Unpacking Social Defenses: A Resource-Dependence Lens on Technology Ventures, Venture Capital, and Corporate Relationships

Benjamin L. Hallen
Department of Strategy and Entrepreneurship
London Business School
London, United Kingdom
E-mail: bhallen@london.edu

Riitta Katila
Department of Management Science & Engineering
Stanford University
Stanford, CA
E-mail: rkatila@stanford.edu

Jeff D. Rosenberger
Wealthfront
San Francisco, CA
E-mail: jrosenbe@stanford.edu

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ABSTRACT

Inter-organizational relationships offer many potential benefits, but they also expose firms to dangers, such as misappropriation, that pull partners apart. This tension between collaboration and competition is central to tie formation, especially for young technology-focused firms who have both high need for resources and high appropriability of their own resources. Prior work has examined legal and timing defenses that enable inter-organizational ties; we focus here on social defenses. In a longitudinal study of equity tie formation between young firms and established corporations, spanning 5 technology-based industries and 25 years, we unpack the effects of social defenses and find, intriguingly, that third-party social defenses are particularly significant when more traditional defenses are unavailable. Beyond providing resources and legitimacy, ties with centrally positioned third parties are a critical mechanism whereby young low-power firms can enhance their power in tie formation. Our study also sheds light on how a portfolio of ties helps young technology firms mobilize resources and manage resource vulnerabilities.

> "They took our ideas and tried to claim them as their own, and they tried to crush a little company."
>
> The founder of Infoflows, describing the young firm's once-promising partnership with the established firm Corbis (Lohr, 2010)

Firms depend on their environments for resources. But as resource-dependence scholars point out, environments are not always dependable (Pfeffer & Salancik, 1978). As a consequence, firms engage in an array of tactics to maintain control over the resources they need and to reduce dependence on others. Empirical research has confirmed several key tactics to gain control over significant resources, including mergers and acquisitions (Casciaro & Piskorski, 2005), ties with the government (Hillman et al., 2009), and offers of board seats to representatives of key resource holders (Pfeffer, 1972).

Recently a stream of research on resource dependence has also identified inter-organizational ties as prevalent and important tactics to reduce dependence (Gulati, 1995a). Collaborative ties offer access to resources and alter how a firm is perceived by others (Podolny, 1993; Zaheer & Bell, 2005). But such ties also produce new dependencies, and often shift relative power, such as when partners compete for control over valued resources and seek to force the other party to accept an unfavorable power imbalance (Emerson, 1962). These outcomes are particularly likely when the prospective partners are also competitors. Competitors have reasons to collaborate for shared benefit but often simultaneously behave opportunistically, misappropriating intellectual property or adversely altering the other's agenda for their own benefit (Gulati & Singh, 1998; Agarwal, Croson, & Mahoney, 2010).

Prior research has examined one particularly challenging situation in which a potential partner (often termed a *shark*) is both particularly attractive and particularly dangerous, a scenario that often characterizes tie formation between young firms and potentially rivalrous established corporations (see Diestre & Rajagopalan, 2012; Katila, Rosenberger, & Eisenhardt,

2008). Specifically, this work examines young firms' decisions to form partnerships with corporations—that is, to "swim with sharks"—in preference to safer partners likely to offer somewhat less attractive resources but also fewer risks of misappropriation.[1] Katila and colleagues (2008), for example, found that young technology firms are likely to choose sharks when they need the particular resources that these partners can uniquely provide and can defend their own resources well against misappropriation. More recently, Diestre and Rajagopalan (2012) looked at the "sharks dilemma" in the context of R&D ties between young biotechnology firms and large pharmaceutical corporations. They focused in particular on the corporate shark's ability and incentives to appropriate knowledge, and found that young firms are more likely to form relationships when corporate sharks are less dangerous.

Central to the sharks dilemma is the resource-dependence concern of power imbalance (Pfeffer & Salancik, 1978). Resource interdependencies draw firms into the relationship and create mutual dependence, but the young partner may begin to lose its leverage once its unique technology or market opportunity has been revealed fully enough to be misappropriated. In the absence of relevant defenses, the established partner may become the near-exclusive power holder in the relationship. To prevent such imbalances, prior research points out that young firms undertake classic power-balancing operations (Emerson, 1962): they form coalitions (e.g., enlist the power of the state via legal defenses), reassess their resource needs and adjust their goals (e.g., delay the tie via timing defenses), and find alternative partners whose interests are more genuinely interdependent (e.g., find less dangerous sharks). In sum, the research on sharks draws attention to deterrents to tie formation and demonstrates that, for young firms, the decision to enter into a relationship entails not merely getting access to resources but also protecting the

[1] In nature, the relationship between sharks and their small-fish partners is both dangerous and beneficial: small fish eat parasites off the shark's skin, a joint benefit, in turn gaining protection (from mid-sized fish) and transportation (a free ride) – though they also run the risk of being eaten themselves (Clark and Nelson, 1997).

firm's own resources from exploitation.

Despite these significant insights, scholarly work on the sharks dilemma focuses on specific defenses only available to some, but not all ventures. It is unspecific, for example, about how relationships form when suitable defenses are lacking, such as when legal and timing defenses are unavailable or when the most dangerous sharks also have the best resources. Another unexamined question is the influence of social context, because social defenses provided by a firm's existing partners -that can prevent misappropriation in subsequent relationships- may be particularly relevant for young firms with limited access to other defenses. It remains unexplored, however, whether all social defenses are equally valuable, or whether some types are particularly helpful for young firms—even potentially able to substitute for other defenses. Given these unresolved questions, this study asks: *How do social defenses influence young firms' tie formation with corporate partners (sharks)?*

We tested the effects of social defenses using quantitative data from 1979 to 2003 on 700 young U.S. firms in five technology-intensive industries that made decisions about entering into corporate venture-capital (CVC) relationships. We also gathered qualitative evidence, including interviews with entrepreneurs, corporate investors, and venture capitalists, to deepen our understanding. Our analysis centers on corporate investment (equity) relationships that come about because of young ventures' need for the resources that corporations possess, and despite the often-high risk of misappropriation of the ventures' own resources that makes defenses salient in these relationships. Further, we focus on third-party social defenses that draw on young firms' existing venture-capital (VC) investors and on their network connections. VCs are an effective source of social defenses due to their ownership in the young firm, the prevalence of past and future interactions among VCs and CVCs, and their ability to relay both information

and relationship opportunities within their investment networks.

This paper contributes to our theoretical grasp of an understudied aspect of resource dependence manifested at the critical juncture when relationships form. Resource-dependence studies typically focus on adjusting dependencies post-formation, ignoring the reality that young firms need to anticipate resource misappropriation prior to forming a tie. We highlight social defenses that borrow the power of third parties on behalf of young and otherwise low-power firms when they form new ties. More broadly, we contribute to the recent research stream on low-power firms and their ability to overcome constraints at tie formation (Ahuja, 2000b; Hallen, 2008). Our contribution is to introduce social defenses as a way to mitigate power loss, and thus lower barriers to tie formation, especially for young firms.

We also contribute to the network literature's search for "mechanisms . . . by which firms overcome the fears associated with partnerships" (Gulati, 2007: 49). In particular, we unpack the range and influence of social defenses, with an emphasis on the primary role of centrally positioned third parties to facilitate tie formation. We also find that geographical proximity has an unexpected aligning effect, with nearby third parties able to reinforce their preferences about 'safer' partners more strongly than distant third parties can. Finally, we show that social defenses are particularly important when other defenses are weak or absent. Thus social defenses enable relationships that would otherwise fail to form. Taken together, our results suggest a broader and more nuanced view of social defenses.

THE RESEARCH CONTEXT: TECHNOLOGY VENTURES AND THEIR FUNDING PARTNERS

Prior literature on venture financing provides a foundation for understanding the resource-dependence challenges relevant to our study. One stream focuses on young firms' funding

relationships with *venture capitalists* (VCs). Research reveals that entrepreneurs form equity relationships with VCs because they need both financial resources and advice on formulating and executing strategy (Sapienza, 1992). VCs in turn enter into these relationships both to provide financial returns to their institutional investors and because they view themselves as particularly capable of helping entrepreneurial firms reach successful exit events (Wasserman, 2012). In fact, VCs' self-perceived identities often center on their role as co-creators of entrepreneurial firms (Hellmann, 2000; Graebner & Eisenhardt, 2004). In keeping with these observations, the VCs whom we interviewed frequently used the term "we" to refer to themselves as members of the venture team and to indicate that their interests and those of the venture were the same. Prior research on venture financing confirms this alignment. VCs typically align their own incentives with entrepreneurs' (Bitler et al., 2005), contract out agency risks via term sheets[2] (Kaplan & Stromberg, 2004), and monitor their investments by occupying positions on young companies' boards (Sapienza & Gupta, 1994). While board representation and interaction collectively result in VCs having a degree of authority over young companies, they also constrain VC behavior by subjecting them to fiduciary responsibilities (Gulati & Singh, 1998). Overall, since VCs seek financial returns via venture success, and stake their professional identities on coaching successful ventures, their strategic alignment with entrepreneurs is typically high.

A related stream of research focuses on young enterprises' funding relationships with *corporate venture capitalists* (CVCs). Young firms typically form CVC relationships to gain access to corporate resources (Dushnitsky & Lenox, 2006; Park & Steensma, 2012). Some of the entrepreneurs we interviewed received large cash infusions from corporations; others sought physical resources (e.g. access to manufacturing or testing facilities or sales channel) or, in the

[2] A term sheet is a legal document that specifies an investor's funding terms (Bagley and Dauchy, 2003). Commonly utilized terms such as founder vesting, liquidation preferences, and the use of equity (vs debt) ensure that both entrepreneurs and VC investors are primarily motivated to achieve a favorable exit event (i.e., acquisition or IPO).

words of one interviewee, “corporate [investors] who could help with customers and who would be useful from a business perspective,” resources typically not readily available elsewhere. Corporations in turn sometimes formed such ties to use excess resources (e.g., idle capacity in a sales channel or at a manufacturing plant), but they were particularly eager to do so to acquire insight into potentially disruptive technologies (Tushman & Anderson, 1986). Via interactions with ventures (e.g., pre-investment due-diligence discussions and post-investment liaison relationships), for example, corporations gained understanding of new technologies and markets that the ventures had explored (Dushnitsky & Lenox, 2005a; Wadhwa & Kotha, 2006). Thus, from the corporate perspective, investment relationships with new firms offered both financial gain and (perhaps even primarily) access to new resources, especially technology.

Yet the same factors that promote resource interdependencies in CVC relationships make corporations a more dangerous type of partner—that is, sharks. Corporations whose technologies, customers, or manufacturing capabilities are particularly attractive to young ventures may also have strong incentives to misappropriate young firms’ own innovations or to alter young firms’ agendas to their own advantage (Dushnitsky & Lenox, 2006; Kale et al., 2000). For example, one of our corporate interviewees noted that investments in ventures had enabled his firm to “influence [ventures’] activities in directions that are of interest to us, far beyond what is afforded us in typical R&D contracts.” Similarly, a well-regarded VC observed that “corporations have other motives for doing venture capital, . . motives [that] aren't particularly well aligned with the founders, managers, and financial investors. So there's always tension in a corporate venture investment, and it's not always healthy” (Wilson, 2008). This tension stands in sharp contrast to the alignment of other investors, such as VCs, who typically invest for purely financial reasons and structure their investments to align their interests closely

with those of the young firm (Sahlman, 1990). Unlike VCs, furthermore, few corporate investors occupy board seats as part of their investment relationships. As a consequence, they avoid board-related fiduciary responsibilities that would require them to act in a young firm's interest, and preserve the flexibility to pursue their own strategic interests. Overall, our fieldwork and prior research on the sharks dilemma both indicate that relationships between young firms and corporate investors, as compared to VCs, entail a sharp extra tension between attractive corporate resources and possible misappropriation of the young firm's own resources.

SOCIAL DEFENSES AND CORPORATE PARTNERS

When contemplating CVC ties, young firms balance gaining corporate resources against defending their own resources. Most organizational-theory research on corporate sharks focuses on formal legal instruments and partnering with known and trusted actors as defenses against resource misappropriation (e.g., Diestre & Rajagopalan, 2012; Katila et al., 2008). Network theorists, by contrast, have examined the ability of third parties to facilitate trust in relationships and reduce misappropriation (Bae & Gargiulo, 2004; Burt, 2005). Third parties are interesting because their influence is a by-product of network structure; it is not dyad-specific (Gulati, 1995b; Li, Eden, Hitt, & Ireland, 2008). As a consequence, social defenses provided by existing third-party partners may be particularly attractive to young firms and to those new to a setting that have yet to develop trust and affect through dyadic interactions. The literature points to several mechanisms by which third parties can act as social defenses. We focus on two, disciplining and aligning, that are particularly relevant to tie formation. We then present hypotheses about how each may influence young firms' willingness to form ties with corporate partners.

Social Defenses

Effects of social defenses: Disciplining. Third parties can influence tie formation because they represent a threat to *discipline* opportunistic partners. For example, third parties may (1) terminate current ties or avoid future ties with the offending party (Ahuja, 2000a; Burt, 2005: 105–111) or (2) broadcast allegations of opportunistic behavior that could damage the offending party's reputation (Gulati, 1995a; Soda, Usai, & Zaheer, 2004). Recipients of broadcasts may in turn participate in such disciplining, either to protect themselves from misappropriation or out of a sense of obligation to the third party. Disciplining is thus a form of reputational threat with broad future implications (Raub & Weesie, 1990). Viewed through the lens of power balancing, disciplining gives the low-power firm a way to influence its partner's reputation, and thus increases the high-power firm's motivation to behave well in the relationship. Disciplining is thus a classic power-balancing tactic: because the threat of discipline puts its reputation at risk, the high-power actor becomes more motivationally invested in the goals of the otherwise low-power actor, and as a result its dependence in the relationship increases (Emerson, 1962). In sum, the threat of disciplining reduces power imbalance in relationships.

Core to the third party's effectiveness at disciplining is its position in the overall network. Specifically, when third parties are (1) more desirable partners themselves and (2) better able to broadcast allegations, the partners in the relationship realize that they have much to lose from behaving opportunistically and are therefore more likely to behave properly (Pollock, 2004; Portes & Sensenbrenner, 1993). These features of third parties are nicely captured by centrality—that is, by the extent to which the third party is connected to well-connected others (Bonacich, 1987). Centrally placed third parties are more desirable partners themselves because they occupy valuable network positions, and because they are implicitly of high quality and well-

regarded by others, and, as a consequence confer prestige on the firms with which they connect (Podolny, 1993; Pollock & Gulati, 2007; Pollock, Chen, Jackson, & Hambrick, 2010). Central third parties are also likely to possess better platforms from which to broadcast allegations and calls for disciplining, both because their allegations are apt to be perceived as credible and noteworthy (Benjamin & Podolny, 1999) and because the short network paths between themselves and others in the field accelerate the spread of information (Gulati & Gargiulo, 1999; Podolny, 2001). Thus, relationships are more likely to form in the presence of third parties with better ability to discipline misbehaving partners.

Effects of social defenses: Aligning. Third parties can also influence tie formation by helping to identify better-aligned dyads. For example, third parties may suggest partners, or characteristics of partners, that would reduce the threat of opportunistic behavior in a relationship. From the power-balancing perspective (Emerson, 1962), aligning identifies mutually beneficial relationships, and discourages those relationships in which opportunistic behavior is especially likely. If the point of disciplining is to enable the low-power actor to increase its power by grabbing the coattails of a third-party chaperone, the point of third-party aligning is to enhance its power by "setting up a good blind date" with desirable prospective partners with mutual dependence (Emerson, 1962).

The third party's effectiveness at aligning is determined by how frequently it interacts with the focal venture, and thus how well it knows its needs and vulnerabilities. Such familiarity is important in two ways. First, third parties that interact frequently with the focal partner are likely to be more interested in, and better able to identify, aligned relationships. They know the firm well, and can tailor their recommendations about potential relationships and well-aligned matches (Gulati, 1995a; Sorenson & Stuart, 2001). Second, frequent interaction makes

recommendations more influential, because third parties have more opportunities to explain the reasoning behind their views on potential partners. As a whole, the logic of aligning suggests that third-party connections enable relationships by helping identify partners whose interests are well aligned.

Social Defenses and the Formation of Corporate Relationships

The hypotheses that follow focus on existing relationships with venture-capital investors as social defenses, and on the effects of such defenses on young firms' subsequent ties with corporate investors (CVCs). Drawing on prior literature, we examine two significant network characteristics of VC investors: their centrality and their proximity to the young firm (Lee, Pollock, & Jin, 2011; Sorenson & Stuart, 2001). The *centrality* of a young firm's VC investors captures the VCs' position in the overall venture-capital syndication network, and therefore their network reach, desirability, and influence. Central VCs like Sequoia Capital and New Enterprise Associates are viewed as highly desirable syndicate partners by other investors (including CVCs), and are well-positioned to influence industry information flows. Geographic *proximity* between the young firm and its VC investors captures the strength of the immediate tie, because more proximate VC investors are likely to interact more frequently with a young firm; thus, they have a closer and more influential relationship. We will consider how these two characteristics give rise to social defenses and change power dynamics in the venture-CVC relationship.

Hypothesis 1 proposes that central-VC-backed young firms are likely to form more corporate investment relationships, for two reasons. First, the mere presence of a central VC as an investor is likely to discourage opportunistic behavior, because corporate investors in the venture do not want to jeopardize future relationships with a high-status VC. In particular, more central VCs typically invest in higher-quality ventures (Hallen, 2008), making such VCs

particularly attractive future syndication partners for corporate investors. Thus, we expect young firms to anticipate that the presence of central VCs will motivate good behavior, and therefore to be more confident about forming corporate relationships.

Second, we expect that central VCs can more effectively tarnish the reputations of misbehaving corporate partners, because they enjoy shorter paths to more organizations and because as high-status investors their allegations are perceived as particularly credible and noteworthy. In other words, VCs that are more central in the co-investment (syndication) network are likely to have more effective platforms from which to broadcast, giving their young firms a larger pool of defenders when a corporate partner misbehaves. Central VCs are also motivated to sanction misbehaving corporate investors because their own financial performance (and their access to future capital) is often tied to their ventures' ability to retain control of intellectual property and reach successful exit events. In fact, developing a "reputation for toughness" (cf., Agarwal et al., 2009) can protect the VC's current and future investments. VCs compete with other investors for the most promising venture investment opportunities, and they will be viewed favorably as investors if they are ready to reveal corporate misbehavior. Overall, we argue that central VCs' interest in maintaining their own desirability as future partners, and their ability and incentives to broadcast misbehavior to the co-investment network, make them "chaperones" that facilitate corporate relationships by lowering the power of corporations relative to young firms.

Of course, tie formation also depends on the interests of the corporate partner; in other words, it indeed takes two to tango. From the corporate perspective, central VC-backed young firms are attractive because they are more likely to be of high quality (Pollock & Gulati, 2007; Sorensen, 2007). So even though CVCs may recognize that they will be more constrained, young

firms backed by central VCs are likely to be more attractive and conspicuous investment targets for them. Thus we propose:

Hypothesis 1. Entrepreneurs with more central VC investors will form more investment relationships with corporations.

Field evidence also suggests that VC investors that are geographically near their portfolio firms are more actively involved with them and understand their needs better (Lee, Pollock, & Jin, 2011; Sorenson & Stuart, 2001). By contrast, the formal and often superficial nature of board meetings may inhibit the ability of remote VCs to offer rich advice and that of entrepreneurs to accept it (Garg, 2013).

Hypothesis 2 proposes that young firms whose VC investors are geographically more proximate are likely to engage more corporate partners. First, we argue that because they are nearby, local VCs pay more attention to and are more highly motivated to be involved in their portfolio companies. Therefore, they are likely to be able to suggest better-aligned partners. That is, a local VC with a rich understanding of a young firm's resources and vulnerabilities can offer customized advice about potential fit with particular CVC partners. Also, local VCs are available to explain the reasoning behind their recommendations, making them more influential from the young firm's standpoint. "You can't have people just glancing at the board book two days before the board meeting," explained one entrepreneur we interviewed. "You need somebody who is meeting with you a couple of times a week . . . a breakfast meeting . . . somebody who is going to stay in tune with what is going on in your head . . . the things they can anticipate because they are connected enough to what is going on." Overall, geographic proximity to VC investors tends to increase interaction, mentoring, and knowledge flow due to more frequent planned interaction and more serendipitous interaction (Cox, 2010; Sapienza & Gupta, 1994). By contrast, distant VC partners are likely to be less helpful, less aware that such decisions are under consideration

(especially early on), and perhaps also less motivated to assess alignment, and less knowledgeable about alignment with potential CVC partners. Thus, due to their greater influence and better-tailored advice, proximate VCs will make young firms feel safer about pursuing corporate relationships by suggesting dyads in which power will be better balanced.

Local-VC-backed firms can also be attractive for corporate investors. Local VCs are able to offer richer and stronger assessments of the young firm's quality (Sorenson & Stuart, 2001) and more likely to allocate disproportionate attention to endorsing nearby rather than distant firms (Levinthal & March, 1993), and these nuanced recommendations are likely to attract more potential corporate partners. In contrast, young firms without local VC investors may receive weaker and less precise endorsements, and thus appear less attractive. We propose:

Hypothesis 2. Entrepreneurs with geographically more local VC investors will form more investment relationships with corporations.

Thus far we have examined VC centrality and VC proximity separately, but have not discussed how they would influence relationship formation in combination. But because many young firms have both central VCs and proximate ones, these dynamics are germane. We propose that centrality and proximity are complements, in a sense that the influence of VC centrality on tie formation rises with increase in VC proximity. For example, VC syndicates that possess both qualities may have an even better understanding of both sides of the coin—that is, they might meet frequently and informally with young firms to give rich advice about desirable partners, and also be particularly able to discipline if a partner misbehaves due to their centrality and network reach. Furthermore, the guidance of VCs that are both proximate and central may be particularly salient and meaningful if it is delivered via proximate, informal interaction with central high-status investors (Hovland, Janis, & Kelley, 1953; Magee & Galinsky, 2008). In sum, having more local VCs may shift the influence of VC centrality from a pure disciplining defense

to a complementary combination of disciplining and aligning—potentially making young firms increasingly comfortable engaging with more corporate sharks.

From the corporate-investor perspective, the backing of central and local VCs may also enhance the attractiveness of a young firm. Specifically, this combination may better assure CVCs of a young firm's quality and thus enhance its prospects, with proximity enhancing the richness and reliability of a VC's advice and endorsement of the venture, and centrality making it more likely that a VC has taken a hand in developing a high-quality young firm and will continue to do so. Overall, we propose that centrality and proximity are complements such that their combination will further increase the number of a young firm's ties with corporations.

Hypothesis 3. The more local its VC investors, the stronger the relationship between the centrality of a young firm's VCs and the number of corporate investment relationships it forms.

Hypotheses 1–3 focus on social defenses, but research on the sharks dilemma shows that several other defenses also enable corporate relationships. Katila and colleagues find that strong trade secret regimes make corporate relationships more likely because trade secrets are an agreeable defense both for the young firm and for the corporation (Katila et al., 2008). This is because trade secrets provide young firms with a legal right to damages in the event of misappropriation, while assuring corporate investors that a young firm's insights have not been broadly disclosed. They also find that forming relationships at a later stage in a venture's development (termed a *timing defense*) makes corporate relationships more likely: as young firms mature, their innovations become harder to imitate and misappropriate, thus reducing the likelihood of detrimental shifts in power (see also Pisano & Mang, 1993). For instance, early-stage board meetings are likely to focus on technology decisions; later-stage meetings focus more on marketing and the sales pipeline and thus are apt to reveal less about the technology. Additionally, corporate investors are also likely to prefer investing in older ventures because they

gain access to more advanced technologies. Overall, both trade secrets and timing having been found to be mutually agreeable defenses for young firms and their corporate investors.

But prior literature has left unexplored how ties form when secrecy and timing defenses are weak or unavailable. Legal defenses, such as trade secrets, are typically enforceable only in certain industries (Heeley, Matusik, & Jain, 2007; Levin et al., 1987). Similarly, timing defenses are less available to early-stage firms, and often entail opportunity costs because they delay access to the resources that CVC relationships can provide.

Hypothesis 4 proposes that, though these traditionally studied "formal" defenses (Teece, 1986; Dushnitsky & Lenox, 2005a; Katila et al., 2008) may be the most salient, social defenses are likely to become especially valuable when these other defenses are weak or unavailable. In other words, because social defenses are a by-product of network structure, they can be effective even when other defenses are not readily or fully available. In particular, for ventures with weak trade-secret regimes, central or proximate third-party partners (and their related skills in disciplining and aligning) may compensate for lack of a strong regime and facilitate access to corporate resources. Because trade secret regimes are tied to an industry whereas social defenses are not, under weak trade-secret regimes, social defenses via central and proximate partners may provide a competitive advantage over same-industry rivals that lack such defenses. Similarly, social defenses that borrow the power of central VC partners are available even for early-stage firms, and may be particularly significant for them because they lack the timing defense that is available to mature firms. Also the aligning quality of nearby VCs can compensate for the lack of timing defense, and, may even be particularly useful because local VCs can make the partner match without giving away insights into the venture's technology.

From the corporate perspective, third-party social defenses may also replace traditional

defenses to some extent. Just as trade secret protections may attractively convey to corporate investors that a young firm's intellectual properly has not been widely revealed (Katila et al., 2008), so too may central or nearby VC investors provide substitute guarantees that the venture's inventions and technologies have not been widely leaked and their value not captured by others in the industry. In addition, while corporations generally prefer to form relationships with later-round ventures whose quality and value has been more thoroughly established (Katila et al., 2008), having central or nearby VC investors may provide alternative signals of quality and rich endorsement that help attract corporations to young ventures. We thus propose:

Hypothesis 4a. The weaker its secrecy defenses, the stronger the relationship between the centrality of a young firm's VCs and the number of corporate investment relationships it forms.

Hypothesis 4b. The weaker its timing defenses, the stronger the relationship between the centrality of a young firm's VCs and the number of corporate investment relationships it forms.

Hypothesis 4c. The weaker its secrecy defenses, the stronger the relationship between the proximity of a young firm's VCs and the number of corporate investment relationships it forms.

Hypothesis 4d. The weaker its timing defenses, the stronger the relationship between the proximity of a young firm's VCs and the number of corporate investment relationships it forms.

METHODS

Sample and Data Sources

We analyzed the formation of corporate investment (CVC) relationships by VC-backed, high-technology firms over the 25-year period from 1979 through 2003. We chose VC-backed firms because such backing indicates high technology and market potential and likely interest on the part of CVC investors, and because such young firms are thus apt to have a choice in their formation of ties, including the option of forgoing corporate ties entirely.

Our sample was drawn from the population of U.S. high-technology firms that received their initial venture funding between 1979 and 1995. We began the sample in 1979, the year that the U.S. Department of Labor clarified its "prudent-man" rule to explicitly allow pension-fund

managers to invest in high-risk assets, including venture capital (Hochberg, Ljungqvist, & Lu, 2007). This regulatory change greatly increased the available supply of venture funding (Gompers & Lerner, 2001). We sampled ventures founded through 1995, but continued data collection for rounds occurring through 2003. Since ventures typically take five to seven years after their first round to experience an exit event (Fenn, Liang, & Prowse, 1997), this extended data collection allowed for a more complete perspective on tie formation by young firms.

Our unit of analysis is the funding round. Venture investments are made in a series of discrete rounds because investors generally stage their investments to coincide with substantial advances in a venture's progress (Hallen & Eisenhardt, 2012; Sahlman, 1990). Data were collected for each venture's funding rounds until an exit event or through 2003.

Our key data source was the VentureXpert database. These data, collected by the National Venture Capital Association, provide an accurate description of U.S. venture financing (Lerner, 1995; Kaplan, Sensoy, & Stromberg, 2002), including detailed information about ventures, their VC and corporate investors, and funding rounds. The database is also well suited to our study in allowing for our unusually long sampling period, and for a focus on VC-backed technology ventures for which CVCs often offer both substantial benefits and substantial risks.

We triangulated the VentureXpert data on financing rounds with the VentureOne database and with Lexis-Nexis media articles. VentureXpert data were drawn from investor surveys, VentureOne data from entrepreneur surveys, and Lexis-Nexis data from archived corporate press releases and media coverage. Using these complementary data sources allowed us to draw on multiple informants about each event, increasing the accuracy of our data. We constructed the sample by first sampling venture rounds from VentureXpert, and then corroborating rounds and specific investments via VentureOne. We used the same process to find

data missing in VentureXpert. For data that remained missing or that was inconsistent in the two databases, we examined media coverage and press releases from Lexis-Nexis. These efforts added information to roughly 20 percent of rounds, producing uniquely refined and comprehensive data on investments in ventures in five industries over the course of 25 years.

Our round-level sample is a stratified random sample of 700 ventures drawn from the population of high-technology ventures that received initial funding in 1979–1995. We stratified our sample by year and by five broad technology-industry groups designated by VentureXpert—biotechnology, electronics, communications, software, and medical products—and included about 140 firms in each industry. The most prevalent 2-digit SIC codes are 73 (21 percent), 28 (20 percent), 36 (17 percent), 38 (13 percent), 35 (9 percent), and 48 (9 percent). Overall, our sample encompasses approximately 11 percent of the U.S. technology ventures funded during the time period in question. The sampled ventures raised 18,168 investments, including over 1,200 corporate investments, in 4,073 funding rounds.

To complement the round-level data, we collected extensive data to compile a network-level dataset on characteristics of venture investors and their networks. Consistent with past studies, the network data were collected from VentureXpert, and include all five-year network-history windows from 1974 through 2003. The data include 3,622 investors (VCs and CVCs) based in the United States and active during this period, and their 163,736 venture investments. To triangulate and expand the data on corporate investors (for purposes of dyad analysis), we used the Compustat, Hoover's, and Securities Data Corporation databases.

We also conducted several background interviews to better understand the context. First, we interviewed technology entrepreneurs, partners at VC firms, corporate venture investors, business-unit managers, a lawyer specializing in technology ventures, and an angel investor.

Second, we drew on systematic fieldwork data tracking both investors and entrepreneurs on the round-by-round fundraising strategy of nine ventures. Finally, we read news articles on corporate investments to further understand these relationships, and co-taught several master's and executive-level venture-financing courses with VC partners.

Measures

Dependent variable. Our dependent variable is *the number of corporate venture investors* that participated in a given round of a young firm's funding.[3] We coded an investor as corporate if it was a non-financial firm that purchased private equity (we excluded loans and public offerings). We excluded subsidiaries of banks and insurance companies in order to focus on CVC investors that could offer complementary resources and that might also be likely to engage in misappropriation. CVC investors were coded using company directories, annual reports, and databases on public companies (e.g., Compustat and Worldscope). Two researchers independently coded the data with the aid of a computer program that matched inconsistent spellings and repeat investments. We included both U.S. and foreign corporate investors to make our coverage more comprehensive than that of studies focused exclusively on U.S. investors (e.g., Dushnitsky & Lenox, 2005a). Overall, we coded over 1,200 corporate investments.

We also recognize that some corporations are more likely than others to be direct rivals of the young firm. Though our study focuses on the question of whether or not relationships form with corporate sharks, intriguing directions for future work include questions about the heterogeneity of corporate partners and specific partner choice. See Table 3 for our dyad analysis

[3] A count variable was used because each additional corporate investor increases potential exposure to misbehavior. Furthermore, CVC investments exhibit a different and less path-dependent empirical pattern than a venture's VC investments. VCs typically invest in follow-on rounds, since prior VC investors tend strongly both to follow on and to bring in new VC investors to set the valuation. For instance, approximately 43 percent of the funding rounds in our data included more VC investors than the previous round. By contrast, CVC investment patterns are different. Only 4 percent of the funding rounds had more CVC investors than the previous round; fully 76 percent of funding rounds had *fewer* CVC investors than the previous round.

of specific types of corporate partners pertinent to this latter direction.

Independent Variables

Social defenses. We constructed two measures of social defenses. First, we measured *VC centrality* by the centrality of the venture's VC investors in the field-level formal co-investment network (Hochberg et al., 2007; Walker, Kogut, & Shan, 1997). We used eigenvector centrality (Bonacich, 1972). This is an attractive measure because it weights each tie by the connected VC's centrality, and therefore captures the range of a VC's direct connections and the recursive network reach of those connections. Thus, eigenvector centrality is appropriate to capture the desirability (status) of the VC as a current and future syndicate partner, and also to capture the threat of disciplining embodied in the VC's ability to broadcast allegations of a CVC's misappropriation to others. We followed Lee, Pollock, and Jin (2011) to calculate eigenvector centrality from a binary adjacency matrix, placing a tie between two VCs if they co-invested during the five-year window ending in the year prior to the round. This network was constructed using all investors active during the focal five-year window. We scaled each year's centralities between 0 to 1 to allow better inter-year comparisons. As in prior work, ventures without VC investors or with VCs unconnected to the primary network component were assigned a centrality of 0 to indicate that they did not have third-party VC ties as social defenses.[4] We then calculated the eigenvector centrality scores for all of the venture's VCs (i.e., VCs that had invested in the venture in any past round) and took the maximum score as the measure (Hallen, 2008). Maximum score has several advantages. First, aggregating centralities would probably over-count network reach. Investors new to a deal often syndicate with habitual syndication partners, suggesting that all VCs entering a given round have redundant network reach. Similarly, using an

[4] Only 1 percent of our sample ventures' first rounds involved solely a corporate investor and no VC investors. Excluding these firms from the sample did not influence our results.

average measure of centrality is undesirable as it would dilute the measure if ventures have both highly central and less central investors.

We measured *VC proximity* by identifying the geographical distances between the venture and all of its VC investors in any past round and taking an inverse of the shortest distance. We used the distance to the closest VC because Sorenson and Stuart (2001) found that remote VCs often rely on nearby VCs to provide primary monitoring and mentoring to a venture (average distance produced results that were similar). Distance in miles was calculated using longitudes and latitudes determined from the zip codes of the firms' headquarters. Low values of this variable (approaching 0) indicate distant VCs; high values indicate local VCs. We assigned a value of 0 to ventures without VC investors from any past round (akin to distant VCs), because such ventures would not enjoy the social defenses of a proximate VC.

Secrecy defenses. Consistent with prior findings that young firms use trade secrets (not patents) as a legal defense against misappropriation (Katila et al., 2008), we measured the strength of trade-secret defenses in a venture's industry. Trade secrets represent an exclusive source of protection for a diverse range of intellectual property, from know-how to recipes to customer lists, as long as firms actually keep them secret (Epstein, 2004). Since the strength of trade-secret protection varies across industries, we measured *secrecy defense* in a venture's industry using the Carnegie Mellon Survey of Industrial R&D, matching industries at the 3-digit SIC-code level at which the survey was conducted (Cohen, Nelson, & Walsh, 2000). These data have been used extensively in prior studies and are considered the primary source on comparative appropriability (Arora & Ceccagnoli, 2006; Gulati & Singh, 1998). Furthermore, the collection date of these data (1994) falls at the approximate midpoint of our time range, 1979–2003. Our specific measure is the percentage of product inventions for which surveyed

R&D managers in an industry believed trade secrets to be effective at preventing appropriation. In our sample, the values ranged from about 34 percent in electronic components and accessories (SIC 367) to almost 62 percent in metalworking machines and equipment (SIC 354).

Timing defenses. We measured a venture's *timing defense* by investment round (e.g., first, second, etc.) and logged this measure to reduce skew (Sahlman, 1990). Investment round is an appropriate measure because it reflects the technology and customer-development milestones that the venture has reached—that is, those "proofpoints" that make investors more willing to invest in a new round and simultaneously make misappropriation more difficult (Hallen & Eisenhardt, 2012; Katila & Mang, 2003). To further isolate the effects of timing defenses, we also controlled for a venture's age and resource needs, as described in detail below. We also tested an alternative measure of timing defenses using an ordinal measure of *venture development stage* obtained from the VentureOne database; this alternative measure was available for only about half of the rounds, but it confirmed our original results.

Controls

Since it is resource needs that push young firms to form CVC relationships, we measured a venture's need for greater capital infusions by *round size* of the focal funding round (in thousands of U.S. dollars). Because entrepreneurs determine the size of a round by balancing their firm's capital requirements against unnecessary ownership dilution from excessive funding, this is an effective measure of a firm's capital needs. We used the producer price index (PPI) to adjust the variable for inflation and logged it to mitigate skew.

We also included controls to account for a venture's need for the complementary resources that CVCs provide, using Compustat data. First, we controlled for the need for manufacturing resources through *manufacturing intensity*; measured as the capital intensity of

the venture's industry, since ventures in highly capital-intensive industries are likely to need greater manufacturing assets to produce their products. Our measure of capital intensity was the average ratio of fixed assets to sales in the venture's industry in the focal year. Second, because ventures with high marketing resource needs may seek corporate investors for their brand names, market knowledge, and distribution channels (Basu, Phelps, & Kotha, 2009; Khaire, 2010), we measured *marketing intensity* through the average ratio of advertising expenditures to sales in the venture's industry. While complementary resource needs tend to be quite consistent in a given industry but differ across industries (Katila & Shane, 2005), using industry-level measures was also beneficial given the difficulty of collecting venture-level data in a large-sample, multi-decade study such as ours. We measured both manufacturing and marketing intensity at the industry level using the granular 4-digit Standard Industrial Classification (SIC) codes.

Because prior work suggests that embeddedness factors between focal partners facilitate tie formation (Gulati & Gargiulo, 1999), we controlled for several of them. We included *corporate background* as a dummy variable indicating whether a venture was a spinoff of a corporation (value = 1), because spinoffs may inherit connections and knowledge from the parent that can make corporate ties more likely (Agarwal et al., 2004). And since tie formation may be path-dependent (Schoonhoven & Romanelli, 2001), we included *prior CVC investors* as a binary measure with a value of 1 if any of the venture's prior rounds included a CVC investor.

To further control for the interest of corporate investors in a venture (venture attractiveness), we included a control for the venture's technology assets (Stuart et al., 1999). We measured *technology assets* by the number of ultimately successful patent applications that each venture filed yearly, and weighted the counts by the forward citations that each patent had received in the seven years subsequent to issue in order to capture differences in the quality of

inventions. To better account for the aging of ventures and the related accumulation of experience (beyond what we controlled for directly with the timing-defense variable), we also controlled for *venture age* using data from VentureXpert on the number of months between a venture's founding and the focal round (logged).

Because prior work suggests that corporations in general are less likely to invest in industries in which patents are a strong defense (Dushnitsky & Lenox, 2005b), we controlled for the strength of patent protection in a venture's industry. To assess *patent strength*, we consulted the Carnegie Mellon Survey of Industrial R&D (Cohen et al., 2000) and used as our measure the percentage of product inventions for which patents are considered an effective protection mechanism in the industry.

Finally, because the availability of funding may vary across environments and influence the pursuit of corporate investors, we also controlled for the availability of venture-capital funding and for VC-firm density in the region. We measured *availability of venture capital* by the total annual inflation-adjusted investment on the part of VC firms in our five focal industries, as reported by VentureXpert (in billions of U.S. dollars). We measured the VC-richness of the region (*VC rich region*) as the venture's location relative to many potential VC investors. Based on Sorenson and Audia (2000), we constructed the measure as the sum of the inverse distances in miles between the focal venture *i* and VC firm *j* where *j* is drawn from the set of all U.S.-based VCs whose window of activity included the year of the focal round (i.e., VCs who invested for the first time either before or during the focal year, and whose most recent investment was either during or after the focal year). The more VC firms there were in proximity to the young firm, the higher the value of the variable. Distance was calculated using longitudes and latitudes from zipcodes and logged to reduce skew: $ln(\Sigma [1 / (d_{ij} + 1)] + 1)$. Finally, we included dummy

variables to control for any unobserved *industry-effects* in a venture's industry, and *calendar-year* dummies to capture potential fluctuations in the economy that could influence corporate tie formation.

Statistical Method

We used negative binomial regressions because our dependent variable, the number of CVC relationships formed in a given funding round, exhibited overdispersion. To control for venture heterogeneity, we used the Generalized Estimating Equations (GEE) regression method. GEE accounts for autocorrelation that arises because each venture was included in the sample repeatedly across multiple rounds (Liang, Zeger, & Qaqish, 1986). In contrast to random effects, the GEE method does not require the strong assumption that unobserved venture-specific effects are uncorrelated with the regressors. We used the exchangeable correlation structure to capture within-subject correlation, since it permitted us to include ventures that raised only one round of investment, and used the negative binomial distribution and link functions. Finally, we also ran Poisson GEE regressions with similar results.

RESULTS

Table 1 reports descriptive statistics and correlations. Our ventures raised an average of four to five rounds, with the size of an average round of $4 million. Rounds involved, on average, four investors. The correlations between the independent variables were low, and all variance inflation factors (VIFs) were below the traditional threshold of 10 (the highest was 4.3), suggesting that the reported estimates are unlikely to suffer from multicollinearity bias.

Main Findings

Table 2 presents the results for the GEE negative binomial regression analysis predicting the number of CVC investment relationships formed in a round. To interpret the interactions, we

graphed estimated CVC relationship formation in Figures 1 and 2 using model 7 from Table 2. Because multicollinearity across main effects and their interaction terms can be an issue, we centered the variables prior to calculating the interactions (Cronbach, 1987).

-- Insert Tables 1 and 2, and Figures 1 and 2 near here --

Model 1 in Table 2 includes the control variables. We find that more corporate investment relationships form when a venture has high financial-resource needs and a prior relationship with a corporation (i.e., spinoff or prior corporate rounds). In line with the strategic motivations of corporate investors, we also find that ventures with better technology assets are likely to have more corporate partners.

In hypothesis 1, we argued that ventures with more central VC investors will form more corporate ties. Model 2 adds VC centrality and the secrecy- and timing-defense variables. As expected, the coefficients for both the secrecy- and timing-defense variables are positive and significant ($p<0.05$ or lower). The coefficient for VC centrality is positive and significant in model 2 ($p<0.01$) and in the full model 7 ($p<0.05$), supporting the hypothesis.[5]

In hypothesis 2 we argued that ventures with nearby VC investors will acquire more corporate investors. The coefficient for VC proximity is unexpectedly negative but not significant in model 3, and negative and significant in model 7 ($p<0.01$). We will return to this unexpected finding in the Discussion section.

In terms of effect size, a one-standard-deviation increase in VC centrality is associated with a 4.2 percent increase in the number of corporate investors in a round.[6] To illustrate the practical significance of these effects, if a venture with a relatively low-centrality VC portfolio

[5] We use the full model 7 to interpret the effect of centrality because omitting any key explanatory variables (such as centrality's interaction with proximity) can lead to bias in the estimation of the remaining parameters (Kennedy, 1998: 103).

[6] Effect size is calculated as the exponent of a one-standard-deviation change in an explanatory variable multiplied by the coefficient in model 7—e.g., for centrality, e^(0.121 * 0.343) = 1.042.

receives an investment from a high-centrality VC investor (e.g., Sequoia Capital), its likelihood of acquiring a CVC investor in the next round increases by over 10 percent. Similarly, a one-standard-deviation increase in VC proximity is associated with a 9.9 percent decrease in the number of CVCs in a round.

In hypothesis 3, we proposed that the positive effect of central VCs on corporate relationships will be amplified when those VCs are also nearby. As with hypothesis 2, the resulting interaction is unexpectedly negative and marginally significant ($p<0.10$) in model 4 and negative and strongly significant ($p<0.01$) in model 7. To better explain this effect, we illustrate the findings in Figure 1. This figure indicates that the effect is asymmetric, and that greater proximity actually alters centrality's slope from positive to negative when VCs are closer than average to the venture. In order to test for the significance of the interactions at key levels of VC proximity, we followed Hilbe's (2011) procedure. The test shows that the coefficient for the interaction is significant at the minimum and maximum levels of proximity (using a $p<0.05$ threshold), but not significant at the mean level of proximity. Overall, these results confirm that VCs' centrality has a positive effect on CVC tie formation when VCs are remote, but that this effect sharply declines and turns negative when VCs are nearby. In terms of practical significance, a shift from low- to high-centrality VCs *increases* the expected number of CVC investors in the next round by 16 percent if all of the VCs are very distant geographically. In contrast, if a current VC is nearby, the same shift in VC centrality *decreases* the expected number of CVCs by 34 percent. We expand on this unexpected result in the Discussion section.

To test hypothesis 4, that social defenses compensate for traditional defenses, we assessed the interactions of social defenses with secrecy and timing defenses in models 5 and 6 and in the full model 7. Our findings again confirm the hypotheses for central-VC social

defenses. The interactions of VC centrality with secrecy and timing defenses are negative and significant in the full model ($p<0.01$), and the interactions of VC proximity with the same variables are significant (but positive given the negative main effect; $p<0.01$; $p<0.1$) in model 7. Overall, the results show that VC centrality comes into play and influences the acquisition of corporate investors particularly when legal and timing defenses are weak or unavailable. Intriguingly, a similarly hypothesized interplay of nearby VCs and these other defenses does not pan out, and the effect of local VCs is to rather pull partners further away from one another when traditional defenses are weak. We return to this unexpected result in the Discussion.

Figure 2 illustrates the interaction effects of hypothesis 4. The figure shows that central VCs enable corporate relationships when ventures are early-stage and lack trade-secret protection. For instance, a shift from less-central to more-central VCs produces a 99-percent increase in the expected number of CVCs in the next round when secrecy defenses are low, and a 58-percent increase when timing defenses are low. The corresponding effect is an 8.9-percent increase at mean levels of secrecy and timing.

Further, the figure illustrates that the negative relationship between VC proximity and CVC tie formation is unexpectedly most pronounced when ventures lack strong timing and secrecy defenses. For example, a shift from remote to nearby VCs decreases the expected number of CVC investors in the next round by 59 percent when secrecy defenses are weakest (versus a 15-percent increase when secrecy defenses are strongest). Likewise, the same shift from remote to nearby VCs decreases the expected number of CVCs by 45 percent when timing defenses are weakest (versus an 8-percent decrease when timing defenses are strongest). As above, we verified that all interactions were significant ($p<0.05$) at the various levels depicted in Figure 2 (e.g., the minimum, mean, and maximum levels of secrecy and timing; Hilbe, 2011).

Finally, Figure 2 intriguingly indicates a negative relationship between VC centrality and more CVC investors at very high levels of secrecy or timing defenses. In contrast, prior literature and our own arguments suggested a flat (or slightly positive) relationship. One likely explanation is that CVCs may avoid ventures with multiple strong, overlapping defenses in the belief that expropriating value from such a relationship would be too difficult. Overall, the results confirm that social defenses, and central VC ties in particular, step in to influence tie formation with corporate sharks when legal and timing defenses are weak.

Additional Analyses

CVC heterogeneity. Our core hypotheses center on the question of whether ventures form ties with sharks. But it is also intriguing to ask with whom they form such relationships. In order to examine which specific partners are likely to be chosen, we conducted a *dyad-level analysis* to ask why a tie formed between a particular pair of firms and not between another pair (Table 3). This analysis focused on better understanding the heterogeneity of corporate partners—that is, how social defenses influence engaging with *more or less dangerous corporate investors* (Diestre & Rajagopalan, 2012). Results of these additional analyses confirm that our main findings on social defenses are robust.

In our analysis, we included both venture-CVC dyads that actually formed and all dyads that could have formed but did not in a particular round. Dyads were created using our sample ventures, and the set of all public U.S. corporate investors that invested in any of the industries we examined, resulting in 11,132 dyad observations in total. To estimate the dyad models, we used a conditional logit regression grouped by round.

-- Insert Table 3 around here --

To examine the influence of CVC heterogeneity on tie formation, we first looked at the

situation in which the corporate partner is potentially dangerous because it possesses the technical *abilities* to use and misappropriate the young firm's technology. Because highly R&D-intensive corporations tend to have the technical abilities to better absorb a young firm's innovations, we interacted corporate R&D expenditures with social defenses. The coefficient for corporate R&D expenditures is positive and significant as expected, but the interactions with VC centrality and VC proximity are not. Thus, though technology-intensive corporations are more likely to engage in relationships when they can absorb the technology of the venture, social defenses do not seem to compensate for the potential influence of such more dangerous partners.

We then examined the situation in which the corporation is potentially more dangerous because its market *incentives* to misappropriate the young firm's technology are higher. We measured market incentives by a dummy variable that indicated whether the venture and the corporation operated in the same industry (business relatedness) because the risk of opportunism is greater in such situations (Dushnitsky & Shaver, 2009). Here, the results confirmed that relationships with more dangerous same-industry sharks are particularly likely when a venture is backed by more central VCs, and more unlikely when the VC investors are nearby. The results thus corroborate our main findings on social defenses' influence on tie formation with sharks. Notably, these results hold when we control for prior dyadic relationships between a particular VC and a particular CVC (i.e., closure of the VC-CVC-venture triad). Overall, these analyses show that when corporations have strong market incentives to misappropriate (i.e., are especially shark-like), third-party social defenses matter even more.

VC centrality. We also tried several *alternative measures of VC centrality* (and the related disciplining ability) to assess the robustness of our results. For example, the results were robust to (1) the number of ventures the VC had taken public in the preceding five years, and, (2)

the number of ventures it had invested in (Lee et al., 2011) both of which capture the VC's desirability as a future syndicate partner and ability to broadcast misbehavior within co-investment networks.

We also ruled out the possibility that an endorsement effect of central-VC ties provides an alternative explanation for our findings. If this were the case, we would expect a positive interaction of the traditional defenses with VC-centrality defense in Table 2. This would be because ventures would enjoy the protection of the other defenses plus the ability to better attract CVCs due to a central VC's endorsement. The observed negative interactions in Table 2 fail to support this alternative explanation and are consistent with VC centrality as a social defense.

VC proximity. We conducted additional analyses to explore our unexpected findings on VC proximity. While we cannot of course completely reject the possibility that VC proximity has "the wrong sign" in our results (a negative rather than the hypothesized positive effect), several tests suggest that this is unlikely. As described in detail below, we ruled out problems related to multicollinearity, measurement, and omitted variables that may all cause a change in the sign of a coefficient (Kennedy, 2005).

We first checked whether collinearity is an issue by obtaining the variance-inflation factors (VIF) for all the variables (Menard, 2002). All were less than the recommended cutoff value (e.g., VIF for VC proximity was 1.90), thus allaying concern about multicollinearity. We then examined the correlations of proximity with the other variables, but all were low (Table 1). The only exception is the moderate (r=0.47) correlation between proximity and the VC-rich-region variables. Consequently, we made an effort to reduce multicollinearity by removing the common variance in the covariate (i.e., VC rich region) by residualizing. That is, we predicted VC-rich-region by VC proximity, and used the residual as an instrument in place of the original

VC-rich-region control in a separate analysis. We also omitted the other explanatory variables that may be collinear (e.g., VC centrality) but VC proximity had a negative coefficient also alone. Overall, these tests confirmed our original results on VC proximity.

We also ruled out measurement issues. The results were robust to using alternative versions of VC proximity (e.g., we replaced a max score of the variable with the mean), and to alternative sampling method (dyad analysis: see Table 3). We also added a binary control variable that indicated whether or not the venture was located in Silicon Valley or the Boston area (since such ventures have a large number of potential VC investors nearby) and may have different decision-making calculus regarding CVCs, and this could influence our results. The original results on VC proximity persisted. Additionally, because the effect may be primarily driven by situations in which the most central VCs are also the most proximate, we added a three-way interaction of centrality and proximity with a new binary variable that took a value of 1 if the most central VC was also proximate (i.e., within 40 miles of the venture, equivalent to the distance between Silicon Valley and San Francisco). Our original results were again supported.

We then turned to examining our underlining assumptions about VC proximity and the related aligning logic of social defenses. An alternative explanation that is parsimonious with our findings is that VC partners are cautious about corporate investors in general, and that proximate VCs are likely to be particularly influential in steering ventures away from CVCs. Like parents who have more control over their kids when they still live at home than when they are away at college, local VCs may be better able to monitor and advise young firms and perhaps to stop them from doing something they perceive as ill-advised. Greater VC proximity may thus, as theorized, transform the effect of VC centrality by producing an aligning defense, but this

aligning defense may on aggregate push young firms away from (rather than toward) CVCs.

To further examine this alternative argument, we regressed the effects of VC proximity and its interaction with centrality on the likelihood of adding another VC (rather than a CVC) investor. Indeed, rather than the negative interaction coefficient in the original models predicting CVC relationships, the coefficient for the interaction predicting VC relationships was now positive and significant at the $p<0.1$ level, supporting our revised theory that local VCs may indeed push young firms toward VC rather than CVC partners.

We also analyzed our qualitative evidence from fieldwork to further refine this new theory. Our interviews indicated that many VCs indeed had reservations about corporations as venture investors. “They [VCs] believe that bringing in a CVC . . . isn’t helpful, because it may give you a label of being in the pocket of the corporation,” one interviewee said. “There is also an element of, ‘Don’t know you; not prepared to do a deal with you.’” A VC investor further asserted, “We do not want the venture to become [a big corporation’s] R&D arm.”

The therapeutics venture Neurex provides a good illustration of such aligning effects. Based in Menlo Park, California, Neurex was initially funded by the VCs Biovest Partners and Sutter Hill Ventures—the latter was both local and central—and thereafter by the VCs Accel, Mayfield, New Enterprise Associates, Sequoia, and Greylock in a second round. Consistent with our finding that ventures with central and proximate VCs generally avoid CVCs, Neurex continued to raise funds solely from VCs in subsequent rounds until its IPO in 1993. By contrast, Vivid Semiconductor in Chandler, Arizona, took its initial funding in 1995 from the distant but central VCs Institutional Venture Partners and Kleiner Perkins Caufield & Byers (both of Menlo Park). It later added corporate investor Amkor Electronics, illustrating the positive influence of centrality when VCs are distant. Overall, evidence suggests that many VCs reinforce their

preference to limit CVC investments in young firms that are nearby, thus further corroborating the VC-proximity effect that we found.

DISCUSSION

Prior literature has drawn attention to the swimming-with-sharks dilemma: that potential corporate partners are both particularly attractive and particularly dangerous. This paper looks at young firms' formation of ties with these sharks by elaborating both how resource dependencies push partners into relationships and how rivalrous misappropriation and related risks of power imbalance pull them away. Our contributions are (a) to unpack the role of social defenses as a particularly accessible strategy for young firms to protect against potentially opportunistic partners, and (b) to examine the interplay between social and other types of defenses.

Contributions to Resource-Dependence Theory

Our core contribution is to resource-dependence theory (Hillman et al., 2009; Pfeffer & Salancik, 1978). We extend the theory by highlighting resource-dependence and power-balance considerations at the pivotal juncture of tie formation—rather than during the relationship, as is typical of resource-dependence work. In particular, our work contributes to the emerging literature on tie formation by low-power firms. The motivation to study low-power firms and their strategies follows from the insight that many traditional resource-dependence strategies, including mergers, joint ventures, and partnering with trusted local partners, are unavailable to these firms, either because their powerful partners are likely to resist power-balancing operations (Casciaro & Piskorski, 2005) or because they lack a history of trustworthy long-term relationships. Our approach harkens back to Emerson's (1962) original concept of power networks: social defenses provide protections by enabling low-power firms to effectively borrow the power of powerful third parties in their environments. We thus respond to Wry and

colleagues' call to leverage resource-dependence theory's insights about power "beyond dyadic relationships" (2013: 445) and to re-examine the overlooked "complex and interconnected environments that Pfeffer and Salancik [originally] theorized" (2013: 463).

We also extend network theory by unpacking the characteristics of third parties that give rise to varying forms of social defenses. First, we document the role of centrally positioned partners as a powerful social defense. Our findings indicate that the disciplining defense made possible by central VC investors is unique among social defenses in that it pushes young firms to expand their portfolios of relationships to include corporate partners. The underlying mechanism here is that the threat of disciplining increases the high-power partner's motivational commitment to the relationship, because corporate partners have more to lose if they behave opportunistically in the presence of central third parties.

Our results also confirm the significance of VCs' geographical proximity and of the related aligning defense, but in an unexpected way. We find that a young firm's proximity to its VC investors sharply reduces the number of corporate sharks that it will partner with, even when the VCs are also central in their networks. Our further analyses suggest that, rather than promoting CVCs, local VCs often cause ventures to shun corporate investors in favor of more path-dependent portfolios—that is, "better-aligned" VC investors. Viewed through the lens of resource dependence, this finding suggests that ventures may have a more balanced power relationship with new VCs than with new CVCs, and that VCs that are nearby are able to reinforce their preferences about corporate investors more strongly than VCs that are geographically distant. Altogether, our findings indicate that aligning is a broader mechanism than was previously thought, and that it operates by (a) finding alternative sources for required resources (VC investors), and, even more significantly, by (b) adjusting goals so as to depend

less on certain resources (i.e., the resources offered by a CVC). Overall, while the implicit effect of disciplining by central VCs is to make corporate investors more dependent on the venture relationship (by introducing a reputation threat), the contrary effect of aligning keeps young firms from becoming too dependent on corporate partners.

Further, our finding that proximity effects overshadow centrality effects also suggests the existence of boundary conditions for social defenses and for their effectiveness at changing power dynamics. Prior work on disciplining, at both the dyadic level and the field level, tends to concentrate on the extremes of single and highly repetitive relationships and to overlook the middle ground. But many CVCs participate in venture investing only occasionally[7]—and thus both they and VCs may be unsure about the level of repetition, thus influencing the relative threat that disciplining provides. For future work, sharks relationships offer a promising path to richer understanding of social defenses, their boundary conditions, and the conditions under which disciplining or aligning is likely to dominate.

Our contributions to understanding resource dependence also have limitations that offer opportunities for future work. One limitation is that we examine only VC ties as social defenses, though these investments account for only a fraction of a young firm's possible relationships. Future research on ventures' other inter-organizational relationships, such as strategic alliances and industry consortia (cf., Prashantham & Birkinshaw, 2008; Wang & Zajac, 2007), may uncover other sources and kinds of defenses, especially because each type of relationship is likely to be associated with a different underlying network structure (cf., Rosenkopf and Schilling, 2007). Another limitation is our focus on formation of relationships. Future work could contribute by comparing the efficacy of social defenses to that of other defenses in

[7] In our data CVCs invest on average in only one of every four funding rounds.

enabling *high-performing* ties (cf., Tucci, Ginsberg, & Hasan, 2011). Because corporate venture relationships are perceived as relatively distant and exploratory (and less path-dependent) ties that enable both parties to transcend local search, analyzing the contributions of these ties to such performance outcomes as breakthrough innovation would be an interesting avenue for future work (cf., Tushman & Anderson, 1986; Utterback, 1994; Katila & Chen, 2008).

Another useful path for future work is to examine disciplining and aligning as resource-dependence tactics more generally, in other types of situations. Beyond entrepreneurship, such defenses may be relevant in multiple situations in which the other party holds virtually all the cards and thus few traditional resource-dependence strategies, including mergers, joint ventures, and board interlocks, are apt to be effective (e.g., a smaller firm supplying goods to Walmart or Amazon, or nonprofits interacting with major donors). Such situations are important to study: we are only beginning to understand how and with what tactics low-power firms can attempt to level the playing field in these situations.

Contributions Beyond Resource Dependence

Finally, we show that social defenses are particularly important when other defenses are unavailable. Research has typically examined secrecy and timing defenses in isolation from social defenses, but we unite these previously separate perspectives. First, we find that the effects of social defenses on tie formation are significant even when we control for more traditional defenses. Second, and even more significantly, we find that social defenses may take the place of traditional defenses when the latter are weak or nonexistent. This finding suggests an equifinality of defense mechanisms, such that firms with weak trade-secret protection or low timing defenses might instead gain protection from social defenses and vice-versa. In contrast, the literature on social networks often highlights the path-dependent, rich-get-richer effects of existing (and

prominent) connections (Argote & Miron-Spektor, 2011; Gulati & Gargiulo, 1999; Sine et al., 2003). Our theory and findings offer a different path, and suggest that third parties are most beneficial to—and influential on—firms that are otherwise more vulnerable. Thus, third-party social defenses have an equalizing effect in helping less-privileged firms to gain resources.

We also contribute to understanding how entrepreneurs mobilize resources by building a portfolio of diverse ties (cf., Mitchell & Singh, 1992). Prior literature demonstrates that the resource-mobilization strategies of young firms are strongly influenced by path-dependency (exploitation), and that resources are obtained from prior employers or from other local, trusted partners. Our findings show, by contrast, that social defenses via early third-party ties may help young firms acquire resources from diverse others in the environment (exploration). Thus, whereas prior literature has emphasized early connections' importance for gaining legitimacy (Stuart et al., 1999), our findings show that early connections (especially prominent ones) are also critical to engage new partners with different resources (Katila & Ahuja, 2002). In this way, our findings offer an expanded understanding of the importance of network ties to young firms, and rich insight into the origins of resource mobilization by entrepreneurial firms.

Conclusion

Tension between collaboration value and competitive misalignment is ubiquitous in inter-organizational relationships. Resource-dependence theorists have identified a range of mechanisms for managing such tensions, but it is less clear how young firms can protect themselves early on, when relationships form. Our research specifies the types of third-party defenses that are particularly relevant for young firms entering into relationships with corporate sharks, and thus offers both a richer and more precise perspective on social defenses and a holistic perspective that integrates social, legal, and timing defenses.

TABLE 1. DESCRIPTIVE STATISTICS AND CORRELATIONS

		Mean	S.D.	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	Number of CVCs	0.29	0.64														
2	VC centrality	0.48	0.34	0.07													
3	VC proximity	0.11	0.25	0.01	0.17												
4	Secrecy defense	49.46	5.61	0.08	0.02	0.01											
5	Timing defense	1.24	0.76	0.05	0.66	0.19	0.03										
6	Round size	6.73	2.86	0.19	0.00	-0.02	0.03	-0.08									
7	Venture age	3.56	1.23	0.03	0.41	0.15	-0.03	0.65	-0.03								
8	Manufacturing intensity	0.62	0.47	0.02	-0.12	-0.04	0.05	-0.03	0.06	-0.01							
9	Marketing intensity	0.04	0.04	0.05	-0.05	0.04	0.20	0.01	0.06	-0.02	0.00						
10	Corporate background	0.09	0.28	0.05	0.05	-0.01	0.08	0.02	0.02	-0.07	-0.06	-0.02					
11	Prior CVC investors	0.40	0.49	0.13	0.44	0.11	0.06	0.55	-0.03	0.38	-0.07	-0.06	0.04				
12	Technology assets	11.73	45.46	0.10	0.10	0.00	0.07	0.05	0.06	0.04	0.00	0.04	0.06	0.00			
13	Patent strength	40.37	9.79	-0.03	0.01	0.10	0.05	0.00	-0.02	-0.01	-0.02	0.15	-0.11	-0.02	0.02		
14	Availability of venture capital	1.26	4.06	0.07	0.02	0.00	-0.04	0.11	0.17	0.10	0.18	0.04	-0.03	0.04	0.00	-0.01	
15	VC-rich region	1.91	1.02	0.05	0.05	0.47	0.08	0.09	0.05	0.10	0.09	0.22	-0.05	0.02	0.05	0.11	0.11

Correlations above 0.03 are significant at the $p<0.05$ level.

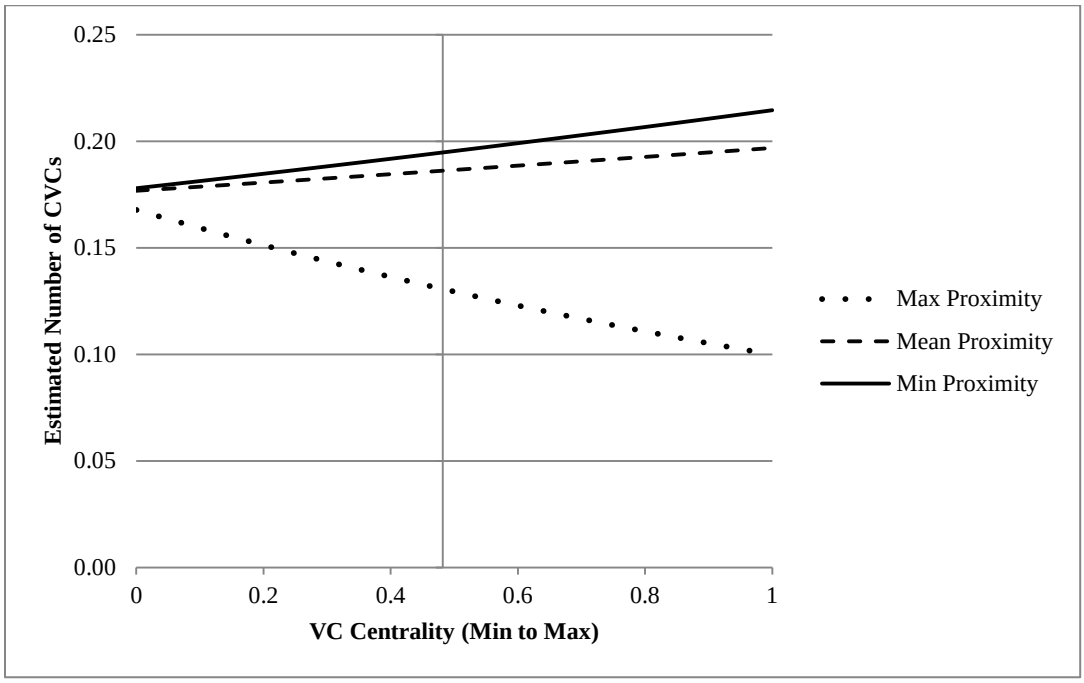
TABLE 2. GEE NEGATIVE BINOMIAL REGRESSION ANALYSIS OF THE NUMBER OF CORPORATE INVESTORS

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
Intercept	-1.144***	-1.031***	-2.087***	-1.046***	-1.379***	-1.032***	-0.155**
	(0.105)	(0.115)	(0.172)	(0.117)	(0.161)	(0.114)	(0.072)
Defenses							
VC centrality		0.275***	0.050	0.255***	0.208**	0.279***	0.121**
		(0.091)	(0.099)	(0.093)	(0.103)	(0.093)	(0.048)
VC proximity			-0.080	0.008	-0.077	-0.109	-0.412***
			(0.110)	(0.122)	(0.121)	(0.138)	(0.087)
Secrecy defense		0.018***	0.007	0.019***	0.012*	0.018***	0.023***
		(0.006)	(0.005)	(0.006)	(0.007)	(0.006)	(0.006)
Timing defense		0.158***	0.021	0.145**	0.155**	0.164***	0.085***
		(0.060)	(0.062)	(0.061)	(0.063)	(0.061)	(0.029)
Social defenses x other defenses							
VC centrality x VC proximity				-0.716*			-0.706***
				(0.368)			(0.191)
VC centrality x Secrecy defense					-0.000		-0.049***
					(0.013)		(0.012)
VC centrality x Timing defense					-0.250**		-0.378***
					(0.103)		(0.048)
VC proximity x Secrecy defense						0.014	0.047***
						(0.023)	(0.014)
VC proximity x Timing defense						0.054	0.158*
						(0.163)	(0.090)
Firm controls							
Round size	0.145***	0.138***	0.139***	0.137***	0.133***	0.138***	0.005*
	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)	(0.002)
Venture age	-0.090***	-0.155***	-0.004	-0.150***	-0.132***	-0.154***	0.019
	(0.018)	(0.020)	(0.030)	(0.021)	(0.023)	(0.020)	(0.018)

Manufacturing intensity	0.345***	0.346***	0.365***	0.341***	0.321***	0.342***	-0.010
	(0.081)	(0.088)	(0.074)	(0.090)	(0.095)	(0.089)	(0.072)
Marketing intensity	-3.379***	-1.777***	-0.267	-1.962***	-1.342**	-1.846***	-2.270***
	(0.707)	(0.566)	(0.615)	(0.599)	(0.668)	(0.579)	(0.608)
Corporate background	0.318***	0.269***	0.178**	0.268***	0.310***	0.271***	0.202***
	(0.074)	(0.072)	(0.072)	(0.074)	(0.082)	(0.072)	(0.071)
Prior CVC investors	0.417***	0.234***	0.357***	0.240***	0.198***	0.232***	0.345***
	(0.053)	(0.060)	(0.063)	(0.060)	(0.063)	(0.060)	(0.032)
Technology assets	0.002***	0.002***	0.002***	0.002***	0.002***	0.002***	0.000**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Patent strength	-0.002	0.002	-0.002	0.002	-0.003	0.002	-0.006***
	(0.004)	(0.005)	(0.004)	(0.005)	(0.005)	(0.004)	(0.001)
Industry controls							
Availability of venture capital	-0.002	-0.000	0.003	-0.000	0.000	-0.000	-0.011
	(0.006)	(0.005)	(0.004)	(0.005)	(0.005)	(0.005)	(0.008)
VC-rich region	0.046	0.056*	0.059**	0.063*	0.071*	0.064*	0.125***
	(0.033)	(0.033)	(0.029)	(0.035)	(0.037)	(0.035)	(0.017)
Biotechnology	0.041	-0.006	0.359***	0.014	0.285**	-0.008	-1.045***
	(0.097)	(0.097)	(0.108)	(0.100)	(0.131)	(0.098)	(0.078)
Electronics	0.065	0.009	0.384***	0.022	0.263**	0.011	-1.082***
	(0.103)	(0.114)	(0.106)	(0.114)	(0.132)	(0.113)	(0.073)
Communications	-1.288***	-1.108***	-0.736***	-1.089***	-0.850***	-1.111***	-1.685***
	(0.263)	(0.274)	(0.232)	(0.275)	(0.290)	(0.273)	(0.242)
Software	-0.299***	-0.128	0.243**	-0.117	0.119	-0.129	-1.239***
	(0.105)	(0.121)	(0.108)	(0.122)	(0.139)	(0.121)	(0.096)
Year Fixed Effects	Y	Y	Y	Y	Y	Y	Y
N	4073	4073	4073	4073	4073	4073	4073
Chi2	1210.575	1024.389	837.919	997.353	640.800	1030.217	1622.786

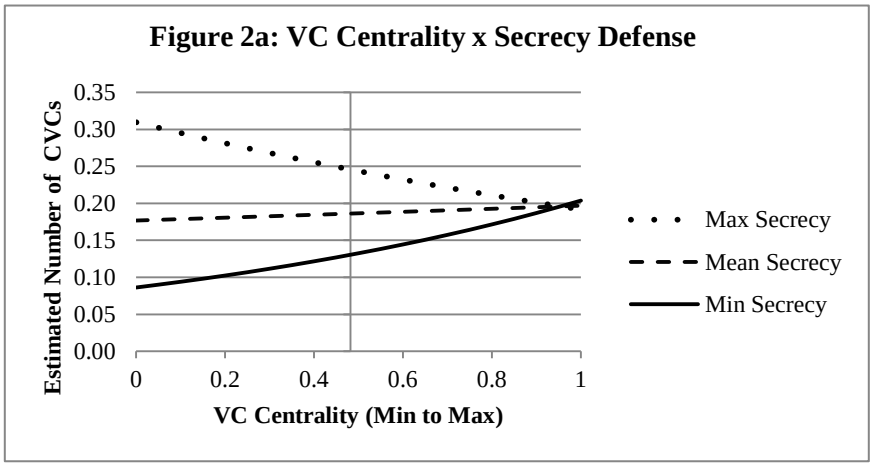
* p < 0.10; ** p < 0.05; *** p < 0.01; two-tailed tests. Standard errors are in parentheses; 700 ventures; 4,073 funding rounds.

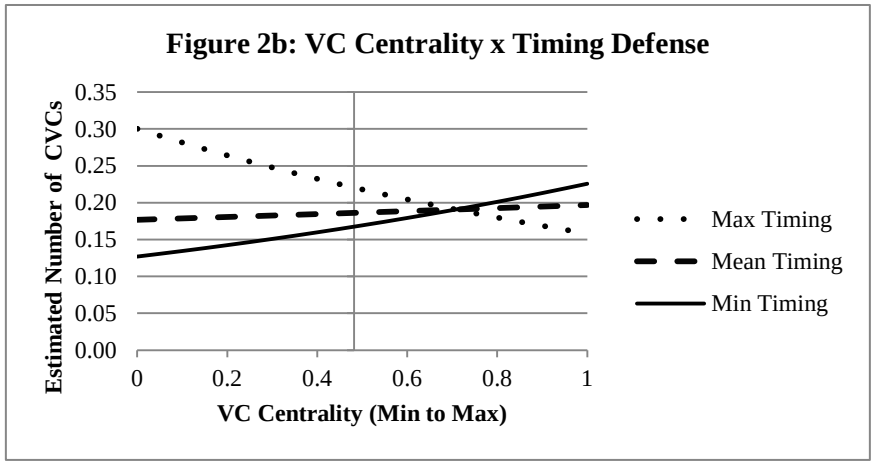
FIGURE 1. INTERACTION OF VC CENTRALITY AND VC PROXIMITY (H3)*

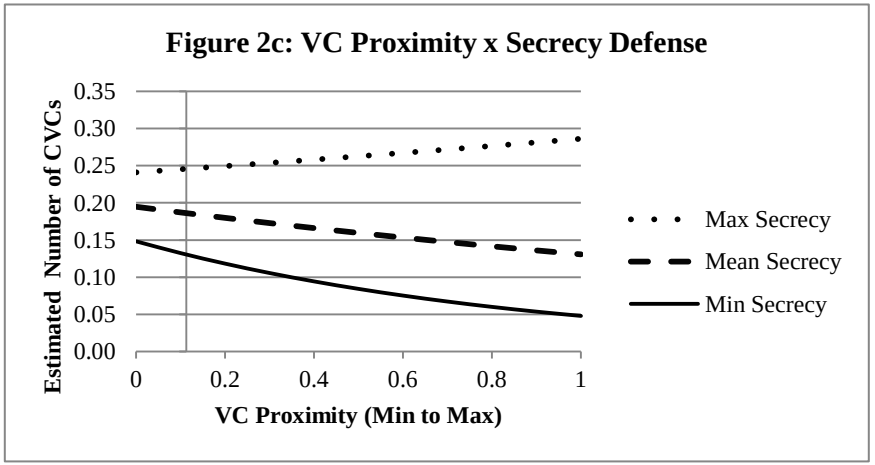


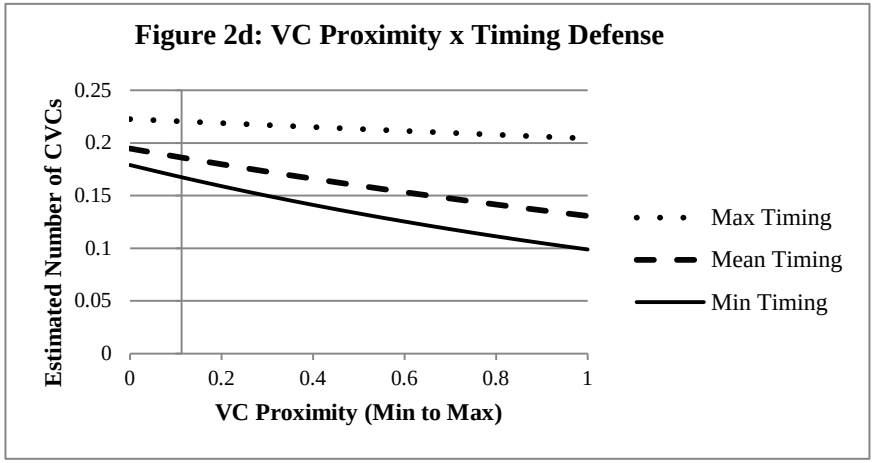
* All estimates are based on Model 7 in Table 2. Estimates are for the probability of including CVCs at the mean value of all variables, except those reported as varying. The vertical axis has been positioned to indicate the mean-level of VC centrality.

FIGURE 2. INTERACTIONS OF SOCIAL AND OTHER DEFENSES (H4)*









* All estimates are based on Model 7 in Table 2. Estimates are for the probability of including CVCs at the mean value of all variables, except those reported as varying. The vertical axis has been positioned to indicate the mean-level of VC centrality / VC proximity.

Table 3. Conditional-Logit Analysis of the Likelihood of Tie in a Dyad-Round†

	Model 1	Model 2	Model 3	Model 4
Dangerousness of Corporate Investor				
Corporate R&D (ln)	0.071**	0.077**	0.075**	0.081**
	(0.034)	(0.034)	(0.034)	(0.034)
Same Industry CVC	0.570***	0.568***	0.559***	0.556***
	(0.140)	(0.140)	(0.139)	(0.140)
Hypothesized Interactions				
VC centrality x Corporate R&D (ln)		0.112		0.117
		(0.096)		(0.097)
VC proximity x Corporate R&D (ln)		0.130		0.144
		(0.141)		(0.139)
VC centrality x Same Industry CVC			0.784*	0.825**
			(0.408)	(0.408)
VC proximity x Same Industry CVC			-0.901*	-0.925*
			(0.542)	(0.554)
Controls				
Corporate-venture distance[a] (ln)	-0.048**	-0.049**	-0.046**	-0.047**
	(0.020)	(0.020)	(0.020)	(0.020)
Prior corporate-venture tie	4.794***	4.794***	4.823***	4.824***
	(0.221)	(0.221)	(0.223)	(0.224)
Strength of common third-party ties[b]	0.676***	0.677***	0.686***	0.687***
	(0.163)	(0.163)	(0.162)	(0.163)
VC centrality x Strength of common third-party ties	-1.530***	-1.585***	-1.511***	-1.568***
	(0.371)	(0.376)	(0.370)	(0.375)
Joint centrality[c] (CVC-VC)	2.910***	2.580***	3.043***	2.717***
	(0.826)	(0.854)	(0.834)	(0.860)
CVC centrality	-1.924**	-1.677**	-2.088***	-1.847**
	(0.797)	(0.817)	(0.799)	(0.819)
Chi2	953.709	956.300	959.611	962.561

* p < 0.10; ** p < 0.05; *** p < 0.01; two-tailed tests. Standard errors are in parentheses; N=11,132 dyads.

a - Geographical distance between a venture and a corporate investor in miles.

b - Measured by number of CVC-VC ties over prior five years.

c - Accounts for mutual attraction of central VCs and central CVCs. Calculated following Gulati and Gargiulo (1999).

† We exploit the matched nature of the sample design, utilizing a fixed effect for each venture-round case. This approach produces unbiased and efficient estimates of effects conditional on both round-level factors and the decision to accept corporate venture capital. The tradeoff is that we are unable to include variables that are invariant at the dyad level (VC proximity, VC centrality).

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