of the accessibility of complementary partner resources and the enhanced visibility to prospective funded ventures. First, CVC and alliances may offer access to complementary resources. Because of time-compression diseconomies, causal ambiguity, and the tacit nature of certain resources (Dierickx and Cool, 1989; Kogut, Shan, and Walker, 1992), firms encounter challenges in developing certain resources internally and, thus, seek resources such as proprietary technologies from external sources (Ahuja, 2000). From the perspective of an investing firm, CVC may sponsor valuable innovations that the firm can then commercialize via its technology and marketing alliances with third parties that furnish complementary resources (Rothaermel, 2001; Tripsas, 1997). Obtaining one type of external resource increases the need for the other type (Arora and Gambardella, 1990). Thus, a firm's alliance formation may reinforce its CVC investment because of the complementary external resources associated with each type of relationship.

In addition, a firm may leverage its alliance relationships to enhance its visibility and, consequently, its CVC investment activity, which reinforces the positive association between CVC investment and alliance formation. A firm that becomes heavily involved in alliances gains network resources that are made accessible by its alliance partners (Lavie, 2006; Gulati, 2007). These network resources contribute to the firm's visibility and make it more attractive not only to prospective alliance partners (Gulati and Gargiulo, 1999), but also to entrepreneurial ventures that seek CVC sponsorships. Such visibility serves as an important driver of CVC activity (Birkinshaw *et al.*, 2002). Hence, by contributing to network resource visibility, alliance formation enhances the firm's legitimacy (Pfeffer and Salancik,1978) and creates opportunities for CVC investment.

In sum, the reinforcement perspective suggests that the pursuit of resources beyond the firm's boundaries, as reflected in the resource complementarity and network resource visibility mechanisms, can account for a positive association between alliance formation and the tendency to make CVC investment.

The attenuating effect of alliance formation on CVC investment

The attenuation perspective suggests a negative association between a firm's tendencies to form alliances and engage in CVC investments. The underlying logic is twofold: not only can these two types of relationships offer access to similar external resources, but firms may also face internal resource allocation constraints in managing these two types of relationships. Under such conditions, CVC becomes redundant when alliances are formed.

The first argument rests on the assumption that, at the most fundamental level, both alliances and CVC can advance technology commercialization. Although alliances entail greater interaction in the value chain and may not involve equity claims that are essential in CVC, both types of relationships can ultimately leverage market opportunities to promote emerging technologies. Moreover, both provide access to nonpecuniary external resources. In the case of alliances, a firm may engage in joint learning, codevelopment, and commercialization with its alliance partners, whereas in the case of CVC investments, a firm achieves these objectives by assuming an active role in managing funded ventures through board memberships or informal consultations (Birkinshaw *et al.*, 2002; Dushnitsky, 2004; Gulati

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and Higgins, 2006). Hence, the benefits of alliances with partner firms may be equivalent to the returns from investment in entrepreneurial ventures.

Besides competition for external resources, alliances and CVC compete for available internal resources. Whereas competition for external resources can lead to redundancy between alliances and CVC, competition for internal resources exacerbates the costs accruing to a firm that attempts to simultaneously form alliances and make CVC investments. To the extent that a firm invests resources primarily in internal operations, it imposes resource allocation constraints on its external relationships, which may yield a mutually exclusive association between CVC investment and alliance formation. In particular, alliance formation entails commitment of technological, marketing, and financial resources, which are essential for the success of alliances (Gulati, Khanna, and Nohria, 1994; Parkhe, 1993). Thus, alliance formation may limit the availability of free cash flows that can be otherwise used for making CVC investments (Bourgeois, 1981). Indeed, firms' decisions to not pursue CVC are motivated, in part, by lack of corporate resources (McNally, 1997), as revealed by the sensitivity of CVC activity to the investing firm's cash-flow condition (Dushnitsky and Lenox, 2005a). In addition to financial resources, both alliances and CVC activity consume dedicated technological and human resources (Chesbrough, 2002; Dyer *et al.*, 2001). Hence, alliances may come at the expense of supporting funded ventures. Thus, internal resource allocation constraints limit the firm's capacity to develop both types of interfirm relationships and, therefore, reinforce the trade-offs between them.

In sum, redundancy of external resources accessed through alliances and CVC relationships, along with the competition for internal resources that support these relationships, may result in a negative association between CVC investment and alliance formation.

HYPOTHESES

How can we reconcile the seemingly conflicting perspectives of reinforcing versus attenuating effects of alliance formation on CVC investment? We argue that the nature of dependence of CVC investment on alliance formation is not universal, but rather contingent on firm-specific attributes, namely the frequency of alliance formation and the firm's internal resource stock, age, and CVC experience. These attributes act as boundary conditions on the reinforcing association between CVC investment and alliance formation.

The association between CVC investment and alliance formation is likely to change with the frequency of alliance formation. We suggest that both reinforcing and attenuating pressures may occur, but their effects become dominant at different frequencies of alliance formation. Specifically, as more alliances are formed at any given time, their positive impact on CVC due to resource complementarity and network resource visibility diminishes and becomes dominated by the negative effects resulting from external resource redundancy and internal resource allocation constraints. This leads to an overall inverted U-shaped association between firms' CVC investment and alliance formation, as depicted in Figure 1.

First, resource complementarity entails that various unique resources are made available from external sources. Increases in the number of alliances create additional opportunities to commercialize emerging technologies which, in turn, may stimulate an established firm's propensity to engage in CVC in search for ventures that can furnish such technologies (Arora and Gambardella, 1990). The more alliances the firm enters, the better it can combine the unique network resources of its alliance partners with technology resources originating from prospective funded ventures. Accordingly, extending the firm's resource base via alliances is likely to facilitate CVC activity with the aim of increasing the number of possible resource combinations (Kogut and Zander, 1992). However, given the finite number of opportunities to combine external technologies with alliance partners' unique resources, alliance formation will facilitate CVC investment at a decreasing rate. The positive association between CVC investment and alliance formation will diminish once the number of alliances formed increases substantially and consequently undermines the firm's ability to deploy emerging technologies of its funded ventures via its network of alliance partners. Put differently, the complementary benefit of simultaneously engaging in CVC investments and alliances will likely decrease with the number of alliances formed: beyond a certain threshold, the existence of yet another alliance offers marginal added value as an outlet for leveraging and commercializing venture technologies. Hence, complementarity gives way to redundancy once the

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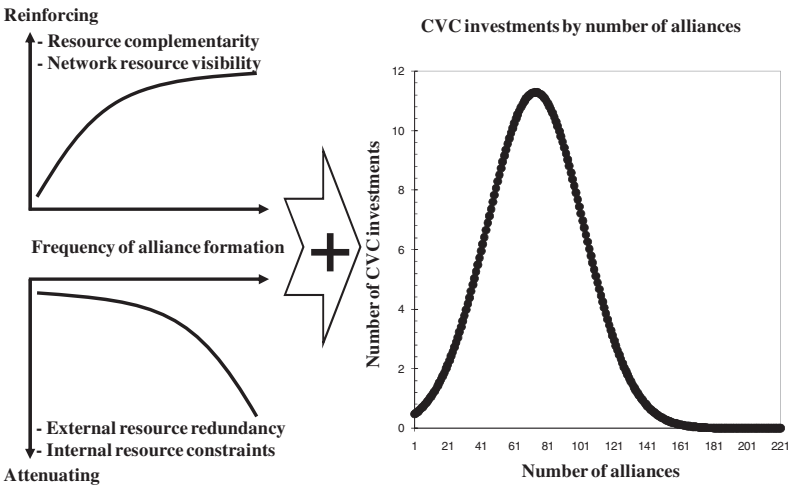

Figure 1. The association between CVC investment and alliance formation

numerous R&D, production, and marketing alliance partners fail to offer novel opportunities for promoting the technology sourced from the funded ventures.

Similarly, the visibility benefits of network resources ascribed to alliance formation are likely to increase at a diminishing rate. The first few alliances that a firm enters contribute substantially to its legitimacy and visibility, thus facilitating opportunities for investing in entrepreneurial ventures that seek funding (Gulati and Higgins, 2006). A funded venture is also more likely to become aware of the investing firm's funding among other resources by observing its alliance formation activity. However, once the investing firm has already established its market presence by developing an extensive alliance portfolio, each additional alliance offers only a marginal contribution to the firm's visibility and attractiveness to prospective funded ventures. Thus, resource complementarity and network resource visibility generate a curvilinear association between alliances and CVC activity, such that CVC investment increases with alliance formation at a diminishing rate.

An increase in the number of alliances formed not only diminishes the complementarity and visibility associated with CVC activity, but also reinforces redundancy. Specifically, the number of alliances may attenuate the need for CVC investment because of external resource redundancy. To the extent that new alliance partners can furnish technologies that resemble those offered by newly funded ventures, redundancy of external resources (Baum *et al.*, 2000; Burt, 1992) is likely to unfold and limit the need for CVC. An expanding portfolio of alliances enables the firm to tap into a large pool of network resources so that the external resources the firm seeks to appropriate from CVC activity may become redundant. In fact, the larger the number of alliance partners that the firm approaches, the more likely that the resources accessed through a prospective CVC investment become redundant. Thus, the negative association between CVC investment and alliance formation ascribed to external resource redundancy is likely to transpire at an increasing pace.

Finally, much like external resource redundancy, internal resource allocation constraints intensify with the frequency of alliance formation. An increase in the number of alliances limits the firm's capacity to allocate resources for sponsoring other ventures or to devote the technological and human resources needed for maintaining an increasing number of relationships with such funded ventures. The firm's alliances consume financial, technological, marketing, and managerial resources that could otherwise be used to support CVC engagements. Hence, as the number of alliances increases beyond a certain point, internal resource allocation constraints may inhibit the firm's motivation and ability to simultaneously invest CVC in funded ventures. Internal resource allocation constraints, then, lead to a negative association between CVC investment and alliance formation, which intensifies with the number of alliances formed.

In sum, resource complementarity and network resource visibility cause alliance formation to

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reinforce CVC investment at a diminishing rate, whereas external resource redundancy and internal resource allocation constraints make alliances attenuate CVC investments at an increasing pace (see Figure 1). Taken together, these conflicting pressures result in a curvilinear association between CVC investment and alliance formation, whereby CVC investment will first increase and then decrease with alliance formation after a certain threshold has been reached. If the reinforcing association is dominant, that threshold will be reached at a relatively high frequency of alliance formation. If, however, the attenuating association is dominant, a negative association between CVC investment and alliance formation will transpire at a low frequency. In any case, we expect an inverted U-shaped association between CVC investment and alliance formation. Overall, the effect of alliance formation on CVC investment is likely to shift from positive to negative with increases in the number of alliances formed.

Hypothesis 1: CVC investment will exhibit an inverted U-shaped association with alliance formation, whereby a firm's number of CVC investments will first increase and then decrease with the number of alliances formed.

We next suggest that as firms invest in internal resources, mature, and become more experienced CVC investors, the reinforcing association between alliances and CVC is weakened, while attenuating pressures become more pervasive. These firm-specific attributes consistently moderate the association between alliances and CVC at any given level of alliance formation.

As far as internal resources are concerned, their deployment weakens the effect of network resource visibility while amplifying resource allocation constraints. A firm accumulates internal resource stocks, which are required for its organization (Dierickx and Cool, 1989). Prior research underscores the role of financial, technological, and human assets as functional resources that support a firm's internal operations (Chatterjee and Wernerfelt, 1991; Montgomery and Hariharan, 1991). To the extent that a firm accumulates such resource stock, it becomes more visible and attractive to prospective ventures. The CVC investment opportunities of the firm will expand due to its internal resource stock and, consequently, its network resources will play a less important role in establishing the firm's market presence. Thus, the greater the firm's internal pool of resources, the weaker the contribution of alliance formation to the firm's CVC investment activity. In other words, deploying resources to internal uses will weaken the reinforcing association between alliances and CVC.

Moreover, to the extent that the firm invests financial, technological, and human capital in its internal organization, this may come at the expense of investments that could otherwise support external relationships. Extant research underscores the role of resources in facilitating continued experimentation with novel technologies (Levinthal and March, 1981; Drazin and Schoonhoven, 1996), such as those undertaken by funded ventures (Dushnitsky and Lenox, 2005b) and new alliances (Lavie, 2006). Of course, some resources may be nonrivalrous in use—typically, intangible resources like knowledge—which can be disseminated or reproduced without diminishing their value (Winter and Szulanski, 2001). Resource allocation constraints will be mitigated to the extent that such internal resources are fungible and can be flexibly redeployed in the firm's external relationships (Sirmon, Gove, and Hitt, 2008). Nevertheless, as long as at least some of the resources that CVC targets and alliance partners compete for cannot be redeployed without loss of value, assigning such resources to the firm's internal organization will restrict CVC and alliance opportunities. For instance, a firm's decisions to retain cash, invest in internal R&D, or hire new employees exacerbate resource allocation constraints imposed on the firm's external relationships. Such constraints simultaneously affect the firm's resource allocation to new alliance as well as to CVC targets. A firm's alliance relationships consume capital, technological, and certain managerial resources that could be otherwise used to support CVC activity. When such resources are channeled to internal uses instead, the competition between alliances and CVC for the remaining resources intensifies. Hence, a firm's investment in internal resources amplifies resource allocation constraints on external relationships, thus strengthening the negative association between CVC investment and alliance formation.

In sum, we expect firms that channel their internal resource stocks to support their organic growth will face increasing trade-offs between CVC investment and alliance formation. These trade-offs gain traction irrespective of the number of alliances formed, so that the internal resource stock negatively moderates the positive association between alliances and CVC.

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Hypothesis 2: The trade-off between CVC investment and alliance formation will intensify with a firm's internal resource stock, so that the positive association between the firm's number of alliances formed and the number of CVC investments will be weakened.

In addition, the influence of alliance formation on CVC investment is likely to evolve during a firm's life cycle as the firm experiences changing resource requirements. Consequently, resource complementarity between alliance partners and funded ventures will be weaker for older firms. Firms typically rely on interfirm relationships for accessing external resources that are in short internal supply (Dyer and Singh, 1998; Pfeffer and Salancik, 1978), such as financial, technological, manufacturing, and marketing resources (Ahuja, 2000). However, at different stages of their life cycles, firms may experience varying needs for different types of resources. Young firms need multiple resources (Stinchcombe, 1965), including funding to support early-stage R&D, product commercialization, and market entry. Thus, they seek access to various external resources simultaneously. As firms mature, they tend to gain possession of relevant resource stocks, or at least acquire those critical resources that serve as their core assets (Dierickx and Cool, 1989; Teece, 1986). Hence, mature firms are likely to demonstrate a more specific need for resources of a particular type. Insofar as CVC and alliances provide access to different types of resources, firms may tend to form relationships of a particular type as they mature. We further expect mature firms to either form alliances or make CVC investments because they build on distinct internal resources: CVC necessitates that firms primarily leverage their financial capital (Gompers and Lerner, 1998), whereas alliances harness firms' technology and marketing resources (Rothaermel and Deeds, 2004). In sum, the trade-off between investing CVC and forming alliances may intensify as firms mature, weakening the reinforcing association between CVC investment and alliance formation. Since the effect of a firm's age is expected to apply consistently, irrespective of the number of alliances formed, it will manifest as a linear moderation effect.

Hypothesis 3: The trade-off between CVC investment and alliance formation will intensify with a firm's age, so that the positive effect of the firm's number of alliances formed on its number of CVC investments is weakened as the firm matures.

Besides a firm's age, accumulated CVC experience may lead to specialization that weakens the reinforcing effect of alliance formation on CVC investment. In particular, CVC experience contributes to a relational capability that intensifies internal resource allocation constraints while weakening the effect of network resource visibility emanating from alliance formation.

The term relational capability refers to the systematic tendency of some firms to identify opportunities for forming interfirm relationships and manage them more effectively than other firms (Anand and Khanna, 2000a; Kale *et al.*, 2002; Lorenzoni and Lipparini, 1999). Prior research has focused on a narrow aspect of relational capability by limiting its concern to alliances. It highlighted firms' skills in assimilating knowledge across alliances, increasing the visibility of alliances, internally coordinating alliances, and instituting alliance management practices (Kale *et al.*, 2002). We contend that a parallel skill set may apply to managing other types of interfirm relationships such as those involving CVC. Relational capabilities that derive from firms' prior experience are idiosyncratic and path dependent (Chung *et al.*, 2000; Gulati and Gargiulo, 1999). Accumulated experience informs organizational routines (Zollo, Reuer, and Singh, 2002), which emerge from trial and error and repetition of established patterns of behavior (Gavetti and Levinthal, 2000). Accumulated experience encourages firms to engage in local search and employ their experiences in familiar contexts, limiting their engagement in alternative types of interfirm relationships. In addition, extensive experience with CVC may increase the efficiency of managing CVC investments.

Therefore, as a firm accumulates CVC experience, it will be more inclined to allocate resources to support new CVC relationships. The frequency of employing a routine increases its efficient use and the likelihood of desirable outcomes which, in turn, reinforce its future application (Levinthal and March, 1993; Levitt and March, 1988). Thus, a firm that has gained experience in managing CVC investments is more likely to favor this type of relationship over other types of relationships such as alliances. The more experienced a firm is in sponsoring funded ventures, the more likely it is to pursue similar investment opportunities since it can accumulate and apply its idiosyncratic experience in a relevant context without encountering significant adjustment costs (Gulati, Lavie, and

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Singh, 2009; Gulati and Singh, 1998; Lavie and Miller, 2008). Hence, the efficient use of established routines in recurrent CVC will increase the trade-off between CVC investment and alliance formation. At a given level of available resources, the competition between CVC and alliances for financial, technological, and human resources needed to support these relationships will intensify. Thus, CVC experience will amplify resource allocation constraints and strengthen the negative association between CVC investment and alliance formation.

Finally, a firm that has developed a relational capability by accumulating CVC experience is likely to become a desirable sponsor in the eyes of prospective entrepreneurial ventures. Such a firm gains visibility and becomes attractive by demonstrating superior skills in managing relationships with funded ventures. Consequently, prospective ventures can rely on the firm's prior CVC experience and enhanced CVC management skills, rather than infer from secondary cues—such as a firm's alliance formation activity—about the prospects of establishing CVC relationships with that firm. Thus, the CVC experience of the firm replaces the network resources of alliance partners as an indicator of the firm's attractiveness to these ventures. The firm's relevant CVC experience helps establish its presence in the CVC market and, thus, weakens the network resource visibility effect, which would otherwise contribute to a positive association between CVC investment and alliance formation. Overall, the reinforcing effect of alliance formation on CVC investment is likely to be consistently weakened with accumulated CVC experience irrespective of the number of alliances formed.

Hypothesis 4: The trade-off between CVC investment and alliance formation will intensify with a firm's CVC investment experience, whereby the positive effect of the firm's number of alliances formed on its number of CVC investments is attenuated by the firm's accumulated number of CVC investments.

RESEARCH METHODS

Research setting and sample

We tested our hypotheses with a pooled time-series dataset of firms in the U.S. software industry from 1990 to 1999.[4] Our sample included all 372 publicly traded U.S.-based software firms that were active in 2001 and had at least five years of Compustat records.[5] This industry (SICs 7371 through 7374) offers a suitable research setting for several reasons. First, both alliance formation and CVC investment have become pervasive in this industry, enhancing the meaningfulness, reliability, and variance of our variables. For example, a typical publicly traded software firm formed, on average, more than five alliances per year during the 1990s (Lavie, 2007). This industry also served as a major setting for CVC activity, with firms investing CVC primarily in other software and Internet-based ventures (Dushnitsky and Lenox, 2005b). In fact, a recent survey identified the software industry as the most attractive sector for CVC activity, with a 13.4 percent share of all CVC investment (MacMillan *et al.*, 2008). Second, this industry features a high proportion of publicly traded firms, ensuring the accessibility of financial information. The tendency of young and small software firms to become publicly traded early in their life cycle reduces potential size- and age-related biases. Finally, the worldwide software industry has been dominated by U.S.-based firms (Rudy, 2000), thus increasing the representativeness of our sample.

Data collection

Our dataset combined archival information on firms' alliance activity, CVC investments, and financial records. We collected information on alliance formation following the procedure reported by Anand and Khanna (2000b). We first compiled records of alliances formed by the sampled firms from 1985 to 1999 from the Securities Data Corporation (SDC) database and then complemented and corrected these records by searching alliance announcements and status reports in press releases available in the Factiva database, press releases and alliance listings posted on corporate Web sites, and SEC filings accessed from the Edgar database. These sources

[4] We tracked alliances and CVC investments back to 1985 in order to account for firms' corresponding experience.

[5] Selection bias was ruled out based on the lack of difference between the 372 sampled firms and the remaining publicly traded firms in the industry (297 firms including those with less than five years of records, or headquarters in foreign countries) in terms of total assets ($t = 1.430$, $p = 0.152$), net sales ($t = 0.525$, $p = 0.600$), number of employees ($t = 0.274$, $p = 0.785$), net income ($t = 1.481$, $p = 0.139$), cash ($t = 1.505$, $p = 0.133$), long-term debt ($t = 0.066$, $p = 0.947$), stock price ($t = 1.273$, $p = 0.204$), and other relevant measures.

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have been used in prior research on alliances (e.g., Lavie, 2007; Lavie and Rosenkopf, 2006). Most alliance announcements were cross-validated by at least two sources. We also verified that the announced alliances involved interactive collaboration per our definition and, therefore, eliminated several resale, licensing, and supply-chain relationships that resembled arm's-length transactions rather than collaborative relationships. Overall, from 1990 to 1999, 360 of the 372 sampled firms formed alliances. A total of 12,928 alliances were identified involving 5,548 unique partners. On average, a firm formed 34.75 alliances from 1990 to 1999. For each alliance, we coded the date of announcement, partners' identities, partners' equity stakes in the alliance, and classification to categories of agreements. An alliance could involve multiple types of agreements. Specifically, the documented alliances involved the following types of agreements: 51.60 percent marketing, 50.00 percent R&D, 14.47 percent original equipment manufacturing or value added resale (OEM/VAR), 12.32 percent licensing, 5.16 percent service, 2.03 percent manufacturing, and 1.94 percent supply agreements. Additionally, 3.71 percent of the alliances were classified as equity-based alliances with the rest being nonequity alliances. 3.89 percent of the alliances involved more than two partners. These multipartner alliances were segregated into dyadic alliances. On average, each alliance involved 2.43 partners and 1.33 types of agreements.

We collected information on firms' CVC investments from the Thomson Financial's VentureXpert database, which combines data from industry associations (such as the National Venture Capital Association) and the investment banking community. These sources have been used in several studies of venture capital investment (e.g., Dushnitsky and Lenox, 2005a; Gompers, 1995). This database covers investment, exit, and performance activity in the private equity sector starting from 1969. We searched the population of all private equity investments that originated by corporate investors or their funds. We collected data on the number and amounts of CVC investments made by the firms in our sample. In particular, we counted the number of funded ventures in which each firm invested. Overall, 29 software firms in our sample made CVC investments. These figures are consistent with investment patterns documented by prior research (Dushnitsky, 2006). We took special care to ensure there was no double counting of transactions in the SDC and VentureXpert databases so that CVC investments were not mistaken for equity alliances. No such overlap was found. Hence, we verified that each CVC investment and alliance indeed represented distinct activities.

Finally, we used the Compustat database for accessing firm-level financial data, such as cash, R&D investments, and number of employees. We ensured consistent tracking of the sampled firms in the alliance, CVC, and Compustat datasets by employing a matching algorithm and manual checks. Since we were interested in studying firm-level tendencies, the firm-year was considered the unit of analysis. Thus, we transformed the data to 2,448 firm-year observations by pooling it across all alliances and CVC investments of each firm in a given year. In this process, we retained observations for years in which firms operated but formed no alliances or made no CVC investments.

Dependent variable

We examine firms' inclinations to engage in CVC investments as a function of their concurrent alliance formation decisions.[6] Hence, our dependent variable captures the investments made by a firm in funded ventures both within and outside the software industry. This measure is calculated as an annually updated count of the number of unique ventures in which the firm has invested in a given year. Following prior research (Dushnitsky and Lenox, 2005b; McNally, 1997; Sykes, 1990), this measure was preferred to a measure of the total dollar amount that the firm has invested in a given year, since we are interested in the formation of interfirm relationships rather than in the value of the firm's investments. The use of a count variable also provides a common measure for assessing both CVC and alliance formation. While it is possible to refer to the cost associated with a CVC investment, it is difficult to gauge the dollar value or cost of most alliance relationships.

Independent variable and moderators

The number of alliances serves as our independent variable. This variable was constructed by counting

[6] Our focus on CVC as the dependent variable and alliance formation as an independent variable enables us to test comprehensive models with interaction effects without facing some convergence problems ascribed to the lower variation in firms' number of CVC investments when the number of alliances serves as the dependent variable.

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all the alliances that a firm formed in a given year with any partner, including nonsoftware partners and prior partners. We take into account simultaneous alliances formed in the same year in which the firm engaged in CVC activity, in order to capture the concurrent dependence and theorized trade-offs between alliance formation and CVC investment.

We include the firm's age, resources, and CVC experience as moderators to correspondingly test Hypotheses 2–4. To capture the firm's financial, technological, and human resources, we use three corresponding indicators of available cash, value of R&D investments, and number of employees as reported in Compustat (e.g., Chatterjee and Wernerfelt, 1991; Gulati, *et al.* 2009; Montgomery and Hariharan, 1991). To capture the overall impact of the firm's internal resource stock we employed principal components factor analysis of these time-variant indicators which yielded a single factor with an eigenvalue greater than 1 (eigenvalue = 2.29) and high scale reliability (Cronbach's $\alpha = 0.84$).[7] The resulting factor scale serves as our composite measure of firm resources per each firm-year. This variable is used for testing Hypothesis 2 by including an interaction term of firm resource stock and the number of alliances formed. For each firm-year, we measure age as the number of years since the founding of the firm based on information gathered from SEC filings and complementary corporate archives. This variable is used for testing Hypothesis 3 by including an interaction term of the firm's age and the number of alliances formed. Finally, for each year (t) we calculate the firm's CVC experience as a count of all prior CVC investments made by the firm between 1985 and the preceding year (t-1). This variable is incorporated in the interaction term with the number of alliances formed for testing Hypothesis 4.

Control variables

We control for interindustry variation by focusing on the analysis of a single industry. To capture further nuances, we control for the firm's industry sector based on the four-digit SIC code reported in Compustat. This control variable accounts for potential fixed subsector differences in CVC investment patterns. For instance, CVC investment may be more likely by firms in the packaged software sector that seek off-the-shelf software components and emerging technologies. Intertemporal trends and macroenvironmental shocks are controlled for by including a series of year dummy variables corresponding to pairs of years ranging from 1990 to 1999. In addition, we control for the proportion of equity alliances in the firm's alliance portfolio that may substitute for the firm's CVC investments. We also control for firm characteristics using time-variant measures. Specifically, we incorporate the main effects of our moderating variables—namely resources, age, and CVC experience—as controls, given the expected tendency of mature, affluent, and experienced firms to engage in CVC investment (Dushnitsky and Lenox, 2005b; Wadhwa and Kotha, 2006). The firm's CVC experience serves as an important control for possible unobserved, time-variant firm-level characteristics that may affect CVC activity (Dushnitsky and Lenox, 2005a). CVC experience controls for such unobserved heterogeneity and endogeneity in firms' tendencies to engage in CVC investment, assuming that such tendencies involve dynamic feedback and are captured by firms' patterns of prior CVC investments (Blundell, Griffith, and Van Reenen, 1995).

Analysis

We examine the impact of alliance formation on firms' CVC investments. Our dependent variable is based on count data and, as such, is bounded at zero and assumes only integer values. We address the discrete nature of this variable by adopting a negative binomial regression model. The negative binomial model is a generalized version of the Poisson model that corrects for overdispersion (Greene, 2002) and has been used in various studies of overdispersed counts, including prior studies of interfirm relationships (Griliches, Pakes, and Hall, 1987; Haunschild and Beckman, 1998). In addition, the analysis of panel data raises concerns about serial correlation of errors within cross-sections, which may deflate standard errors and inflate significance levels. We address autocorrelation concerns by incorporating first-order autoregressive errors in the tested models, assuming correlation of errors across adjacent years, i.e., AR(1) process. We test our models using the GENMOD procedure in SAS that

[7] It is a common practice to combine raw data items into a single composite index. For instance, prior research has followed such practice to capture a firm's investment opportunity set (Rajgopal and Shevlin, 2002), managerial action (Rodan and Galunic, 2004), and compensation schemes (Dushnitsky and Shapira, 2009).

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Table 2. Descriptive statistics and correlations (n = 2,448)

Variable	Mean	Std. Dev.	Min.	Max.	1.	2.
1. Number of CVC investments	0.07	0.79	0	25		
2. Number of alliances	4.93	10.22	0	219	0.61***	
3. Number of R&D alliances	2.46	6.20	0	125	0.61***	0.93***
4. Number of marketing alliances	2.54	5.37	0	105	0.52***	0.92***
5. Firm cash	42.84	246.40	0	7429	0.71***	0.69***
6. Firm R&D	26.16	123.37	0	2970	0.69***	0.72***
7. Firm employees	1.72	5.42	0.001	75.3	0.26***	0.42***
8. Firm resources (factor score)	0	1	–0.28	19.71	0.65***	0.70***
9. Firm age	14.88	11.51	1	134	0.03	–0.04*
10. CVC experience	0.17	2.16	0	42	0.42***	0.32***
11. Proportion of equity alliances	0.04	0.13	0	1	0.01	0.02
12. SIC 7371	0.04	0.19	0	1	–0.01	–0.06**
13. SIC 7372	0.64	0.48	0	1	0.05*	0.17***
14. SIC 7373	0.27	0.44	0	1	–0.04†	–0.14***
15. SIC 7374	0.05	0.22	0	1	–0.01	–0.04*
16. Years 1990–1991	0.95	0.22	0	1	0.02	0.05**
17. Years 1992–1993	0.93	0.25	0	1	0.02	0.04**
18. Years 1994–1995	0.89	0.32	0	1	0.03	0.06**
19. Years 1996–1997	0.85	0.36	0	1	0.01	–0.01
20. Years 1998–1999	0.85	0.36	0	1	–0.10***	–0.17***

supports generalized equations estimation (GEE) of negative binomial models with autocorrelation covariance parameters.

Expectedly, the number of alliances formed is highly correlated with some of the firm's resources. Thus, we have taken several measures to eliminate concerns of potential multicollinearty: (1) excluding highly correlated variables, such as alliance experience; (2) combining correlated indicators, namely firm cash, R&D investments, and number of employees, into a single variable that represents the firm's resources; (3) mean centering all variables before introducing them to the reported models; and (4) relying on partial models with separate moderation effects for hypothesis testing. We tested for potential multicollinearity, finding that the maximum VIF index ranges from 1.12 to 2.85 in these partial models, not exceeding the critical value (Kleinbaum *et al.*, 1998). Our efforts eliminated multicollinearity in the partial models but not in the full model, which, therefore, is not reported.[8]

[8]The maximum VIF index reached 51.82 when including all the explanatory variables in the full model. Because this VIF value exceeds the critical value of 10, it renders some interaction effects insignificant. Such evident multicollinearity is a result of the multiple inclusions of the number of alliances in each of the explanatory variables. Note that the correlations between our moderators, namely a firm's resources, age, and CVC experience, were rather low and, thus, do not contribute to such multicollinearity.

RESULTS

Descriptive statistics are reported in Table 2. On average, the firms in our sample formed 4.93 alliances per year, with a maximum of 219 annual alliance formations (Microsoft in 1999). Overall, the percentage of firms that engaged in alliances increased from 45.63 percent in 1990 to 85.75 percent in 1999, while the average annual number of alliances per firm increased from 1.85 to 9.10 during that period. The lower number of CVC investments reflects the selective, yet increasing, use of this type of interfirm relationship. Specifically, CVC activity of software firms grew from no investments in 1990 to a maximum of 25 investments in 1999 per firm per year. CVC investors included industry incumbents such as Adobe, Microsoft, Novell, and Oracle. Overall, the correlation matrix reveals low correlations across variables, with the exception of the positive correlation between the number of CVC investments and the number of alliances formed. Additionally, firm resources are positively correlated with the number of alliances and CVC investments, thus supporting our decision to control for such resources when examining the relationship between alliance formation and CVC investment.

Table 3 reports the results of negative binomial regressions for firms' CVC investments. Model 1

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3.	4.	5.	6.	7.	8.	9.	10.	11.
0.77***								
0.72***	0.59***							
0.75***	0.60***	0.81***						
0.40***	0.40***	0.56***	0.57***					
0.72***	0.61***	0.91***	0.91***	0.79***				
–0.02	–0.05*	0.07***	0.13***	0.09***	0.05*			
0.31***	0.29***	0.31***	0.35***	0.13***	0.30***	0.04†		
0.02	0.04†	0.04*	0.06**	0.10***	0.07***	0.07**	–0.01	
–0.05*	–0.05**	–0.02	–0.04†	–0.00	–0.03	0.04*	–0.02	–0.04*
0.16***	0.15***	0.04†	0.06**	–0.14***	–0.00	–0.21***	0.05**	–0.05*
–0.13***	–0.14***	–0.04*	–0.05*	0.02	–0.03	0.17***	–0.04*	0.04*
–0.06**	–0.01	0.02	–0.01	0.28***	0.08***	0.07**	–0.02	0.06**
0.05*	0.04*	0.01	0.01	–0.02	0.01	–0.01	0.01	–0.06**
0.02	0.04†	0.01	0.01	–0.01	0.01	–0.02	0.02	–0.02
0.04*	0.07***	0.02	0.01	0.00	0.01	0.02	–0.00	0.01
–0.01	0.01	0.01	0.00	0.02	0.01	0.03	–0.00	0.02
–0.11***	–0.21***	–0.07***	–0.04†	–0.00	–0.04*	–0.04*	–0.03	0.03

Variable	12.	13.	14.	15.	16.	17.	18.	19.
13. SIC 7372	–0.27***							
14. SIC 7373	–0.12***	–0.81***						
15. SIC 7374	–0.05*	–0.31***	–0.14***					
16. Years 1990–1991	–0.00	0.04†	–0.03	–0.01				
17. Years 1992–1993	0.00	0.03	–0.02	–0.02	–0.06**			
18. Years 1994–1995	0.00	–0.01	0.01	–0.00	–0.08***	–0.09***		
19. Years 1996–1997	0.00	–0.02	0.02	0.01	–0.10***	–0.11***	–0.15***	
20. Years 1998–1999	0.00	–0.02	0.02	0.01	–0.10***	–0.11***	–0.15***	–0.18***

Significance level (2-tailed): †$p < 0.1$, *$p < 0.05$, **$p < 0.01$, ***$p < 0.001$.

tests for the effects of control variables on CVC investment, revealing that CVC investment was more pervasive in the SIC 7371 (computer programming services), SIC 7372 (packaged software products), and SIC 7373 (computer integrated systems design) subsectors of the software industry. Yet, these industry effects diminish when the main variables are introduced, with the exception of SIC 7372, which remains highly significant. The year controls reveal increasing popularity of the practice of CVC investment throughout the years 1992 to 1999. These year effects persisted in all the partial models. Additionally, CVC investment increases with the availability of resources, such as R&D expenditures and available cash. Albeit insignificant in Model 1, a firm's age produces significant positive effects in remaining models, suggesting that older firms are more active as CVC sponsors. Hence, established and more affluent firms are more likely to engage in CVC investments. Model 1 also reveals path dependence in CVC investment, showing that experienced CVC investors are more likely to engage in subsequent CVC. Finally, the association between involvement in equity alliances and CVC investment is negative yet insignificant. Equity secures the ownership stake of the investing firm in the funded venture with the hope for financial gain at time of IPO or trade sale. In turn, the role of equity in alliances is to exert control, protect proprietary assets, and align joint decision making with the interests of the investing alliance partners.

Model 2 introduces the main effect of the number of alliances formed, which is positively related to CVC investment. It demonstrates that a firm's CVC

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Table 3. Negative binomial panel regression results for CVC investment

Dependent variable	Number of CVC investments					
Independent variable	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Intercept	–7.655***	–6.330***	–6.442***	–6.585***	–6.761***	–6.544***
	(0.638)	(0.504)	(0.420)	(0.439)	(0.615)	(0.475)
SIC 7371	3.174**	1.548	1.667†	1.826†	2.255*	1.749†
	(1.105)	(0.960)	(0.949)	(0.970)	(1.010)	(1.962)
SIC 7372	3.593***	2.099***	2.131***	2.261***	2.534***	2.238***
	(0.748)	(0.594)	(0.568)	(0.600)	(0.665)	(0.579)
SIC 7373	1.872*	0.541	0.556	0.698	0.806	0.670
	(0.782)	(0.734)	(0.691)	(0.681)	(0.816)	(0.717)
SIC 7374						
Years 1990–1991						
Years 1992–1993	–2.562***	–3.709**	–3.049**	–3.245**	–2.841***	–3.762***
	(0.669)	(1.130)	(1.154)	(1.061)	(0.771)	(0.905)
Years 1994–1995	–1.354	–1.575†	–1.650†	–1.700†	–1.611†	–1.786†
	(0.904)	(0.930)	(0.939)	(0.955)	(0.902)	(1.008)
Years 1996–1997	0.500	0.565	0.614	0.620	0.499	0.628
	(0.952)	(0.943)	(0.936)	(0.923)	(0.930)	(0.948)
Years 1998–1999	1.744***	1.265**	1.277**	1.271**	1.158**	1.266**
	(0.483)	(0.435)	(0.445)	(0.446)	(0.445)	(0.429)
Firm resources	1.411***	0.573***	0.627***	0.796***	0.821***	0.635***
	(0.063)	(0.079)	(0.075)	(0.091)	(0.099)	(0.076)
Firm age	0.083	0.365*	0.357*	0.338*	0.302*	0.348*
	(0.245)	(0.150)	(0.140)	(0.142)	(0.132)	(0.141)
CVC experience	0.130***	0.174**	0.246***	0.255***	0.196***	0.339***
	(0.035)	(0.053)	(0.050)	(0.050)	(0.053)	(0.047)
Proportion of equity alliances	–0.394	–0.199	–0.217	–0.245	–0.273	–0.189
	(0.291)	(0.231)	(0.253)	(0.266)	(0.263)	(0.231)
Number of alliances		0.837***	1.089***	0.921***	0.659***	0.900***
		(0.130)	(0.205)	(0.154)	(0.123)	(0.141)
Number of alliances^2			–0.078***			
			(0.011)			
Firm resources × number of alliances				–0.083***		
				(0.010)		
Firm age × number of alliances					–0.527***	
					(0.095)	
CVC experience × number of alliances						–0.090***
						(0.008)
n Firm-year	2,448	2,448	2,448	2,448	2,448	2,448
n Firms	372	372	372	372	372	372
Maximum VIF	1.117	2.189	2.832	2.847	2.728	2.358
Log likelihood	–89.831	–79.163	–70.333	–69.299	–77.356	–73.627

Significance level (2-tailed): †$p < 0.1$, *$p < 0.05$, **$p < 0.01$, ***$p < 0.001$.

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activity increases with the tendency to form alliances. However, the quadratic term of the number of alliances in Model 3 has a negative effect. Hence, consistent with Hypothesis 1, the association between a firm's CVC activity and alliance formation follows an inverted U-shaped pattern, with CVC investment initially increasing and then decreasing with the number of alliances formed. As depicted in Figure 1, the predicted number of CVC investments reaches a maximum of 11.28 investments when the firm forms 73 alliances per year.

Model 4 indicates a significant negative interaction effect of a firm's resources and the number of alliances on CVC in support of Hypothesis 2, suggesting that firms that allocate resources to internal use face a diminished reinforcing effect of alliances on CVC investment. Model 5 reveals a significant negative interaction effect of a firm's age and the number of alliances on CVC, in support of Hypothesis 3. Finally, Model 6 grants support to Hypothesis 4 by revealing a negative interaction effect of CVC experience and the number of alliances on CVC investment, suggesting that prior CVC experience may weaken the reinforcing association between CVC investment and alliance formation.

Robustness tests

To test the robustness of our findings, we considered alternative variable operationalizations and model specifications. First, we considered the number of active alliances (including those formed in prior years) as an alternative independent variable, assuming that the tendency to engage in CVC investment may be affected by the firm's existing alliances rather than only by its newly added ones. Second, we introduced a control for the firm's alliance experience at year (t), measured as the firm's accumulated number of alliances formed between 1985 and the preceding year (t − 1). To the extent that CVC activity influences alliance formation, this pattern may be captured by the alliance experience measure, which controls for potential endogeneity. Third, we split our number of alliances measure into technology alliances and marketing alliances and ran separate models for these two independent variables (see Tables 4 and 5 in the Appendix). This alternative specification can reveal whether our findings are contingent on the value-chain function of alliances. Fourth, we excluded equity alliances from our count of alliances formed to verify that our findings do not materially change when distinguishing between equity and nonequity alliances (see Table 6 in the Appendix). All of these alternative specifications produced consistent results, suggesting that our reported findings are insensitive to firms' alliance experience and the distinctions between equity and nonequity alliances, active and newly formed alliances, and technology and marketing alliances. In addition, we incorporated a control variable for the number of acquisitions initiated by the firm. Acquisitions can substitute for CVC investments or follow such investments to the extent that firms seek to increase their ownership stake in entrepreneurial ventures. Corresponding models reveal a positive association between acquisitions and CVC investments without weakening the significance of our reported results concerning the association between CVC investment and alliance formation. Moreover, to isolate the moderating effect of CVC experience, in auxiliary analysis we added an interaction effect between the number of alliances formed and the firm's alliance experience. This additional moderating variable turned out insignificant, while our reported moderation effect of CVC experience and alliance formation retained its significance level.

We also explored various specifications that further illustrate the effect of the resource-based mechanisms that drive the association between CVC investment and alliance formation, namely resource complementarity, network resource visibility, external resource redundancy, and internal resource constraints. For example, the moderation effect of firm resources reported earlier, furnishes support to the internal resource constraints argument since the reinforcing effect of alliance formation on CVC investment diminishes when the firm invests its resources in internal development rather than external relationships. In auxiliary analysis, we also found support to the external resource redundancy argument, showing that a firm's CVC investment becomes less likely with increases in the R&D investments of its alliance partners. That is, alliances with partners that invest heavily in R&D expenditures may be considered closer substitutes for funded ventures in the sense that both types of interfirm relationships provide access to emerging technologies. In turn, the reinforcing effect of resource complementarity gains support from evidence showing how CVC investment increases with the marketing efforts of alliance partners. In this case, alliance partners that engage in intensive marketing activities may be considered close complements to CVC investments since the former may provide

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market access to technologies furnished by funded ventures. Finally, CVC investment increases at a diminishing rate as a function of the size of the firm's alliance portfolio and the number of times its alliance activity is covered in the press. In line with our network resource visibility argument, enhanced visibility of the firm's alliances increases investment opportunities and attracts CVC targets at a reduced rate (see Table 7 in the Appendix).

Similarly, we tested for various alternative models that furnished consistent findings. For instance, we estimated a model wherein the indicators of a firm's resources (i.e., available cash, value of R&D investments, and number of employees) are introduced separately instead of lumped together under the factor score for the firm's resources. We also considered alternative measures of these indicators, such as solvency (cash divided by long-term debt), a logarithmic function of available cash, and a lagged measure of cash for capturing a firm's financial resources. We then incorporated an alternative measure of total asset value for a firm's resources. These alternative operationalizations produced results consistent with those reported. Additionally, we examined whether a firm's resources, age, and CVC experience attenuate the overall nonlinear association between CVC investment and alliance formation by including interactions with the quadratic term of the number of alliances. In the case of a firm's resources and age, the additional interactions were statistically insignificant, while our reported effects remained significant. We, thus, conclude that consistent with our hypotheses, the moderating effects of a firm's resources and age persist linearly at various levels of alliance activity rather than change the inverted U-shaped association between CVC investment and alliance formation.[9] Finally, in auxiliary analysis, we ran zero-inflated negative binomial models that control for the firm's propensity to engage in CVC activity in a given year. These models produced consistent results. Overall, the auxiliary analyses demonstrate the robustness of our findings.

[9] Nevertheless, our auxiliary analysis reveals that CVC experience attenuates the overall association between CVC investment and alliance formation so that the inverted-U function becomes less concave. In addition, we considered the possibility of a direct nonlinear effect of a firm's age on the tendency to engage in CVC investment. Although an inverted U-shaped effect of a firm's age on CVC investment was found in some models, this direct effect did not significantly change the reported moderation effect of a firm's age.

DISCUSSION

Toward an integrated resource-based theory of interfirm relationships

The possible influence of alliance formation on CVC investment has been traditionally overlooked. Scholars have contributed to independent streams of research on alliances or venture capital activity, neglecting the interplay between these alternative types of interfirm relationships that a firm can pursue. In turn, practitioners have established separate organizational units for managing alliances and CVC investments, yet increasingly recognize that CVC investment decisions may be intertwined with alliance formation decisions. Still, the discussion has been traditionally limited to the dyad level, assuming that alliances may be a precursor of CVC investment in a particular target venture (Birkinshaw *et al.*, 2002; McNally, 1997; Sykes, 1990) or that venture capital backing facilitates alliance formation among start-up firms (Hsu, 2006). Our study examines the broader phenomenon of interdependence between CVC investment and alliance formation at the firm level rather than focusing on the dyad level of analysis. Hence, we focus on the investing firm's propensity to make CVC investments and form alliances instead of limiting our investigation to the likelihood of forming interfirm relationships between pairs of firms (Chung *et al.*, 2000; Gulati, 1995b). The firm-level and dyadic analyses address different questions and entail distinct theoretical frameworks (Stuart, 1998). This allows us to explain why alliance formation may facilitate CVC investment not only among a firm's existing alliance partners but also in other, previously unrelated ventures. Furthermore, whereas some studies control for alliances when examining the implications of CVC investment (Katila, Rosenberger, and Eisenhardt, 2008; Keil *et al.*, 2008; Wadhwa and Kotha, 2006), we uncover an inherent association between CVC investment and alliance formation, which calls for scrutiny when interpreting the performance implications of CVC given the endogeneity defined by such association.

Our findings demonstrate how the reinforcing effect of alliance formation on CVC investment is contingent on an array of firm-specific attributes and eventually turns into an attenuating association once the frequency of alliance formation exceeds a certain threshold. This shift can be ascribed to external resource redundancies and internal resource

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allocation constraints that intensify as the firm enters additional alliances. We also find that as firms deploy internal resources, mature, and gain CVC experience, the reinforcing association between CVC and alliances is weakened. We attribute these patterns to mitigated resource complementarity and network resource visibility mechanisms as well as to dominant resource allocation constraints that underscore the trade-offs between CVC and alliances. In particular, established firms, rich with financial, technological, and human capital, can leverage their market presence to attract potential CVC targets without relying on the visibility afforded by their alliance portfolios. Similarly, as firms accumulate experience with CVC investments, they specialize and become more efficient in making subsequent CVC investments at the expense of alternative types of relationships (such as alliances). Consequently, experience breeds tie-specific relational capability (Anand and Khanna, 2000a; Dyer and Singh, 1998), which undermines the reinforcing effect of alliance formation on CVC investment. These findings suggest that, despite interdependencies between CVC investment and alliance formation, unique features of these relationships intervene in guiding further development of the corresponding network. Hence, a firm's CVC investment policy depends on the overall configuration of its interfirm relationships as well as the configuration of available internal and external resources.

Our study extends prior research that has applied resource-based theory in the context of interfirm relationships (e.g., Eisenhardt and Schoonhoven, 1996; Gnyawali and Madhavan, 2001; Lavie, 2007) by explaining how a firm's bundle of internal resources and external network resources (Gulati, 1999; Lavie, 2006) affects not only alliance formation but also related phenomena such as CVC investment. At the most fundamental level, both alliances and CVC serve as channels for various resources, including technology and financial capital. Each type of relationship may be more or less efficient in channeling a particular type of resource, yet the choice between CVC and alliances in any given situation depends on the composition of relationships that the firm enters and maintains.

Besides advancing resource-based theory, we contribute to the networks literature by shedding light on the coevolution of different types of interfirm networks. Extant research considers how relational attributes—such as trust and familiarity (Gulati, 1995a)—as well as structural properties—such as referrals and intermediation (Burt, 1992; Gulati and Gargiulo, 1999)—contribute to the evolution of networks. We conclude that in addition to path dependence in the evolution of a network comprising a certain type of interfirm relationships, firms experience interdependencies with other types of networks. Hence, the evolution of a firm's CVC network derives from the history of same type relationships as well as the concurrent trade-offs and synergies with other types of networks, such as alliance portfolios. Therefore, we complement prior research that has focused on path dependence and structural contingencies in the evolution of interfirm networks of a particular type (Ahuja, 2000; Chung *et al.*, 2000; Gulati, 1995b; Gulati and Gargiulo, 1999) or the independent implications of different types of relationships (Beckman, Haunschild, and Phillips, 2004; Gulati and Westphal, 1999; Rosenkopf and Almeida, 2003). Network evolution should be studied by juxtaposing various types of interfirm networks while considering some boundary conditions under which the evolution of one type of network reinforces or attenuates the evolution of the other.

Limitations and directions for future research

We offer firsthand evidence on the interdependence between CVC and alliance formation in the U.S. software industry. Although we examine intraindustry patterns and develop context-free resource-based theory, future research may seek to generalize our findings to other industries. Critical to such studies is the ability to employ rich data that reliably discern distinct types of interfirm relationships. The pharmaceutical industry, for instance, would be appropriate since interfirm relationships are well documented in that setting (Arora and Gambardella, 1990; Powell *et al.*, 1996). However, in some industries, hybrid agreements that blur the distinction between alliances and CVC investments may prevail. Furthermore, scholars should consider interdependence across additional types of relationships, such as wholly owned subsidiaries, mergers and acquisitions, patent licensing, and employee mobility networks (Keil *et al.*, 2008; Rosenkopf and Almeida, 2003).

Besides interdependence with other types of interfirm relationships, there may be other antecedents to CVC investments. Future research may invest further effort to uncover why some firms engage in

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CVC activity while others do not. Specifically, when studying the contingent nature of interdependence between CVC investment and alliance formation, a promising direction for future research would be to consider not only firm-specific attributes (such as a firm's internal resource stock, age, and experience), but also partner-specific and relation-specific attributes. Prior research has made some progress in studying the implications of such attributes in the context of alliances (e.g., Dyer and Singh, 1998; Gulati *et al.*, 2009; Lavie, 2006), yet the resource endowments of prospective partners, the nature of past relationships with specific partners, and available governance routines may guide a firm's tendency to make CVC investments versus form alliances. In the same vein, future research may follow the literature on the dedicated alliance function (Kale, *et al.*, 2002) to consider how the establishment of a dedicated CVC arm may affect the reported conclusions. It is possible that prior CVC experience is associated with the prevalence of such dedicated function. Perhaps such function leads to specialization that limits coordination across these two types of interfirm relationships, yet to the extent that the dedicated alliance function and the CVC arm are aligned, this may result in improved resource allocation and complementary use of these relationships. Empirically, scholars may wish to offer more direct evidence of the applicable mechanisms that drive the association between CVC investment and alliance formation. Survey methods may be used to more effectively capture the fine-grained resource-based mechanisms that we introduced in this study. It would also be interesting to extend our study of public firms to the private sector as well as consider the association between alliances and CVC from the perspective of entrepreneurial ventures that seek external funding.

While our study explains firms' tendencies to establish different types of relationships, practitioners may also be concerned with the choice of an appropriate type of relationship for a particular dyadic engagement. Should a firm hold a minority equity investment in a funded venture or instead form an alliance with that venture? Once a CVC relationship is established, should the firm upgrade the relationship into an alliance and, if so, when? Future research may examine these questions in more detail. Finally, recent research has begun to investigate the implications of different network configurations for firms' innovation efforts, growth, and financial performance (Baum *et al.*, 2000; Goerzen and Beamish, 2005; Lavie, 2007; Stuart, Hoang, and Hybels, 1999; Stuart, 2000), but has paid little attention to alternative types of relationships in this regard. Future research may examine whether substitution or complementarity of different types of relationships enhances firm performance. Despite its limitations, our study elucidates the ambiguity around the interdependence across distinctive types of interfirm relationships and its role in shaping the evolution of interfirm networks.

CONCLUSION

Both CVC investment and alliance formation play important roles in emerging technology markets. In practice, firms manage these two types of relationships separately. Scholars have traditionally studied these relationships independently without alluding to the possible trade-offs and cross-fertilization between them. In the current study, we theorize and demonstrate that firms' alliance formation activities influence their CVC investment policies. Thus, we uncover some of the antecedents to firms' tendencies to engage in CVC investments. More importantly, we reveal how CVC relationships coevolve with a firm's' alliance portfolio. Our findings portray a complex pattern of dependence between CVC investment and alliance formation whereby alliances both reinforce and attenuate CVC given firm-specific boundary conditions.

Our study draws implications for a more comprehensive and effective use of firms' toolkits of interfirm relationships. Although we find that CVC investment and alliance formation are interdependent and shaped by firm-specific attributes, this is not to suggest that managers take these considerations for granted when developing interfirm relationships. In recent years scholars have stressed the importance of centralizing and formalizing alliance practices and CVC funds in the form of dedicated corporate functions (Chesbrough, 2002; Dyer *et al.*, 2001; Dushnitsky, 2004; Kale *et al.*, 2002), yet we suggest that these efforts may be insufficient, as firms should coordinate efforts across different types of interfirm relationships. Recent research suggests that a firm's alliance experience can either enhance or undermine the firm's corporate acquisition performance, contingent on how it structures its acquisitions (Zollo and Reuer, forthcoming). Our study extends this view by revealing interdependencies between alliance formation and CVC investment

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relationships. Managers should take into account the potential trade-offs between CVC, alliances, and perhaps other types of interfirm relationships when seeking to internalize resources owned by other firms or to leverage their own firms' internal resources.

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REFERENCES

Ahuja G. 2000. The duality of collaboration: inducements and opportunities in the formation of interfirm linkages. *Strategic Management Journal* **21**(Special Issue): 317–343.

Alter C, Hage G. 1992. *Organizations Working Together*. Sage Publications: Newbury Park, CA.

Alvarez SA, Barney JB. 2001. How can entrepreneurial firms really benefit from alliances with large firms? *Academy of Management Executive* **15**: 139–151.

Anand BN, Khanna T. 2000a. Do firms learn to create value? The case of alliances. *Strategic Management Journal* **21**(3): 295–317.

Anand BN, Khanna T. 2000b. The structure of licensing contracts. *Journal of Industrial Economics* **48**(1): 103–135.

Arora A, Gambardella A. 1990. Complementarity and external linkages: the strategies of the large firms in biotechnology. *Journal of Industrial Economics* **38**(4): 361–379.

Barney JB. 1991. Firm resources and sustained competitive advantage. *Journal of Management* **17**(1): 99–120.

Baum JAC, Calabrese T, Silverman BS. 2000. Don't go it alone: alliance network composition and start-ups' performance in Canadian biotechnology. *Strategic Management Journal* **21**(3): 267–294.

Beckman CM, Haunschild PR, Phillips DJ. 2004. Friends or strangers? Firm-specific uncertainty, market uncertainty, and network partner selection. *Organization Science* **15**(3): 259–275.

Becton Dickinson. http://www.bd.com/bdventures (accessed 30 May 2005).

Birkinshaw J, van Basten Batenburg R, Murray G. 2002. *Corporate Venturing: The State of the Art and the Prospects for the Future*. London Business School: Centre for the Network Economy, London, U.K.

Block Z, MacMillan I. 1993. *Corporate Venturing: Creating New Business Within the Firm*. Harvard Business School Press: Boston, MA.

Blundell R, Griffith R, Van Reenen J. 1995. Dynamic count data models of technological innovation. *The Economic Journal* **105**(429): 333–344.

Bourgeois LJ. 1981. On the measurement of organizational slack. *Academy of Management Review* **6**(1): 29–39.

Burt RS. 1992. *Structural Holes: The Social Structure of Competition*. Harvard University Press: Cambridge, MA.

Chatterjee S, Wernerfelt B. 1991. The link between resources and type of diversification: theory and evidence. *Strategic Management Journal* **12**(1): 33–48.

Chesbrough HW. 2002. Making sense of corporate venture capital. *Harvard Business Review*. 4–11 March.

Chi T, McGuire DJ. 1996. Collaborative ventures and value of learning: integrating the transaction cost and strategic option perspectives on the choice of market entry mode. *Journal of International Business Studies* **27**: 285–308.

Chung S, Singh H, Lee K. 2000. Complementarity, status similarity, and social capital as drivers of alliance formation. *Strategic Management Journal* **21**(1): 1–22.

The Daily Deal. 2002. Securing deals online. 27 February.

Dierickx I, Cool K. 1989. Asset stock accumulation and sustainability of competitive advantage. *Management Science* **35**: 1504–1513.

Drazin R, Schoonhoven CB. 1996. Community, population, and organization effects on innovation: a multilevel perspective. *Academy of Management Journal* **39**: 1065–1084.

Dushnitsky G. 2004. Limitations to interorganizational knowledge acquisitions. Unpublished Ph.D. dissertation, Stern School of Business, New York University.

Dushnitsky G. 2006. Corporate venture capital: past evidence and future directions. In *Oxford Handbook of Entrepreneurship*, Casson M, Yeung B, Basu A, Wadeson N (eds). Oxford University Press: Oxford, U.K.; 387–434.

Dushnitsky G, Lenox MJ. 2005a. Corporate venture capital and incumbent firm innovation rates. *Research Policy* **34**: 615–639.

Dushnitsky G, Lenox MJ. 2005b. When do firms undertake R&D by investing in new ventures? *Strategic Management Journal* **26**(10): 947–965.

Dushnitsky G, Lenox MJ. 2006. When does corporate venture capital investment create firm value? *Journal of Business Venturing* **21**(6): 753–772.

Dushnitsky G, Shapira ZB. Entrepreneurial finance meets corporate reality: comparing investment practices and performance of corporate and independent venture capitalists. *Strategic Management Journal*. Forthcoming.

Dyer JH, Kale P, Singh H. 2001. How to make strategic alliances work. *Sloan Management Review* **42**(4): 37–43.

Dyer JH, Singh H. 1998. The relational view: cooperative strategies and sources of interorganizational competitive advantage. *Academy of Management Review* **23**(4): 660–679.

Eisenhardt KM, Schoonhoven CB. 1996. Resource-based view of strategic alliance formation: strategic and social effects in entrepreneurial firms. *Organization Science* **7**(2): 136–150.

Ernst and Young. 2008. *Global corporate venture capital survey 2008–09: benchmarking programs and practices.* Available at: http://www.ey.com/GL/en/Services/Strategic-Growth-Markets/SGM_VC_Global_corporate_venture_capital_survey (accessed 21 January 2009).

Gavetti G, Levinthal DA. 2000. Looking forward and looking backward: cognitive and experiential search. *Administrative Science Quarterly* **45**(1): 113–137.

Gimeno J. 2005. Competition within and between networks: the contingent effect of competitive embeddedness on alliance formation. *Academy of Management Journal* **47**(6): 820–842.

Gnyawali DR, Madhavan R. 2001. Cooperative networks and competitive dynamics: a structural embeddedness perspective. *Academy of Management Review* **26**(3): 431–445.

Goerzen A, Beamish PW. 2005. The effect of alliance network diversity on multinational enterprise performance. *Strategic Management Journal* **26**(4): 333–354.

Gompers P. 1995. Optimal investment, monitoring, and the staging of venture capital. *Journal of Finance* **50**(5): 1461–1491.

Gompers P, Lerner J. 1998. The determinants of corporate venture capital successes: organizational structure, incentives, and complementarities. NBER Working Paper, W6725.

Greene WH. 2002. *Econometric Analysis* (5th edn). Prentice-Hall: Upper Saddle River, NJ.

Griliches ZA, Pakes A, Hall BH. 1987. The value of patents as indicators of inventive activity. In *Economic Policy and Technological Performance,* Dasgupta P, Stoneman P (eds). Cambridge University Press: Cambridge, U.K.; 97–124.

Gulati R. 1995a. Does familiarity breed trust? The implications of repeated ties for contractual choices. *Academy of Management Journal* **35**(4): 85–112.

Gulati R. 1995b. Social structure and alliance formation patterns: a longitudinal analysis. *Administrative Science Quarterly* **40**(4): 619–652.

Gulati R. 2007. *Managing Network Resources: Alliances, Affiliations, and Other Relational Assets*. Oxford University Press: New York.

Gulati R. 1998. Alliances and networks. *Strategic Management Journal* **19**(4): 293–317.

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

Gulati R, Gargiulo M. 1999. Where do interorganizational networks come from? *American Journal of Sociology* **104**(5): 1439–1493.

Gulati R, Higgins MC. 2006. Stacking the deck: the effect of upper echelon affiliations for entrepreneurial firms. *Strategic Management Journal* **27**(13): 1–26.

Gulati R, Khanna T, Nohria N. 1994. Unilateral commitments and the importance of process in alliances. *Sloan Management Review* **35**(3): 61–69.

Gulati R, Lavie D, Singh H. 2009. The nature of partnering experience and the gains from alliances. *Strategic Management Journal* **30**(11): 1213–1233.

Gulati R, Nohria N, Zaheer A. 2000. Strategic networks. *Strategic Management Journal* **21**(Special Issue): 203–215.

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

Gulati R, Westphal JD. 1999. Cooperative or controlling? The effects of CEO-board relations and the content of interlocks on the formation of joint ventures. *Administrative Science Quarterly* **44**: 473–506.

Hagedoorn J. 1995. Strategic technology partnering during the 1980s: trends, networks, and corporate patterns in noncore technologies. *Research Policy* **24**: 207–231.

Harrigan KR. 1988. Strategic alliances and partner asymmetries. In *Cooperative Strategies in International Business,* Contractor FJ, Lorange P (eds). Lexington Books: Lexington, MA; 205–226.

Haunschild PR, Beckman CM. 1998. When do interlocks matter? Alternate sources of information and interlock influence. *Administrative Science Quarterly* **43**: 815–844.

Hill S, Birkinshaw J. 2008. Strategy-structure configurations in corporate venture units: impact on performance and survival. *Journal of Business Venturing* **23**(4): 423–444.

Hill S, Maula M, Birkinshaw J, Murray G. 2009. Transferability of the venture capital model to the corporate context: implications for the performance of corporate venture units. *Strategic Entrepreneurship Journal* **3**(1): 3–27.

Hsu DH. 2006. Venture capitalists and cooperative start-up commercialization strategy. *Management Science* **52**(2): 204–219.

DOI: 10.1002/sej

Kale P, Dyer JH, Singh H. 2002. Alliance capability, stock market response, and long-term alliance success: the role of the alliance function. *Strategic Management Journal* **23**(8): 747–767.

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

Keil T. 2002. *External Corporate Venturing: Strategic Renewal in Rapidly Changing Industries*. Quorum Books: Westport, CT.

Keil T. 2004. Building external corporate venturing capability. *Journal of Management Studies* **41**(5): 799–825.

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

Kleinbaum DG, Lawrence LK, Muller KE, Nizam A. 1998. *Applied Regression Analysis and Other Multivariable Methods* (3rd edn). Brooks/Cole Publishing Company: Pacific Grove, CA.

Kogut B, Kulatilaka N. 1993. Operating flexibility, global manufacturing, and the option value of a multinational network. *Management Science* **39**(11): 123–139.

Kogut B, Shan W, Walker G. 1992. Competitive cooperation in biotechnology: learning through networks? In *Networks and Organizations: Structure, Form, and Action,* Nohria N, Eccles RG (eds). Harvard Business School Press: Boston, MA; 348–365.

Kogut B, Zander U. 1992. Knowledge of the firm, combinative capabilities, and the replication of technology. *Organization Science* **3**(3): 383–397.

Koza MP, Lewin AY. 1998. The coevolution of strategic alliances. *Organization Science* **9**(3): 255–264.

Lavie D. 2006. The competitive advantage of interconnected firms: an extension of the resource-based view. *Academy of Management Review* **31**(3): 638–658.

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

Lavie D, Miller SR. 2008. Alliance portfolio internationalization and firm performance. *Organization Science* **19**(4): 623–646.

Lavie D, Rosenkopf L. 2006. Balancing exploration and exploitation in alliance formation. *Academy of Management Journal* **49**(6): 797–818.

Levinthal DA, March JG. 1981. A model of adaptive organizational search. *Journal of Economic Behavior and Organization* **2**: 307–333.

Levinthal DA, March JG. 1993. The myopia of learning. *Strategic Management Journal* **14**(Special Issue): 95–112.

Levitt B, March JG. 1988. Organizational learning. In *Annual Review of Sociology*, Vol. 14, Scott WR, Short JF (eds). Annual Reviews: Palo Alto, CA; 319–340.

Lorenzoni G, Lipparini A. 1999. The leveraging of interfirm relationships as a distinctive organizational capability: a longitudinal study. *Strategic Management Journal* **20**(4): 317–338.

MacMillan I, Roberts E, Livada V, Wang A. 2008. *Corporate venture capital (CVC): seeking innovation and strategic growth*. National Institute of Standards and Technology, U.S. Department of Commerce, NIST GCR 08-916: 1-48. Available at: http://www.nvca.org/pdf/NIST4_CVC_073108_Web.pdf (accessed 21 January 2009).

Maula M. 2007. The Supply of Corporate Venture Capital. In *Handbook of Research on Venture Capital*, Landström H (ed). Edward Elgar Publishing Ltd.: Cheltenham, U.K.

McNally K. 1997. *Corporate Venture Capital: Bridging the Equity Gap in the Small Business Sector*. Routledge: London, U.K.

Montgomery CA, Hariharan S. 1991. Diversified expansion by large established firms. *Journal of Economic Behavior and Organization* **15**(1): 71–89.

Nicholls-Nixon CL, Woo C. 2003. Technology sourcing and output of established firms in a regime of encompassing technological change. *Strategic Management Journal* **24**(7): 651–666.

Ohmae K. 1989. The global logic of strategic alliances. *Harvard Business Review* **67**(2): 143–154.

Parkhe A. 1993. Strategic alliance structuring: a game theoretic and transaction cost examination of interfirm cooperation. *Academy of Management Journal* **36**(4): 794–829.

Peteraf MA. 1993. The cornerstones of competitive advantage: a resource-based view. *Strategic Management Journal* **14**(3): 179–191.

Pfeffer J, Salancik GR. 1978. *The External Control of Organizations: A Resource Dependence Perspective*. Harper and Row: New York.

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

Rajgopal S, Shevlin T. 2002. Empirical evidence on the relation between stock option compensation and risk taking. *Journal of Accounting and Economics* **33**: 145–171.

Roberts EB, Berry CA. 1985. Entering new businesses: selecting strategies for success. *Sloan Management Review* **26**(3): 3–17.

Robinson DT, Stuart TE. 2007. Financial contracting in biotech strategic alliances. *Journal of Law and Economics* **50**: 559–595.

Rodan S, Galunic DC. 2004. More than network structure: how knowledge heterogeneity influences managerial performance and innovativeness. *Strategic Management Journal* **25**(6): 541–562.

Rosenkopf L, Almeida P. 2003. Overcoming local search through alliances and mobility. *Management Science* **49**(6): 751–766.

DOI: 10.1002/sej

Rosenkopf L, Schilling MA. 2007. Comparing alliance network structure across industries: observations and explanations. *Strategic Entrepreneurship Journal* **1**(3–4): 191–209.

Rothaermel FT. 2001. Incumbent's advantage through exploiting complementary assets via interfirm cooperation. *Strategic Management Journal* **22**(6–7): 687–699.

Rothaermel FT, Deeds DL. 2004. Exploration and exploitation alliances in biotechnology: a system of new product development. *Strategic Management Journal* **25**(3): 201–222.

Rudy J. 2000. Standard and Poor's Industry Surveys—Computers: Software Database; 1–38.

Siegel R, Siegel E, MacMillan I. 1988. Corporate venture capitalists: autonomy, obstacles, and performance. *Journal of Business Venturing* **3**: 233–247.

Sirmon DG, Gove S, Hitt MA. 2008. Resource management in dyadic competitive rivalry: the effects of resource bundling and deployment. *Academy of Management Journal* **51**(5): 918–935.

Stinchcombe AL. 1965. Organizations and social structure. In *Handbook of Organizations,* March JG (ed). Rand McNally: Chicago, IL; 142–193.

Stringer R. 2000. How to manage radical innovation. *California Management Review* **42**(4): 70–88.

Stuart T. 1998. Network positions and propensities to collaborate: an investigation of strategic alliance formation in a high-technology industry. *Administrative Science Quarterly* **43**(3): 668–698.

Stuart T. 2000. Interorganizational alliances and the performance of firms: a study of growth and innovation rates in a high-technology industry. *Strategic Management Journal* **21**(8): 791–811.

Stuart T, Hoang H, Hybels R. 1999. Interorganizational endorsements and the performance of entrepreneurial ventures. *Administrative Science Quarterly* **44**: 315–349.

Sykes H. 1990. Corporate venture capital: strategies for success. *Journal of Business Venturing* **5**: 37.

Teece DJ. 1986. Profiting from technological innovations: implications for integration, collaboration, licensing, and public policy. *Research Policy* **15**: 285–303.

Timmons JA. 1994. *New Venture Creation* (4th edn). Richard D. Irwin: Homewood, IL.

Tong TW, Reuer JJ, Peng MW. 2008. International joint venture and the value of growth options. *Academy of Management Journal* **51**(5): 1014–1029.

Tripsas M. 1997. Unraveling the process of creative destruction: complementary assets and firm survival in the typesetter industry. *Strategic Management Journal* **18**(Summer Special Issue): 119–142.

Wadhwa A, Kotha S. 2006. Knowledge creation through external venturing: evidence from the telecommunications equipment manufacturing industry. *Academy of Management Journal* **49**(4): 1–18.

Wernerfelt B. 1984. A resource-based view of the firm. *Strategic Management Journal* **5**(2): 171–180.

Williamson OE. 1991. Comparative economic organization: the analysis of discrete structural alternatives. *Administrative Science Quarterly* **36**: 269–296.

Winter SG, Szulanski G. 2001. Replication as strategy. *Organization Science* **12**(6): 730–743.

Zahra SA. 1996. Governance, ownership, and corporate entrepreneurship: the moderating impact of industry technological opportunities. *Academy of Management Journal* **39**(6): 1713–1735.

Zahra SA, Covin J. 1995. Contextual influences on the corporate entrepreneurship-performance relationship: a longitudinal analysis. *Journal Business Venturing* **10**(1): 43–59.

Zollo M, Reuer JJ, Singh H. 2002. Interorganizational routines and performance in strategic alliances. *Organization Science* **13**(6): 701–713.

Zollo M, Reuer JJ. Experience spillovers across corporate development activities. *Organization Science*. Forthcoming.

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APPENDIX

Table 4. Negative binomial panel regression results for CVC investment and marketing alliances

Dependent variable Independent variable	Number of CVC investments					
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Intercept	–7.655*** (0.638)	–7.633*** (0.415)	–7.274*** (0.417)	–7.571*** (0.520)	–7.632*** (0.645)	–7.585*** (0.444)
SIC 7371	3.174** (1.105)	3.283** (0.994)	2.902** (1.023)	3.242** (1.078)	3.366** (1.089)	3.246** (1.027)
SIC 7372	3.593*** (0.748)	3.494*** (0.499)	3.077*** (0.524)	3.356*** (0.646)	3.506*** (0.682)	3.381*** (0.508)
SIC 7373	1.872* (0.782)	1.872** (0.680)	1.419* (0.700)	1.696* (0.736)	1.668* (0.828)	1.785* (0.716)
SIC 7374						
Years 1990–1991						
Years 1992–1993	–2.562*** (0.669)	–3.145*** (0.902)	–2.786** (0.845)	–2.820** (0.895)	–2.554*** (0.650)	–3.089*** (0.854)
Years 1994–1995	–1.354 (0.904)	–1.320 (0.906)	–1.400 (0.927)	–1.405 (0.930)	–1.389 (0.888)	–1.503 (1.006)
Years 1996–1997	0.500 (0.952)	0.509 (0.995)	0.569 (1.003)	0.586 (0.983)	0.451 (0.963)	0.623 (0.978)
Years 1998–1999	1.744*** (0.483)	1.345** (0.461)	1.355** (0.469)	1.347** (0.480)	1.230** (0.464)	1.300** (0.498)
Firm resources	1.411*** (0.063)	0.994*** (0.076)	0.919*** (0.079)	1.211*** (0.100)	1.203*** (0.096)	0.931*** (0.073)
Firm age	0.083 (0.245)	0.286† (0.155)	0.294* (0.149)	0.265† (0.154)	0.256† (0.132)	0.269† (0.144)
CVC experience	0.130*** (0.035)	0.161** (0.051)	0.229*** (0.050)	0.230*** (0.050)	0.180*** (0.052)	0.448*** (0.035)
Proportion of equity alliances	–0.394 (0.291)	–0.319 (0.273)	–0.317 (0.277)	–0.344 (0.289)	–0.362 (0.290)	–0.244 (0.218)
Number of marketing alliances		0.496*** (0.105)	0.882*** (0.169)	0.565*** (0.112)	0.322** (0.104)	0.580*** (0.103)
Number of marketing alliances^2			–0.092*** (0.011)			
Firm resources × number of marketing alliances				–0.089*** (0.009)		
Firm age × number of marketing alliances					–0.435*** (0.102)	
CVC experience × number of marketing alliances						–0.097*** (0.007)
n Firm-year	2,448	2,448	2,448	2,448	2,448	2,448
n Firms	372	372	372	372	372	372
Log likelihood	–89.831	–83.149	–76.113	–75.222	–81.589	–77.967

Significance level (2-tailed): †$p < 0.1$, *$p < 0.05$, **$p < 0.01$, ***$p < 0.001$.

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Table 5. Negative binomial panel regression results for CVC investment and technology alliances

Dependent variable Independent variable	Number of CVC investments					
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Intercept	–7.655*** (0.638)	–5.707*** (0.654)	–5.916*** (0.596)	–6.160*** (0.665)	–6.454*** (0.747)	–5.908*** (0.619)
SIC 7371	3.174** (1.105)	0.574 (0.993)	0.801 (0.942)	1.024 (1.007)	1.872† (1.044)	0.730 (0.964)
SIC 7372	3.593*** (0.748)	1.449† (0.754)	1.561* (0.754)	1.804* (0.820)	2.189** (0.834)	1.572* (0.740)
SIC 7373	1.872* (0.782)	–0.121 (0.782)	–0.069 (0.724)	0.216 (0.767)	0.549 (0.884)	–0.011 (0.742)
SIC 7374 Years 1990–1991						
Years 1992–1993	–2.562*** (0.669)	–4.538*** (1.209)	–3.007* (1.372)	–3.804** (1.153)	–2.517*** (0.703)	–4.617*** (0.909)
Years 1994–1995	–1.354 (0.904)	–1.606† (0.924)	–1.726† (0.945)	–1.751† (0.938)	–1.561† (0.849)	–1.818† (0.980)
Years 1996–1997	0.500 (0.952)	0.594 (0.941)	0.661 (0.939)	0.651 (0.925)	0.512 (0.925)	0.654 (0.955)
Years 1998–1999	1.744*** (0.483)	1.513*** (0.407)	1.548*** (0.410)	1.520*** (0.410)	1.350** (0.443)	1.529*** (0.392)
Firm resources	1.411*** (0.063)	0.654*** (0.087)	0.756*** (0.082)	0.898*** (0.110)	0.934*** (0.102)	0.744*** (0.085)
Firm age	0.083 (0.245)	0.311† (0.161)	0.305* (0.154)	0.285† (0.158)	0.206 (0.139)	0.297† (0.156)
CVC experience	0.130*** (0.035)	0.139** (0.048)	0.219*** (0.048)	0.229*** (0.049)	0.172* (0.044)	0.282*** (0.046)
Proportion of equity alliances	–0.394 (0.291)	–0.240 (0.248)	–0.291 (0.281)	–0.310 (0.299)	–0.351 (0.298)	–0.245 (0.261)
Number of technology alliances		0.773*** (0.132)	1.064*** (0.210)	0.869*** (0.142)	0.564*** (0.125)	0.836*** (0.134)
Number of technology alliances^2			–0.089*** (0.012)			
Firm resources × number of technology alliances				–0.087*** (0.011)		
Firm age × number of technology alliances					–0.815*** (0.097)	
CVC experience × number of technology alliances						–0.093*** (0.008)
n Firm-year	2,448	2,448	2,448	2,448	2,448	2,448
n Firms	372	372	372	372	372	372
Log likelihood	–89.831	–79.737	–69.015	–68.347	–76.415	–74.335

Significance level (2-tailed): †$p < 0.1$, *$p < 0.05$, **$p < 0.01$, ***$p < 0.001$.

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Table 6. Negative binomial panel regression results for CVC investment and nonequity alliances

Dependent variable Independent variable	Number of CVC investments					
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Intercept	–7.663*** (0.632)	–6.296*** (0.531)	–6.428*** (0.420)	–6.560*** (0.430)	–6.636*** (0.653)	–6.528*** (0.502)
SIC 7371	3.262** (1.094)	1.500 (0.960)	1.650† (0.943)	1.799† (0.958)	2.096* (1.016)	1.717† (0.964)
SIC 7372	3.642*** (0.744)	2.041*** (0.619)	2.087*** (0.574)	2.217*** (0.596)	2.392*** (0.699)	2.192*** (0.602)
SIC 7373	1.908* (0.756)	0.507 (0.746)	0.541 (0.701)	0.675 (0.788)	0.717 (0.838)	0.650 (0.737)
SIC 7374 Years 1990–1991						
Years 1992–1993	–2.658*** (0.674)	–3.694** (1.143)	–2.998** (1.131)	–3.234** (1.065)	–2.991*** (0.791)	–3.730*** (0.894)
Years 1994–1995	–1.306 (0.876)	–1.520† (0.883)	–1.590† (0.897)	–1.620† (0.896)	–1.545† (0.858)	–1.721† (0.963)
Years 1996–1997	0.488 (0.988)	0.580 (0.951)	0.624 (0.945)	0.628 (0.931)	0.518 (0.947)	0.646 (0.957)
Years 1998–1999	1.768*** (0.480)	1.242** (0.435)	1.263** (0.443)	1.257** (0.440)	1.144** (0.439)	1.249** (0.428)
Firm resources	1.370*** (0.062)	0.510*** (0.077)	0.580*** (0.070)	0.740*** (0.085)	0.693*** (0.092)	0.585*** (0.073)
Firm age	0.085 (0.255)	0.381* (0.153)	0.370** (0.142)	0.354* (0.143)	0.337* (0.139)	0.361* (0.144)
CVC experience	0.131*** (0.034)	0.177** (0.054)	0.250*** (0.050)	0.257*** (0.050)	0.197*** (0.055)	0.353*** (0.047)
Number of nonequity alliances		0.871*** (0.135)	1.136*** (0.219)	0.944*** (0.161)	0.741*** (0.131)	0.925*** (0.145)
Number of nonequity alliances^2			–0.084*** (0.012)			
Firm resources × number of nonequity alliances				–0.083*** (0.010)		
Firm age × number of nonequity alliances					–0.434*** (0.089)	
CVC experience × number of nonequity alliances						–0.092*** (0.008)
n Firm-year	2,448	2,448	2,448	2,448	2,448	2,448
n Firms	372	372	372	372	372	372
Log likelihood	–90.083	–77.663	–68.439	–67.956	–76.192	–72.030

Significance level (2-tailed): †$p < 0.1$, *$p < 0.05$, **$p < 0.01$, ***$p < 0.001$.

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Table 7. Negative binomial panel regression results for CVC investment and specific mechanisms[a]

Dependent variable Independent variable	Number of CVC investments		
	Model 3a	Model 3b	Model 3c
Intercept	–6.213***	–5.323***	–4.623***
	(0.490)	(0.543)	(0.606)
SIC 7371	1.522	2.515*	1.587†
	(1.040)	(1.039)	(0.960)
SIC 7372	1.817***	2.120***	1.567**
	(0.545)	(0.554)	(0.536)
SIC 7373	0.109	1.145	0.558
	(0.663)	(0.769)	(0.714)
SIC 7374			
Years 1990–1991			
Years 1992–1993	–3.043***	–1.409**	–1.470*
	(0.663)	(0.483)	(0.674)
Years 1994–1995	–1.267	–1.258	–1.015†
	(0.936)	(0.769)	(0.606)
Years 1996–1997	0.791	–1.082†	0.898†
	(0.861)	(0.576)	(0.541)
Years 1998–1999	2.033***	1.349**	1.274**
	(0.349)	(0.518)	(0.480)
Firm resources	0.760***	1.092***	0.8547***
	(0.066)	(0.085)	(0.066)
Firm age	0.044	–0.324	–0.087
	(0.229)	(0.277)	(0.193)
CVC experience	0.154***	0.014	0.099
	(0.041)	(0.162)	(0.090)
Proportion of equity alliances	–0.584	–0.609	–0.629
	(0.463)	(0.448)	(0.411)
Network resource visibility	1.638***		
	(0.180)		
Network resource visibility^2	–0.064***		
	(0.006)		
Resource complementarity		0.646*	
		(0.278)	
Resource complementarity^2		–0.760†	
		(0.409)	
External resource redundancy			–0.103
			(0.145)
External resource redundancy^2			–1.822**
			(0.640)
n Firm-year	2,448	2,448	2,448
n Firms	372	372	372
Log likelihood	–72.864	–52.964	–68.471

Significance level (2-tailed): †$p < 0.1$, *$p < 0.05$, **$p < 0.01$, ***$p < 0.001$.

[a]Network resource visibility is captured by the number of alliance-related press releases, resource complementarity is measured with the marketing investments of alliance partners, external resource redundancy is proxied by the R&D investments of alliance partners, whereas internal resource constraints are captured by the moderating effect of internal resource stock as reported in Model 3 (Table 3).

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