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# THE SELECTION AND NURTURING EFFECTS OF CORPORATE INVESTORS ON NEW VENTURE INNOVATIVENESS

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*Corporate investors can provide valuable resources to their new venture investees, but their interests may conflict with those of independent venture capitalist (IVC) coinvestors. We explore how the preferences, resources, and influence of corporate investors vis-à-vis their IVC coinvestors affect their selection of investment opportunities and subsequent nurturing of new venture investees. We show that corporate investors tend to fund new ventures with greater pre-funding innovative capabilities and new ventures receiving corporate funding exhibit greater post-funding rates of innovation compared to those funded solely by IVCs, particularly when their corporate investors are highly reputable relative to their IVC coinvestors.* 

## INTRODUCTION

New ventures are typically resource constrained and rely on external investors to exploit entrepreneurial opportunities (Stinchcombe, 1965). These ventures have traditionally relied on independent venture capitalists (IVCs) for capital funding and managerial guidance (Gorman and Sahlman, 1989; Sahlman, 1990; Gompers and Lerner, 2004). In recent years, however, a growing number have pursued corporate venture capital (CVC) funding to supplement funding by IVCs (Dushnitsky, 2006; Gaba and Meyer, 2008; Katila, Rosenberger, and Eisenhardt, 2008). CVC refers to minority equity investments made by established firms in privately held entrepreneurial ventures (Gompers and Lerner, 1998). Unlike IVCs who are generally interested in maximizing their capital gains by increasing the market value of their new venture investees, corporate investors are interested in maximizing the overall value of their corporate parents (Hellmann, 2002). Thus, corporate investors often pursue broader strategic objectives from their new venture investments (Dushnitsky, 2006).

These broader objectives, however, can conflict with the narrower goals of their IVC coinvestors (Hellmann, 2002; Dushnitsky and Shaver, 2009). In particular, corporate investors are generally interested in exploiting possible synergies between their investees' innovative capabilities and their own existing operations (Dushnitsky and Lenox, 2005; Wadhwa and Kotha, 2006). Pursuit of such interests, however, may hamper more immediate capital gains (generally preferred by IVCs), which are attained by maximizing the market value of new ventures.

This study adopts a multiple agency perspective (e.g., Hoskisson *et al*., 2002; Arthurs *et al*., 2008) to explore how the preferences, resources, and influence of corporate investors vis-à-vis their IVC coinvestors affect both their selection of investment

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opportunities and their subsequent nurturing of new venture investees.[1] We develop the premise that corporate investors generally place a higher value on having their new venture investees focus on innovation than do IVC investors, because a corporate investor can benefit disproportionately from technological synergies with investees—possibly at the expense of other value creating activities that favor IVC capital gains. We first suggest that corporate investors will tend to fund new ventures having greater pre-funding innovative capabilities compared to those solely funded by IVCs. We then suggest that, because corporate investors can efficiently provide complementary resources supporting their preference for innovative investees, CVC funded ventures will exhibit greater post-funding rates of innovation as compared to their counterparts solely funded by IVCs.

Moreover, we recognize that not all coinvestors in new ventures are equally influential in determining their investees' pursuits. Accordingly, we suggest that the post-funding rates of innovation of CVC funded ventures are further enhanced when corporate investors are more influential relative to their IVC coinvestors. Prior studies have considered formal governance mechanisms such as ownership percentage (Hoskisson *et al*., 2002) or board rights (Arthurs *et al*., 2008) in assessing the relative influence of various ownership constituents on firm behavior. Although we control for these formal sources of influence, an investor's ability to influence a jointly owned venture has been shown to be less a function of ownership percentage and more a function of its potential to contribute to a venture's survival (Yan and Gray, 1994; Mjoen and Tallman, 1997; Yan, 1998; Steensma and Lyles, 2000). Thus, we focus on an informal source of investor influence, specifically that stemming from an investor's reputation for facilitating new venture success. Because new ventures are resource constrained and rely on external investors for valuable resources and guidance, they are particularly responsive to the preferences of investors with a proven record for guiding their investees to success. We argue that when new ventures are funded by multiple types of investors (i.e., corporate investors, IVCs), the investors that are more reputable in terms of having guided new ventures to successful outcomes will influence their investees to a greater degree and promote their preferences over those of coinvestors with less successful records.

In this study, we do not assume that innovation necessarily leads to financial success. New ventures are severely resource constrained and must concentrate on activities leading to the greatest return on investment. Among various competing activities that new ventures can pursue, innovation is likely to generate positive return up to a certain threshold, but is likely to face diminishing marginal productivity beyond that point. Thus, a high commitment to innovation-oriented activities may or may not translate into greater financial profitability for the new ventures. Indeed, prior studies find that innovation is only one of many ingredients for venture success (Song *et al*., 2008) and its importance is highly context specific (Rosenbusch, Brinckmann, and Bausch, 2011).

This study complements a growing body of literature exploring the impact of external investors on the outcome of new ventures (e.g., Hellmann and Puri, 2002; Hsu, 2006; Hochberg, Ljungqvist, and Lu, 2007). In particular, our research joins a nascent stream of literature examining the effect of corporate investors on new ventures (e.g., Katila *et al*., 2008; Maula, Autio, and Murray, 2009) by providing insights into the developmental consequences of CVC funding on new ventures that face increasingly diverse funding sources. Although the recent diffusion of CVC has generated much interest, prior studies have emphasized the outcomes for corporate investors (e.g., Dushnitsky and Lenox, 2005; Benson and Ziedonis, 2009; Tong and Li, 2011). By taking the perspective of new ventures, this study contributes to the corporate governance literature that focuses on young private firms. Because the separation of ownership and control in these firms begins with the induction of external investors, our work illustrates the path dependency of early governance structures and its influence on the strategy and outcomes for young private firms.

We begin by providing an overview of a multiple agency perspective, describing the diverging preferences of corporate investors and IVCs for their new venture investees. We explain how corporate investors express their preferences by investing in new ventures with greater innovative capabilities and subsequently provide the complementary resources critical to enhancing post-funding rates of innovation by their new venture investees—resources that

[1] We use the term 'nurturing' to broadly refer to how corporate investors influence development of their new venture investees. We do not assume positive or negative consequences of the nurturing activities by corporate investors on the ultimate market performance of those ventures.



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IVCs are less capable of providing. We then consider how the relative influence of corporate investors vis-à-vis their IVC coinvestors can vary depending on the reputation each group has for facilitating a new venture's success and how the distribution of influence between the investor groups may further affect the post-funding rates of innovation by new ventures. We follow with an explanation of our methods and presentation of our results. We conclude by discussing insights gained from this study, its limitations, and future research directions.

## BACKGROUND AND HYPOTHESES DEVELOPMENT

### A multiple agency perspective

According to a multiple agency perspective, categorizing principals and agents into two homogenous groups is too simplistic for depicting the governance of modern firms, which often have multiple principals and agents (Hoskisson *et al.,* 2002; Child and Rodrigues, 2003; Fiss and Zajac, 2004). In many firms, multiple types of owners may act as principals, leading to potentially conflicting preferences for their investees. The nature of these preferences and the relative influence of owners can determine the choices made on behalf of the firm. For instance, the degree to which large manufacturing firms focus on innovation depends on the preferred timing of cash flows for the different types of institutional investors (Hoskisson *et al*., 2002). Firms with greater levels of pension fund ownership invest more heavily in research and development (R&D) compared to firms owned substantially by mutual funds. This difference in R&D levels may be attributed to the various time horizons of the two types of investors. Pension funds have a longer time horizon and are more supportive of R&D expenditures that can cause a negative cash flow in the short run but increase firm value in the long run. In contrast, mutual funds, which have shorter time horizons, will value R&D expenditures to a lesser degree (Hoskisson *et al*., 2002). In a similar vein, Fiss and Zajac (2004) show that the extent to which firms attempt to maximize shareholder value depends on the varying preferences of the multiple ownership constituents and their relative influence on the firms. Overall, owners are not homogenous in their preferences and aspirations for their investees.

A multiple agency perspective is particularly appropriate for analyzing the behavior of pre-IPO new ventures because they are often funded by multiple types of investors, each with potentially conflicting preferences. Moreover, external investors tend to play a greater role in overseeing their private investees as compared to public firms (Lerner, 1995). Traditionally, new ventures have relied on IVCs for capital funding and managerial guidance (Gorman and Sahlman, 1989; Sahlman, 1990; Gompers and Lerner, 2004). In recent years, new ventures have increasingly supplemented funding from IVCs with capital from corporate investors (Dushnitsky and Lenox, 2005; Gaba and Meyer, 2008). As a result, a considerable number of new ventures now receive funding from both IVCs and corporate investors (Katila *et al*., 2008). Because the preferences, resources, and influence of each type of investor investing in their new venture vary, a multiple agency perspective is particularly applicable for assessing both the selection of investees by investors for funding and how such investors influence investee behavior after funding.

### The selection of investment opportunities by corporate investors

Corporate investors and IVCs have substantially different paradigms for evaluating the attractiveness of potential investees and the success of their new venture investments. IVCs are typically limited partnerships funded by large institutions (e.g., universities, insurance companies, pension funds) who invest in privately held entrepreneurial ventures in order to realize capital gains through an exit event such as an IPO or acquisition (Gorman and Sahlman, 1989; Gompers and Lerner, 2004). IVCs are generally compensated through management fees based on fund size as well as a fraction of profit from their return on invested funds (Sahlman, 1990). Superior capital gains from their venture investments not only increase the wealth of the managing partners of venture capital firms, but can also signal their success—enhancing subsequent fundraising efforts, leading to larger management fees, and attracting better quality ventures (Gompers and Lerner, 2004). Thus, capital gains based on the market value of the new venture are essential to an IVC's business model.

In contrast, CVC units of corporate investors generally have broader objectives for investing in new ventures. Although CVC units may also be motivated by the potential for capital gains, their focus is less on the potential market value of any given



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investee and resulting capital gains, and more on contributing to the overall value of their corporate parents (Dushnitsky, 2006). Investments in new ventures can create strategic value for a corporate parent in a number of ways, quite apart from capital gains. The innovative pursuits of a new venture can supplement a corporate investor's internal R&D, effectively serving as an extension of the corporate parent's R&D unit. This learning opportunity may enable corporate investors to combine new ventures' innovative capabilities with their own to create substantial value (Dushnitsky and Lenox, 2005; Wadhwa and Kotha, 2006). Thus, the innovations created by new venture investees provide value to corporate investors beyond simply contributing to new venture profitability and a corresponding increase in investee market value.

Further, the products and innovations developed by the new venture may stimulate demand for complementary products produced by the corporate investor (Kann, 2000; Chesbrough, 2002). Even when an investee's innovation is not particularly profitable on its own, it may be critical to the value of complementary products of its corporate investor. The bundle of the two innovations may add substantial value, particularly for those corporate investors interested in developing a robust ecosystem for their technology (Adler and Kapoor, 2010). For instance, Qualcomm, the pioneer of the CDMA wireless technology standard, operates an active CVC unit that invests in new ventures developing wireless components, equipment, and services in the value chain to support the proliferation of Qualcomm's technology standard.

Corporate investors often benefit disproportionately from the innovations created by new ventures as compared to IVC coinvestors who benefit only to the extent that such innovations generate new venture profit and increase the market value of the venture. The innovative pursuits of the new venture investees and their synergies with the corporate investor are essential to a corporate investor's business model. The market value of the new venture as an independent entity is often secondary. Although the overall viability of the new venture may be important to the corporate investor, *maximizing* the potential for capital gains of the new venture investee is not critical to its being deemed a success by the corporate investor.

In contrast, innovations benefit new ventures and their IVC investors only to the extent to which they contribute to greater profitability and market value of the new ventures. Because new ventures typically face severe resource constraints, they are more likely to examine the opportunity costs of innovation-oriented activities and their effect on venture profitability and capital gains.

Taken together, because of the differences between the preferences of CVC and IVC investors, we suggest that new ventures funded by corporate investors will have greater innovative capabilities at the time of funding than new ventures funded solely by IVC investors.

> *Hypothesis 1 (H1): CVC funded ventures will have greater pre-funding innovative capabilities as compared to new ventures funded solely by IVCs.*

### The nurturing of new venture investees by corporate investors

Not only do corporate investors' preferences regarding the activities of their investees set them apart from IVC coinvestors, so does their ability to efficiently provide investees valuable complementary resources to fulfill these preferences. In order to accelerate investees' innovation, corporate investors will collaborate with them, closely wedding the resources of the corporate parent to the needs of the new venture (Keil, Maula, and Wilson, 2010). Such collaboration facilitates the transfer of knowledge and resources between the new venture and the business units of the corporate investor, helping realize synergies between the two firms (Dushnitsky and Lenox, 2005; Wadhwa and Kotha, 2006). Corporate investors are more likely to provide resources that are specifically tailored to the innovation activities of new ventures with limited fear of holdup or being taken advantage of compared to other firms that do not own equity in the new ventures (Kim and Mahoney, 2010; Park and Steensma, 2012). For instance, a wireless service provider might invest in a new venture that develops software for wireless handsets. The software venture could then receive access to the service provider's unique user base to test and stabilize its software code, tailoring it for the bundle of services that the wireless provider offers in the marketplace. Likewise, a corporate investor from the semiconductor sector might offer a fabless design venture use of one of its fabrication facilities adapted for the unique needs of the venture to accelerate technological development and improve yield. Because these resources are adapted to the needs of



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the investee, they cannot be easily provided by other firms that lack equity ties to the new venture and consequently are reluctant to customize their resources and services (Reed and DeFillippi, 1990; Pisano, 1990).

However, corporate investors generally have limited experience managing such investments as compared to IVCs (Dushnitsky and Shapira, 2010; Ivanov and Xie, 2010). Moreover, establishing an equity tie with a specific corporate investor typically constrains new ventures from obtaining resources from competitors of their corporate investor. Indeed, new ventures that do not require specialized resources are often better off forgoing an equity tie with a corporate investor because such a tie may restrict them from pursuing other relationships in the open market (Park and Steensma, 2012).

In contrast, IVCs often increase the value of their investees (and subsequent capital gains) by playing a broker's role, matching resources from the external market to the needs of their investees (Hellmann and Puri, 2002; Hsu, 2006; Hochberg *et al*., 2007). Although these brokered arrangements may be valuable to the new venture because they entail market exchanges that are subject to holdup and other transactional difficulties, the resources attained tend to be less tailored to the specific needs of the new venture (Williamson, 1985). Moreover, because IVCs control the match between market resources and investee needs, they can promote their interests by selectively matching new ventures with those resources that will maximize the market value of their new venture investees (Burt, 1992). Although innovation can be a stepping-stone to new venture success, an IVC's overriding preference will be to maximize capital gains through whatever value chain activities possible. Thus, any brokerage effort is less likely to be focused on resources that solely boost levels of innovation, compared to the type of resources provided directly by corporate investors.

Taken together, because corporate investors have a stronger preference that new venture investees exploit their innovative capabilities and are able to provide tailored resources to facilitate this, we suggest that new ventures funded in part by corporate investors will exhibit greater post-funding rates of innovation as compared to those funded solely by IVCs. Thus:

> *Hypothesis 2 (H2): CVC funded ventures will exhibit greater post-funding rates of innovation as compared to new ventures funded solely by IVCs.*

Although corporate investors may prefer to have investees focus on innovation, and they can provide supportive resources to facilitate this, their ability to influence their investees to pursue innovation may vary. A corporate investor's preference for its investees to focus on innovation may be at odds with the preferences of its IVC coinvestors. Although a focus on innovation may align with maximizing market value of the new venture and capital gains returned to IVCs, oftentimes it does not.

Typically, new ventures are severely resource constrained. Resources dedicated to each business activity in a new venture's value chain (R&D, marketing, distribution, production, and so on) bear substantial opportunity costs (Mizik and Jacobson, 2003). Indeed, innovation is only one of eight factors employed to enhance the performance of a new venture (Song *et al*., 2008) and its importance is highly context specific (Rosenbusch *et al*., 2011). Thus, the corporate investor's preference for the investee to focus on innovation may come at the expense of the investee's pursuit of other value chain activities that could optimize the new venture's market value and IVCs' potential capital gains.

Although new ventures maximize their profitability by allocating resources to the composition of value chain activities that produce the greatest marginal return on investment, they typically operate in highly uncertain and ambiguous environments, where they lack foresight regarding that optimal composition (Dew *et al*., 2008). In light of this limitation, new ventures may be heavily influenced by their key investors (Sanders and Carpenter, 2003). In this contest for influence on new venture strategy, some investors will be more influential than others. A firm's influence with respect to another firm in various types of exchange relationships depends, in part, on its reputation. In general, a firm's reputation is a function of its record of past performance as perceived by stakeholders (Rindova *et al*., 2005). Firms with strong performance records are generally more reputable than those with weaker records (Podolny and Phillips, 1996). A firm's reputation is particularly salient to potential partners operating in highly uncertain environments where new ventures typically operate (Podolny, 1994).

A salient aspect of an investor's reputation is its ability to facilitate the success of its investees. Some investors have a long history of facilitating success of new ventures, whereas others have little experience in doing so (Nahata, 2008). A strong record of success can feed on itself, creating a virtuous cycle.



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New ventures gain legitimacy and endorsements by associating with reputable investors, affording them greater access to vital resources in the marketplace (Stuart, Hoang, and Hybels, 1999; Zimmerman and Zeits, 2002; Graffin and Ward, 2010) and enhancing their likelihood of success, which further boosts the reputation of their investors. An investor's proven record for leading its investees to successful outcomes will garner a reputation that can be inferred by potential investees as a signal of quality (Nahata, 2008).

Exchange partners are more willing to cater to the needs of highly reputable firms in hopes of benefiting from their reputation and the quality of services and products good reputation signals (Hsu, 2004). Highly reputable firms secure a greater effort from partners than less reputable firms do from similar partners. The greater the difference in reputations between firms in an exchange relationship, the more effort the less regarded firm will exert in attending to the needs of the more highly reputed (Castellucci and Ertug, 2010). Likewise, when there is conflict among important constituents *within* a firm, the relative reputation of the various constituents will determine whose interests will likely receive attention. Hayward and Boeker (1998) found that where conflicting interests existed at an investment bank, more highly reputable departments, in terms of their significance to the bank's past performance, had a greater influence on the subsequent decisions and direction of the organization.

Although investors can also garner influence through formal governance mechanisms, such as equity share and board representation, an investor's influence on a new venture has been shown to be primarily an outcome of its reputation as derived from its perceived potential to contribute to a venture's survival (Yan and Gray, 1994; Mjoen and Tallman, 1997; Yan, 1998; Steensma and Lyles, 2000). New ventures are more likely to act on the preferences of highly reputable investors, because failing to comply might jeopardize their access to what they perceive to be quality support (Castellucci and Ertug, 2010). Moreover, reputation also mitigates potential opportunistic behavior of investors, because jeopardizing their good reputation in helping their venture investees succeed may reduce their ability to attract and nurture subsequent venture investees that may generate rent from their venture investments.

The reputation hierarchy of investors in conjunction with their preferences will likely affect the behavior of new ventures. Because corporate investors place higher value on having new venture investees focus on innovation than do IVCs, the extent to which new ventures focus on innovative pursuits will further depend on how influential their corporate investors are vis-à-vis IVC coinvestors. Relatively reputable corporate investors, based on the success of past investees, can exert greater influence over current investees inducing a focus on innovation. However when corporate investors are less reputable, the co-investing IVCs can exercise greater influence over the decisions of investees. IVCs prefer maximizing capital gains from an investee through an optimal composition of value chain activities that may not necessarily include a strong focus on innovation as generally preferred by corporate investors.

Thus, we suggest that the post-funding rates of innovation of new venture investees will be enhanced beyond that due to the mere presence of corporate investors (i.e., H2) when their corporate investors have a greater reputation for investee success relative to their IVC coinvestors.

> *Hypothesis 3 (H3): CVC funded ventures whose corporate investors are relatively more reputable with regard to prior investee success (versus co-investing IVCs) will exhibit greater post-funding rates of innovation as compared to CVC funded ventures whose corporate investors are relatively less reputable (versus co-investing IVCs).*

## METHODS

### Data, sample, and research design

We used the VentureXpert database to obtain a sample of 508 U.S. ventures in computer hardware (n = 111, VentureXpert code = 2100), semiconductor (n = 199, VentureXpert code = 3111/3112), and wireless service (n = 198, VentureXpert code = 1320) industries that received their first round of funding from CVC and/or IVC investors from 1990 to 2003. These industries exhibited robust CVC investment activities and provided a sample of new ventures that represented a significant portion of all VC funded ventures during our sample period (Dushnitsky and Lenox, 2005). A sample drawn from multiple industries also enhances the generalizability of our findings. We limited our sample to U.S. ventures in order



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to control for the institutional environment surrounding the development of new ventures. In addition, missing or inaccurate data occurred more frequently with non-U.S.-based ventures.

Of the 508 sample ventures, 271 (53%) received CVC funding in addition to IVC funding, whereas the remaining ventures were funded solely by IVCs. The proportion of CVC funded ventures was higher than those in prior studies (e.g., Gompers and Lerner, 1998; Katila *et al*., 2008) because, consistent with our theory, our unit of analysis was at the level of new ventures, as opposed to funding rounds or investments. Taking funding rounds (24%) or investments (10%) as our unit of analysis, the percentage of CVC funding in our sample was consistent with prior studies.

We supplemented the VentureXpert database with additional data sources including LinkSV (www.linksv.com), the Internet Archive service (www.archive.org), and hand-collected data from press releases and company Web sites to ensure accuracy and reduce the occurrence of missing data. We used the U.S. Patent and Trademark Office (USPTO) database for patent data, the Security Data Corporation (SDC) database for alliance data, and COMPUSTAT for industry-level control variables.

## Variable definitions

### *Dependent variables*

We measured *Pre-funding innovative capabilities* (H1) by counting the number of patent applications (that were subsequently granted) by new ventures prior to their first round of funding, whereas we measured *Post-funding rates of innovation* by counting the number of patent applications (that were subsequently granted) during the three years following their last round of VC financing (H2 and H3). We consider timing of patent applications rather than that of patent grant to account for the period in which innovation took place. Moreover, because *Post-funding rates of innovation* captures a time window after the last round of funding (i.e., post-test), it is equivalent to a change score that allows causal inference and greatly reduces the threat of spuriousness (Allison, 1990). Although the presence of corporate investors would likely have a prolonged impact, the three-year measure isolated the short-term impact of corporate investors on the innovation outputs of new ventures. Approximately two-thirds of all new ventures had either exited (by IPO or acquisition) or failed within three years of their last round of funding. We captured the timing of patent applications rather than patent grants because of the typical two- or three-year lag between them. Thus, the timing of patent applications was a better indicator of the occurrence of innovation activities. Nevertheless, we conducted robustness checks using alternative time windows for patent applications. These findings are discussed in the results section.

### *Explanatory variables*

*CVC funded* (H1 and H2) took a value of '1' if a new venture was funded by at least one corporate investor and '0' if the new venture was funded solely by IVCs. An investor was classified as a corporate investor using the VentureXpert classification system. Financial service firms (insurance companies, banks, etc.) were not classified as corporate investors because their strategic objectives are typically not related to sourcing knowledge through venture innovation (Dushnitsky and Shaver, 2009).

We went through two steps to obtain a measure of *Relative reputation of corporate investors* (vis-à-vis co-investing IVCs) for H3. Going public is typically considered the most successful outcome for new ventures (Gompers and Lerner, 1998). Consistent with other studies (e.g., Hsu, 2006; Nahata, 2008), we counted how many investees were associated with each investor in the focal new venture that went public prior to the focal investment. For each new venture in our sample, we calculated the natural log of: (1) the number of ventures taken public by corporate investors prior to the focal venture; and (2) the number of ventures taken public by all investors (corporate investors and IVCs) prior to the focal venture. To compute reputation for success of corporate investors relative to IVCs, we divided our value from Step 1 by the value in Step 2 for each new venture in our sample.[2] We took the natural log of the number of prior ventures taken public by investors for two reasons. First, this measure was highly skewed because many investors took a small number of new ventures public, whereas a small number of investors took a large number (more than 100) public. Use of the natural log enhances the normality of error terms in such cases (Wooldridge, 2002).

[2] When neither corporate investors nor IVCs had prior IPO experience, we assigned '0' to the relative reputation of corporate investors. We discuss our results derived from using alternative measures for such occurrences in the robustness check section.



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Second, a natural log measure was a more realistic proxy for capturing the reputation of a particular investor, given the diminishing contribution of additional IPO experience to an investor's reputation (i.e., the first portfolio company taken public by an investor will likely increase its reputation more strongly than the hundredth). Finally, we used a ratio measure to capture the influence of corporate investors *relative* to that of co-investing IVCs because we were interested in the influence of a particular type of investor over a new venture's decision-making process. Thus, the relative influence Intel Capital, generally considered to be a highly reputable corporate investor, will have on a new venture likely depends on whether its co-investing IVCs also have reputations for successful investees. We discuss our results using an alternative measure of investor reputation developed by Lee, Pollock, and Jin (2011) in the robustness check section.

### *Control variables*

We controlled for a number of industry- and venture-level factors that might be associated with *Pre-funding innovative capabilities* and *Post-funding rates of innovation*. At the industry level, we controlled for *Industry size*, *Industry growth rate*, and *Industry concentration*. These factors may influence the munificence and dynamism of an industry through its life cycle and can determine the strategy of new ventures (Covin and Slevin, 1990). We applied the VentureXpert-Standard Industry Classification (SIC) concordance scheme (Dushnitsky and Shaver, 2009) for computer (3571), wireless (4812), and semiconductor (3674) firms. We measured *Industry size* by totaling the sales of all firms in each industry in our sample, using the COMPUSTAT database. We measured *Industry growth rate* by calculating annual sales growth for a particular industry. We measured *Industry concentration* by totaling the market share of the four largest firms in each industry. We measured these variables for the year in which new ventures received their first round of funding to test H1 and the selection equation, whereas we measured these variables for the year following the last round of VC funding of new ventures to test H2 and H3, reasoning that this year would be the most appropriate for assessing the post-funding influence of these variables on the post-funding rates of innovation by new ventures.

Because we wanted to isolate the effect of an informal influence of investors (i.e., reputation for facilitating venture success) on the post-funding rates of innovation by new ventures for testing H2 and H3, we controlled for the formal governance mechanisms of investors. First, we proxied ownership share of CVC investors (*CVC investment percentage*) by measuring the amount of CVC invested capital as a percentage of total invested capital.[3] Second, we used a binary indicator for *Corporate investor board membership* in the new venture. We also controlled for *Pre-funding innovative capabilities* and *Pre-funding number of alliances* because these factors can indicate the inherent quality of new ventures, influencing their subsequent rates of innovation.

Further, to accurately assess and isolate the influence of our *Relative reputation of corporate investor* ratio variable for H3, we needed to control for the main effects of the denominator and numerator of the ratio (Firebaugh and Gibbs, 1985).[4] Thus, we controlled for the natural log of the number of ventures taken public by corporate investors as well as the natural log of number of ventures taken public by all investors associated with each new venture. This also controlled for the effect the general quality of investors had on the innovative capabilities of new venture investees.

Because particular corporate investors may have different strategic objectives and policies regarding the level of investee innovation, we assigned binary indicators for the seven corporate investors that appeared most frequently in our sample (*Intel, Motorola, Nokia, Cisco, Acer, Mitsubishi*, and *Dell*) with at least six investments (more than 1% of the sample). This set of corporate investors accounted for 34 percent of our sample of new ventures that had received corporate investments. We controlled for *Survival* of new ventures as of January 2009 to account for the possible association between venture performance and the level of innovation. Finally, we controlled for *Age*, industry (*Computer* and *Wireless*), and location (*CA*, *MA*, and *TX*) of new ventures to eliminate alternative explanations of a particular venture's life cycle, industry, or location related to varying levels of innovation. Table 1 summarizes variable definitions and descriptive statistics. Table 2 provides a bivariate correlation matrix.

[3] Although ownership share would have been a more accurate control variable, VentureXpert does not provide this information for investors in privately held ventures.

[4] Controlling for the main effects is consistent with general practices when testing the influence of any multiplicative or interaction effect.



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Table 1. Variable definitions and summary statistics

| Variable | Definition | Mean | S.D. |
|---|---|---|---|
| Dependent variables | | | |
| Pre-funding innovative capabilities | Number of patent applications (that were subsequently granted) prior to first round of VC funding by a new venture | 1.77 | 11.42 |
| Post-funding rates of innovation | Number of patent applications (that were subsequently granted) within three years of last round of VC funding by a new venture | 1.75 | 7.56 |
| Explanatory variables | | | |
| CVC funded (H1) | '1' if a new venture received CVC funding | 0.53 | 0.50 |
| Relative reputation of corporate investors (H2) | ln (number of companies taken public by corporate investors + 1) divided by ln (number of portfolio companies taken public by all investors in the syndicate + 1) | 0.13 | 0.24 |
| Industry-level control variables | | | |
| Industry size[a] | Sum of sales by all public firms of the industry that a new venture operated | 4.82 | 0.39 |
| Industry growth rate | Growth rate of the industry that a new venture operated | 0.09 | 0.16 |
| Industry concentration rate | Total market share by four largest firms in the industry that a new venture operated | 0.62 | 0.19 |
| Venture-level control variables | | | |
| CVC investment percentage | Percentage of equity investment amount by corporate investors | 0.11 | 0.20 |
| Corporate investor board membership | '1' if a corporate investor took a board seat in a new venture | 0.08 | 0.27 |
| Number of funding rounds[a] | Number of VC funding rounds that a new venture went through | 1.00 | 0.73 |
| Number of investors[a] | Number of unique investors in a new venture in all funding rounds | 1.42 | 0.80 |
| Total amount of funding[a] | Amount of total investments in a new ventures by all investors | 3.05 | 1.31 |
| Pre-funding number of patents[a] | Number of patent applications (that were subsequently granted) prior to first round of VC funding by a new venture | 0.38 | 0.76 |
| Pre-funding number of alliances[a] | Number of alliances established prior to first round of VC funding by a new venture | 0.04 | 0.22 |
| Reputation of corporate investors[a] | Total number of portfolio companies taken public by all corporate investors in a new venture | 0.58 | 1.11 |
| Reputation of investment syndicate[a] | Total number of portfolio companies taken public by all investors in a new venture | 2.92 | 1.81 |
| Survival | '1' if a new venture exited successfully (via IPO or acquisition) or still in operation | 0.73 | 0.44 |
| Age[a] | Age of new venture at last round | 1.47 | 0.76 |
| Intel | '1' if a new venture received funding from Intel | 0.08 | 0.27 |
| Motorola | '1' if a new venture received funding from Motorola | 0.03 | 0.18 |
| Nokia | '1' if a new venture received funding from Nokia | 0.02 | 0.12 |
| Cisco | '1' if a new venture received funding from Cisco | 0.02 | 0.12 |
| Acer | '1' if a new venture received funding from Acer | 0.02 | 0.12 |
| Mitsubishi | '1' if a new venture received funding from Mitsubishi | 0.02 | 0.12 |
| Dell | '1' if a new venture received funding from Dell | 0.01 | 0.11 |
| Computer | '1' if a new venture operated in the computer industry | 0.22 | 0.41 |
| Wireless | '1' if a new venture operated in the wireless industry | 0.39 | 0.49 |
| CA | '1' if a new venture was located in CA | 0.54 | 0.50 |
| MA | '1' if a new venture was located in MA | 0.07 | 0.26 |
| TX | '1' if a new venture was located in TX | 0.07 | 0.25 |
| Availability of CVC funding[a] | Sum of all CVC investments in focal industries for each year that a new venture raised VC funding | 5.48 | 1.73 |

[a]Log transformed to enhance normality.



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Table 2. Correlation matrix

| Variables | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 Pre-funding innovative capabilities | 1.00 | | | | | | | | | | | | | | | | | | |
| 2 Post-funding rates of innovation | 0.13 | 1.00 | | | | | | | | | | | | | | | | | |
| 3 CVC funded | 0.08 | 0.11 | 1.00 | | | | | | | | | | | | | | | | |
| 4 Relative reputation of corporate investors | 0.02 | 0.06 | 0.47 | 1.00 | | | | | | | | | | | | | | | |
| 5 Industry size (last round)[a] | 0.00 | 0.01 | 0.13 | 0.17 | 1.00 | | | | | | | | | | | | | | |
| 6 Industry growth rate (last round) | –0.04 | 0.09 | –0.01 | –0.09 | –0.34 | 1.00 | | | | | | | | | | | | | |
| 7 Industry concentration (last round) | 0.07 | –0.12 | –0.04 | –0.02 | –0.22 | 0.04 | 1.00 | | | | | | | | | | | | |
| 8 Number of funding rounds[a] | –0.01 | 0.01 | 0.36 | 0.10 | 0.37 | –0.20 | –0.02 | 1.00 | | | | | | | | | | | |
| 9 Number of investors[a] | 0.05 | 0.06 | 0.46 | 0.22 | 0.29 | –0.17 | –0.08 | 0.75 | 1.00 | | | | | | | | | | |
| 10 Total amount of funding[a] | 0.07 | 0.15 | 0.38 | 0.20 | 0.30 | –0.15 | –0.06 | 0.68 | 0.72 | 1.00 | | | | | | | | | |
| 11 CVC investment percentage | 0.03 | 0.01 | 0.51 | 0.43 | –0.05 | 0.05 | –0.01 | –0.01 | 0.03 | 0.06 | 1.00 | | | | | | | | |
| 12 Corporate investor board membership | 0.00 | –0.05 | 0.26 | 0.20 | 0.04 | –0.05 | 0.03 | 0.20 | 0.15 | 0.15 | 0.35 | 1.00 | | | | | | | |
| 13 Pre-funding number of patents[a] | 0.59 | 0.28 | 0.10 | 0.11 | 0.08 | 0.00 | –0.12 | 0.06 | 0.09 | 0.14 | 0.05 | 0.05 | 1.00 | | | | | | |
| 14 Pre-funding number of alliances[a] | 0.01 | 0.08 | –0.02 | –0.01 | –0.20 | 0.06 | 0.07 | –0.08 | –0.05 | –0.05 | 0.06 | 0.01 | 0.07 | 1.00 | | | | | |
| 15 Reputation of corporate investors[a] | 0.02 | 0.02 | 0.49 | 0.83 | 0.24 | –0.13 | 0.01 | 0.32 | 0.36 | 0.28 | 0.30 | 0.15 | 0.09 | –0.00 | 1.00 | | | | |
| 16 Reputation of investment syndicate[a] | 0.07 | 0.06 | 0.33 | 0.35 | 0.28 | –0.17 | 0.02 | 0.54 | 0.63 | 0.57 | 0.04 | 0.11 | 0.11 | 0.01 | 0.62 | 1.00 | | | |
| 17 Survival | 0.05 | 0.11 | 0.18 | 0.14 | 0.19 | 0.02 | –0.07 | 0.32 | 0.28 | 0.34 | 0.07 | 0.11 | 0.11 | –0.01 | 0.19 | 0.27 | 1.00 | | |
| 18 Age (last round)[a] | 0.09 | 0.05 | 0.29 | 0.16 | 0.32 | –0.16 | 0.01 | 0.58 | 0.43 | 0.47 | –0.01 | 0.08 | 0.16 | 0.05 | 0.25 | 0.36 | 0.39 | 1.00 | |
| 19 Availability of CVC[a] | 0.01 | 0.03 | 0.27 | 0.19 | 0.35 | –0.09 | –0.41 | 0.41 | 0.42 | 0.43 | 0.07 | 0.12 | –0.01 | –0.16 | 0.22 | 0.24 | 0.15 | 0.17 | 1.00 |

Observations for 508 firms. Correlations above 0.09 or below –0.09 are significant at the 5 percent level.
[a]Log transformed to enhance normality.




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## Analytical approach

We applied appropriate analytical approaches to test our hypotheses according to the nature of our dependent variables and potential sampling issues.[5] Because we measured *Pre-funding innovative capabilities* and *Post-funding rates of innovation* by the count of new venture patent applications (subsequently granted), a count variable with a tendency to be overdispersed, we used negative binomial models for all our analyses (Hausman, Hall, and Griliches, 1984). To test H1, we used a negative binomial model using *Pre-funding innovative capabilities* as our dependent variable and *CVC funded* as our explanatory variable. To test H2 and H3, we used a two-stage modeling process to address any potential endogeneity that might arise due to the self-selection process of new ventures receiving CVC funding based on their resource needs and environmental conditions (Heckman, 1979; Shaver, 1998; Hamilton and Nickerson, 2003).

In the first stage,[6] we used a probit model and included industry- and venture-level factors to obtain the propensity of new ventures receiving CVC funding. We applied two strategies to model the first-stage equation. First, we altered the timing to capture industry- and venture-level control variables. Rather than using the year following the last round of funding, as we did in the second-stage equation, we took the year in which new ventures raised their first round of funding, reasoning that environmental and firm factors in this year would be more influential in whether to include a corporate investor in the investment syndicate. Second, we included an instrument, *Availability of CVC funding*, in our first-stage equation. We measured *Availability of CVC funding* by aggregating the total amount of CVC funding invested in new ventures in focal industries for a given year, reflecting the supply of CVC funding for new ventures at a particular time period. *Availability of CVC funding* was highly correlated with *CVC funded* ($r = 0.27$) but not significantly correlated with *Post-funding rates of innovation* ($r = 0.03$). Theoretically, *Availability of CVC funding* is likely to influence the supply of CVC funding that may influence the likelihood of new ventures obtaining CVC funding, but there is little rationale to suggest that the general availability of CVC funding will increase a particular venture's post-funding rate of innovation.

In the second stage, we predicted *Post-funding rates of innovation* by new ventures using negative binomial models, including all industry- and venture-level control variables and the Inverse Mill's ratio ($\lambda$) from the first-stage model accounting for the selection of new ventures regarding CVC funding.

## Results

Table 3 provides the results of the negative binomial model predicting *Pre-funding innovative capabilities* of new ventures. New ventures raising a larger amount of funding ($p < 0.05$) and older ventures ($p < 0.01$) generally had greater pre-funding innovative capabilities, whereas wireless ventures had weaker pre-funding innovative capabilities ($p < 0.05$). After controlling for various industry- and venture-level characteristics, we find that CVC funded ventures had greater pre-funding innovative capabilities than those solely funded by IVC ($p < 0.05$). Thus, H1 was supported.

Table 4 provides the results for the first-stage equation predicting the propensity of new ventures to receive CVC funding. *Number of investors* ($p < 0.01$), *Total amount of funding* ($p < 0.10$), *Age* ($p < 0.10$), and *Availability of CVC funding* ($p < 0.10$) increased the propensity for new ventures receiving CVC funding, whereas *Reputation of IVCs* ($p < 0.01$) decreased it.

Table 5 presents the results for the second-stage model predicting *Post-funding rates of innovation* by new ventures. In Model 5-1, we included all industry- and venture-level control variables. *Pre-funding innovative capabilities* ($p < 0.01$), *Pre-*

[5] Although a longitudinal panel design would more precisely delineate the causal effect of corporate investments on subsequent outcomes and control for firm-specific fixed effects, we were unable to design a longitudinal panel study for a number of reasons. First, our sample ventures were private firms for which time-variant data were severely limited. Second, because the influence of corporate investors is likely to persist for a prolonged period, it might be necessary to impose decaying functions in order to analyze their influence on innovation outcomes. Such a modeling strategy requires strong assumptions about our data generation process. Because our sample ventures were typically very young and lacked the fixed characteristics of established firms, not controlling for fixed effects is less problematic in our context.

[6] Although we could have used H1 results to set up as the first stage model to test H2 and H3, we opted against it or two reasons. First, our explanatory variable for H2 was *CVC funded*, making it theoretically more relevant to treat it as an endogenous variable. Second, our dependent variable for H1, *Pre-funding innovative capabilities*, was a count variable that would make the model less suitable for a first-stage model (Lee, 1983), particularly because we logged *Pre-funding innovative capabilities* as a control variable in our second-stage equation, to enhance its normality.



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Table 3. Selection effect: pre-funding innovative capabilities of new ventures

| | Model 3-1 | Model 3-2 |
|---|---|---|
| Explanatory variable | | |
| CVC funded | | 0.793** |
| | | (0.431) |
| Industry-level controls | | |
| Industry size at first round[a] | 0.224 | 0.315 |
| | (0.419) | (0.404) |
| Industry growth at first round | 0.370 | 0.224 |
| | (0.729) | (0.701) |
| Industry concentration at first round | 1.635 | 0.759 |
| | (0.911) | (1.922) |
| Venture-level controls | | |
| Number of funding rounds[a] | –0.378 | –0.339 |
| | (0.261) | (0.258) |
| Number of investors[a] | 0.011 | –0.089 |
| | (0.283) | (0.284) |
| Total amount of funding[a] | 0.490*** | 0.441*** |
| | (0.137) | (0.131) |
| Pre-funding number of alliances[a] | –0.133 | –0.122 |
| | (0.382) | (0.352) |
| Reputation of corporate investors[a] | 0.023 | 0.091 |
| | (0.107) | (0.123) |
| Reputation of IVC investors[a] | 0.026 | 0.050 |
| | (0.080) | (0.079) |
| Age at last round[a] | 1.002*** | 0.946*** |
| | (0.202) | (0.186) |
| Industry indicators | Yes[b] | Yes[b] |
| Location indicators | Yes | Yes |
| Constant | –2.908 | –3.537 |
| | (2.707) | (2.659) |
| Log likelihood | –602.2 | –599.9 |
| Number of observations | 508 | 508 |

*$p < 0.10$, **$p < 0.05$, ***$p < 0.01$. Two-tailed tests.
[a]Log transformed to enhance normality.
[b]Wireless venture produced fewer number of patents at the 10 percent level.

Table 4. First-stage probit model: the likelihood of new ventures receiving CVC funding

| | Model 4-1 | Model 4-2 |
|---|---|---|
| Industry size at first round [a] | –0.041 | –0.187 |
| | (0.221) | (0.259) |
| Industry growth at first round | 0.223 | 0.210 |
| | (0.399) | (0.399) |
| Industry concentration at first round | 0.714 | 0.397 |
| | (1.170) | (1.188) |
| Number of funding rounds[a] | 0.100 | 0.066 |
| | (0.140) | (0.141) |
| Number of investors[a] | 0.947*** | 0.924*** |
| | (0.140) | (0.140) |
| Total amount of funding[a] | 0.174** | 0.150* |
| | (0.078) | (0.080) |
| Pre-funding innovation capabilities[a] | 0.091 | 0.099 |
| | (0.088) | (0.089) |
| Pre-funding number of alliances[a] | 0.008 | 0.047 |
| | (0.325) | (0.325) |
| Reputation of IVCs[a] | –0.247*** | –0.238*** |
| | (0.046) | (0.046) |
| Age at first round[a] | 0.149* | 0.159* |
| | (0.091) | (0.092) |
| Industry indicators | Yes | Yes |
| Location indicators | Yes | Yes |
| Availability of CVC funding[1a] | | 0.082* |
| | | (0.062) |
| Constant | –1.618 | –1.173 |
| | (1.490) | (1.552) |
| Log likelihood | –270.4 | –269.5 |
| Number of observations | 508 | 508 |

*$p < 0.10$, **$p < 0.05$, ***$p < 0.01$. Two-tailed tests unless noted by [1], where one-tailed test was used.
[a]Log transformed to enhance normality.

*funding number of alliances* ($p < 0.05$), and *Survival* ($p < 0.01$) increased *Post-funding rates of innovation* by new ventures, whereas operating in the wireless industry ($p < 0.10$) decreased it. Moreover, we note that the Inverse Mill's ratio ($\lambda$) was not significant at the 10 percnet level. In Model 5-2, we added *CVC funded* to our control model (5-1). In Model 5-3, we added *Relative reputation of corporate investors* in the control model. Finally, we included both of our explanatory variables to the control model in Model 5-4. All coefficients and significant levels of control variables remained relatively unchanged across the models.

We used the full model (5-4) to assess the nurturing effect of corporate investors on the post-funding rates of innovation by new ventures. H2 predicted that CVC funded new ventures would exhibit greater *Post-funding rates of innovation* compared to those funded solely by IVCs. All else being equal, we suggest the mere presence of corporate investors with their preference for innovation and ability to efficiently provide complementary resources will lead to higher *Post-funding rates of innovation* among investees. In Model 5-4, *CVC funded* was positively associated with *Post-funding rates of innovation* ($p < 0.05$). Thus, H2 was supported.

H3 predicted that the increase in innovative capabilities of new ventures would be further enhanced above and beyond post-funding rates of innovation



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Table 5. Nurturing effect: post-funding rates of innovation of new ventures

| | Model 5-1 | Model 5-2 | Model 5-3 | Model 5-4 | Model 5-5 *Post hoc* | Model 5-6 Alternative measure[a] | Model 5-7 Alternative measure[b] |
|---|---|---|---|---|---|---|---|
| Explanatory variable | | | | | | | |
| CVC funded[1] | | 0.793** | | 0.770** | 0.739** | 0.641* | 0.100 |
| | | (0.431) | | (0.424) | (0.416) | (0.458) | (0.368) |
| Relative reputation of corporate investors (vs. IVCs)[1] | | | 4.427*** | 4.282*** | 4.516*** | 2.073** | 0.483 |
| | | | (1.766) | (1.726) | (1.810) | (1.052) | (1.026) |
| Industry-level controls | | | | | | | |
| Industry size at last round[c] | –0.747 | –0.708 | –0.745 | –0.730 | –0.386 | –1.107** | –1.785*** |
| | (0.541) | (0.522) | (0.529) | (0.515) | (0.500) | (0.497) | (0.461) |
| Industry growth at last round | 0.435 | 0.072 | 0.059 | –0.305 | 0.367 | 0.273 | 0.827 |
| | (1.141) | (1.138) | (0.149) | (1.152) | (1.145) | (1.179) | (0.947) |
| Industry concentration at last round | –2.166 | –2.292 | –2.149 | –2.248 | –1.889 | –2.255 | 2.067 |
| | (1.616) | (1.574) | (1.606) | (1.565) | (1.571) | (1.613) | (1.258) |
| Venture-level controls | | | | | | | |
| CVC investment percentage | 0.805 | 0.209 | 0.035 | 0.958 | 0.904 | 1.059 | 0.013 |
| | (1.025) | (1.132) | (1.063) | (1.182) | (1.146) | (1.113) | (0.931) |
| Corporate investor board membership | –1.304 | –1.284 | –1.345 | –1.325 | –1.167 | –1.435 | –0.880 |
| | (1.671) | (1.670) | (1.687) | (1.681) | (1.656) | (1.664) | (1.492) |
| Number of funding rounds[c] | –0.358 | –0.355 | –0.250 | –0.251 | –0.566 | –0.325 | 0.495 |
| | (0.422) | (0.419) | (0.413) | (0.412) | (0.401) | (0.423) | (0.340) |
| Number of investors[c] | 0.048 | –0.017 | –0.212 | –0.242 | –0.885 | 0.617 | 0.720 |
| | (0.956) | (0.949) | (0.951) | (0.946) | (0.779) | (0.498) | (0.770) |
| Total amount of funding[c] | 0.095 | 0.039 | 0.004 | –0.043 | –0.275 | 0.271* | 0.118 |
| | (0.245) | (0.242) | (0.249) | (0.246) | (0.229) | (0.162) | (0.204) |
| Pre-funding innovative capabilities[c] | 0.749*** | 0.791*** | 0.733*** | 0.780*** | | 0.936*** | 1.252*** |
| | (0.216) | (0.218) | (0.211) | (0.214) | | (0.210) | (0.191) |
| Pre-funding number of alliances[c] | 1.852** | 0.700** | 0.616** | 1.474** | 1.389** | 1.439** | 0.283 |
| | (0.753) | (0.737) | (0.741) | (0.726) | (0.709) | (0.736) | (0.522) |
| Reputation of corporate investors[c] | –0.417 | –0.482 | –0.223 | –0.245 | –0.644 | –0.089 | –0.216 |
| | (0.303) | (0.302) | (0.428) | (0.417) | (0.416) | (0.072) | (0.294) |
| Reputation of investment syndicate[c] | 0.314 | 0.326 | 0.476* | 0.473* | 0.844*** | 0.354** | 0.204 |
| | (0.257) | (0.252) | (0.216) | (0.256) | (0.219) | (0.141) | (0.205) |
| Survival | 1.252*** | 1.276*** | 1.137*** | 1.170*** | 1.305*** | 1.170*** | 0.585* |
| | (0.405) | (0.400) | (0.407) | (0.401) | (0.391) | (0.411) | (0.315) |
| Age at last round[c] | –0.431 | –0.490 | –0.401 | –0.457 | –0.561* | –0.282 | 0.376 |
| | (0.300) | (0.302) | (0.307) | (0.308) | (0.311) | (0.279) | (0.240) |
| Investor indicators | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Industry indicators | Yes[d] | Yes[d] | Yes[d] | Yes[d] | Yes[d] | Yes[d] | Yes[e] |
| Location indicators | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Inverse Mill's ratio (λ) | –1.030 | –0.916 | –1.248 | –1.102 | –2.910** | 0.369 | 0.136 |
| | (1.473) | (1.449) | (1.466) | (1.448) | (1.181) | (0.692) | (1.183) |
| Constant | 5.639 | 5.487 | 5.858* | 5.762* | 9.300** | 4.674* | 7.395** |
| | (3.516) | (3.399) | 3.469 | (3.373) | (3.157) | (2.698) | (2.990) |
| Log likelihood | –532.9 | –531.2 | –529.1 | –527.4 | –535.4 | –529.0 | –1.407.1 |
| Number of observations | 508 | 508 | 508 | 508 | 508 | 508 | 508 |

*$p < 0.10$, **$p < 0.05$, ***$p < 0.01$. Two-tailed tests unless noted by [1], where one-tailed test was used.
[a]A measure developed by Lee *et al*. (2011) was used for *Relative reputation of corporate investors (vs. IVCs).*
[b]Forward citation of new ventures was used to measure *Post-funding rates of innovation of new ventures.*
[c]Log transformed to enhance normality.
[d]Wireless venture produced fewer number of patents at the 10 percent level.
[e]Wireless venture produced patents with lower impact (forward citations) at the 1 percent level.



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from the mere presence of corporate investors (i.e., H2) if their corporate investors were particularly influential, based on a superior reputation relative to co-investing IVCs. After controlling for the simple presence of corporate investors (i.e., *CVC funded*), *Relative reputation of corporate investors* was positively related to *Post-funding rates of innovation* by new ventures ($p < 0.01$). Thus, H3 was supported.

Although our results suggest that corporate investors positively influence the post-funding rates of innovation by new ventures, all else being equal, understanding the size of their effect is important. Because our model specification is nonlinear, interpreting effect size requires many assumptions. Marginal effects may vary depending on the value of the dependent variable. We used new ventures funded solely by IVCs as our baseline. According to our model, the predicted number of patents during the three years following the last round of funding by new ventures that are funded solely by IVC is 0.89. Our results suggest that the number of patents applied for by similar ventures receiving CVC funding from corporate investors with a sample average level of relative reputation increased by 116% (1.03 additional patents) over those funded solely by IVCs. The results also suggest that the number of patents applied for by similar ventures receiving CVC funding from relatively highly reputable and influential corporate investors (i.e., one standard deviation above the sample mean) increased by 245 percent (2.18 additional patents) over those funded solely by IVCs.

As part of a *post hoc* analysis, we qualitatively assessed whether the selection of investees in terms of *Pre-funding innovative capabilities* or the nurturing of investees by CVC investors led to greater increases in *Post-funding rates of innovation*. To do so, we compared the improvements in the log-likelihood across various empirical models. First we compared Model 5-1, which includes *Pre-funding innovative capabilities,* but does not include *CVC funded* or *Relative reputation of corporate investors,* to Model 5-4, which includes all variables. The change in the log-likelihood due to the addition of the CVC variables over and above the influence of *Pre-funding innovative capabilities* was 5.5 ($p < 0.02$). We then compared Model 5-5, which includes the CVC variables, but does not include *Pre-funding innovative capabilities,* to Model 5-4. The change in the log-likelihood due to the addition of *Pre-funding innovative capabilities* over and above the two CVC variables was 8.0 ($p < 0.001$). These comparisons suggest that the selection effect associated with *Pre-funding innovative capabilities* is stronger than the nurturing effect of CVC involvement on *Post-funding rates of innovation*, although both effects are influential. We note, however, that caution is needed when interpreting these qualitative comparisons.

### Robustness checks and *post hoc* analyses

We conducted several robustness checks. First, to measure *Post-funding rates of innovation*, we used alternative time frames to count the number of patent applications by new ventures. When we accounted for more comprehensive periods of patent applications, (1) five years following the last round of funding and (2) between first round and their exit/defunct year, the findings were consistent with our main results. Larger coefficients for explanatory and control variables were obtained due in part to increased mean and variance in the numbers of post-funding patent applications for the prolonged time frames.

Second, we used an alternative specification to establish causal inference for dependent variables measured in two different time periods (Allison, 1990). Recall that our dependent variable is essentially a change score in that it counts the number of patents within a three-year window following the last round of funding. An alternative specification for the change score dependent variable in our design is to control for the cumulative count of patents at the time of last funding and predict the cumulative patent count three years after the last funding (Allison, 1990). Both *CVC funded* and *Relative reputation of corporate investors* were significant at the 5 percent level.

Third, we inserted binary indicators to denote whether new ventures received their first (first-stage equation) and/or last (second-stage equation) round of funding during the dot-com bubble (1998 to 2000) or bust (2001 to 2003) periods to investigate the possibility that these periods had some idiosyncratic effect on our findings. These results were generally consistent with our main results. No variables that indicated bubble or bust periods were significant in predicting pre-funding innovative capabilities or post-funding rates of innovation of new ventures.

Fourth, we tested H3 using an alternative ratio for *Relative reputation of corporate investor*. Instead of using as the denominator of our ratio variable the number of new ventures taken public by all investors in the syndicate, we used the number of



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new ventures taken public only by IVC coinvestors. These, too, were consistent with our main results. We had originally assigned '0' to those ventures when both corporate investors and IVCs had no prior IPO experience, because zero over zero in our ratio variable would result in an undetermined value. If we substituted these zero values with the ratio of corporate investors to the total number of investors, proxying the influence of corporate investors by taking the fraction of corporate investors on the total number of investors, our results would be slightly stronger in terms of coefficients and *p*-values for our explanatory variables. However, if we excluded 70 ventures that had investors with no prior IPO experience, the presence of corporate investors (*CVC funded*) showed a slightly weaker effect on the post-funding rates of innovation by new ventures, whereas the coefficient for *Relative reputation of corporate investors* remained significant at the 5 percent level.

Moreover, we tested H3 using an alternative measure of investor reputation developed by Lee *et al*., (2011) to calculate the relative reputation of corporate investors. The measure is a composite score that takes into account prominence and quality of outcomes that determine a VC's reputation, including total number of portfolio companies a VC invested in, the total funds invested in portfolio firms, the total dollar amount of funds raised, the number (count) of individual funds raised, the number of portfolio firms taken public, and VC age (Lee *et al*., 2011). We assessed the relative reputation of corporate investors by comparing the reputation of the lead corporate investor to that of the lead IVC using the same methodology to derive our main relative reputation variable.[7] Not surprisingly, the alternative measure was highly correlated with our original measure ($r = 0.62$, $p < 0.001$). Although somewhat weaker both in terms of significance and magnitude, perhaps because the variance of the new measure for CVC reputation is substantially less than the variance of our original measure based solely on the number of investors to go public, our results were generally consistent with our main results. Model 5-6 in Table 5 reports our results using the alternative measure of investor reputation.

[7] We took the reputation of lead corporate and independent VCs respectively instead of average reputation from the members of each group in the syndicate to calculate the relative reputation because we reasoned that, in case of conflicting interests, investors with greater voice will carry greater weight in determining the course of action taken by the new ventures.

Fifth, because the stage in which corporate investors joined the investment syndicate may impact their influence on new ventures, we conducted a couple of robustness checks. We first added binary indicators if they joined the investment syndicate in the first or last round. Our results were essentially unchanged and neither indicator was significant at the 10 percent level. We then excluded 74 firms that received CVC investments in their last round of funding. Although dropping approximately 15 percent of our sample ventures eliminated some statistical power, our results remained generally consistent with our main results. The coefficient for *Relative reputation of corporate investors* (versus IVCs) became somewhat larger, but its significant level was slightly weaker ($p < 0.10$). We suspect that the loss of statistical power from eliminating 15 percent of our total sample, or 27 percent of the CVC funded venture sample led to these weaker results. Sixth, we tested H3 using a subsample of CVC funded ventures only, because the relative reputation of corporate investors could be relevant for only such ventures. Despite the decrease in sample size, our overall results were consistent with our main results.

Our theoretical development and empirics addressed how corporate investors influence post-funding rates of innovation irrespective of the subsequent impact of the innovation. As a *post hoc* analysis, we assessed whether corporate investors influenced the impact of post-funding innovation of new venture investees as well. We used a three-year window from patent grant to count the number of forward citations attributed to post-funding patents of each new venture (Trajtenberg, 1990). This alternative dependent variable was correlated with our dependent variable based on a simple count of post-funding patents ($r = 0.51$, $p < 0.001$). Model 5-7 of Table 5 provides the results of our *post hoc* analysis. These results suggest that while corporate investors enhance raw rates of innovation (i.e., post-funding patent counts), they have little influence on whether the innovation of new ventures is ultimately impactful. We consider reasons for this discrepancy later.

## DISCUSSION

We explored how the preferences, resources, and influence of corporate investors vis-à-vis IVC coinvestors can affect their selection of new venture investees and post-funding rates of innovation by



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their investees. We developed the premise that corporate investors generally place greater value on having new venture investees focus on innovation than IVC coinvestors do, because a corporate investor can benefit disproportionately from technological synergies with its venture investee—possibly at the expense of other value-creating activities more conducive to IVC capital gains.

We find that such preference placed on innovation by corporate investors provides support for the selection effect associating a greater number of pre-funding patents for new ventures receiving CVC funding as compared to those solely funded by IVCs. Moreover, we find that new ventures funded in part by CVC exhibit greater post-funding rates of innovation compared to comparable new ventures that were funded solely by IVCs. We suggest that corporate investors have a stronger preference than their IVC counterparts for new venture investees enhancing their innovative capabilities and are able to efficiently provide tailored resources to facilitate this preference. In contrast, IVCs are primarily interested in increasing the value of their investees and their subsequent capital gains by emphasizing value chain activities not necessarily including a focus on innovation. IVCs play a broker's role in matching market resources to the needs of their investees. Because these arrangements entail market exchanges that are subject to holdup and other transactional problems, such resources tend to be less tailored to the specific needs of new ventures compared to those sourced from an equity holding corporate investor.

We also find that the rates of innovation by new venture investees is further enhanced when their corporate investors are highly reputable relative to their co-investing IVCs in terms of facilitating the success of previous new venture investees. We suggest that investees will be more attentive to the preferences of more highly reputable investors, granting them a greater level of influence over subsequent investee decisions and pursuits. Because corporate investors generally place higher value than IVCs on having their investees focus on innovation, due to the potential technological synergies between the investees and corporate investors, their greater influence relative to their IVC coinvestors will lead investees to place greater emphasis on innovative pursuits.

Overall, our results suggest an ordering in terms of post-funding rates of innovation by new ventures. All else being equal, new ventures funded solely by IVCs exhibit the lowest post-funding rates of innovation, whereas those funded in part by highly reputable and influential corporate investors (vis-à-vis their IVC coinvestors) exhibit the highest rates of innovation. The combination of theory and empirical results suggest that the variability in innovation levels across new ventures is caused, in part, by the differing preferences, resources, and influence of corporate investors and their IVC counterparts. Moreover, the superior rates of innovation by CVC funded ventures stem from both the preference of corporate investors in selecting new ventures with greater pre-funding innovative capabilities and the nurturing ability of corporate investors in providing resources for new ventures to enhance their rates of innovation.

## Contributions

This study contributes to several research streams. First, it contributes to the literature in technology entrepreneurship and CVC. Although the CVC phenomenon has received increasing attention in recent years, most studies have focused on the antecedents and consequences of established firms investing in new ventures (e.g., Dushnitsky and Lenox, 2005; Wadhwa and Kotha, 2006; Benson and Ziedonis, 2009; Tong and Li, 2011). This article joins the nascent stream of literature investigating the CVC phenomenon from the perspective of new ventures (e.g., Katila *et al*., 2008; Maula *et al*., 2009). Our study provides insights into the developmental consequences of new ventures considering CVC funding. Founders of new ventures may wish to take the implications of funding sources into account. Although the potential resources of corporate investors may appear particularly attractive to entrepreneurs, corporate investors have their own interests at heart, which may not necessarily coincide with other investors' interests or maximize the market value of the new venture. Further, consistent with prior studies examining the selection and nurturing effects of venture capital investors (e.g., Sørensen, 2007), our study shows that the greater innovativeness of CVC funded ventures stems from both the selection effect of corporate investors preferring to invest in new ventures with greater innovative capabilities and the nurturing effect of those investors in providing their investees with greater resources to boost their rates of innovation.

Second, this study advances the multiple agency perspective (e.g., Hoskisson *et al*., 2002; Arthurs *et al*., 2008) by showing that strategic outcomes of new ventures are affected by intangible sources of



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investor influence derived from a reputation of being associated with successful new ventures. The role of informal governance mechanism may be seen as particularly strong in this context, because new ventures often lack internal resources and are dependent on external resource providers for their success (Katila *et al*., 2008). At the same time, formal mechanisms of influence may be particularly infeasible for corporate investors. Our qualitative interviews revealed that corporate investors were often reluctant to sit on the boards of their portfolio companies, or had policies against it, due to the threat of litigation for not fulfilling fiduciary duties associated with board representation. Indeed, only about 8 percent of our sample ventures had corporate investors on their boards. Our study also illustrates the path dependency of early corporate governance structures on the development of young firms (e.g., Argyres and Liebeskind, 1999). Although new ventures may gain valuable resources from accepting equity investments by corporate investors, they must balance such benefits when the interests of those corporate investors diverge from those of their other investors.

Third, from the point of view of corporate investors, our work establishes a link between the literatures exploring corporate governance and the resource-based view of the firm (e.g., Wernerfelt, 1984; Barney, 1991). Our findings suggest that the reputation of corporate investors for facilitating new venture success, arguably a rare and inimitable resource, may lead to economic rents by granting them influence over current investees to pursue technological synergies over competing preferences of coinvestors. This rent-seeking mechanism may be particularly strong when new ventures and corporate investors operate in highly uncertain and complex environments (Amit and Schoemaker, 1993).

## Limitations and future research directions

This study is not without its limitations. The pre-funding innovative capabilities and post-funding rates of innovation by new ventures were measured by counting the number of patent applications. Prior studies have pointed out the deficiencies in using patent data as a measure of innovation (e.g., Pavitt, 1985). In addition, our control measurement of percentage of invested capital by corporate investor to proxy ownership share did not always accurately reflect true ownership share since different share prices may be applied, depending on the developmental stage of new ventures and market conditions surrounding a particular funding round. More fine-grained data from private sources could enhance the reliability of our predictions.

Due to the lack of publicly available data, we could not account for the influence of investors beyond corporate investors and IVCs, most notably angel investors who tend to get involved in the early stages of new ventures (e.g., Goldfarb *et al*., 2010). Although we suspect that angel investors are motivated by financial gain and, thus, have interests aligned with IVCs, a future study exploring how angel investors influence new venture outcomes—especially if their motivations go beyond financial gain—could be valuable. Our *post hoc* analyses suggest that the selection of innovative investees contributes more to post-funding rates of innovation than the nurturing of CVC investors. Moreover, we were not able to conduct an analysis exploring different resource needs by new ventures or tease out different mechanisms that corporate investors may use to help the new ventures increase their innovation. Thus, a more fine-grained dataset could more precisely compare the selection and nurturing effects of corporate investors and also examine the nurturing role of corporate investors in fulfilling different resource needs of the new ventures through different mechanisms that could lead to higher post-funding rates of innovation by CVC funded ventures.

In addition to overcoming these limitations, there are several possibilities for extending this study. Our primary results in conjunction with *post hoc* analyses suggest that, while corporate investors enhance raw rates of post-funding innovation (i.e., post-funding patent counts), they have little influence on whether the innovation of new ventures is ultimately impactful (i.e., greater forward citations). Although fully theorizing for such a discrepancy falls outside the scope of this article, one possible explanation is that CVC funded ventures allocate excessive resources to R&D, leading to relatively unproductive outcomes on average and potentially suboptimal performance (Tandon, 1983). It may be in the best interest of corporate investors to have their investees 'swing for the fences' in terms of pursuing risky R&D, leading to higher rates of patenting, but ultimately it may be less impactful on average. If CVC funded ventures are indeed inefficiently devoting excessive resources to R&D, it would be useful to determine the conditions under which these circumstances arise, which alternative activities experience the greatest loss, and the degree of multiple agency costs ventures paid for the involvement of corporate



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investors. Future theoretical and empirical research might also look at how new ventures mitigate or reduce agency costs rising from the presence of corporate investors. Such findings could provide normative recommendations for new ventures, achieving more effective governance structures to enhance their performance.

Future research may wish to explore how the background and experience of new venture founders can influence their interactions with established firms. We suspect that the resources and knowledge entrepreneurs bring to their ventures impact the way they interact with corporate investors. A nontrivial number of our sample ventures were funded by multiple corporate investors. Although most were complementary good producers, a few had competing firms investing in the same ventures. It would be fruitful to understand how such dynamics influence the bargaining power and ultimate outcomes of such ventures.

Because our sample was based on new ventures during initial stage of diffusion of CVC, we have limited knowledge about the evolutionary process of CVC investment practices. Future studies could explore the learning aspect of corporate investors as well as the new ventures receiving investments. Finally, in order to control for institutional environments, our sample was limited to new ventures based in the U.S. Because institutional contexts can play an important role in the governance of firms, comparisons of power dynamics among various stakeholders in new ventures across institutional contexts could lead to important advances in the study of international entrepreneurship.

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