Swimming with Sharks: Technology Ventures, Defense Mechanisms and Corporate Relationships

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This paper focuses on the tension that firms face between the need for resources from partners and the potentially damaging misappropriation of their own resources by corporate "sharks." Taking an entrepreneurial lens, we study this tension at tie formation in corporate investment relationships in five U.S. technology-based industries over a 25-year period. Central to our study is the "sharks" dilemma: when do entrepreneurs choose partners with high potential for misappropriation over less risky partners? Our findings show that entrepreneurs take the risk when they need resources that established firms uniquely provide (i.e., financial and manufacturing) and when they have effective defense mechanisms to protect their own resources (i.e., secrecy and timing). Overall, the findings show that tie formation is a negotiation that depends on resource needs, defense mechanisms, and alternative partners. These findings contribute to the recent renaissance of resource dependence theory and to the discussion on the surprising power of entrepreneurial firms in resource mobilization.●

A central question in organization and strategy research is how firms gain resources (Penrose, 1959; Thompson, 1967). In response, researchers have identified several approaches, including the acquisition of other firms (Ahuja and Katila, 2001) and organic development (Katila and Chen, 2008). But because acquisitions can be too expensive or unavailable (Graebner and Eisenhardt, 2004), and organic development can be too slow (Eisenhardt and Tabrizi, 1995), interorganizational relationships have become an attractive way to obtain resources, especially for new firms that must quickly mobilize a variety of resources.

When firms consider forming interorganizational relationships, they face a fundamental tension. On the one hand, they are pushed toward forming relationships by their dependence on others for needed resources (Emerson, 1962; Pfeffer and Salancik, 1978; Zaheer, McEvily, and Perrone, 1998). On the other hand, they are also pushed away from relationships by concerns about possibly damaging misappropriation of their own resources by their partners (Gulati and Singh, 1998; Ahuja, 2000; Katila and Mang, 2003). Although the tension between cooperation and competition can occur throughout relationships (Brandenburger and Nalebuff, 1996; Santos and Eisenhardt, 2008), it is particularly influential at tie formation (Das and Teng, 2000). When firms are forming ties, they have the greatest flexibility to choose among potential partners or simply avoid ties with too much potential for misappropriation or too little resource value. So the tension between cooperation that satisfies resource needs and competition that creates the potential for resource misappropriation is at the core of relationship formation and is likely to be a primary determinant of whether firms choose to form ties at all.

Research confirms the influence of resource needs on relationship formation. Resource dependence theory is the principal approach for explaining when firms form interorganizational relationships (Pfeffer and Nowak, 1976). Building on exchange arguments (Emerson, 1962), resource dependence scholars have argued and found that dependence on others

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for resources leads firms to seek ties with them to reduce uncertainty (Gulati, 1995b; Scott, 2002). For example, although not specific about the desired resources, scholars studying new firms show that these firms form ties with established firms when they depend on them for resources (Shan, 1990; Eisenhardt and Schoonhoven, 1996; Ozcan and Eisenhardt, 2008). Social network theory complements resource dependence by indicating with whom ties form. For example, this theory emphasizes that direct and indirect ties provide information about potential partners and partnership opportunities and so enhance the likelihood that firms will prefer to form ties with trusted partners (Gulati and Gargiulo, 1999). Some recent work in transaction cost economics further confirms that firms choose between different governance mechanisms based on the strength of their resource needs (Mayer and Salomon, 2006).

In contrast, research has been less concerned with the influence of potential misappropriation of resources on relationship formation. Resource dependence scholars focus on the resource interdependence that pushes firms to form ties (Pfeffer and Salancik, 1978), not on the potential misappropriation that pushes them away. For example, scholars studying relationships between new and established firms strongly emphasize the positive outcomes for new firms (Stuart, Hoang, and Hybels, 1999; Baum, Calabrese, and Silverman, 2000; Gulati and Higgins, 2003) but neglect the negative ones. Network scholars implicitly address potential misappropriation by arguing that firms are more likely to form ties with embedded partners whom they already know and whose reliability is confirmed (Gulati, 1995b; Chung, Singh, and Lee, 2000). But they do not directly address misappropriation in situations in which no local partner has the needed resources, local partners are themselves unreliable, or partners with the highest potential for misappropriation also have the best resources. Transaction cost scholars focus on the efficient governance of existing ties. They emphasize alignment between partners and specify the most efficient governance mechanisms to protect against potential misappropriation during the relationship (Mowery, Oxley, and Silverman, 1996; Dyer, Singh, and Kale, 2008). But because transaction cost scholars study existing ties, they neglect the decision calculus by which firms form ties in the first place.

Overall, prior research and theory address the cooperative side of relationship formation and the role of resource needs. But they neglect the critical competitive side and the influence of potential resource misappropriation at the pivotal time of relationship formation. As a result, they miss how resource dependencies and potential resource misappropriation operate simultaneously at tie formation. Prior research and theory also ignore multiple types of resources and multiple types of potential partners, including ones with highly attractive resources but also significant potential risks for resource misappropriation. This tension between very attractive resources and high misappropriation risks is what we term the "sharks dilemma."

A particularly appropriate setting in which to study the tension between resource needs and potential resource misap-

propriation at tie formation is the entrepreneur's decision to enter a corporate investment relationship. This is an equity relationship in which the agreement includes an equity purchase of a portion of a private, new (typically less than seven-year-old) entrepreneurial firm by another company that is typically larger, older, more established, and publicly traded. This setting is appropriate for several reasons.

First, the tension between resource dependence and misappropriation is highly acute. Given that new firms usually must make investments in advance of profits, they often require extensive financial resources from outside the firm. In addition, they often have too few operational resources. At the same time, established firms often have excess operational resources, including manufacturing or sales capacity that they cannot fully utilize (Penrose, 1959; Pisano, 1990), and significant financial resources. Thus new firms often are pushed toward corporate investment relationships. Yet corporate investment relationships may also involve misalignment between the partners that increase potential misappropriation concerns and push new firms away from these relationships. For example, corporate partners may be interested in access to the venture's resources, such as technologies and other intellectual property, in ways that are counter to the strategic interests of the new firm (Doz, 1988; Santos and Eisenhardt, 2008). This potential misappropriation is especially critical for new firms because their intellectual property is more easily appropriated than are the resources of established firms, such as manufacturing facilities, and because equity relationships typically lock the venture into the tie until a liquidity event. In addition, although established firms rely on defenses such as patents or equity during relationships (Pisano, 1990), new firms are less able to defend themselves once ties form. They typically have limited time and legal resources to defend themselves against opportunistic actions in ongoing ties and so are likely to anticipate potential misappropriation of their resources when they consider tie formation. Thus when new firms consider whether to enter a corporate investment relationship, they often face an acute tension between the cooperative resource dependencies that push them toward relationships and the competitive misappropriation concerns that push them away.

Second, new firms may have a choice among viable alternative types of partners when forming corporate relationships. For instance, they may be able to form ties with other types of partners (e.g., venture capitalists) that may have less risk of resource misappropriation than do corporate partners (Sahlman, 1990). Although not all new firms have these alternative partners, those new firms that are of interest to corporations as investments are also likely to be of interest to other types of partners and to have alternative partners. And yet research has neglected whether firms should form ties with corporate partners that have the most-needed resources but also the highest potential for misappropriation—and so "swim with sharks"—over less risky partners with less-critical resources. Third, corporate investment relationships also have practical import. About 25 percent of entrepreneurial firms with professional investments, including about 50 per-

cent of technology-based ones (Rosenberger, 2005), have one or more corporate investment relationships. They are also a source of insights into new technologies and so complement research and development (R&D) activities within corporations (e.g., Dushnitsky and Lenox, 2005a; Basu, Phelps, and Kotha, 2006). In this study, we examined when firms form such interorganizational relationships in the context of the sharks dilemma by analyzing the entrepreneur's choice to enter corporate investment relationships. We relied on fundraising-round data for 701 new firms in five U.S. technology-intensive industries from 1979 to 2003. We sampled firms that were open and able to gain professional investment ties and then examined when they chose established firms over less-risky professional investors. We supplemented our data with fieldwork, including interviews with entrepreneurs, corporate investors, and venture capitalists, to deepen our understanding of the phenomenon.

This study makes two core contributions. First, we make several competitive, cooperative, and bilateral extensions to resource dependence theory. Of particular note is the sharks dilemma—whether to select partners with uniquely attractive resources but also with substantial risks over safer but less well-endowed partners—which adds to recent work in resource dependence theory (e.g., Casciaro and Piskorski, 2005; Gulati and Sytch, 2007; Ozcan and Eisenhardt, 2008) by including the potential for misappropriation of resources. Second, we contribute novel, counterintuitive findings on how entrepreneurs mobilize resources, by highlighting entrepreneurs' distinctive defenses against misappropriation, such as secrecy and the timing of a corporate tie, which focus on anticipating resource misappropriation prior to formation and differ from the well-known defenses of established firms, which focus on post-formation defense. These defense mechanisms are at the heart of entrepreneurs' power in relationships with established firms. We also challenge the conventional overly optimistic view of the benefit of corporate ties for entrepreneurial outcomes and the notion that entrepreneurial firms are weak, passive actors. The study shows that extant research is likely to overstate the benefits of ties with established firms and understate the power of new firms as they form new corporate relationships to satisfy their resource needs.

TECHNOLOGY VENTURES AND CORPORATE RELATIONSHIPS

The literature on venture financing provides useful grounding for this study. One stream of research examines venture capital investments, often taking the venture capitalist's (VC) perspective. Research identifies the resources that VCs both contribute and gain from these relationships and indicates that their interests are well aligned with the venture's. VCs typically contribute financial resources, legitimacy, advice, referrals for executive hires, and industry connections (Sapienza, 1992). They typically align the incentives of entrepreneurs with their own (Bitler, Moskowitz, and Vissing-Jorgensen, 2005), contract out agency risks via term sheets that specify an investor's funding terms (Kaplan and Stromberg, 2004), and monitor investments through board

seats (Gompers, 1995). These forms of hierarchical and board control enable both partners to exchange information and regularly initiate and ratify decisions (Gulati and Singh, 1998) and thus mitigate possible misalignment, including potentially damaging misappropriation of resources. Finally, because VCs seek a financial return that is related to the venture's success, the interests are well aligned and the likelihood of their misappropriating the resources of new firms is reasonably low.

Other research takes the perspective of the new firm on VC investment relationships. The findings indicate that ventures enter relationships with VCs to obtain new business partners, gain introductions to possible executive team members, and obtain help in formulating strategy (Smith, 2001). The findings also show that VC investment relationships are advantageous to new firms. New firms with investment relationships with VCs (especially prominent ones) grow faster, have better reputations, gain more introductions to potential alliance partners, and are more likely to attain an initial public offering (IPO) (Stuart, Hoang, and Hybels, 1999; Davila, Foster, and Gupta, 2003; Beckman, Burton, and O'Reilly, 2007). Overall, these studies reveal that the resources provided by VCs fit those needed by entrepreneurs, the interests of VCs are relatively well aligned with venture success, and the likelihood of their misappropriating the venture's resources is fairly low.

A second research stream has examined investment relationships in new firms when the investor is a corporation. This work takes the corporate perspective by studying relationship formation as the corporate partner's decision (Chesbrough and Tucci, 2003; Benson and Ziedonis, 2005; Dushnitsky and Lenox, 2005a; Wadhwa and Kotha, 2006). The rationale is that the corporation is the dominant partner in the relationship and so has the choice of whether, how much, and in whom to invest. In contrast to the VC investment literature, this work highlights the significant role of the non-financial (i.e., strategic) interests of corporations in relationships with new firms. Corporations are not just buying a piece of the new firm in a financial transaction but, rather, are exchanging their own resources for access to promising new technologies that may speed their own technology development, provide information on possible acquisitions, and even block new products that might compete with their own (Helft, 2006; Wadhwa and Kotha, 2006; Hoyem and Huston, 2007). In particular, investment in new firms is usually a complement to, and sometimes a substitute for, the corporation's own R&D (Mason and Rohner, 2002). Research indicates that established firms are more likely to enter an investment relationship with a new firm, and benefit from it, when they can easily absorb technology because the venture's technology is related to their own (Gompers and Lerner, 2002), the patent regime of the venture's industry is weak (Dushnitsky and Lenox, 2005b), and when the venture's technology is novel and significant (Stuart, 2000). They also tend to invest in industries in which technology opportunities are plentiful and to accept lower valuations (Gompers and Lerner, 2002). Overall, established firms are not very good at innovation or realize that in some markets innovation needs to come from

external sources (see Anderson and Tushman, 1990; Mitchell and Singh, 1992; Bowen et al., 1994; Utterback, 1994). From the corporate perspective, then, investment relationships with new firms are strategic, not just (or even primarily) financial transactions. In addition, corporate investors are less likely to be well aligned with the interests of new firms than are VCs. For example, unlike VCs, many corporate investors do not take a board seat as part of the investment relationship, and so opportunities to use hierarchical controls to align the interests of the new and established firms are more limited. Our interviews with corporate investors indicate that they often prefer not to have a board seat in order to avoid a conflict between their corporate strategic interests and fiduciary responsibilities to the new firm. By remaining off the board, they can more readily pursue their corporate interests. As a former head of Sun's venture arm said, "The interests of a corporation and a venture are seldom, if ever, aligned." Because corporate investors are less aligned with new firm's success than VCs and more interested in the new firm's resources for their own use, they are more likely to misappropriate resources.

In contrast, there is no research (that we know of) that takes the new firm's perspective on corporate investment relationships. Rather, the corporation is viewed as the powerful, resource-rich and highly desirable partner (e.g., Stuart, Hoang, and Hybels, 1999; Maula, Keil, and Zahra, 2003) that dominates the decision to form an investment relationship, while the new firm is the resource-poor, passive target that is highly motivated to enter these relationships by enhanced prestige and access to corporate resources. Yet this one-sided view is probably incomplete. Several observations suggest that young firms are active decision makers, too. First, recent findings show that corporate investors are not as powerful as might be anticipated. They sometimes fail to get their first-choice investment (Gompers, 2002; Santos and Eisenhardt, 2008) and cannot make the acquisitions they prefer (Graebner and Eisenhardt, 2004). Also, while corporate investors may have many possible relationships, they typically want ties with the most desirable new firms with the best resources. Yet these new firms are precisely the ones that are likely to be of interest to other investors and to have choices among alternative partners. Finally, consistent with their weaker-than-expected power, corporations are more likely to pay too much by investing in overvalued transactions, relative to other investors (Gompers and Lerner, 2002), and pay too much if they subsequently acquire the venture (Benson and Ziedonis, 2005). Importantly, these findings indicate that though they are important, corporations are not the only relevant actors in the decision to form corporate investment relationships.

Second, in-depth field studies of venture fundraising reveal a complex process (Zott and Huy, 2007; Hallen and Eisenhardt, 2008) and show that entrepreneurs are also knowledgeable participants (along with their existing "angel" and VC investors) in fundraising, including being involved in when to raise money, how much to raise, and whom to approach (e.g., Tyebjee and Bruno, 1986; Dorf and Byers, 2005; Katila

and Cox, 2008). For example, our interviews revealed that entrepreneurs (often with their principal investors) choose among potential corporate partners. One entrepreneur described purposefully orchestrating the process and courting some corporations while rejecting others. As she noted, "Fundraising was about limiting the amount of people involved, but getting the right people involved [i.e., most appropriate corporate investors]. There were some that we had to convince to come on, and others we had to limit." Entrepreneurs also often determine, usually with their VCs, whether a corporation is able to invest at all. As another entrepreneur noted, "We got a huge deal done with [Blue Chip Corporation] where they got to re-market our product. . . . That was really key to us. But we didn't give them a board seat, and we didn't let them invest." Many entrepreneurs also recognize the non-financial and strategic interests of corporate partners. As one entrepreneur described, "Strategics [a common name for corporate investors] don't care about the valuation. That's not their motivation. They're in it for other reasons like access to technology, market manipulation, or a jump on competitors." The central point is that entrepreneurs are active and knowledgeable decision makers in their fundraising process, thereby making the entrepreneurial lens important to when new firms form corporate investment relationships.

Resource Needs

Financial resources. Resource dependence theorists studying interorganizational relationships argue that firms facing uncertainty about accessing resources are likely to form ties with firms that have the needed resources (Pfeffer and Nowak, 1976; Eisenhardt and Schoonhoven, 1996; Gulati, 2007). A key task for entrepreneurs in charge of mobilizing financial resources is then to form relationships so that the venture can prosper. When the costs of technology development or sales are high, the financial resource needs of new firms may outstrip the funding capabilities of many types of investors. This is often true when entrepreneurs are funded by individual "angel" investors who have limited capital and VC firms that limit their total investment in each venture to meet their portfolio goals and maximize their overall financial return through large returns from small investments (Gupta and Sapienza, 1992; Gompers and Lerner, 2001). In these situations, forming investment relationships with established firms can be attractive. These firms are especially rich sources of capital because they often do not face the external portfolio pressures that VCs do and can therefore provide outsized cash infusions from a single source, without the venture having to court and coordinate a large syndicate of investors.

Hypothesis 1 (H1): Entrepreneurs with large financial resource needs will be more likely to form an investment relationship with a corporation.

Complementary resources. The second resource argument focuses on the new firm's need for the operational resources that established firms often possess and other types of investors seldom provide. New firms rarely own all of the

resources necessary for the development and commercialization of their products (Teece, 1986). For example, Santos and Eisenhardt (2008) studied a venture that allowed investment by five established firms to gain access to their key marketing and distribution resources. This example suggests that new firms that need complementary resources (e.g., manufacturing, a sales force, and branding) can potentially use funding relationships to harness such resources from investing corporations. Thus we hypothesize that entrepreneurs will be more likely to pursue corporate relationships when complementary resources are necessary to develop and commercialize products in the industry in which they operate.

Hypothesis 2 (H2): Entrepreneurs with large complementary resource needs (i.e., manufacturing and marketing) will be more likely to form an investment relationship with a corporation.

Resource hierarchy. While the prior hypotheses addressed financial and complementary resource needs from the new firm's perspective, relationship formation is bilateral, such that the interests of both parties are germane to tie formation (Emerson, 1962; Pfeffer and Salancik, 1978). Corporate investors are likely to be especially interested in relationships that involve complementary resources, because having excess operational resources can be a rationale for an established firm to be interested in an investment relationship (Penrose, 1959). More important, because corporate investors usually have a strong strategic interest in the young firm's technology (Mason and Rohner, 2002; Wadhwa and Kotha, 2006), they may be particularly keen to provide complementary resources. Providing complementary resources may enable the corporate partner to gain access to the new firm's resources or influence its technology development because of the coordination demands of using these resources. Providing manufacturing resources may be particularly appealing to corporations because product development decisions are often intertwined with manufacturing choices at the design stage (Utterback, 1994; Wasti and Liker, 1999), and further insights into technology are often revealed during manufacturing (Pisano, 1989). New firms may also prefer corporate relationships when they need manufacturing resources (over marketing ones) because manufacturing resources are often expensive and slow to create, important to operational success, and uniquely available from corporations. In contrast, marketing resources are often easily available in non-equity relationships such as revenue-sharing agreements that enable new firms to gain resources without diluting ownership. In contrast, although financial resources are highly attractive to new firms because of their fungibility, simply providing financial resources may be less appealing to established firms because they offer little opportunity to gain insight into the new firm's resources, especially intellectual property. Thus complementary resource needs (especially for manufacturing) are more likely to propel relationship formation than are needs for financial resources. Incorporating the corporate view suggests the following ordering of resource importance:

Hypothesis 3 (H3): There is a resource hierarchy in which entrepreneurs with complementary resource needs (first manufacturing, then marketing) will be more likely to form an investment relationship with a corporation than entrepreneurs with financial resource needs.

Defense Mechanisms

Patent defense. Resource dependence theorists have developed theory that accounts for resource needs (Pfeffer and Salancik, 1978) that can be extended to potential misappropriation. Although firms decrease uncertainty surrounding access to needed resources by forming ties with firms that have those resources (Pfeffer and Salancik, 1978), these ties can also increase uncertainty if the resources are gained from partners possibly inclined toward unwanted resource appropriation. As Pfeffer (1982) noted, dependence occurs when one partner needs the resources of the other and cannot easily gain these resources elsewhere. If misappropriation of a new firm's resources is successful, it allows established firms to gain some control over the focal firm's resources, ultimately lessening their dependence and diminishing the focal firm's power. Thus potential misappropriation is an additional source of uncertainty for new firms when ties are formed. Defense mechanisms can mitigate this uncertainty and help the focal firm maintain its power in the relationship. So when defense mechanisms are available, firms are more likely to form ties with partners who might potentially misappropriate their resources. Because firms can usually anticipate the potential for misappropriation, they are likely to avoid relationships when they have weak defenses.

New firms are at a particular risk of losing their technology resources because the established firm's primary motivation for the relationship is typically a strategic interest in the new firm's technology (Basu, Phelps, and Kotha, 2006). These appropriation risks are characterized by the degree to which the new firm can protect and exploit the financial benefits of its technology (Levin et al., 1987) and are most acute when investing firms can easily influence and capture the financial benefits of the new firm's intellectual property. For example, there can be subtle pressure on the new firm to pursue a technology agenda that is favorable to the established firm but has potential adverse financial consequences to the new firm. A corporate investor noted, "Our corporate venture unit has definitely given us leverage in negotiating contracts with the startups we have invested in, as well as having input into product development." Given that new firms are likely to be aware of attempts to access and control their technology resources, they are more likely to enter corporate investment relationships when defense mechanisms are available to mitigate this uncertainty.

Although new firms usually cannot rely on some common defense mechanisms to protect their intellectual property, such as economies of scale and complementary assets, because of their small size and limited resources (Teece, 1986), they can use two common legal instruments to protect their inventions: patents and trade secrets (Katila and Mang, 2003; Anton and Yao, 2004). These instruments can be used independently or simultaneously to protect different

parts of the same invention (Cohen, Nelson, and Walsh, 2000). A patent gives the holder the right to exclude others from the use of the invention covered by the patent (Walker, 1995). Patents further allow the holder to prosecute others who infringe, regardless of the source of the infringers' ideas and so are an effective means (or, at a minimum, delay infringement) of protecting some parts of the venture's product invention when the corporation's interests are not aligned with the venture's. Because the strength of patent protection varies across industries, however, new firms should prefer corporate investment relationships when the patent regime in the venture's industry is strong (rather than when it is weak), because it increases their ability to defend against the competitive aspects of the relationship.

Hypothesis 4a (H4a): Entrepreneurs with inventions that are more strongly protected by patents will be more likely to form an investment relationship with a corporation.

Secrecy defense. Although patents provide protection against a broad range of appropriation behaviors, the threshold for receiving a patent is high, requiring novelty, utility, and non-obviousness of the invention (Walker, 1995). In contrast, a second legal instrument, trade secrets, offers an exclusive source of protection to a diverse range of intellectual property, from know-how to recipes to customer lists, as long as the firm keeps them secret (Epstein, 2004). Both the use of improper means to discover trade secrets and the use of improperly discovered trade secrets are illegal, making trade secrets an effective means of protecting intellectual property. Nondisclosure agreements, material transfer agreements, and non-compete clauses that may mitigate the risk that the corporation will hire the venture's employees or otherwise transfer intellectual property are commonly used to protect trade secrets (Scotchmer, 2004). Because the strength of trade secret protection varies across industries, however, new firms should be better able to protect their technical inventions and be more likely to enter into corporate investment relationships when the trade secret regime in their industry is strong.

Hypothesis 4b (H4b): Entrepreneurs with inventions that are more strongly protected by secrecy will be more likely to form an investment relationship with a corporation.

Timing defense. While legal defense mechanisms such as patents and trade secrets may be useful to protect specific inventions, new firms may also protect their technology resources and themselves more broadly by timing their corporate relationships to coincide with later funding rounds. The timing of an investment round tracks the progressive maturation of the venture. Each successive round is tied to a significant development in the venture, such as completion of design, pilot production, first profit, etc., thus demarcating the new firm's development stages (Sahlman, 1990). Later timing is likely to make it more difficult for a partner to appropriate intellectual property (Lerner and Merges, 1998) because it is easier to protect a more mature technology that is more fully embodied in a product from possible appropriation. For example, biotech entrepreneurs use this reasoning

when they delay R&D collaborations with unfamiliar partners (Katila and Mang, 2003). Although Katila and Mang (2003) focused on R&D collaborations in a particular industry, it seems likely that entrepreneurs in other industries and pursuing other types of relationships may also use timing as a defense mechanism. Also, later timing of the relationship makes it more difficult for established firms to influence the product portfolios and strategic agendas of new firms because their products and strategies will be more well developed, robust, and visible (Sahlman, 1990; Rivkin, 2000). New firms are therefore more likely to pursue corporate investment relationships in later funding rounds, when the firm's technologies, products, and strategic agendas are more mature and so more defensible. In addition, later timing is also an effective defense mechanism because better-aligned investors such as VCs typically are present from prior rounds to help thwart competitive actions by corporate investors. Thus we propose:

Hypothesis 5 (H5): Entrepreneurs protected by later timing will be more likely to form an investment relationship with a corporation.

Defense hierarchy. Again, relationship formation is also influenced by the corporate investor's preferences. Established firms may be deterred by strong legal protections such as patents because they limit access to the new firm's technology. Research shows that corporations prefer ties to ventures with weak patent regimes because this gives easier access to the venture's technology (Dushnitsky and Lenox, 2005a). Thus, although patent protection may be in the interests of the new firm, it may discourage potential corporate partners. In contrast, corporations may be less deterred by trade secrets because they are a weaker protection mechanism than patents (Scotchmer, 2004). Finally, both parties may prefer timing as a defense mechanism. Established firms may prefer to form relationships in later financing rounds, when the quality of the venture and its resources are clearer, and there is less uncertainty. They are also less likely to tie up their operational resources and waste their financial resources on a low-quality new firm. New firms may prefer timing as a defense mechanism because it has few (if any) legal costs and is more broadly applicable than legal defense mechanisms that focus on specific inventions. Adding the corporate view suggests the following ordering:

Hypothesis 6 (H6): There is a defense mechanism hierarchy in which entrepreneurs protected by later timing will be more likely to form an investment relationship with a corporation than entrepreneurs protected by intellectual property defense mechanisms (first trade secrets, then patents).

Integrating Resource Needs and Defense Mechanisms

As argued earlier, the cooperative push toward resources versus the competitive push away from potential misappropriation poses a fundamental tension for both parties. Although it is clearly desirable for new firms to access needed resources from their partners while also maintaining high protective defenses for their own resources, this is less desirable from the partner's view (and vice versa). Thus we propose that

new firms are more likely to enter corporate relationships when the preferences of the two firms are reinforcing, such that there are mutually desirable resources and mutually desirable defenses. This logic recognizes that tie formation is an integrative negotiation of both firms' preferences. Similarly, we propose that when there is asymmetry, such that one partner is likely to receive (or lose) more than the other, a tie is less likely.

Hypothesis 7 (H7): Entrepreneurs that simultaneously integrate the opposing forces of competition and cooperation will be more likely to form an investment relationship with a corporation.

METHODS

Sample and Data Sources

We analyzed the choice to form corporate investment relationships by new firms over a 25-year period from 1979 to 2003. The sample of new firms was drawn from the population of U.S. investor-backed technology ventures that received their first venture funding between 1979 and 1995. We chose investor-backed ventures because their ability to attract external funding indicates viable technology and marketing agendas and thus that they have a choice of investors (Hellman and Puri, 2000; Davila, Foster, and Gupta, 2003). We chose technology ventures because of their substantial needs for financial and complementary resources and their intellectual property, which is likely to exacerbate risks for misalignment and the related tension that is a focus in this study. We analyzed data on these ventures by funding round from 1979 to 2003.

We began the sample in 1979, the year in which the U.S. Department of Labor clarified the "prudent man" stipulation in the Employment Retirement Income Security Act to allow pension fund managers to invest in VC funds (Gompers and Lerner, 2001). This policy change dramatically increased the supply of venture funding in the ensuing years (Bygrave and Timmons, 1992). We concluded sample selection with the firms founded in 1995 but continued data collection for all firms until 2003. Because a venture typically takes five to seven years to experience a liquidation event after the first investment round (Fenn, Liang, and Prowse, 1997), ending with firms founded in 1995 enabled us to follow most sample firms through all funding rounds and gain a more complete picture of their actions.

Our unit of analysis was the funding round. Entrepreneurs form investment relationships at discrete points in time, termed funding rounds, because investors typically stage their financing of ventures into rounds that track a venture's progress and so limit the risks associated with such investments (Sahlman, 1990; Podolny, 2001), while entrepreneurs use discrete funding rounds to match investors' timing and limit distractions from running their firms (Graebner and Eisenhardt, 2004; Hallen, 2008). Data were collected for each venture's funding rounds through 2003 or until a liquidation event, an initial public offering or an acquisition, occurred.

Our primary source of data was the Venture Economics database, which provides detailed information about ventures,

firms investing in these ventures, and funding rounds. Venture Economics is a particularly appropriate choice for several reasons. First, it has been used extensively in prior research and has been shown to provide an accurate and comprehensive description of venture financing (Lerner, 1995). Various studies (e.g., Kaplan, Sensoy, and Stromberg, 2002) and our own analysis further show that the data are representative of the U.S. ventures that receive funding from professional investors. Second, Venture Economics was launched in 1969 and enables a study of an unusually long time period, 1979–2003, contributing to more robust results. Third, firms in Venture Economics receive funding from external investors and so are likely to have innovative technologies (Hellman and Puri, 2000) and, even more significant for our study, a choice among types of investor-partners.

We triangulated data from Venture Economics with data from VentureOne and Lexis-Nexis to develop a comprehensive and accurate database. The three databases rely on distinct yet complementary data sources. Investors provide Venture Economics data, entrepreneurs are the source of VentureOne data, and archived corporate press releases and media coverage are the source of Lexis-Nexis data. Both Venture Economics and VentureOne also cross-check their data (including investment amounts) with entrepreneurs, investors, and public sources. By using these complementary sources, we were able to use multiple informants for the same events and increase the completeness and accuracy of our data. For example, while investors are sometimes coded as "undisclosed" in Venture Economics, we were able to identify them in VentureOne or Lexis-Nexis. As did Lerner (1995) and Kaplan, Sensoy, and Stromberg (2002), we also examined possible chronological, geographic, and success biases in the two venture financing databases that may influence accuracy of the data. Consistent with this prior work, we found that Venture Economics was more likely to report earlier and VentureOne later rounds, but we did not find other major biases. Specifically, we did not find a systematic bias in geographical regions: neither Boston nor San Francisco was overrepresented, although Venture Economics was more likely to include fewer Massachusetts and VentureOne more California rounds. We also confirmed Kaplan, Sensoy, and Stromberg's (2002) observation that the databases did not oversample larger funding rounds or ventures that subsequently went public (eliminating a concern for success bias).

We began by forming the sample from Venture Economics data, then corroborated the information and identified missing investor and other information with data from VentureOne. Finally, if there was still missing or inconsistent information (e.g., undisclosed investors), we examined news articles and press releases in Lexis-Nexis to identify them. Overall, this coding effort of multiple data sources added information to roughly 20 percent of the rounds. As an additional check, we repeated the statistical analyses of our hypotheses using only data from Venture Economics and then only data from VentureOne. Both sets of results were strongly consistent with our reported findings from the combined database. As described later, we further supplemented these data with

information from other sources (e.g., Securities Data Corporation, Compustat, and Hoover's) to measure the independent variables and controls that were not captured in fundraising databases. The result is a uniquely refined and comprehensive database on corporate investment relationships in five industries over 25 years.

We drew a stratified random sample of 701 ventures from the population of technology ventures that received their first funding in 1979–1995. We stratified the sample by year and by five broad industry groups as designated in Venture Economics: medical, biotechnology, communications, electronics, and software. These five industry groups represent the largest technology industries during the study period and include over 80 percent of the technology ventures funded during this time. We chose the sample size using standard statistical power calculations to capture small size effects (Cohen, 1988; Green, 1991). The sample represents approximately 11 percent of the U.S. technology ventures funded during this time period. In all, these firms (approximately 140 in each industry) raised 18,168 investments in 4,077 funding rounds, our unit of analysis, between 1979 and 2003. Table 1 provides examples of ventures and corporate investors in our sample.

As part of this study, we also conducted interviews with five technology entrepreneurs, three VCs, four corporate venture

Table 1

Examples of Sample Ventures and Corporate Investors

Biotech	Communications	Medical	Electronics	Software
		Ventures		
Genzyme	Ascend Communications	Abaxis	ChipX	Clarify
Gilead	Auspex Communications	Acuson Corporation	Cirrus Logic	Electronic Arts
IDEC Pharmaceuticals	Bridge Communications	Aksys	Cymer	Great Plains Software
Immunex	Cascade Communications	Cephalon	Form Factor	Intuit
Isis Pharmaceuticals	Efficient Networks	Dura Pharmaceuticals	Global Imaging Systems	Object Design
Martex Biosciences	Grand Junction Networks	Endocardial Solutions	Sanmina-SCI Corporation	Rational Software
Matrix Pharmaceuticals	LCI Communications	Hologic	Silicon Wireless	Slate Corporation
Nanogen	Network Equipment Technologies	InSite Vision	Transmeta	Sybase
Tularik	StrataCom	SangStat Medical	Xilinx	Verisign
		Corporate Investors		
Abbot Labs	3Com	Abbot Labs	3M	Apple Computer
Baxter	Alltel	American Hospital Supply	AT&T	EMC
Dow Chemical	Ameritech	Baxter	Compaq	Fairchild
Eli Lilly	AT&T	Eli Lilly	General Electric	Hewlett Packard
Hoechst	Cisco	General Electric	General Motors	Hughes Aircraft
Johnson & Johnson	Motorola	Hoffmann-La Roche	HP	IBM
Procter & Gamble	Nokia	Johnson & Johnson	Medtronic	Microsoft
Sandoz	Nortel Networks	Medtronic	Philips	Nortel
Schering-Plough Corp.	Siemens	Raychem	Raytheon	Novell
Smith Kline Beecham	Tellabs	Smith Kline Beecham	Viacom	Xerox

investors, two business unit managers, a lawyer specializing in technology ventures, and an angel investor. This fieldwork supplemented our quantitative data collection. We also read news articles on corporate investments to understand these relationships better, and one author co-taught a master's level venture financing course several times with a VC partner.

Measures

The primary dependent variable is the likelihood that a new firm forms an investment relationship with an established firm (*corporate venture investment relationship)* in a round. It is a binary variable that equals one if a new firm receives a corporate investment in a funding round and zero if it does not. We captured both U.S. and foreign corporate investments, making our coverage more comprehensive than those studies that focus on U.S. investors only (e.g., Dushnitsky and Lenox, 2005a, 2005b). We coded investment partners as corporate if they provide equity (we excluded loans and public offerings) and are non-financial firms. This definition of corporate investors excludes subsidiaries of banks and insurance companies, for example, to focus on corporations with non-financial and potentially misaligned strategic interests.

We coded over 1,200 corporate investments. We used company directories, annual reports, and databases on public companies such as Compustat and Worldscope to identify the investors and the industries in which they operated. Two authors independently coded the data with the help of a computer program that matched inconsistent spellings and repeat investments. We also created two related dependent variable measures: the *number of corporate venture investors* and the *hazard rate to first corporate investor.*

Resource needs variables. We operationalized three independent variables to measure resource needs. We measured the new firm's *financial resource need* by the funding round amount in thousands of U.S. dollars. The round amount is an effective measure of the amount of capital needed because entrepreneurs determine the size of a funding round by trading off their capital requirements against unnecessary ownership dilution from raising excessive funding (Gompers and Sahlman, 2002). This tension keeps entrepreneurs from raising less funding than they need, and risking the viability of the new firm, or raising more than they need and ceding too much ownership to investors. We used the producer price index (PPI) to adjust the round amount for inflation and then logged it to mitigate skewness. We also computed an alternative measure: deviation of the financial resource need from the industry-mean for the round. The results we present below also hold for this alternative measure.

We measured *complementary resource need* by those operational resources that new firms often do not have but require to be viable. Because the need for specific complementary resources is associated closely with participation in specific industries (Arora and Gambardella, 1990; Katila and Shane, 2005) and these firm-level data are extremely difficult to collect in a multi-industry and multi-decade study such as ours, we measured this variable at the granular 4-digit Standard

Industrial Classification (SIC) code level. We also used alternative measures from a different source, noted below.

In our first set of measures, we identified two primary types of complementary resources that are frequently discussed in the literature: manufacturing and marketing (Geletkanycz and Hambrick, 1997; Gulati and Westphal, 1999). We measured *manufacturing resource need* by the capital intensity of the industry, because new firms in highly capital-intensive industries are likely to require greater manufacturing assets to commercialize their products. Our measure of capital intensity was the average ratio of fixed assets to sales in each industry yearly. We measured *marketing resource need* by the advertising intensity of each industry, because if the advertising intensity in the industry is high, product commercialization is likely to be marketing-intensive and require the joint exploitation of marketing resources and new technology. Our measure of advertising intensity was the average ratio of advertising expenditures to sales in each industry yearly. We collected these data from Compustat at the 4-digit SIC level.

To determine the industry for the above measures, we identified a primary SIC code for each new firm. Although Venture Economics assigns a broad industry classification for each new firm, it does not assign the more precise SIC codes that we use. Consequently, we collected SIC codes for each venture from Disclosure, Standard & Poor's, and Hoover's databases. When we were unable to locate a pre-assigned SIC code for a venture in any of these three databases, we mapped the venture's business description in Venture Economics and the industry classification that Venture Economics assigns to each venture to four-digit SIC codes following a matching procedure documented in Dushnitsky and Lenox (2005a). In total, our sample ventures operate in 64 different four-digit SIC categories.

We compiled alternative measures for complementary resource needs using alliance intensity data from the Securities Data Company (SDC). Alliance intensity is an excellent alternative measure because it reflects how likely the firms in an industry are to gain marketing or manufacturing resources from alliance partners. To construct the measures, we collected yearly alliance data for each four-digit SIC industry and created two alternative measures: *manufacturing alliance intensity* (number of manufacturing alliances/net sales in each industry yearly) and *marketing alliance intensity* (number of marketing alliances/net sales in each industry yearly). Because the SDC alliance data are only available from the year 1987 onward, we had to limit this robustness check to a smaller subsample. Despite the smaller sample, however, the results we present below also hold for these alternative measures of resource needs.

Defense-mechanism variables. We measured patent defense and secrecy defense using the Carnegie Mellon Survey of industrial R&D (Cohen, Nelson, and Walsh, 2000). The respondents (randomly selected R&D managers stratified by industry) estimated the effectiveness of defense mechanisms to protect technical inventions from imitation in their industry. Although the survey data are time-invariant, the

source is robust because the efficacy of particular defense mechanisms against appropriability within industries is stable (Gulati and Singh, 1998). Further, the collection date (1994) is at the approximate midpoint of our time range (1979–2003). Finally, the Carnegie survey has been used extensively in research (e.g., Gulati and Singh, 1998; Shane, 2002; Arora and Ceccagnoli, 2006) and is considered the primary source of comparative data on appropriability. Our measure of *patent defense* is the percentage of product inventions for which patents are considered an effective protection mechanism in a particular industry. Our measure of *secrecy defense* is the percentage of product inventions for which trade secrets are considered an effective protection mechanism in a particular industry. Because the Carnegie data are measured at the three-digit SIC level, we used three-digit values of patent defense and secrecy defense for the corresponding four-digit sublevels that we developed for each venture.

We measured the third mechanism, *timing defense,* by the investment round (e.g., first, second, etc.) and logged this variable to reduce skewness. We argued that it is easier for entrepreneurs to protect a more developed technology that is embodied in a product and for which technical and strategic agendas are established (Katila and Mang, 2003). Consequently, investment round is an appropriate measure of timing defense because it reflects the venture's maturity (Sahlman, 1990) and because the commercial and technical progress of the venture is the primary determinant of its ability to advance to the next round (Shane and Stuart, 2002). We also used an alternative measure, development stage (Gompers and Lerner, 2002), with similar results.

Controls. Prior work suggests that inertial behavior influences tie formation (Schoonhoven and Romanelli, 2001), and so we controlled for it. Consistent with other interorganizational relationship studies (Katila and Mang, 2003), we included a time-variant variable for *cumulative corporate investments* and measured it by the number of prior corporate investment relationships formed by each new firm. Because prior work also suggests that social embeddedness factors facilitate tie formation (Gulati, 1995a), we controlled for several of them. We controlled for whether the new firm was a spinoff of a corporation (*corporate background),* expecting that a spinoff with founders from an established firm is particularly likely to inherit connections and knowledge from its parent (Agarwal et al., 2004; Klepper and Sleeper, 2005; Beckman, Burton, and O'Reilly, 2007). We measured spinoff with a dummy variable set to one if the venture is a spinoff and zero otherwise. We also controlled for whether prominent VCs invested in the new firm, expecting that these VCs are more likely to be able to broker ties with established firms. Prominent VCs have central network positions (Stuart, Hoang, and Hybels, 1999) and are more likely to have prior connections to corporations (e.g., have prior deals together, have sold portfolio companies to them, or have syndicate partners with such connections) than less prominent VCs. We measured *prominent VC affiliation* by an investing VC's centrality in venture capital syndication networks. More details of this measure are provided in the Appendix. We also

controlled for regional entrepreneurial development (*region)*. We measured region as the new firm's geographic location in an entrepreneurially dense and sophisticated region. Because Boston and San Francisco outrank the other U.S. metropolitan regions in entrepreneurial development (Bygrave and Timmons, 1992; Gompers and Lerner, 2001), we measured region with a dummy variable coded as one if the new firm is located in Boston or San Francisco, and zero otherwise. The new firm's location (by zip code) was collected from Venture Economics (or if needed, from VentureOne and Lexis-Nexis) and was time-variant. Following Saxenian (1999), we defined Boston to include Middlesex, Norfolk, Suffolk, and Essex Counties and San Francisco to include San Francisco, Alameda, San Mateo, and Santa Clara Counties.

We controlled for *firm age* with data from Venture Economics on the number of months between the date when the venture began operations and the date of the investment round and logged this variable. We also collected *firm size* data, measured by number of employees yearly. Although employee data are available from Corporate Technology Directory only for about half of our firms, we confirmed our results with this reduced database. But because firm size and age are highly correlated and missing size data substantially reduce our sample size, we used firm age as the control.

We controlled for the *availability of venture capital* because the availability of venture funding may vary across industries and time and may influence the propensity to enter corporate investment relationships. We measured the variable by the total annual inflation-adjusted investment by VC firms in each of our five industries, in hundreds of millions of U.S. dollars, as reported by Venture Economics. We also included variables for the broad industry segments in which our sample firms operate to control for any other unobserved *industry effects.* We included controls for five segments—biotechnology, communications, software, electronics, and medical—based on venture SIC codes. In alternate tests, we also used variables based on the original Venture Economics categories and our results held.

Finally, we included controls for the year of the investment round to capture any *temporal effects* that might contribute to the likelihood of a corporate investment relationship, such as year-to-year variations in the supply of capital, beyond what we have directly controlled. Temporal effects were incorporated by using (unreported) dummy variables for the calendar years 1979–2003 (1995 is the omitted year).

Statistical Methods

We used logistic regression to test the likelihood that a new firm will form a corporate investment relationship in an investment round. We also used negative binomial regression to analyze whether the factors that predict the likelihood of entering a corporate investment relationship also predict the number of corporate investors that will be engaged in a funding round. In logistic and negative binomial regressions, the number of observations equals the total number of funding rounds in the sample.

Table 2

Descriptive Statistics and Correlations

Variable	Mean	S.D.	1	2	3	4	5	6	7	8	9	10	11	12
1. Likelihood of corporate venture investment	.22	.42												
2. Financial resource need (logged)	6.73	2.86	.18											
3. Manufacturing resource need	.62	.47	.01	.06										
4. Marketing resource need	.04	.04	.07	.06	.005									
5. Patent defense	40.4	9.79	.01	–.02	–.02	.15								
6. Secrecy defense	49.5	5.61	.08	.03	.05	.20	.05							
7. Timing defense (logged)	1.24	.76	.05	–.07	–.03	.01	–.002	.03						
8. Cumulative corporate investments	.004	.10	.06	.02	.01	–.003	–.02	.02	.03					
9. Corporate background	.09	.28	.06	.02	–.06	–.02	–.11	.08	.02	–.01				
10. Prominent VC affiliation	.30	.46	.05	.15	–.07	–.07	.02	–.03	.07	–.02	–.02			
11. Region	.44	.50	.04	.06	–.10	.11	–.04	.08	.03	–.003	–.03	.17		
12. Firm age (logged)	3.56	1.23	.03	–.03	–.01	–.02	–.01	–.03	.65	.03	–.07	–.02	–.04	
13. Availability of venture capital	12.6	40.6	.08	.17	.04	–.02	–.01	–.04	.11	.10	–.03	–.03	.04	.10

To control for venture heterogeneity, we used the Generalized Estimating Equations (GEE) regression method. The GEE method accounts for autocorrelation that arises because each venture is measured repeatedly across multiple funding rounds (Liang, Zeger, and Qaqish, 1986). The standard errors that we report are derived from the Huber/White robust estimator of variance, which is insensitive to the choice of the correlation structure in the GEE method. As a sensitivity test, we also ran a random effects estimation, which provided the same pattern of findings.[1] We report the GEE results, because unlike the random effects estimator, the GEE method does not require the strong assumption that the unobserved venture-specific effects are uncorrelated with the regressors.

To further probe the hypotheses, we analyzed the rate of the first corporate venture investment, using a Cox event history model (Cox, 1972). The venture is placed in the risk set upon the date of its founding, and the first corporate venture funding is the hazard event (Allison, 1984). As in the logistic and negative binomial regressions, the unit of analysis is the venture funding round. Unlike in the other two models, the venture leaves the risk set upon receiving its first corporate investment. Thus Cox regression allows us to isolate the potentially unique role of the first corporate investment in each venture.

RESULTS

Table 2 reports descriptive statistics and correlations for the variables (additional descriptive statistics are in the Appendix). The average amount raised in a funding round was approximately $4 million, and ventures raised capital in four to five funding rounds, on average. A typical funding round had four investors, and in one out of five rounds, at least one of the investors was a corporation. Corporations usually coinvested with VC firms (84 percent of the corporate rounds had both VC and corporate investors) but did not often coinvest with each other (only 25 percent of the corporate rounds had multiple corporate investors). Overall, the independent variables show considerable variance, and the correlation matrix indicates low correlations among the independent variables. The exception is the correlation between

1
Fixed effects models are not appropriate here for several reasons. First, such models exclude variables that do not vary across rounds in each venture panel, such as the patent defense variable. Second, because our sample includes several ventures for which the dependent variable does not vary over time—either the venture had no corporate investors in any round (45 percent) or had corporate investors in all rounds (2 percent)—fixed effects modeling would introduce sample selection bias. Lastly, fixed effects estimation is not recommended for studies with a large number of ventures and relatively short time panels, as in our sample (Greene, 2000).

timing defense and firm age variables (r = .65). Consequently, these variables were entered in the models both separately and simultaneously, but the results were unaffected by this choice.

Our sample distribution is similar to that of previous studies on investor-backed ventures (e.g., Gompers and Lerner, 2002). For instance, the mix of performance outcomes is comparable to previous studies: 36 percent of the ventures went public, 31 percent were acquired, 11 percent liquidated, and 22 percent remained private. Fifty-five percent of the ventures had a corporate investor in at least one funding round (only 2 percent had corporate investors in all rounds). Industry-by-industry distributions are available from the authors.

Table 3 reports the results for the GEE logistic regression analysis predicting the likelihood that a venture will enter a corporate investment relationship. Model 1 in table 3 includes the control variables only. We find that longer-tenured ventures (firm age), ventures with past corporate relationships (cumulative corporate investments), and those started by former corporate employees (corporate background) and funded by central VCs (prominent VC affiliation) are more likely to enter corporate investment relationships. The results also show that corporate relationships are more likely when VC funding (availability of venture capital) is more plentiful in the industry, indicating that corporate and VC investments are complements rather than substitutes. Further, ventures in biotechnology and electronics are more likely to form corporate investment relationships than those in the other industry segments that we studied. But the results show no significant evidence that entrepreneurs in the well-developed entrepreneurial regions of Boston and San Francisco are more likely to enter corporate investment relationships than entrepreneurs elsewhere. In an additional (unreported) regression, we also tested whether the results are sensitive to operationalization of region. Some research suggests that although Boston and San Francisco share many similarities, they also differ (e.g., Saxenian, 1994). We included separate coefficients for Boston and San Francisco and (in a different test) for other prolific entrepreneurial regions (i.e., San Diego and Seattle, consistent with our focus on technology ventures), with no significant changes in the results.

Model 2 introduces the resource needs variables, financial and complementary resources. We argued that corporate investment relationships are particularly attractive to entrepreneurs when they have unusually high financial resource needs (H1) and high complementary resource needs (H2). The coefficient for financial resource need is positive and significant in model 2 and in the full model 4, supporting hypothesis 1. Because corporate investors are uniquely positioned to provide large amounts of funding, entrepreneurs are more likely to enter corporate investment relationships in the funding rounds in which their funding needs are high.

To test hypothesis 2, that new firms with higher complementary resource needs (marketing and manufacturing) are more likely to enter corporate investment relationships, we

Table 3

GEE Logistic Analysis of the Likelihood of Corporate Venture Investment Relationship (N = 701 ventures, 4,077 funding rounds)*

Variable	Model 1	Model 2	Model 3	Model 4
Intercept	–2.49•••	–3.98•••	–3.56•••	–4.93•••
	(0.29)	(0.35)	(0.78)	(0.81)
Cooperation				
Financial resource need		0.18•••		0.18•••
		(0.02)		(0.02)
Manufacturing resource need		0.39••		0.44•••
		(0.18)		(0.18)
Marketing resource need		–1.16		–0.98
		(1.38)		(1.38)
Competition				
Patent defense			0.002	–0.002
			(0.01)	(0.01)
Secrecy defense			0.02••	0.02••
			(0.01)	(0.01)
Timing defense			0.15••	0.25•••
			(0.08)	(0.08)
Controls				
Cumulative corporate investments	4.61••	5.39••	4.68••	5.56
	(2.30)	(2.67)	(2.37)	(2.82)
Corporate background	0.63•••	0.63•••	0.60•••	0.57
	(0.18)	(0.19)	(0.18)	(0.19)
Prominent VC affiliation	0.28•••	0.12	0.27•••	0.10
	(0.09)	(0.10)	(0.09)	(0.10)
Region	0.09	0.08	0.06	0.05
	(0.12)	(0.12)	(0.12)	(0.12)
Firm age	0.18•••	0.18•••	0.12••	0.08
	(0.04)	(0.04)	(0.05)	(0.05)
Availability of venture capital	0.002••	0.001	0.003••	0.001
	(0.001)	(0.001)	(0.001)	(0.001)
Biotechnology	0.86•••	0.81•••	0.78•••	0.74
	(0.19)	(0.21)	(0.20)	(0.22)
Communications	–0.30	–1.04••	–0.24	–1.09
	(0.31)	(0.45)	(0.32)	(0.47)
Electronics	0.54•••	0.55•••	0.54•••	0.50
	(0.19)	(0.20)	(0.21)	(0.22)
Software	0.08	0.15	0.22	0.29
	(0.20)	(0.20)	(0.21)	(0.22)
Wald chi square	127.0	218.1	133.9	231.6

• $p < .10$; •• $p < .05$; ••• $p < .01$; one-tailed tests for main effects, two-tailed tests for controls.
* Robust standard errors are in parentheses. All models include unreported temporal effects.

assessed the coefficients in model 2. The coefficient for manufacturing resource need is positive and significant at the $p < .05$ level in model 2 and at the $p < .01$ level in the full model 4, supporting the hypothesis. The coefficient for marketing resource need is not significant in either model. To further assess the effects of complementary resource needs, we examined alternative measures using alliance intensities compiled from the SDC database, as described earlier. Because SDC alliance data are only available from 1987, we limited this robustness check to a subsample for 1987–2003 (3,086 funding rounds). The influence of manufacturing alliance intensity and the related manufacturing resource need was robust despite the 25-percent reduction in sample size. Manufacturing alliance intensity had a positive and significant ($p < .01$) effect on the likelihood of forming a corporate investment relationship. Marketing alliance intensity had, unexpectedly, a negative and significant effect ($p < .01$). We return to these results in the Discussion.

Hypothesis 3 proposed a hierarchical ordering that reflected the preferences of both parties—i.e., complementary resource needs are more influential than financial resource needs in the formation of a corporate investment relationship. Because the coefficient for marketing resources was not significant in our main tests, to test hypothesis 3, we compared the relative ordering of the two significant resource needs, financial and manufacturing resources. Because the logistic model reports coefficients indicating the effect that a one-unit change in a covariate has on the log odds of relationship formation, the regression coefficients are not directly comparable. To compare them, we translated the log odds into values indicating the probability of relationship formation resulting from a change in the independent variable, using a formula suggested by Petersen (1985). The coefficients used to estimate the changes in probabilities are those from model 4, and the probabilities are evaluated at the mean of the dependent variable. In contrast with hypothesis 3, the need for financial resources is a more significant predictor of relationship formation than the need for manufacturing resources. A one-standard-deviation increase in financial resources increases the probability of relationship formation by 10 percent. A one-standard-deviation change in manufacturing resource needs increases the probability by 4 percent. Finally, we examined the influence of combinations of simultaneous resource needs by testing interactions between the three resource needs (pairing each with another). No interaction is significant at the $p < .05$ level, suggesting that resource needs have independent effects.

Model 3 in table 3 introduces the defense mechanism variables. We argued that new firms are likely to anticipate that established firms have strategic interests related to technology resources and may misappropriate these resources, and so new firms rely on defense mechanisms to mitigate this possibility. We examined three defense mechanisms (i.e., patents, secrecy, and timing) that new firms are likely to use to protect their technology. Hypothesis 4a proposed that new firms will enter relationships when patents are a strong defense mechanism. The coefficient for patent defense is not statistically significant in either model 3 or in the full model 4. The hypothesis is not supported. In contrast, the positive and statistically significant coefficient ($p < .05$) for secrecy defense (H4b) in models 3 and 4 indicates that entrepreneurs are more likely to enter corporate investment relationships when trade secrets provide a shield against appropriation of intellectual property by corporate partners, supporting hypothesis 4b.

Hypothesis 5 predicted that the timing of corporate investment relationships in later funding rounds would protect the new firm's technology resources because entrepreneurs in later rounds are more likely to have embodied the firm's intellectual property, related technologies, and knowledge into tangible products and well-known technical and strategic agendas. To test this hypothesis, we added timing defense to model 3. The positive and significant relationship between timing defense and tie formation in model 3 ($p < .05$) and in model 4 ($p < .01$) confirms the hypothesis.

To test hypothesis 6 on the relative influence of defense mechanisms, given the preferences of both parties, we focused on the two significant ones: secrecy and timing. Similar to our examination of the relative influence of resource needs (H3), we made several comparisons. First, Petersen's (1985) formula confirmed that late timing is a more significant predictor of relationship formation than trade secrecy protection. A one-standard-deviation increase in timing increased the probability of relationship formation by 4 percent, while a one-standard-deviation increase in secrecy increased the probability by 2 percent. Second, we examined the influence of combinations of defense mechanisms by testing interactions between mechanisms. None is significant at the $p < .05$ level, indicating that their effects are independent. Thus hypothesis 6 is supported.

Tables 4 and 5 report the results for the negative binomial and Cox regression analyses for the number of corporate investors and the hazard to first corporate investment,

Table 4

GEE Negative Binomial Regression Analysis of the Number of Corporate Investors (N = 701 ventures, 4,077 funding rounds)*

Variable	Model 1	Model 2	Model 3	Model 4
Intercept	–2.55•••	–3.76•••	–3.25•••	–4.23•••
	(0.21)	(0.24)	(0.51)	(0.51)
Cooperation				
Financial resource need		0.13•••		0.13•••
		(0.01)		(0.01)
Manufacturing resource need		0.63•••		0.65•••
		(0.07)		(0.07)
Marketing resource need		–0.37		–0.36
		(0.78)		(0.77)
Competition				
Patent defense			0.0001	–0.003
			(0.01)	(0.01)
Secrecy defense			0.01••	0.01••
			(0.01)	(0.01)
Timing defense			0.07•	0.17•••
			(0.05)	(0.05)
Controls				
Cumulative corporate investments	0.29	0.62••	0.28	0.61••
	(0.27)	(0.26)	(0.27)	(0.25)
Corporate background	0.42•••	0.38•••	0.39•••	0.26•••
	(0.09)	(0.09)	(0.09)	(0.10)
Prominent VC affiliation	0.22•••	0.12••	0.21•••	0.10•
	(0.06)	(0.06)	(0.06)	(0.06)
Region	0.22•••	0.16••	0.23•••	0.12•
	(0.06)	(0.07)	(0.06)	(0.07)
Firm age	0.12•••	0.12•••	0.09•••	0.05
	(0.03)	(0.03)	(0.03)	(0.04)
Availability of venture capital	0.002•••	0.0002	0.002•••	0.0001
	(0.001)	(0.001)	(0.001)	(0.001)
Biotechnology	0.45•••	0.32••	0.39•••	0.27•
	(0.13)	(0.14)	(0.14)	(0.14)
Communications	–0.001	–1.03•••	0.01	–1.10•••
	(0.21)	(0.26)	(0.22)	(0.27)
Electronics	0.45•••	0.42•••	0.41•••	0.37•••
	(0.13)	(0.13)	(0.14)	(0.14)
Software	0.12	0.12	0.21	0.20
	(0.14)	(0.14)	(0.15)	(0.15)
Deviance	2657	2492	2654	2478

• $p < .10$; •• $p < .05$; ••• $p < .01$; one-tailed tests for main effects, two-tailed tests for controls.
* Robust standard errors are in parentheses. All models include unreported temporal effects.

respectively. The negative binomial results in table 4 are similar to the logistic regression results in table 3. Entrepreneurial region also now has consistently positive effects. The Cox results for the first corporate investment in table 5 also support our main findings. Together, these analyses provide strong confirmation of our main results.

Table 6 reports the findings for hypothesis 7, which predicted that new firms are more likely to form a corporate investment relationship when the preferences of the two firms are mutually reinforcing: when there are mutually desirable resources, then ties are especially likely when there are also mutually desirable defenses. We tested this hypothesis by interacting resource needs with defense mechanisms. We constructed the interactions using the product-term approach (Jaccard, Turrisi, and Wan, 1990) and addressed potential multicollinearity between main effects and interaction terms by centering the variables prior to calculating the interaction, as recommended by Cronbach (1987). Because multicollinearity across interaction terms can be a concern, we tested the interactions in separate models (Gulati and Gargiulo, 1999). We began with the interaction between the resource need (manufacturing) and the defense mechanism (timing) that we hypothesized to be most mutually preferred

Table 5

Cox Regression Analysis of the Hazard of First Corporate Investment (N = 674 ventures, 357 failures, 2,630 funding rounds)*

Variable	Model 1	Model 2	Model 3	Model 4
Cooperation				
Financial resource need		0.22•••		0.22•••
		(0.03)		(0.03)
Manufacturing resource need		0.23		0.30•
		(0.22)		(0.22)
Marketing resource need		–0.18		0.12
		(1.50)		(1.48)
Competition				
Patent defense			–0.01	–0.01
			(0.01)	(0.01)
Secrecy defense			0.03••	0.02••
			(0.01)	(0.01)
Timing defense			0.42•••	0.49•••
			(0.09)	(0.09)
Controls				
Corporate background	0.79•••	0.78•••	0.62•••	0.60•••
	(0.18)	(0.18)	(0.18)	(0.18)
Prominent VC affiliation	0.22•	0.07	0.17	–0.002
	(0.12)	(0.12)	(0.12)	(0.12)
Region	0.18	0.14	0.10	0.05
	(0.11)	(0.11)	(0.11)	(0.11)
Availability of venture capital	0.003	0.001	0.003	0.002
	(0.002)	(0.002)	(0.002)	(0.002)
Biotechnology	0.73•••	0.69•••	0.68•••	0.60•••
	(0.18)	(0.21)	(0.19)	(0.22)
Communications	–0.24	–0.73	–0.16	–0.78
	(0.29)	(0.48)	(0.30)	(0.49)
Electronics	0.41•••	0.34•	0.37•	0.28
	(0.18)	(0.19)	(0.20)	(0.20)
Software	–0.09	–0.09	0.12	0.11
	(0.19)	(0.20)	(0.20)	(0.21)
Log likelihood	–2038.0	–2008.8	–2025.2	–1992.1

• $p < .10$; •• $p < .05$; ••• $p < .01$; one-tailed tests for main effects, two-tailed tests for controls.
* Standard errors are in parentheses. All models include unreported temporal effects.

Table 6

GEE Logistic Regression Analysis of the Likelihood of Corporate Venture Investment Relationship (Interactions)*

Variable	Model 1	Model 2
Intercept	–2.21•••	–2.25•••
	(0.34)	(0.34)
Cooperation		
Financial resource need	0.17•••	0.19•••
	(0.02)	(0.03)
Manufacturing resource need	0.44••	0.43••
	(0.22)	(0.22)
Marketing resource need	–1.02	–1.06
	(1.48)	(1.46)
Competition		
Patent defense	–0.003	0.01
	(0.01)	(0.01)
Secrecy defense	0.02••	0.02••
	(0.01)	(0.01)
Timing defense	0.19•	0.27•••
	(0.08)	(0.08)
Cooperation × Competition		
Financial resource need × Timing defense	0.07•••	
	(0.03)	
Financial resource need × Patent defense		–0.004•
		(0.003)
Controls		
Cumulative corporate investments	5.24•••	5.56•••
	(0.41)	(0.38)
Corporate background	0.56•••	0.58•••
	(0.18)	(0.18)
Prominent VC affiliation	0.10	0.09
	(0.10)	(0.10)
Region	0.01	0.04
	(0.12)	(0.12)
Firm age	0.10•	0.08
	(0.05)	(0.05)
Availability of venture capital	0.001	0.10
	(0.001)	(0.10)
Biotechnology	0.68•••	0.75•••
	(0.23)	(0.23)
Communications	–1.15••	–1.11••
	(0.49)	(0.50)
Electronics	0.47••	0.51••
	(0.22)	(0.22)
Software	0.26	0.30
	(0.22)	(0.21)
Wald chi square	329.2	352.8

• $p < .10$; •• $p < .05$; ••• $p < .01$; one-tailed tests for main effects, two-tailed tests for controls.

* Robust standard errors are in parentheses. All models include unreported temporal effects.

by both partners. This coefficient (in unreported results) was positive but not significant. But because our empirical results above showed that the most influential resource was financial (not manufacturing) and the most influential defense mechanism was timing (as hypothesized), we conducted an alternative test by interacting financial resource need and timing defense. We report the logistic regression results in table 6 (Cox and negative binomial results have the same pattern but are not included to save space). Most striking, the positive and statistically significant ($p < .01$) interaction between financial resource needs and timing defense (model 1) sup-

ports the argument that new firms are more likely to form corporate investment relationships when new firms and their corporate partners have preferences for resource needs (i.e., financial) and defense mechanisms (i.e., timing) that are acceptable to both partners. To examine the asymmetric prediction—that ties are less likely to form when one party gains (or loses) more than the other—we paired a venture favorite (i.e., financial resource need) and corporate repellent (i.e., patent defense). As expected, the interaction between financial resources and patent defense in model 2 has a negative, moderately significant ($p < .10$) coefficient. Together, these findings in models 1 and 2 provide support for hypothesis 7, showing that new firms are especially likely to form ties when the combination of resource needs and defense mechanisms is mutually acceptable to both firms.

Additional Analyses

We conducted additional analyses to explore our findings further. First, we examined whether financial resource need and timing defense move in lock step, so that larger investment rounds come later. Several tests suggest that this is unlikely. First, the correlation between financial resource need and timing defense variables is negative and low (table 2), reducing concerns about relatedness. Second, each variable is a significant predictor of tie formation alone and together, further supporting their distinct effects (Kennedy, 1998: 162). Third, we obtained the variance inflation factors (VIF) for all independent variables in our models (Menard, 2002). All were less than 5.0, the recommended cutoff value (e.g., VIF for financial resource need was 1.09 and for timing defense was 2.07), indicating that the variables are unrelated. Finally, we examined the qualitative evidence from our fieldwork. These data suggest much variety in the temporal pattern of financial resource needs. For example, one software firm raised a very large amount in an initial round, to acquire several key technologies, and then had subsequent, smaller rounds. A telecom venture raised a large amount in an early round to fund a very large-scale technical development in high-capacity routers that required contracting with over 100 engineers, then had a small round, and finished with a moderate round. Still another firm had smaller funding rounds early on and then increased their size. Thus, consistent with the quantitative evidence, we observed a variety of temporal patterns in round amounts. Overall, we conclude that timing defense and financial resource needs are independent predictors of relationship formation.[2]

Second, we conducted a dyad-level analysis of which specific pairs of new and established firms choose to partner with each other to gain insight into the investing firms, including whether these firms consider these ties as financial transactions rather than strategic relationships, as we have argued. We summarize the dyad results here for a subsample for which data were available and provide methods details and results in the Appendix. First, consistent with prior interorganizational research (e.g., Gulati, 1995b), the dyad analysis showed that pairs of new firms and established firms that had partnered previously were more likely to partner, consistent with a strategic relationship. The pairs that partnered

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Another possibility suggested by an anonymous reviewer is that new firms do not take corporate investors early on because they might lose financial control of their firms to their corporate investor. This, however, seems unlikely, because new firms typically raise only what they need to avoid excess dilution regardless of the investor type involved, and established firms often invest at lower valuations than other investors (Gompers and Lerner, 2002).

were also geographically proximate and in related businesses (likely to have complementary resources) and thus had opportunities and motivation for interaction beyond a financial transaction. Third, corporations with high R&D expenditures were more likely to form relationships, suggesting that these ties were a complement to the corporation's own R&D, consistent with many studies and our own fieldwork, emphasizing that corporate investment relationships are primarily strategic (not financial) relationships related to the technology interests of the established firm. Corporations with excess financial resources (free cash flow) were also more likely to form ties, further bolstering H1, on their ability to provide large cash infusions. Thus our dyadic analysis is consistent with corporate investment as a strategic relationship in which established firms are primarily motivated by access to the technology of new firms and are particularly able to provide the resources needed by new firms (i.e., out-sized financial and complementary resources).

Finally, we ran additional analyses to test the robustness of the results. We ran models without the industry segment controls that were in the original regressions and models that substituted them for industry-level independent variables (i.e., complementary resources, patents, secrecy). These additional analyses (available from the authors) supported our results.

DISCUSSION AND CONCLUSION

We examined the entrepreneur's choice to enter corporate investment relationships. Specifically, we focused on the tension between cooperation and competition at the time of relationship formation and explored this tension in 701 new firms in five technology-based industries over a 25-year period. We have several findings. From a cooperative perspective, new firms enter these relationships when they can obtain out-sized financial and manufacturing resources. From a competitive perspective, new firms enter these relationships when they can defend against potential resource misappropriation with the distinctive defense mechanisms of trade secrets and timing. These often overlooked defense mechanisms differ from those of established firms, such as patents. We also indicate that some resource needs and defense mechanisms are more important than others—i.e., hierarchies emerge—and that interorganizational relationships are inherently integrative negotiations—the convergent preferences of the partners are synergistic and reinforcing.

This study provides important advances for resource dependence theorists studying relationship formation. Resource dependence theorists have focused on the resource needs that push firms to form ties and so have emphasized the cooperative side of ties. But they have overlooked that firms also anticipate the potential for damaging appropriation of their resources and so have left the competitive side unexplored. In response, we add the potential for resource misappropriation and include multiple types of resources, defense mechanisms, and partners.

Our findings contribute to the recent renaissance of resource dependence theory (e.g., Casciaro and Piskorski, 2005; Gulati

and Sytch, 2007; Ozcan and Eisenhardt, 2008) in several ways. First, we introduce the sharks dilemma. By examining multiple types of partners, we find that firms swim with sharks rather than safer partners when they need the unique resources that sharks possess and can protect themselves with tailored defense mechanisms that maintain their power within the relationship. Conversely, firms avoid relationships that offer too little resource benefit or entail too much risk. Second, we add the risk of potentially damaging misappropriation of the firm's own resources to the benefits of gaining resources at the pivotal time of tie formation. Past research emphasizes resource needs at the time of tie formation (Gulati, 1995b; Eisenhardt and Schoonhoven, 1996) and defense mechanisms during the relationship (Hamel, 1991; Gulati and Singh, 1998). In contrast, we show that firms simultaneously consider both resource needs and defense mechanisms when they consider forming relationships. Thus they balance the fundamental tension between cooperation and competition.

Unique Defense Mechanisms to Sustain Power

A core insight is the unique configuration of defense mechanisms that new firms use to counteract the potential misappropriation of their resources. From this competitive perspective, we find that new firms are more likely to enter corporate investment relationships when they anticipate that they can protect their technology resources through specific defense mechanisms: trade secrets and timing. Trade secrets, an often overlooked defense mechanism, build a legal barrier around key resources that prevents those resources from being revealed in a public manner. Timing the relationships to occur in later rounds, in turn, gives new firms more defensible resources and a more secure strategic agenda. Indeed, several interviewed VCs stated that they actively discourage corporate investment in immature ventures because these fledgling firms are too vulnerable. As one said, "A venture needs to be strong enough, independent enough, before it takes a corporate investor. Or else the venture becomes a development arm for the corporation." Similarly, an entrepreneur noted the issue from the view of venture strategy, "I don't think you want to have strategics [corporate investors] as the main people initially because then you'll just have too many people steering the bus."

In comparison with the common defense mechanisms of established firms, such as equity ownership (Gulati and Singh, 1998) and patenting (Katila, 2002), timing and secrecy are particularly suited to ventures. For example, they are relatively inexpensive to use. By revealing technology resources later and selectively to specific firms, they rely on restricting information to protect resources rather than on litigation. In comparison with the common approach of established firms of dealing with misappropriation during relationships, anticipation of misappropriation at tie formation is more realistic for ventures. Litigation is costly, ties cannot be easily broken before a liquidity event, and corporate partners often refuse board seats to avoid a fiduciary responsibility to the venture. Overall, entrepreneurs create a unique and well-suited strategy to defend their resources by focusing on tie formation,

anticipating misappropriation, and relying on secrecy and timing.

In contrast, we unexpectedly found that patent regime strength does not influence whether new firms form corporate investment relationships. Although we anticipated that patenting would be less important than timing and secrecy, it was not significant. In addition to the high expense of patent filing and enforcement and corporate preferences for ventures with weak patent regimes (Dushnitsky and Lenox, 2005a), our fieldwork suggests a crucial competitive reason: even though patents are legally defensible, they place information in the public domain that reduces the surprise that is often essential to competitive success, especially for new firms. In contrast, timing and secrecy enable new firms to restrict competitive information to later rounds and to firms of their own choosing. Thus while new firms may use patents as "currency" to buy and sell technology or as competence signals, they consider less expensive, faster, and information-asymmetric mechanisms (i.e., secrecy and timing) in their tie formation choices.

We also offer a distinctly different view of equity investment from previous research. Research often treats equity investment as a defense mechanism, a governance form that established firms use to control their partners (Pisano, 1990; Gulati and Singh, 1998). By taking an equity position, firms coalign their partners' incentives with their own and create hierarchical governance. Yet our findings suggest that this view misses the crucial point that equity investment is not always a defense mechanism. Rather, corporate investment relationships are exchanges in which established firms give uniquely large financial and operational resources in exchange for access to the new firm's technological resources. So financial resources are an essential feature of the exchange that motivates ties between new and established firms.

Broadly, our lens on resource misappropriation extends the core logic of resource dependence theory. Resource dependence theorists studying interorganizational relationships have focused on how firms decrease uncertainty by forming ties to gain needed resources from their environments (Pfeffer and Salancik, 1978). Our contribution is in recognizing that these ties also increase uncertainty by enhancing the likelihood of unwanted resource appropriation. If successful, these actions alter the control of resources and ultimately lessen partners' dependence on the focal firm. Thus the potential for resource misappropriation adds a new source of uncertainty for the resource owner and may diminish its power in the future. Because defense mechanisms mitigate this risk, their availability enhances the likelihood of tie formation, as firms anticipate that they can control their resources and maintain their power in their relationships. There are three key points: (1) executives anticipate the uncertainty of maintaining the dependence of their partners and their own power created by the potential for misappropriation, (2) they form ties when defense mechanisms are available to lower this uncertainty, and (3) defense mechanisms are a focal weapon by which firms sustain their power in relationships. Thus adding the potential misappropriation of resources and

a competitive lens on tie formation are key extensions to the core logic of resource dependence.

Multiple Resources, Bilateral Preferences, and Gaining Power

A closely related core contribution is bringing resources back to the forefront of relationship formation. We found that new firms are more likely to form corporate investment relationships when the push for ties is amplified by multiple resource needs—out-sized financial resources and complementary manufacturing resources that established firms uniquely provide. We also observed the key insight of resource inequality—some resources are more crucial for tie formation than others. As expected, we found that manufacturing resources are more significant than marketing resources. By considering the preferences of both parties, we also offer bilateral insight into why this resource hierarchy emerges. Established firms are likely to prefer manufacturing resources because they offer a better, earlier window into the new firm's technologies. New firms are likely to prefer them because they are often expensive and slow to create, important to operational success, and uniquely available from corporations. In contrast, marketing resources do not have the strategic value that established firms seek because these resources are used downstream from the technical development activity that is usually the primary interest. New firms may also prefer non-equity ties to obtain marketing resources because these ties limit ownership dilution and can be more easily ended.

Contrary to our expectations, we found that financial resources, with their greater fungibility, are the most significant resource for tie formation. For new firms, this preference is clear. Financial resources offer very desirable flexibility and, unlike the use of complementary resources, do not involve sensitive intellectual property. But for the corporation, this preference is not so clear. One reason may be that established firms view corporate investment relationships as financial transactions. But as noted earlier, many studies of corporate investment relationships (Dushnitsky and Lenox, 2005a, 2005b; Wadwha and Kotha, 2006), our fieldwork and dyadic analysis, lower valuations accepted by corporate investors (Gompers and Lerner, 2002), and even wide use of the term "strategics" for corporate investors suggest that this is not the case. Their motivation is primarily strategic. As a chemical firm executive described to us, "Investment in [a startup] gives us a unique window on how this emerging field is developing as well as enables us to influence its activities in directions that are of interest to us far beyond what is afforded us in typical R&D contracts." Another reason may be that financial resources give the established firm some access into the venture's technology resources via arrangements such as observer seats. But a more controversial reason may be that established firms have less power in these ties than expected, making new firms' preferences (e.g., for financial resources) more influential. Consistent with this view, a corporate executive described how his firm competed for ties, "What we try to do structurally is make sure our term sheets are very vanilla and that we don't look for any

unusual M&A rights or rights of information. . . . We are also very open to having [another corporate investor] as one of the co-investors with us to make sure it doesn't seem like just [our] vehicle. That's very comforting for them [the entrepreneurs]. We are very upfront. We don't look for exclusivity. That really puts them at ease." Overall, the key point is that highly desirable new firms may actually be the more powerful partner and dominant decision maker in corporate investment relationships. This is a path for future research.

More broadly, our study of multiple resources and partners' resource preferences elaborates the core cooperative logic of resource dependence. Recent research on tie formation, while acknowledging resource interdependence, has focused on social embeddedness (Gulati, 1995b) and on the importance of ties for firms' outcomes (Stuart, Hoang, and Hybels, 1999; Baum, Calabrese, and Silverman, 2000). In contrast, we showcase resources by highlighting that resources are multiple and unequal (i.e., they fall into hierarchies of importance), and relationships are bilateral (i.e., integration of resource and defense preferences is a prerequisite to forming ties). By refocusing on resources, we develop new testable hypotheses (e.g., on hierarchies) within resource dependence theory and create a realistic view of relationship formation as an integrative negotiation in which the outcome depends on resource needs, defense mechanisms, and alternative partners.

Toward a Richer View of Entrepreneurs

This study also provides important advances for entrepreneurship scholars studying resource mobilization. Scholars often portray new firms as passive bystanders in their relationships with established firms and so have largely left unexamined entrepreneurs as key decision makers. In response, we take the entrepreneur's side. Doing so leads us to question two pieces of conventional wisdom.

One is that entrepreneurs are weak partners dominated by powerful established firms. Though some firms may be weak, the ones in which established firms are most interested are often not. In our quantitative analysis, we found that the resource preferences of new firms (for financial resources) are particularly significant, even when they may not be the preferences of established firms. Intriguingly, new firms also use distinctive defense mechanisms (not those of established firms) to protect their resources and maintain their power in relationships. Our interviews provided further confirmation of the active role of new firm partners. For example, a software entrepreneur described his role in selecting corporate investors, "What we needed was at least one good brand name. We wanted a mix of people who would be useful from a business perspective." Another entrepreneur described choosing among corporate investors, "I think it is exactly like when you are weighing multiple job offers. It is a complex model, and one piece of it is how much money are they going to put in for what percentage of the company. Other pieces include how will they [corporate investors] get along with other investors that you might bring along down the road? And how have they behaved with

other entrepreneurs in companies?" Together, our fieldwork and quantitative analysis indicate that new firms are shapers of their own destiny. Thus, we join the nascent research stream emphasizing the active, influential role of new firms in resource acquisition (Zott and Huy, 2007; Hallen, 2008; Katila and Cox, 2008) and the unique strategies by which they create and sustain power (Katila and Mang, 2003; Graebner and Eisenhardt, 2004; Ozcan and Eisenhardt, 2008; Santos and Eisenhardt, 2008).

The other piece of conventional wisdom that we challenge is the overly optimistic view of ties with established firms that pervades the literature. Research indicates that new firms accelerate product development, are more innovative, and have more rapid IPOs when they have ties with established firms (Eisenhardt and Schoonhoven, 1996; Stuart, Hoang, and Hybels, 1999; Baum, Calabrese, and Silverman, 2000). Though these benefits are clearly real, entrepreneurs also pay close attention to tie formation and avoid relationships with too little benefit or too much risk. As an entrepreneur said to us, "I just don't think their [corporate partner's] interests are with you 100 percent."

The many studies of interorganizational relationships reflect their ubiquitous significance for many firms in many industries. Yet the fundamental tension during tie formation between cooperation that satisfies resource needs and competition that creates the potential for resource misappropriation that makes relationships both useful and challenging has been neglected. By exploring this tension in new firms, we hope to help invigorate resource dependence theory and to illuminate the surprising power of some entrepreneurial firms that are strong enough to swim with sharks.

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APPENDIX

Prominent VC affiliation. We used a VC's eigenvector centrality in venture capital syndication networks (Bonacich, 1972; Hochberg, Ljungqvist, and Lu, 2007) to rank the prominence of a VC. Because research has shown that VCs have their most impact on ventures in the early stage (Bygrave and Timmons, 1992), and because we studied technology ventures for which early-stage investments are particularly crucial (e.g., Sorenson and Stuart, 2001), we ranked early-stage VC firms that invested in research, product development, and initial manufacturing phases (VC firms typically specialize either in early-stage or in late-stage investments). We measured centrality by identifying the ten most central early-stage venture capital firms and then coded a dummy variable that equals one when at least one of the ten central firms invests in the new firm's funding round and equals zero otherwise. The results are also robust across various alternative measures of centrality. We also verified the temporal stability of centrality by confirming that centrality gave similar results over various subperiods in the study and that all central VC firms were investing over the entire study period. All were but one, but because this one had invested since its founding in 1983, it covers most of our study period. We also tested different groupings of venture capital centrality, including the top five, ten, twenty, and thirty firms, and found similar results. We showed the lists to a venture capitalist and to an angel investor, both of whom had extensive venture investment experience, who confirmed the validity of our groupings. We also measured centrality by using continuous rankings for all venture capitalists and obtained similar but slightly weaker results.

Dyad analyses. Dyad-level analyses answer questions about the likelihood that a particular pair of firms (typically labeled firms i and j) forms a relationship. Consistent with prior work that has estimated dyad models (e.g., Gulati and Gargiulo, 1999), we first created venture-by-investor relationship matrices for each funding round in each of the five industries. The cell in each of the matrices takes a value of one if a relationship forms between the two firms in the dyad. Each dyad-round record consists of this dependent variable, along with covariates characterizing the dyad. Because we had no a priori criteria to determine which types of corporations should be included in the risk set of investors in each industry, we included a set that comprises all public U.S. corporate investors that invested in a particular industry in our data. We excluded the foreign corporate investors that were included in the firm-level analyses because limited data were available on them. In total, we have approximately 150,000 dyad observations in our data. To estimate the dyad models, we used a random effects probit regression (Gulati and Gargiulo, 1999).

We included several dyad-level measures. We measured business relatedness by a dummy variable that takes a value of one if both the venture and the corporation in the dyad operate in the same industry. We measured industry using the primary 2-digit SIC code (Palepu, 1985). We measured repeated tie by a dummy variable that takes a value of one if the young and the established firm had partnered previously. As did Sorenson and Stuart (2001), we also measured geographic distance between each venture and each corporate investor in miles, using headquarters location (Kono et al., 1998). Overall, findings in this dyad analysis, which only focused on public U.S. corporate investors, strongly supported our other findings.

Table A.1

Random-effects Probit Analysis of the Likelihood of Investment in a Dyad Round*

Variable	
Intercept	–2.75•••
	(0.18)
Corporate cash flow (logged)	0.03•••
	(0.01)
Corporate R&D expenditure	0.04••
	(0.02)
Business relatedness	0.16•••
	(0.04)
Repeated tie	2.09•••
	(0.06)
Geographic distance (logged)	–0.06•••
	(0.02)
Availability of venture capital	0.002
	(0.006)
Prominent VC affiliation	0.08•
	(0.04)
Firm age	–0.02
	(0.02)
Wald chi square	1188

• $p < .10$; •• $p < .05$; ••• $p < .01$; one-tailed tests for main effects, two-tailed tests for controls.
* 119,718 dyad round observations. Robust standard errors are in parentheses. All models include unreported temporal and industry effects.

Distribution of the sample. In total, our sample ventures operated in 64 different four-digit SIC categories. The biotechnology industry includes biotechnology equipment and research, biosensors, and biotechnology products for humans, animals, and industrial applications (major two-digit SICs 28, 87). The medical industry includes diagnostics, therapeutics, pharmaceuticals, and other medical products and services (38, 80, some 28). The electronics industry includes semiconductors and other electronics, such as fiber optics, optoelectronics, laser-related devices, power supplies, and instrumentation (35, some 36 and 38). The communications industry includes commercial communications, telephony, wireless, data services, and satellite communications (48, some 35 and 36). The software industry includes software, software tools, and software services (73).

We also explored our data for industry insights (table A.2). We compared electronics and communications ventures because our data indicate that both industries have high resource needs, but only moderately defensible technologies, and the tension between cooperation and competition that is central to our study is especially acute in these industries. Yet despite their similarities, electronics ventures (many of which are semiconductor firms)

Table A.2

Characteristics of the Sample by Industry Segment

	Industry Segment				
Characteristics of the sample	Biotech	Electronics	Comm.	Software	Medical
Status of sample ventures at end of data collection					
Acquired	0.18	0.30	0.44	0.40	0.31
Went public	0.60	0.34	0.11	0.23	0.34
Defunct	0.07	0.15	0.09	0.08	0.11
Characteristics of entire sample (all rounds)					
Average number of rounds	4.41	4.60	3.70	4.89	4.90
Amount invested in round in M$	4.76	5.00	7.85	3.06	2.78
Rounds with multiple CVCs	0.04	0.07	0.05	0.03	0.01
Rounds with one CVC	0.22	0.16	0.14	0.14	0.12
Characteristics of corporate rounds					
Amount invested by corporation(s) in M$	3.55	2.84	3.62	1.68	2.52
Number of corporate investors in round	1.19	1.50	1.33	1.27	1.12

were more likely and communications ventures were less likely to partner. Our field interviews (and descriptive data in table A.2) suggest that one reason is a difference in available partners. Electronics ventures form ties with a variety of firms, especially with potential customers (probably because there are electronic components in the products of many different industries) that are less interested in appropriating the technology than competitors would be. In contrast, communications ventures, both in our qualitative and quantitative data, form ties with relatively few, large communications equipment and networking firms, such as Lucent, Nokia, and Cisco, that compete against each other (probably because communications products are often highly specialized for the communications industry). These partners often have competitive interests in the technology (Gompers and Lerner, 2002, also found that investors in communications ventures are disproportionately competitively related). Thus communication ventures face a particularly extreme tension (i.e., high resource needs, only moderately defensible technologies, and more potential misappropriation by partners). As our descriptive data in table A.2 indicate, these ventures appear to cope with this extreme tension by raising fewer funding rounds and by being acquired, thereby avoiding "swimming with sharks."