Strategic Management Journal
Strat. Mgmt. J., **33**: 1–22 (2012)
Published online EarlyView in Wiley Online Library (wileyonlinelibrary.com) DOI: 10.1002/smj.937
Received 16 September 2009; *Final revision received 15 April 2011*

WHEN DOES CORPORATE VENTURE CAPITAL ADD VALUE FOR NEW VENTURES?

HAEMIN DENNIS PARK[1]* and H. KEVIN STEENSMA[2]
[1] *Institute of Entrepreneurship and Innovation, Henry W. Bloch School of Management, University of Missouri-Kansas City, Kansas City, Missouri, U.S.A.*
[2] *Michael G. Foster School of Business, University of Washington, Seattle, Washington, U.S.A.*

New ventures face a trade-off when considering corporate venture capital (CVC) funding. Corporate investors can provide complementary assets that enhance the commercialization of new venture technologies. However, tight links with a particular corporate investor has drawbacks and may constrain new ventures from accessing complementary assets from diverse sources in an open market. Taking this trade-off into account, we explore conditions under which CVC funding is beneficial to new ventures. Using a sample of computer, semiconductor, and wireless ventures, we find that CVC funding is particularly beneficial for new ventures when they require specialized complementary assets or operate in uncertain environments.

INTRODUCTION

New ventures face an increasingly diverse set of funding sources. Although they have traditionally relied on independent venture capital (IVC) as a major funding source, a growing number of them have considered corporate venture capital (CVC) in recent years (Dushnitsky, 2006; Gaba and Meyer, 2008; Katila, Rosenberger, and Eisenhardt, 2008). CVC refers to the practice of established firms taking a minority equity stake in privately held entrepreneurial ventures (Gompers and Lerner, 1998).

Capital funding is fungible in that money provided by one type of investor does not differ from that provided by another type. However, different types of investors may vary in their ability to provide nonfinancial resources that can substantially influence new venture performance (Hsu, 2006). In particular, a critical factor for new ventures successfully commercializing new technologies is accessing complementary assets in an efficient and timely manner (Teece, 1986; Tripsas, 1997; Gans, Hsu, and Stern, 2002). Examples of these assets include expertise and infrastructure for product development, manufacturing, legal, sales, distribution, and customer service activities that must be used in conjunction with the new technology for its commercialization. Unlike established firms that own many of these assets, new ventures face a particularly strong challenge in securing complementary assets for their technology commercialization. They are typically unable to develop such assets internally due to the prohibitive costs and time constraints (Aghion and Tirole, 1994), yet are subject to the potential opportunism of their partners if they source these assets externally in an arm's-length transaction (Williamson, 1985, 1991).

Keywords: corporate venture capital; technology entrepreneurship; complementary assets; transaction costs; new venture performance
*Correspondence to: Haemin Dennis Park, Institute of Entrepreneurship and Innovation Henry W. Bloch School of Management, University of Missouri-Kansas City, Kansas City, MO 64110, U.S.A. E-mail: parkha@umkc.edu

By receiving CVC funding, new ventures not only obtain financial capital but also complementary assets from their corporate investors (Dushnitsky and Lenox, 2005; Katila *et al.*, 2008). For instance, Airvana, a wireless infrastructure hardware and software developer for mobile broadband service providers, received \$90 million in VC funding between 2001 and 2005. Among its investors, Qualcomm, an active corporate investor in the wireless sector, played a key role in Airvana's technology commercialization. In addition to licensing its CDMA technology, Qualcomm shared its extensive product testing infrastructure to facilitate Airvana's product development process. Airvana eventually became highly successful and went public in 2007.

However, new ventures also face drawbacks by receiving CVC funding. CVC units are interested in maximizing the overall value of their parent firms, and these interests can sometimes conflict with those of new ventures. For instance, corporate investors may produce products that compete against those of new ventures (Hellmann, 2002) and expropriate intellectual property (IP) created by new ventures (Dushnitsky and Shaver, 2009). Further, investments from certain corporate investors may constrain new ventures from accessing diverse resource pools on the open market because competitors of corporate investors may be reluctant to work with new ventures that are partially owned by their rivals. In addition, CVC units of established firms often lack the expertise and autonomy to oversee new ventures as compared with IVC firms (Dushnitsky and Shapira, 2010; Ivanov and Xie, 2010). Thus, it remains unclear when CVC funding is beneficial to new ventures.

By establishing an equity link with an established firm, new ventures are partially internalizing the sourcing of complementary assets. Guided by transaction cost (TC) logic (Williamson, 1985, 1991), we examine how the specificity of complementary assets required by new ventures and the environmental uncertainty in which they operate influence whether CVC funding is beneficial or counterproductive for their performance. In assessing the performance implication of CVC funding for new ventures, we illustrate the prescriptive value of TC logic. Although TC logic has been primarily used to predict the choice of governance structure for exchange partners, it has also shown how the misalignment between predicted and actual governance choices impair the performance of involved firms (e.g., Leiblein, Reuer, and Dalsace, 2002; Nickerson and Silverman, 2003; Sampson, 2004; David, O'Brien, and Yoshikawa, 2008). Because the widespread availability of CVC funding for new ventures is fairly new, the performance implication of CVC funding for new ventures remains unclear. Such ambiguity can assist empirical assessment. Firms generally choose an appropriate governance structure for a particular economic transaction that optimizes their performance. However, a new form of governance structure takes time to diffuse, and until decision makers are fully aware of the performance consequences of alternative governance structures (i.e., when market equilibrium has been reached), they are not always likely to choose the appropriate governance structure for their economic transactions. Thus, a sample of firms that choose a particular governance structure is more likely to be distributed randomly during the initial phase of diffusion, enabling the performance effect of a particular governance structure to be more easily isolated, than at a later stage (Armour and Teece, 1978; Teece, 1980). Because CVC funding was not widely diffused until recently (Gaba and Meyer, 2008), our setting is somewhat analogous to a natural experiment comparing the performance of new ventures that have established an equity tie with a corporate investor versus those that did not establish such a tie to source complementary assets.[1]

To better understand our phenomenon of interest, we interviewed several entrepreneurs who had considered or received CVC funding, two corporate venture capitalists, and an attorney who mediates VC contracts. Analysis of these interviews grounded our theory development. We tested our predictions with data on 508 new ventures in the computer, semiconductor, and wireless sectors that received VC funding between 1990 and 2003. Similar to other studies (e.g., Gompers and Lerner, 1998; Stuart, Hoang, and Hybels, 1999; Shane and Stuart, 2002), we assessed the performance of new ventures in terms of their ability to exit through an initial public offering (IPO). In addition, we assessed the performance of new ventures by observing whether they survived or failed due to bankruptcy or ceasing operations. We found that (1) CVC-funded ventures were more likely to go public compared with new ventures that lacked

[1] We thank an anonymous reviewer for this insight.

DOI: 10.1002/smj

CVC funding when they required specialized complementary assets, and (2) CVC-funded ventures were less likely to fail compared with those ventures that lacked CVC funding when they required specialized complementary assets or operated in uncertain environments.

We begin by providing some background regarding the funding opportunities for new ventures and the underlying motivation of the investors and investees. We then consider those contingencies that make CVC funding particularly valuable for new ventures. We continue with a description of our methods and presentation of our results. We conclude by discussing insights learned from this study, its limitations, and opportunities for future studies.

BACKGROUND

New ventures were presumed to have little discretion regarding funding sources. However, growing evidence suggests that there is considerable choice. Entrepreneurs are willing to pay a 10–14 percent premium in the form of a valuation discount to obtain funding from reputable VC firms, forgoing investment proposals from less prominent VC firms (Hsu, 2004). Entrepreneurs may spurn certain investors in favor of those with a better fit with new ventures and can provide valuable managerial resources. The following experience of a software venture CEO whom we interviewed showcases the investor selection process for new ventures:

> *We had to turn down several term sheets (with higher valuation offers) before we accepted one from our current investors. We wanted to build a strong board that would give us the greatest chance for success. We looked at their reputation, past track record of success, skill sets, and industry contacts. We conducted an in-depth due diligence of VCs before accepting the term sheet from our current investors.*

New ventures have traditionally relied on IVC firms to provide financial and managerial resources (Gorman and Sahlman, 1989; Hsu, 2006). IVC funds are typically private partnerships with funding from larger institutions (e.g., university endowments, pension funds) that invest in high-risk/high-return ventures (Sahlman, 1990). Their sole objective is to realize capital gains through the sale of venture equity at an exit event such as an IPO or acquisition. IVC firms often take an active role in helping new ventures succeed by providing managerial advice and referrals to potential customers, alliance partners, management talent, and other investors (Gorman and Sahlman, 1989; Hellmann and Puri, 2000, 2002; Hsu, 2006; Hochberg, Ljungqvist, and Lu, 2007).

In contrast, established firms operate CVC programs to achieve both financial and strategic objectives (Dushnitsky, 2006). Similar to IVC firms, CVC programs look for capital gains through the sale of venture equity at an exit event such as an IPO or acquisition. However, their strategic objectives are often more diverse and complex. On the one hand, CVC programs enable established firms to exploit their existing capabilities. For instance, established firms may operate CVC programs to find new suppliers and buyers, or to expand internationally (Winters and Murfin, 1988). Others want to stimulate the demand for existing products by supporting the commercialization of complementary products (Kann, 2000; Chesbrough, 2002). On the other hand, CVC programs can allow established firms to identify novel products that may replace their existing products or to accelerate their entry into new markets (Kann, 2000; Keil, Zahra, and Maula, 2004; Dushnitsky, 2006). In addition, they may invest in new ventures with promising technologies as an intermediary step to acquiring those ventures (Siegel, Siegel, and MacMillan, 1988; McNally, 1997; Benson and Ziedonis, 2008). In general, established firms view strategic objectives as more important than financial ones (Dushnitsky, 2006).

New ventures benefit from CVC funding by obtaining valuable complementary assets from their corporate investors, including expertise and infrastructure for product development, manufacturing, legal, distribution, marketing, sales, and customer service activities (Dushnitsky and Lenox, 2005; Katila *et al*., 2008). Access to complementary assets in a timely and efficient manner is critical to realize profit from novel technologies (Teece, 1986; Tripsas, 1997; Gans *et al*., 2002). Because new ventures often face significant challenges in developing complementary assets in the short run, funding from firms that can also provide these assets may render their technology commercialization process more efficient and ultimately enhance their performance.

DOI: 10.1002/smj

The benefits of accepting CVC funding, however, come at a price for new ventures. CVC units of established firms are interested in maximizing the overall value of their corporate parents and their interests can conflict with those of new ventures. For instance, corporate investors may produce competing products to those of new ventures and may expropriate IP created by new ventures (Dushnitsky and Shaver, 2009). Moreover, because CVC units are generally less experienced and lack high powered incentives that IVC firms enjoy, the quality of their oversight is generally lower than that of IVC firms (Dushnitsky and Shapira, 2010; Ivanov and Xie, 2010). Further, accepting CVC funding from a particular corporate investor could compromise a new venture's ability to source complementary assets from the open market. For instance, competitors of corporate investors could be reluctant to work with firms that have ownership ties with their rivals. This drawback of CVC funding is illustrated by the following statement by an attorney we interviewed who specializes in legal services for new ventures:

> *Start-ups want to make sure that their strategic investments don't crowd out their short- and long-term strategy. If one receives an investment from, say AOL, it becomes more difficult to make deals with AOL's competitors like Google or Yahoo! because they automatically assume that AOL has the inside track in the start-up.*

Thus, new ventures face a trade-off in partially internalizing a set of recurring transactions to source complementary assets by establishing an equity tie with an established firm. Although new ventures can lower transaction costs, such as costs involved in searching for appropriate resource providers and negotiating contracts, their ability to access the competitive open market, offering a greater variety of resources and competitive pricing, is reduced by establishing an equity link with a particular established firm (Williamson, 1985, 1991). The balance between these benefits and detriments will vary across new ventures and the contexts in which they operate. Guided by transaction cost logic (Williamson, 1985, 1991), we examine how the specificity of complementary assets required by new ventures and the environmental uncertainty in which they operate might affect this trade-off. These factors, in turn, will determine the performance of CVC-funded ventures relative to that of new ventures without CVC funding. However, because we argue that the value of CVC funding depends on contingent factors, we do not present a hypothesis for the main effect of CVC funding on new venture performance.

THEORY AND HYPOTHESES

Specificity of complementary asset requirements

Firms can generally improve their performance by minimizing transaction costs in economic exchanges (Williamson, 1985, 1991). Examples of transaction costs include costs involved to search, negotiate, enforce, and monitor contracts. Asset specificity is viewed as particularly influential in determining the transaction costs of economic exchanges (Williamson, 1985, 1991; David and Han, 2004). Complementary assets vary in their specificity. Specialized complementary assets are tailored to a particular use, whereas generic complementary assets may be deployed for alternative uses without much alteration (Teece, 1986). For instance, some hardware products may require the development of specialized software that constitute specialized complementary assets, whereas a manufacturing facility that makes running shoes is regarded as a generic complementary asset, because it uses generic equipment that can be easily converted to produce other goods (Teece, 1986).

Developing specialized complementary assets internally is generally not feasible for new ventures due to the prohibitive costs and difficulties in developing these assets in the short run (Aghion and Tirole, 1994). Such ventures also face significant challenges in obtaining specialized complementary assets from the open market. The providers of specialized complementary assets to new ventures must make relationship-specific investments that could lose value if the new ventures were to terminate the relationship or not survive. As a result, established firms are reluctant to provide specialized complementary assets to new ventures on the basis of an arm's-length market relationship without imposing excessive contractual stipulations, penalty clauses, and monitoring mechanisms that can increase the cost of such transactions (Williamson, 1985, 1991). Moreover, established firms that provide specialized complementary assets are often rare because such assets must be accrued over a long period of time and are path dependent (Teece, Pisano, and Shuen, 1997), creating a small-numbers bargaining problem (Williamson, 1985; Pisano, 1990).

One way new ventures can mitigate these challenges is through equity funding from established firms that can provide specialized complementary assets. Equity ownership grants control rights that can be exercised if exchange partners behave opportunistically and can serve as a safeguard to allow established firms to provide specialized complementary assets to new ventures (Williamson, 1988). Equity ownership also produces incentives for established firms to provide specialized complementary assets, especially if their assets will contribute significantly to the success of a new venture (Grossman and Hart, 1986; Hart and Moore, 1990). New ventures that require specialized complementary assets for successful technology commercialization can obtain these assets more effectively from established firms that have an equity stake in those new ventures than they could from those established firms without such a stake. In our interview with a business development executive of a wireless software venture, he describes why his company pursued CVC funding from a particular wireless carrier:

> *We wanted inside access to their product testing infrastructure. We had to make sure that our software was fully compatible with theirs. One way of getting favorable treatment was by receiving equity investments from them.*

In contrast, new ventures generally incur lower transaction costs in securing generic complementary assets from the open market. Because such assets do not lose value even if a particular relationship falls apart, asset owners are willing to provide these assets to other firms with limited contractual stipulations (Williamson, 1985, 1991; Pisano, 1990; Rothaermel and Hill, 2005). Thus, it is easier for new ventures to source generic complementary assets compared with specialized complementary assets on the open market. As a result, CVC-funded ventures that access generic complementary assets through their corporate investors will realize little advantage over those ventures without CVC funding that access such assets from the open market. In fact, new ventures without CVC funding that require generic complementary assets may be better off working with a diverse group of firms, foregoing tight links with a specific corporate investor. Therefore, new ventures that require generic complementary assets are not likely to benefit from CVC funding as much as those that require specialized complementary assets. We thus hypothesize that the influence of CVC funding on new venture performance depends on whether the new venture requires specialized or generic complementary assets.

> *Hypothesis 1: CVC funding will be more beneficial to new venture performance when new ventures require specialized complementary assets compared with new ventures that require generic complementary assets.*

Environmental uncertainty

The level of environmental uncertainty in which new ventures operate may also influence the extent to which they will benefit from CVC funding. According to transaction cost logic, exchange partners can write reasonable contracts and avoid contractual hazards when uncertainty is trivial. Writing, executing, monitoring, and renegotiating contracts become more costly when the future is relatively unpredictable. In order to avoid contractual hazards, firms tend to internalize more activities in uncertain environments (Williamson, 1985, 1991).

When new ventures cannot easily predict their future resource needs, those ventures that obtain complementary assets from the open market may incur substantial transaction costs as contracts must continuously be updated to reflect changing needs (Williamson, 1985, 1991). Established firms are also more reluctant to provide complementary assets in uncertain environments because contractual hazards are more likely to arise due to incomplete contracts. An established firm's equity stake in a new venture serves as an efficient safeguard against inappropriate behavior and enables the established firm to efficiently provide complementary assets to the new venture (Williamson, 1985, 1988). Such corporate investors will be more adaptable and willing to make necessary changes in providing complementary assets to new ventures in uncertain environments, compared with suppliers that have no equity stake in these ventures. Thus, when uncertainty is high, CVC-funded ventures can access a steady supply of appropriate complementary assets from corporate investors compared with those ventures without CVC funding that must rely on the open market for such assets.

In contrast, new ventures operating in a stable environment are able to predict their resource needs. Established firms will be less reluctant to provide complementary assets for new ventures in an arm's-length relationship because both parties can write reasonably complete contracts. Equity ownership is less important in stable environments because there is less need to safeguard potential opportunistic behavior. The providers of complementary assets do not have to be as adaptable because the resource needs of new ventures are less likely to change in stable environments. In addition, new ventures without CVC funding that operate in stable environments can take advantage of the benefits of sourcing complementary assets from a competitive open market. Thus, the benefits of CVC funding as a mechanism for securing complementary assets are less critical when new ventures operate in a stable environment compared with an uncertain one. We therefore hypothesize that the influence of CVC funding on new venture performance depends on whether the new venture operates in a stable or an uncertain environment.

Hypothesis 2: CVC funding will be more beneficial to new venture performance when new ventures operate in uncertain environments compared with new ventures that operate in stable environments.

METHODS

Research setting, data, and sample

We used the VentureXpert database as our primary source of data on new ventures, their investors, and VC funding deals. We supplemented the VentureXpert database with several sources, including LinkSV (www.linksv.com), the Internet Archive service (www.archive.org), Factiva, Lexis-Nexis, and hand collected data from Internet searches to increase the accuracy of the data and reduce missing data. In addition, we used COMPUSTAT, the U.S. Patent and Trademark Office (USPTO), and Security Data Corporation (SDC) databases to collect data for various control variables.

Our sample consisted of 198 wireless communications service (VentureXpert code = 1320), 111 computer hardware (VentureXpert code = 2100), and 199 semiconductor (VentureXpert code = 3111//3112) ventures founded in the United States that received their first round of funding from CVC and/or IVC funds between 1990 and 2003. Our sample period facilitated a reasonably complete dataset of venture investments as the frequency of missing data from the VentureXpert database was substantially greater for investments prior to 1990. CVC activities also became prevalent after 1990 (Gaba and Meyer, 2008). A sample period ranging over 14 years ensured sufficient variance of environmental factors, enabling us to test our hypotheses.

We chose the wireless, computer, and semiconductor industries for two reasons. First, these industries exhibited great technological advances and robust CVC investment activities during the sample period (Dushnitsky and Lenox, 2005). Second, these industries provided substantial variance in the specificity of complementary asset requirements for technology commercialization (Monteverde, 1995; Leiblein *et al*., 2002; Rothaermel and Hill, 2005). From the early 1990s to the early 2000s, the wireless communications service industry experienced explosive growth. The penetration rate of wireless service subscriptions grew from less than five percent of the population in the early 1990s to over 75 percent of the population in most industrialized nations by the early 2000s. The wireless industry is highly capital intensive and there are no vertically integrated firms in the United States. New entrants must rely on established firms to gain access to such specialized complementary assets as switching networks that have been built by established firms over the years (Rothaermel and Hill, 2005). Access to switching networks requires both established firms and new ventures to make substantial relationship-specific investments in order to develop customized infrastructure to ensure network compatibility, billing, and other features of the operation. At the same time, the wireless industry suffers from a lack of uniform technological standards throughout its value chain (Suarez, 2005). Industry standards are an important mechanism to reduce asset specificity between contracting partners (Baldwin and Clark, 2000; Spivak and Brenner, 2001; Sahaym, Steensma, and Schilling, 2007). However, multiple nonuniform communications standards (e.g., CDMA, GSM, TDMA, WiFi, WiMax, and so forth) coexist within the wireless industry. Wireless service providers

DOI: 10.1002/smj

have also developed nonstandardized proprietary data services with key software, hardware, and content providers.

In contrast, most new ventures in the computer industry require generic complementary assets such as distribution channels and customer support to commercialize their new products (Rothaermel and Hill, 2005). In the late 1980s and early 1990s, a wave of new ventures entered the computer industry, taking advantage of the open system architecture that standardized key hardware and software components. New entrants typically developed distribution channels and customer support that did not involve specialized complementary assets held by incumbent firms (Rothaermel and Hill, 2005). Consistent with Rothaermel and Hill (2005), we reasoned that firms in the wireless industry generally require specialized complementary assets, whereas firms in the computer industry generally require generic complementary assets.

The semiconductor industry is characterized by a mixed asset specificity environment. Several studies have used the semiconductor industry to analyze the effect of variance in the asset specificity on economic exchanges (e.g., Monteverde, 1995; Leiblein *et al.*, 2002). Because standardization of technology is critical in determining asset specificity of economic exchanges (Baldwin and Clark, 2000; Spivak and Benner, 2001; Sahaym *et al.*, 2007), we distinguished between customized (3111) and standardized (3112) semiconductor developers based on the VentureXpert classification system. The specificity of required complementary assets will likely vary according to the standardization of the semiconductor logic structure, design rules, and process technology. We reason that customized semiconductor products generally require specialized complementary assets, whereas standardized semiconductor products generally require generic complementary assets (Baldwin and Clark, 2000; Spivak and Brenner, 2001; Sahaym *et al.*, 2007).

Variable description

Dependent variables

We used two measures of venture performance. Our first measure was a binary variable that took a value of 1 if new ventures went public as of January 1, 2009, and 0 otherwise. Prior studies have extensively used the occurrence of an IPO as a measure of new venture success (e.g., Gompers and Lerner, 1998; Stuart *et al.*, 1999; Shane and Stuart, 2002). This measure is particularly relevant in this study because our sample industries are highly capital intensive and rapid growth through infusion of capital is an important milestone for new ventures. Although some recent studies have also viewed the acquisition of new ventures as a successful outcome for new ventures (e.g., Waguespack and Fleming, 2009), we chose not to do so for two reasons. First, both investors and entrepreneurs generally consider IPO to be the most successful outcome for new ventures. Gompers and Lerner (1998), for instance, reported that investors realized an average return on investment of 95 percent when portfolio companies went public; whereas their return on investment was only 40 percent when portfolio companies were acquired. Return on investment for having their ventures acquired is likely to be even lower for entrepreneurs because VC firms generally obtain preferred shares granting them the right to claim payoffs equal to or greater than their original investments before entrepreneurs and other common shareholders can be paid, whereas VC firms must convert preferred shares into common shares when new ventures exit through an IPO (Kaplan and Strömberg, 2003). Thus, the relative attractiveness of IPO will be even greater for entrepreneurs. Second, many acquisitions that occurred during the dot-com bust period of 2001–2003 were actually failures. Other studies have documented a similar pattern. According to Waguespack and Fleming (2009), for instance, the average sales price of their sample ventures in the high-tech industries that were acquired prior to 2000 was $190 million, whereas the sales price for new ventures that were acquired after 2000 was $49 million.[2] Given that approximately 90 percent of acquisition exits in our sample occurred in or after 2000, we opt not to categorize acquisitions as a successful outcome. Nevertheless, we report and discuss robustness

[2] Although taking the valuation of new ventures that exited through an IPO and acquisition would have been a valid alternative dependent variable, we faced severe sample selection bias in obtaining the sale price for acquisition exits. We were more likely to obtain the sales price for successful acquisition outcomes compared with that of less successful acquisition outcomes because both investors and entrepreneurs were less likely to disclose their sales price for the latter case and such acquisitions received less attention from the press.

checks in our results section where we ran models using acquisition exists coded as a successful outcome.

Our second measure of venture performance took a value of 1 if new ventures were defunct and 0 otherwise. VentureXpert classifies new ventures as defunct if they are no longer in operation or have declared bankruptcy. Approximately 13 percent of the sample ventures exited through an IPO, and another 27 percent failed. The remaining ventures were either acquired (34%) or remained active (27%) as of January 2009.

Explanatory variables

CVC funding took a value of 1 if a new venture received funding from at least one corporate investor and 0 otherwise. We followed the VentureXpert classification system to determine whether an investor was a CVC or IVC investor. Consistent with prior studies (e.g., Gompers and Lerner, 1998), most CVC-funded ventures were also funded by IVC investors. Thus, IVC-only funded ventures constitute the control group we use to assess the value of CVC funding for new ventures. We exclude diversified banks and insurance companies as CVC investors because the resources they provided do not directly relate to the technology commercialization of new ventures (Dushnitsky and Shaver, 2009).

Specialized complementary asset requirement took a value of 1 if new ventures operated in the wireless or customized semiconductor industries and 0 if they operated in the computer or standard semiconductor industries, according to VentureXpert classifications.

Environmental uncertainty is conceptualized as the level of unpredictability in particular industries. Environmental uncertainty is a relatively broad construct that is arguably proxied somewhat incompletely with a sole measure. The combination of multiple proxies for the same construct can provide a more valid measure (Kerlinger, 1986). We combine two measures to develop an omnibus measure of environmental uncertainty. We construct our first measure using a three-step process. Following Keats and Hitt (1988), we first obtain trends on total industry demand for five years, ending in the year in which new ventures obtained their last round of VC funding (t_{LR}). We compute the industry demand for each year by adding total sales of all firms for a particular standard industrial classification (SIC) code using COMPUSTAT. We applied 3571 for computer, 4812 for wireless, and 3674 for semiconductor firms. Although the mapping between VentureXpert and SIC codes was not always one-to-one, prior studies (e.g., Dushnitsky and Shaver, 2009) and our data inspection indicate a reasonable match between the two code schemes for our sample industries. We then use the resulting trend to forecast the demand for the year following the last round of funding ($t_{LR} + 1$). Finally, we calculate our first measure of environmental uncertainty by taking the difference between actual and predicted industry demands at $t_{LR} + 1$ and dividing it by the total industry demand at $t_{LR} + 1$. The level of environmental uncertainty is captured at $t_{LR} + 1$ because we are interested in assessing how *ex post* environmental uncertainty influences the value of CVC funding for new ventures. Although the influence of corporate investors is likely to interact with environmental uncertainty for a prolonged period, we reason that the year following the last round of funding will likely have the strongest influence on the outcome of new ventures. Indeed, 62 percent of the new ventures in our sample fail or exit within three years of their last funding round.

We obtained a second measure of environmental uncertainty by computing the yearly standard deviation of the natural log of weekly returns for each industry's stock market indices. This measure aims to capture the exogenous uncertainty specific to the technical subfield (Folta, 1998). To obtain the weekly returns, we use the NASDAQ Computer index for the computer industry, the NASDAQ Telecommunications index for the wireless industry, and the Philadelphia Semiconductor index (SOX) for the semiconductor industry. We also take data for the year following the last round of funding to ensure time compatibility between the two measures. The two measures of environmental uncertainty are strongly and positively correlated ($r = 0.33$). We standardize the two measures and add them up to obtain an omnibus measure of environmental uncertainty. We discuss our results using separate measures of environment uncertainty in the robustness tests section.

Control variables

We apply a number of industry- and firm-level control variables that can also influence the performance of new ventures. At the industry level, we control for *industry size* (the sum of total revenues of all firms in the industry) and *industry growth rate* in sales to control for environmental munificence. We also control for *industry concentration* (combined market share of the four largest firms in the industry) because established firms in concentrated industries can possess greater market power and could potentially influence the performance of new ventures. We capture these variables at $t_{LR} + 1$ to keep them consistent with our explanatory variables. Finally, we apply industry indicators for computer and wireless industries, leaving the semiconductor industry as the base industry, to account for industry fixed effects that do not relate to the specificity of complementary asset requirement.

At the firm level, we control for *pre-funding number of patents* and *pre-funding number of alliances* because quality of new ventures prior to receiving VC funding can influence their performance. We also control for *reputation of IVC* firms (number of portfolio ventures taken public prior to focal investments) because more reputable IVC firms provide better resources that can positively influence the performance of new ventures. Likewise, we control for *number of funding rounds, number of investors, total amount of funding, age* at the last round of funding, and location (California, Massachusetts, and Texas) of new ventures that may influence their outcomes. We take the natural log of some of these measures when doing so will enhance normality.

ANALYTICAL APPROACH

Because new ventures are less likely to choose the appropriate governance mode consistent with theory during the initial diffusion phase of a new governance mode (Armour and Teece, 1978; Teece, 1980), endogeneity due to self-selection is not likely to be severe in our setting. However, resource needs and environmental conditions can still influence whether new ventures self-select into receiving CVC funding. Thus, our sample of CVC- and IVC-only funded ventures might not be completely randomly distributed. We take steps to account for this possibility.

After considering several alternatives, we apply the bivariate probit model (Wooldridge, 2002; Greene, 2003) to test our hypotheses.[3] The bivariate probit model is appropriate for obtaining causal inference when both dependent and endogenous explanatory variables are dichotomous. The bivariate probit model jointly computes the maximum likelihood estimates (MLE) of two seemingly unrelated equations:

$$y_1 = y_2\beta_1 + x\beta_2 + \varepsilon_1$$
$$y_2 = z\beta_3 + \varepsilon_2$$

where y_1 denotes the dependent variables (IPO or failure); y_2 denotes the endogenous explanatory variable (CVC funding); x denotes explanatory, control and variables for the treatment equation; and z denotes explanatory, control, and instrumental variables for the selection equation

The first equation estimates the treatment effect of *CVC funding* interacting with s*pecialized complementary asset requirement* and *environmental uncertainty* on the performance of new ventures. The second equation estimates the selection effect influencing the propensity of new ventures receiving CVC funding based on explanatory, control, and instrumental variables. Our modeling strategy aimed to delineate *ex ante* and *ex post* firm and environmental factors that influence the selection and treatment effects of receiving CVC funding for new ventures. We apply the year following the last round of funding ($t_{LR} + 1$) for the explanatory and control variables in the treatment equation because we reason that $t_{LR} + 1$ is the most influential year for predicting performance outcomes. In contrast, we apply the year in which new ventures raise their first round of funding (t_{FR}) for explanatory, control, and instrumental variables in the selection equation reasoning that environmental conditions at t_{FR} will most likely influence the propensity of new ventures receiving CVC funding. Figure 1 captures the time stamps applied for various explanatory and control variables.

In addition to the application of time variance to capture explanatory and control variables,

[3] We consider several alternative models for our analysis. Variations of two-staged models, censored (Heckman) probit model, and treatment effect model violate one or more key assumptions given the binary nature of our dependent and endogenous variables. Nonetheless, results using these models are consistent to our main results. Further, we consider a two-sided matching model (e.g., Sorenson, 2007). However, this model makes some strong assumptions about how investor-venture dyads are formed (Sorenson and Stuart, 2001) and is inappropriate for our analysis. Overall, our theoretical orientation, focusing on the performance implication of CVC funding for new ventures, guides us to use new ventures, as opposed to new venture-investor dyads, as our unit of analysis.

DOI: 10.1002/smj

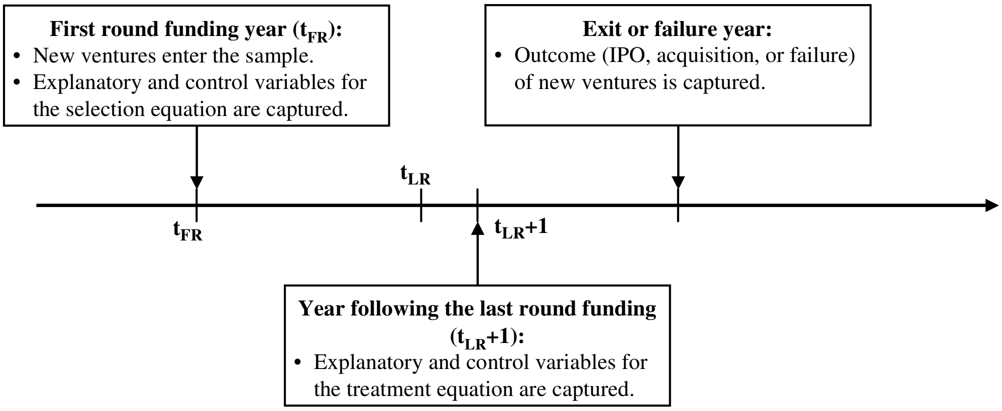

Figure 1. Timeline for explanatory and control variables

we introduce two instruments for the selection equation. A good instrument should be highly correlated with the endogenous variable and not correlated with the dependent variable. Exogenous factors that constitute natural experiments such as time and geography often yield valid instruments (Wooldridge, 2002). We identifiy two instruments that take advantage of circumstances surrounding new ventures at the time when they chose funding sources. Availability of CVC is likely to influence the likelihood of new ventures receiving CVC funding, but is less likely to influence the performance of new ventures. We construct the measure of *availability of CVC* by adding the total amount of investments made by all corporate investors in focal industries for each year that a particular new venture received VC funding. The resulting measure is weakly correlated with *IPO* ($r = -0.02$) and *failure* ($r = -0.15$) and relatively more strongly correlated with *CVC funding* ($r = 0.28$).

We employ a second instrument by calculating the *ex ante* demand uncertainty using the first step of the procedure described above to obtain our first measure of environmental uncertainty. We take the average standard error of total industry demand for the previous five years ending at t_{FR}. If environmental uncertainty had an effect on the attractiveness of CVC funding, we reason that *ex ante* demand uncertainty will influence the decision calculus of new ventures in search of CVC, but that only *ex post* environmental uncertainty will influence their performance outcomes. The resulting *ex ante* demand uncertainty is weakly correlated with *IPO* ($r = 0.01$) and *failure* ($r = -0.02$) and relatively more strongly correlated with *CVC funding* ($r = 0.09$).

RESULTS

Table 1 reports variable definitions and descriptive statistics. Table 2 reports bivariate correlations. The proportion of CVC-funded ventures is noteworthy. Fifty-three percent of our sample ventures received CVC funding. This figure is substantially higher than that of prior CVC studies for several reasons. First, we obtained our sample ventures from highly technology-intensive industries where CVC investments are particularly active. Second, we used new ventures as the unit of analysis, whereas other studies have taken venture investments or financing rounds as the unit of analysis. As new ventures go through multiple funding rounds, corporate investors are more likely to enter the investment syndicate. Using venture investments or funding rounds as units of analysis, we observed that 10 percent of the venture investments and 24 percent of the funding rounds in our sample were CVC funded. These figures are more consistent with those from prior studies.

Finally, the VentureXpert database contains a nontrivial portion of missing investor identities. We observed a systematic bias against corporate investors in the missing data. Although few prominent IVC firms (e.g., Benchmark Capital, Kleiner Perkins, Sequoia) and CVC investors (e.g., Intel, Motorola, Qualcomm) were missing from the investment dataset, corporate investors without formal CVC programs that did not frequently invest in new ventures were more likely to be

DOI: 10.1002/smj

Table 1. Variable definitions and summary statistics

Variable	Definition	Mean	SD
Dependent variables			
(1) *IPO*	1 if a new venture went public	0.128	0.334
(2) *Failure*	1 if a new venture went bankrupt or ceased its operation	0.268	0.443
Explanatory variables			
(3) *CVC funding*	1 if a new venture received funding from at least one corporate investor	0.533	0.499
(4) *Specialized complementary asset requirement (SCAR)*	1 if a new venture operated in the wireless or customized semiconductor industry	0.718	0.450
(5) *Environmental uncertainty*	Combined standardized measures of demand uncertainty and stock market volatility of focal technology sector	0.000	1.601
Industry-level control variables			
(6) *Industry size* (ln)	Total sales of all firms in the focal industry	4.822	0.390
(7) *Industry growth rate*	Growth of sales of all firms in the focal industry	0.091	0.160
(8) *Industry concentration rate*	Sum of market share of four largest firms in focal industry	0.623	0.191
Venture-level control variables			
(9) *Number of funding rounds* (ln)	Number of funding rounds that a new venture raised	0.999	0.726
(10) *Number of investors* (ln)	Number of unique investors from which a new venture received (excludes individual investor)	1.421	0.803
(11) *Total amount of funding* (ln)	Amount of VC investments that a new venture received	3.048	1.309
(12) *Pre-funding number of patents* (ln)	Number of patent application (that were ultimately granted) by a new venture before receiving VC funding	0.380	0.757
(13) *Pre-funding number of alliances* (ln)	Number of alliances formed by a new venture before receiving VC funding	0.044	0.218
(14) *Reputation of IVC firms* (ln)	Number of firms taken public by IVC investors prior to focal investment	2.824	1.831
(15) *Age* (ln)	Years elapsed since the founding of a new venture	1.472	0.762
(16) *Availability of CVC* (ln)	Total amount of CVC investments for years that a new venture raised VC funding	5.482	1.734
(17) *Ex ante demand uncertainty*	Standard errors of industry demand from the linear trend line over previous five years (standardized)	0.000	1.000

Note: ln = natural logarithm of a variable.

absent from the database. Of 928 identified investors from the VentureXpert database, 103 (11.1%) were corporate investors, whereas 108 of 364 (29.7%) undisclosed investors or investors with incomplete information in the VentureXpert database that were eventually identified through alternative sources were corporate investors.

Table 3 shows cross-tabulation results for the relationship between specialized complementary asset requirements of new ventures and whether they were CVC- or IVC-only funded on performance outcomes. Although our study required a multivariate analysis to produce conclusive results, cross-tabulation results were instructive as a first step. We observed that 17.5 percent of CVC-funded ventures and 8.8 percent of IVC-only funded ventures went public if they required specialized complementary assets, whereas 7.7 percent of CVC-funded ventures and 12.8 percent of IVC-only funded ventures went public if they required generic complementary assets. Further, 16.0 percent of CVC-funded ventures and 35.2 percent of IVC-only funded ventures failed if they required specialized complementary assets, whereas 29.2 percent of CVC-funded ventures and 35.9 percent of IVC-only funded ventures failed if they required generic complementary assets. Using Pearson chi-squared tests, the differences in the

Table 2. Correlation matrix

	Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)
(1)	*IPO*	1.00																
(2)	*Failure*	−0.23	1.00															
(3)	*CVC funding*	0.07	−0.18	1.00														
(4)	*Specialized complementary asset requirement*	0.04	−0.09	0.10	1.00													
(5)	*Environmental uncertainty* at $t_{LR} + 1$	−0.01	0.04	−0.01	0.05	1.00												
(6)	*Industry size* at $t_{LR} + 1$	−0.20	−0.20	0.13	−0.17	0.17	1.00											
(7)	*Industry growth rate* at $t_{LR} + 1$	0.09	−0.02	−0.01	0.22	−0.52	−0.34	1.00										
(8)	*Industry concentration* at $t_{LR} + 1$	−0.05	0.07	−0.04	−0.36	−0.32	−0.22	0.04	1.00									
(9)	*Number of funding rounds* (ln)	0.04	−0.32	0.36	0.11	0.03	0.37	−0.20	−0.02	1.00								
(10)	*Number of investors* (ln)	0.12	−0.29	0.46	0.12	0.06	0.29	−0.17	−0.08	0.75	1.00							
(11)	*Total amount of funding* (ln)	0.21	−0.34	0.38	0.10	0.07	0.30	−0.15	−0.06	0.68	0.72	1.00						
(12)	*Pre-funding number of patents* (ln)	0.11	−0.11	0.10	−0.03	0.04	0.08	0.00	−0.12	0.06	0.09	0.14	1.00					
(13)	*Pre-funding number of alliances* (ln)	0.10	0.01	−0.02	−0.00	−0.06	−0.20	0.06	0.07	−0.08	−0.05	−0.05	0.07	1.00				
(14)	*IVC reputation* (ln)	0.11	−0.23	0.12	0.02	0.03	0.24	−0.11	−0.04	0.47	0.57	0.53	0.06	−0.07	1.00			
(15)	*Age* at t_{LR} (ln)	0.09	−0.39	0.29	0.02	−0.05	0.32	−0.16	0.02	0.58	0.43	0.47	0.16	0.05	0.30	1.00		
(16)	*Availability of CVC* (ln)	−0.02	−0.15	0.27	0.50	0.33	0.35	−0.09	−0.41	0.41	0.42	0.43	−0.01	−0.16	0.21	0.17	1.00	
(17)	*Ex ante demand uncertainty*	0.01	−0.02	0.08	0.54	−0.23	−0.40	0.35	0.01	0.10	0.11	0.08	−0.07	0.07	−0.06	0.05	0.25	1.00

Notes: n = 508. ln = natural logarithm of a variable. Correlations above 0.09 or below −0.09 are significant at the 5% level.

Table 3. Cross tabulation results of the percentage of IPOs and failures for new ventures

% IPOs			
Asset specificity	IVC-only	CVC-funded	Significance of difference
Generic	12.8% (n = 78)	7.7% (n = 65)	Not significant
Specialized	8.8% (n = 159)	17.5% (n = 206)	$p < 0.05$

% Failures			
Asset specificity	IVC-only	CVC-funded	Significance of difference
Generic	35.9% (n = 78)	29.2% (n = 65)	Not significant
Specialized	35.2% (n = 159)	16.0% (n = 206)	$p < 0.05$

likelihood of both IPO and failure between CVC- and IVC-only funded ventures that required specialized complementary assets were significant at the five percent level, whereas the differences in the likelihood of both IPO and failure between CVC- and IVC-only funded ventures that required generic complementary assets were not significant.

Tables 4 and 5 provide the bivariate probit model results. To be conservative, we used two-tailed significance tests for all our models, even though one-tailed tests would have been statistically justifiable because of the directionality of our hypotheses (Neter, *et al*., 1996). Table 4 shows the bivariate probit model results using *IPO* as the measure of venture performance. The first column reports the probit model results for the propensity of new ventures receiving CVC funding.[4] *Number of investors* ($p < 0.01$), *total amount of funding* ($p < 0.10$), and *availability of CVC funding* ($p < 0.10$) increased the propensity for new ventures to receive CVC funding, whereas *reputation of IVC firms* ($p < 0.01$) and *ex ante demand uncertainty* ($p < 0.10$) decreased the propensity for new ventures to receive CVC funding.

Table 5 shows the bivariate probit model results using *failure* as the measure of venture performance. The first column reports the probit model results for the propensity for new ventures to receive CVC funding. Consistent with the selection equation in Table 4, *number of investors* ($p < 0.01$), *total amount of funding* ($p < 0.10$), and *availability of CVC* ($p < 0.01$) funding increased the propensity for new ventures to receive CVC funding, whereas *reputation of IVC firms* ($p < 0.01$) decreased the propensity for new ventures to receive CVC funding. Unlike the selection equation in Table 4, however, *industry growth rate* ($p < 0.10$) and *age* ($p < 0.10$) also increased the propensity for new ventures to receive CVC funding, whereas *industry size* ($p < 0.10$) negatively influenced the propensity for new ventures to receive CVC funding. *Ex ante demand uncertainty* was not significant in determining the propensity for new ventures to receive CVC funding.

Model 1 in Table 4 and Model 6 in Table 5 served as the baseline models and included all control variables to predict the likelihood of *IPO* and *failure* for new ventures, respectively. In Model 1, *total amount of funding* ($p < 0.01$) and *age* ($p < 0.10$) positively influenced the likelihood of *IPO* for new ventures, whereas *industry size* ($p < 0.01$) negatively influenced the likelihood of *IPO* for new ventures. In Model 6, *industry size* ($p < 0.10$), *industry growth rate* ($p < 0.05$), *total amount of funding* ($p < 0.01$), and *age* ($p < 0.01$) negatively influenced the likelihood of *failure* for new ventures.

We introduced the main effects of *CVC funding, specialized complementary asset requirement*, and *environmental uncertainty* in Model 2 of Table 4 and Model 7 of Table 5 to predict the likelihood of *IPO* and *failure* for new ventures, respectively. We found a positive and significant effect of *CVC funding* on both the likelihood of *IPO* ($p < 0.01$) and the likelihood of *failure* ($p < 0.01$) for new ventures. Neither *specialized complementary asset*

[4] Because the bivariate probit model jointly computes the MLE for both the selection and treatment equations, coefficients for the selection equation were different for each model. For space reasons and easier display of treatment equation results, we report only the coefficients of the selection equation for Model 5 of Table 4 and Model 10 of Table 5 (full models).

DOI: 10.1002/smj

Table 4. Likelihood of IPO of new ventures

	Propensity to receive CVC funding	Likelihood of IPO of new ventures				
		Model 1	Model 2	Model 3	Model 4	Model 5
Industry size at $t_{LR} + 1$ (ln)		−1.418***	−1.048***	−1.150***	−1.047***	−1.169***
		(0.256)	(0.269)	(0.305)	(0.272)	(0.313)
Industry size at t_{FR} (ln)	−0.442					
	(0.280)					
Industry growth rate at $t_{LR} + 1$		0.845	0.549	0.643	0.545	0.646
		(0.601)	(0.496)	(0.524)	(0.495)	(0.523)
Industry growth rate at t_{FR}	0.128					
	(0.365)					
Industry concentration at $t_{LR} + 1$		−1.332	−0.760	−0.893	−0.769	−0.928
		(0.916)	(0.736)	(0.806)	(0.735)	(0.807)
Industry concentration at t_{FR}	−0.108					
	(1.143)					
Number of funding rounds (ln)	−0.012	−0.304	−0.264	−0.237	−0.267†	−0.241
	(0.137)	(0.188)	(0.161)	(0.165)	(0.159)	(0.163)
Number of investors (ln)	0.898***	0.189	−0.250	−0.200	−0.252	−0.203
	(0.139)	(0.178)	(0.207)	(0.220)	(0.208)	(0.222)
Total amount of funding (ln)	0.155*	0.444***	0.313***	0.331***	0.312***	0.331***
	(0.080)	(0.095)	(0.089)	(0.095)	(0.089)	(0.095)
Pre-funding number of patents (ln)	0.093	0.048	−0.003	0.002	−0.003	−0.003
	(0.083)	(0.097)	(0.084)	(0.089)	(0.084)	(0.090)
Pre-funding number of alliances (ln)	−0.022	0.179	0.211	0.211	0.206	0.203
	(0.289)	(0.326)	(0.259)	(0.266)	(0.256)	(0.262)
Reputation of IVC firms (ln)	−0.215***	0.026	0.108**	0.108**	0.108**	0.108*
	(0.049)	(0.059)	(0.054)	(0.057)	(0.054)	(0.057)
Age at t_{LR} (ln)		0.238*	0.082	0.108	0.082	0.109
		(0.124)	(0.106)	(0.115)	(0.106)	(0.114)
Age at t_{FR} (ln)	0.140					
	(0.096)					
Availability of CVC (ln)	0.102*					
	(0.061)					
Ex ante demand uncertainty	−0.201*					
	(0.105)					
CVC funding			1.369***	0.699	1.374***	0.689
			(0.314)	(0.531)	(0.315)	(0.535)
Specialized complementary asset requirement	−0.042		0.182	−0.291	0.175	−0.312
	(0.248)		(0.318)	(0.363)	(0.316)	(0.354)
Environmental uncertainty at $t_{LR} + 1$			−0.022	−0.011	−0.005	0.023
			(0.052)	(0.056)	(0.075)	(0.080)
CVC funding × specialized complementary asset requirement				0.709**		0.735**
				(0.341)		(0.343)
CVC funding × environmental uncertainty at $t_{LR} + 1$					−0.028	−0.054
					(0.082)	(0.088)
Industry indicators	Yes	Yes	Yes	Yes	Yes	Yes
Location indicators	Yes	Yes	Yes	Yes	Yes	Yes
Constant	0.132	4.558***	2.839**	3.624**	2.886**	3.750***
	(1.602)	(1.301)	(1.280)	(1.475)	(1.290)	(1.508)
Log likelihood		−420.65	−418.49	−416.23	−418.43	−416.05

Notes: n = 508. t_{FR} = year at first funding round. t_{LR} = year at last funding round. ln = natural logarithm of a variable. *, **, or *** indicate significance at the 10%, 5%, or 1% level, respectively, using two-tailed tests. Indented variables only entered in the selection equation. Robust standard errors are in parenthesis.

DOI: 10.1002/smj

Table 5. Likelihood of failure of new ventures

	Propensity to receive CVC funding	Likelihood of failure of new ventures				
		Model 6	Model 7	Model 8	Model 9	Model 10
Industry size at $t_{LR} + 1$ (ln)		−0.401*	−0.023	0.016	−0.110	−0.070
		(0.204)	(0.157)	(0.153)	(0.165)	(0.167)
Industry size at t_{FR} (ln)	−0.505**					
	(0.199)					
Industry growth rate at $t_{LR} + 1$		−1.114**	−0.965**	−1.030***	−0.846**	−0.928***
		(0.453)	(0.306)	(0.292)	(0.410)	(0.348)
Industry growth rate at t_{FR}	0.421*					
	(0.221)					
Industry concentration at $t_{LR} + 1$		−0.781	−0.495	−0.447	−0.600	−0.520
		(0.718)	(0.427)	(0.398)	(0.485)	(0.461)
Industry concentration at t_{FR}	−0.063					
	(0.916)					
Number of funding rounds (ln)	0.000	0.038	−0.071	−0.090	−0.076	−0.090
	(0.135)	(0.169)	(0.132)	(0.137)	(0.135)	(0.133)
Number of investors (ln)	0.834***	0.050	−0.457***	−0.440***	−0.453***	−0.435***
	(0.123)	(0.145)	(0.112)	(0.110)	(0.114)	(0.114)
Total amount of funding (ln)	0.128*	−0.231***	−0.243***	−0.246***	−0.236***	−0.239***
	(0.073)	(0.090)	(0.073)	(0.070)	(0.073)	(0.070)
Pre-funding number of patents (ln)	0.100	−0.061	−0.092	−0.084	−0.089	−0.085
	(0.079)	(0.108)	(0.080)	(0.082)	(0.083)	(0.081)
Pre-funding number of alliances (ln)	−0.296	0.132	0.107	0.120	0.095	0.101
	(0.312)	(0.310)	(0.336)	(0.334)	(0.340)	(0.312)
Reputation of IVC firms (ln)	−0.204***	−0.026	0.103**	0.099**	0.103***	0.098**
	(0.041)	(0.045)	(0.048)	(0.038)	(0.037)	(0.038)
Age at t_{LR} (ln)		−0.546***	−0.418***	−0.428***	−0.424***	−0.435***
		(0.118)	(0.084)	(0.090)	(0.084)	(0.086)
Age at t_{FR} (ln)	0.117*					
	(0.065)					
Availability of CVC	0.146***					
	(0.043)					
Ex ante demand uncertainty	0.012					
	(0.080)					
CVC funding			1.499***	1.821***	1.496***	1.785***
			(0.096)	(0.176)	(0.099)	(0.178)
Specialized complementary asset requirement	−0.121		0.234	0.534	0.231	0.512
	(0.260)		(0.259)	(0.322)	(0.240)	(0.313)
Environmental uncertainty at $t_{LR} + 1$			−0.059**	−0.063**	0.052	0.041
			(0.027)	(0.027)	(0.051)	(0.050)
CVC funding × specialized complementary asset requirement				−0.454**		−0.414**
				(0.189)		(0.197)
CVC funding × environmental uncertainty at $t_{LR} + 1$					−0.157***	−0.152***
					(0.055)	(0.045)
Industry indicators	Yes	Yes	Yes	Yes	Yes	Yes
Location indicators	Yes	Yes	Yes	Yes	Yes	Yes
Constant	0.420	4.558***	0.835	0.428	1.242	0.843
	(1.272)	(1.301)	(0.844)	(0.830)	(0.897)	(0.901)
Log likelihood		−507.40	−499.58	−496.94	−495.39	−493.08

Notes: n = 508. t_{FR} = year at first funding round. t_{LR} = year at last funding round. ln = natural logarithm of a variable. *, **, or *** indicate significance at the 10%, 5%, or 1% level, respectively, using two-tailed tests. Indented variables only entered in the selection equation. Robust standard errors are in parenthesis.

requirement nor *environmental uncertainty* significantly influenced the likelihood of *IPO*, but *environmental uncertainty* had a negative effect ($p < 0.05$) on *failure* for new ventures.

Hypothesis 1 predicted that CVC funding would be more beneficial to new venture performance when new ventures required specialized complementary assets compared with new ventures that required generic complementary assets. We introduced the interaction effect *CVC funding* × *specialized complementary asset requirement* in Model 3 of Table 4 and Model 8 of Table 5 to predict the likelihood of *IPO* and *failure* for new ventures, respectively. We found a positive and significant ($p < 0.05$) coefficient for Model 3 and a negative and significant ($p < 0.05$) coefficient for Model 8 for the interaction between *CVC funding* and *specialized complementary asset requirement*.

Hypothesis 2 predicted that CVC funding would be more beneficial to new venture performance when new ventures operated in uncertain environments compared with new ventures that operated in stable environments. We introduced the interaction effect *CVC funding* × *environmental uncertainty* in Model 4 of Table 4 and Model 9 of Table 5 to predict the likelihood of *IPO* and *failure* for new ventures, respectively. The interaction effect on the likelihood of *IPO* for new ventures shown in Model 4 was not significant. However, the interaction effect on the likelihood of *failure* for new ventures was negative and significant ($p < 0.01$). Model 5 of Table 4 and Model 10 of Table 5 represent the full models incorporating all main and interaction terms. All signs and significance levels of coefficients were consistent with our previous results.

Interaction effects of nonlinear models, however, cannot be simply interpreted using conventional t-tests as in linear models (Ai and Norton, 2003; Hoetker, 2007). Magnitudes of coefficients, significance levels, and even signs can vary across observations because cross-partial derivatives of the expected value of the dependent variable must be computed to obtain true interaction effects and corresponding standard errors (Ai and Norton, 2003). We followed the procedure developed by Norton, Wang, and Ai (2004) to graphically display the magnitude and significance levels of interaction effects.[5] Our graphs indicate that *CVC* × *specialized complementary assets requirement* was significant for predicted probabilities of *IPO* ranging approximately between 0.2 and 0.8. Consistent with our results in Table 4, *CVC* × *environmental uncertainty* was not significant at any levels of predicted probabilities of *IPO*. Further, both *CVC* × *specialized complementary assets requirement* and *CVC* × *environmental uncertainty* were significant at predicted probabilities of *failures* ranging approximately between 0.15 and 0.85. Limited ranges of significance for interaction terms in nonlinear models are typical (Norton *et al.*, 2004). Moreover, effect sizes of the interaction terms, in terms of percentage points in those effects, were generally higher for *CVC* × *specialized complementary asset requirement* compared with *CVC* × *environmental uncertainty*.

Robustness tests

We conducted several additional tests to ensure the robustness of our results. First, we excluded new ventures that received first and last rounds of funding and/or exited during the dot-com bubble (1998–2000) and dot-com bust (2001–2003) periods to examine the possibility that new ventures during these periods were somehow systematically different. Although our statistical power decreased due to smaller sample size, our results for both *IPO* and *failure* as dependent variables were qualitatively similar to our main results. Second, we allowed time windows for IPOs and failures. We tested identical models that were presented in our results but based on performance outcomes (i.e., IPO, failure) taking place within five years after the last round of funding. Only a small number of new ventures were affected by imposing time limits for IPOs and failures. These results were also qualitatively similar to our main results.

Third, we tested our hypotheses using alternative measures of environmental uncertainty. Our current measure is an omnibus measure that combines demand uncertainty and stock market volatility. We ran models using these two measures separately as proxies for environmental uncertainty and found no significant changes in our results. However, the interaction term *CVC* × *environmental uncertainty* had stronger effects (i.e., higher coefficient and lower p-value) when we used demand uncertainty to proxy environmental uncertainty as compared to using stock market volatility in

[5] Although we do not present these graphs due to limited space, they are available on request from the first author.

DOI: 10.1002/smj

predicting the performance of new ventures, especially when *failure* was used as our dependent variable. Fourth, we included acquisition exits as well as IPOs as a measure of success. That is, we categorized new ventures as successful if they went public or acquired. The interaction effect for *CVC funding* $\times$ *specialized complementary asset requirement* became somewhat less significant ($p < 0.10$) compared with that in our original model where new venture performance was based on IPOs only ($p < 0.05$). We suspect that the significance of the interaction term weakened because whether or not new ventures exited through an acquisition was a relatively noisy indicator of their success. Although some acquisitions may be indicative of new venture success, many acquisitions were not for reasons cited in the variable description section above.

Fifth, we included market climate variables (*number of IPOs* in a given year and *NASDAQ index*) to control for the overall market conditions during and after the period in which new ventures raised funding. Our results were essentially unchanged from our main results after inserting these variables into both the selection and treatment equations, respectively. Sixth, because corporate investors would impose limited influence on the IPO of new ventures if they joined the investment syndicate in a later round, we excluded those new ventures that received first-ever CVC funding within two years before the IPO. Although we lost some statistical power by eliminating 19 observations (4% of the sample) using such a criterion, our results were similar or slightly stronger for both *IPO* and *failure* as dependent variables (i.e., increased coefficients and lower p-values). Including those 19 ventures in our main sample may have added some noise to our dataset for analyzing the influence of CVC funding on new venture performance. Our full sample was, thus, a more conservative sample in testing our hypotheses.

DISCUSSION

In recent years, CVC has become an increasingly important funding source for new ventures. However, CVC funding presents both advantages and disadvantages for new ventures. We explored conditions under which CVC funding may be particularly beneficial to new ventures' performance. We found that, in terms of going public and avoiding failure, CVC-funding was generally more beneficial to those new ventures requiring specialized complementary assets as opposed to generic complementary assets. We argue that the tight relationship between new ventures and corporate investors is particularly beneficial in attaining specialized complementary assets. Such equity relationships can mitigate potential opportunistic behavior between new ventures and the providers of specialized complementary assets. It appears that when new ventures require specialized complementary assets, the benefits of corporate investor ties outweigh the ability to access the open market. In contrast, we found that the benefits of CVC funding to new venture performance was relatively limited for those new ventures that merely required generic complementary assets, and the benefits of an equity tie with a corporate investor were minimal is such situations. In fact, by establishing such a tie, new ventures may lose the benefits of accessing diverse resources in the open market.

We also found that CVC funding was generally more beneficial to the performance of new ventures in terms of avoiding failure when those new ventures operated in uncertain environments as opposed to stable ones. Contracting for complementary assets from the open market becomes problematic in uncertain environments when it is difficult for new ventures to accurately assess their needs. Sourcing complementary assets from corporate investors instead of the open market would allow new ventures to avoid the hazards prevalent in uncertain environments when contracting with arm's-length suppliers. It is easier to adapt the required complementary assets to changing environmental conditions when such assets are coming from corporate investors with an equity tie to new ventures. In uncertain environments, such advantages enhance the performance of CVC-funded ventures versus new ventures without CVC funding. In contrast, when new ventures operated in stable environments, there was relatively little difference in the likelihood of venture failure between CVC-funded ventures and those without CVC funding. The benefits of corporate investors would be minimal in such situations. Moreover, by accepting CVC funding, new ventures might lose benefits of accessing diverse resources in the open market. Overall, these results

DOI: 10.1002/smj

suggest that CVC funding may be particularly valuable to new ventures when they require specialized complementary assets or operate in uncertain environments.

Contributions and managerial implications

This study contributes to the technology entrepreneurship literature by exploring how corporate investors influence the performance of new ventures. Although investors are presumed to play an important role in exploiting entrepreneurial opportunities, it is unclear how and under what conditions different types of external investors can help or constrain the success of new ventures. The rapid diffusion of CVC activities in recent years has generated great interest in the CVC phenomenon. However, most studies have investigated the phenomenon from the perspective of corporate investors (e.g., Dushnitsky and Lenox, 2005; Wadhwa and Kotha, 2006). This study joins the nascent stream of the CVC literature that focuses on the perspective of new ventures (e.g., Katila *et al*., 2008) and extends it in several ways. First, we explore the performance implications of CVC funding for new ventures, considering not only the positive aspect of corporate investors as providers of complementary assets but also the potential drawbacks posed by conflicts of interest between corporate investors and new ventures that may constrain those ventures from accessing resources from the open market. Second, we take into account the likelihood of failures as well as IPOs in assessing the performance of new ventures. Third, using new ventures as our unit of analysis, our data reveal that over half of the new ventures in our sample industries had received CVC funding, illustrating the prevalence of symbiotic relationships between new ventures and established firms that have taken place in recent entrepreneurial endeavors.

This study also contributes to the literature by providing empirical validation for the prescriptive value of transaction cost logic. Transaction cost research has long examined factors that determine the *choice* of firm boundaries. With some notable exceptions (e.g., Leiblein *et al*., 2002; Nickerson and Silverman, 2003; Geyskens, Steenkamp, and Kumar, 2006), there has been a relative dearth of research linking such choices to firm performance (David and Han, 2004). Indeed, the use of transaction cost logic on a prescriptive basis has been criticized (Hill, 1990; Ghoshal and Moran, 1996). Our results suggest that when new ventures obtain CVC funding in accordance with transaction cost logic (i.e., specialized complementary asset requirement, high uncertainty), they perform better than they otherwise would. The prescriptive value of transaction cost logic could be particularly strong during the initial diffusion phase of a new governance mode (Armour and Teece, 1978; Teece, 1980).

Another debate in transaction cost literature regards the influence of uncertainty on the integration of firm activities and the outcome of such activities (c.f., David and Han, 2004). Although transaction cost logic suggests that in order to avoid contractual hazards firms will more tightly integrate with exchange partners when operating in uncertain environments, that same integration may hamper their ability to seek alternative resources. Ability to access a competitive, open market may be particularly valuable in highly volatile environments when firms may need to quickly reconfigure their resources (Folta, 1998; Schilling and Steensma, 2001). Our findings suggest that when uncertainty is substantial, the inherent willingness of corporate investors to adapt complementary assets will be more beneficial to new ventures than benefits from accessing alternative sources of those assets. This study provides evidence supporting the prescriptive value of transaction cost logic within the context of investment relationships between new ventures and corporate investors.

Our results can be considered within the broader literature on sourcing relationships and loose-tight coupling (e.g., Weick, 1976; Sanchez and Mahoney, 1996; Schilling and Steensma, 2001) and suggest potential boundary variables for transaction cost logic. Whether tight links with suppliers in uncertain environments enhance performance or hamper the performance of the sourcing firm may depend on the nature of the environmental uncertainty and the adaptability of the sourcing firm. It appears that when the uncertainty is the result of a continuous and evolutionary industry change, such as was the case in our study, the ability to easily adjust a tightly coupled supplier relationship and to limit transaction costs may be more beneficial to the sourcing firm. Perhaps when uncertainty is the result of a discontinuous shift, the ability to flexibly end a loosely coupled relationship and form alternative relationships will be more beneficial to

DOI: 10.1002/smj

the sourcing firm. In addition, new ventures tend to have limited adaptability given their lack of slack. When the sourcing firm has restricted adaptability due to limited slack, the ability to make relatively modest adjustments to a tightly coupled supplier will likely be more beneficial during times of uncertainty. Perhaps when firms are highly adaptable, the ability to flexibly form alternative relationships may be more beneficial to the sourcing firm. It may be the case, however, that new ventures simply lack the adaptability to exploit the benefits of loosely coupled relationships during times of uncertainty. Future research that formally tests these boundary variables would be valuable.

Finally, transaction cost logic has been used primarily to predict appropriate governance mechanisms from the perspective of investors. Only a handful of studies (e.g., Williamson, 1988; David *et al*., 2008) have used transaction cost logic to examine governance mechanisms from the perspective of investment recipients. This study supports that stream of literature.

The managerial implications of this study are straightforward. New ventures should formulate resource acquisition strategy according to their resource needs and the contexts in which they operate. Corporate investors can assist new ventures by efficiently providing complementary assets, but these efficiency gains could come at the cost of potential opportunism by corporate investors and reduced ability to access the open market. By weighing these forces simultaneously, new ventures can formulate a proper resource acquisition strategy.

Limitations and future research

This study is not without its limitations. Similar to prior studies that have analyzed asset specificity in economic exchange (e.g., Monteverde, 1995; Leiblein *et al*., 2002, Rothaermel and Hill, 2005), we rely on a qualitative approach to distinguish the specificity of complementary asset requirements. Although qualitative evidence suggests that complementary asset requirements in the wireless and customized semiconductor industries are more specialized compared with those in the computer and standardized semiconductor industries, future studies may benefit from a more fine-grained measure of specificity in terms of the complementary assets required by new ventures. Likewise, due to the lack of available data, we do not measure the exact equity stake of corporate investors. A more fine-grained measure that takes into account the magnitude of CVC funding that new ventures receive would strengthen our understanding of the influence of corporate investors on the performance of new ventures.

Another limitation involves our sample, which includes only new ventures receiving venture financing from CVC and/or IVC investors. Given the capital-intensive nature of our sample industries, we suspect that most new ventures in these industries will raise venture capital financing of some sort. Although it is possible that some new ventures may grow organically or rely solely on angel funding for their growth, our sample does not include such ventures.

There are several avenues to extend this study. The effect of environmental uncertainty on the contingent value of CVC funding needs to be further explored. Our results suggest that, although CVC funding decreases the likelihood of failure for new ventures operating in uncertain environments, it does not increase the likelihood of new ventures going public in uncertain environments. Uncovering why and how such a difference arises could be valuable. Exploring the possible contingent conditions under which the benefits gained by accessing the open market might be greater than lowering transaction costs by forming an equity link with a corporate investor would also be fruitful. Although our study revealed that an equity link with a corporate investor can be beneficial for new ventures in high uncertainty conditions without a technological discontinuity, it would be valuable to find our whether such benefits are maintained when a technological discontinuity threatens to make the resources provided by a corporate investor more obsolete (Henderson and Clark, 1990).

Another avenue for future research would be to link CVC investment relationships with corporate governance issues. Many new ventures are in the process of building corporate governance structures through the use of external investors as board members. How does the presence of strategic investors influence this process? Conflict of interest between CVC and IVC investors could arise along with the traditional principal-agent relationship issues between investors and entrepreneurs. Perhaps whether corporate investors produce complement or substitute products compared with those of the new ventures could influ-

DOI: 10.1002/smj

ence the magnitude of potential conflicts of interest. It would be interesting to find out how the additional costs of control influence the corporate governance structure and performance of new ventures. Conflicts of interest among different types of investors could also influence the exit choices of new ventures (e.g., IPO versus acquisition). Future research could consider investigating how these divergent interests manifest in the exit outcomes of new ventures.

Finally, an interesting research agenda would be to compare institutional practices for CVC relationships around the world. Although we restricted our sample to U.S. ventures to control for institutional environments, many new ventures in Asia and Europe also consider CVC funding and the established firms in these regions actively invest in new ventures. However, strategic involvement practices appear to vary considerably from one institutional environment to another. How does the involvement of established firms influence entrepreneurial activities in these regions? What institutional arrangements are more or less conducive to competitive or cooperative behaviors between new ventures and established firms? These are interesting research questions to be explored in future studies.

ACKNOWLEDGEMENTS

We thank Associate Editor Constance Helfat and two anonymous reviewers for help in developing this paper. We also thank John Williard for his research assistance in collecting patent data. H. Dennis Park thanks his dissertation committee members Jeff Barden, Gary Erickson, Robert Jacobson, and Corey Phelps, and seminar participants at the 2009 Academy of Management Annual Meeting, ESADE, KAIST, University of Central Florida, University of Missouri-Kansas City, and University of Washington for comments on earlier drafts.

REFERENCES

Aghion P, Tirole J. 1994. The management of innovation. *Quarterly Journal of Economics* **109**: 1185–1209.

Ai C, Norton EC. 2003. Interaction terms in logit and probit models. *Economic Letters* **80**: 123–129.

Armour HO, Teece DJ. 1978. Organizational structure and economic performance: a test of multidivisional hypothesis. *Bell Journal of Economics* **9**: 106–122.

Baldwin CY, Clark KB. 2000. *Design Rules (Volume 1): The Power of Modularity*. MIT Press: Cambridge, MA.

Benson D, Ziedonis RH. 2008. Corporate venture capital as a window on new technologies: implications for the performance of corporate investors when acquiring startups. *Organization Science* **20**: 329–351.

Chesbrough HW. 2002. Making sense of corporate venture capital. *Harvard Business Review* **80**(3): 90–99.

David P, O'Brien JP, Yoshikawa T. 2008. The implications of debt heterogeneity for R&D investment and firm performance. *Academy of Management Journal* **51**: 165–181.

David RJ, Han S-K. 2004. A systematic assessment of the empirical support for transaction cost economics. *Strategic Management Journal* **25**(1): 39–58.

Dushnitsky G. 2006. Corporate venture capital: past evidence and future directions. In *Oxford Handbook of Entrepreneurship (Oxford Handbooks in Business & Management)*, Casson M, Yeung B, Basu A, Wadeson N (eds). Oxford University Press: Oxford, UK; 387–431.

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

Dushnitsky G, Shapira Z. 2010. Entrepreneurial finance meets organizational reality: comparing investment practices and performance of corporate and independent venture capitalists. *Strategic Management Journal* **31**(9): 990–1017.

Dushnitsky G, Shaver M. 2009. Limitations to interorganizational knowledge acquisition: the paradox of corporate venture capital. *Strategic Management Journal* **30**(10): 1045–1064.

Folta TB. 1998. Governance and uncertainty: the tradeoff between administrative control and commitment. *Strategic Management Journal* **19**(11): 1007–1028.

Gaba V, Meyer AD. 2008. Crossing the organizational species barrier: how venture capital practices infiltrated the information technology sector. *Academy of Management Journal* **51**: 976–998.

Gans JS, Hsu D, Stern S. 2002. When does start-up innovation spur the gale of creative destruction? *RAND Journal of Economics* **33**: 571–586.

Geyskens I, Steenkamp J, Kumar N. 2006. Make, buy, or ally: a transaction cost theory meta-analysis. *Academy of Management Journal* **22**: 519–543.

Ghosal SP, Moran P. 1996. Bad for practice: a critique of transaction cost theory. *Academy of Management Review* **21**: 13–47.

Gompers PA, Lerner J. 1998. The determinants of corporate venture capital success: organizational structure, incentives, and complementarities. NBER working paper #6725. National Bureau of Economic Research, Cambridge, MA.

Gorman M, Sahlman WA. 1989. What do venture capitalists do? *Journal of Business Venturing* **4**: 231–248.

Greene WH. 2003. *Econometric Analysis.* Prentice Hall: Upper Saddle River, NJ.

Grossman SJ, Hart OD. 1986. The costs and benefits of ownership: a theory of vertical integration. *Journal of Political Economy* **94**: 691–719.

Hart O, Moore J. 1990. Property rights and the nature of the firm. *Journal of Political Economy* **98**: 1119–1150.

Hellmann T. 2002. A theory of strategic venture investing. *Journal of Financial Economics* **64**: 285–314.

Hellmann T, Puri M. 2000. The interaction between product market and financing strategy: the role of venture capital. *Review of Financial Studies* **13**: 959–984.

Hellmann T, Puri M. 2002. Venture capital and the professionalization of start-up firms: empirical evidence. *Journal of Finance* **57**: 169–197.

Henderson R, Clark K. 1990. Architectural innovation: the reconfiguration of existing product technologies and the failure of established firms. *Administrative Science Quarterly* **35**: 9–30.

Hill CWL. 1990. Cooperation, opportunism, and the invisible hand implications for transaction cost economics. *Academy of Management Review* **15**: 500–513.

Hochberg YA, Ljungqvist Y, Lu Y. 2007. Whom you know matters: venture capital networks and investment performance. *Journal of Finance* **62**: 251–301.

Hoetker G. 2007. The use of logit and probit models in strategic management research: critical issues. *Strategic Management Journal* **28**(4): 331–343.

Hsu DH. 2004. What do entrepreneurs pay for venture capital affiliation? *Journal of Finance* **59**: 1805–1844.

Hsu DH. 2006. Venture capitalists and cooperative start-up commercialization strategy. *Management Science* **52**: 206–219.

Ivanov VI, Xie F. 2010. Do corporate venture capitalists add value to start-up firms? Evidence from IPOs and acquisitions of VC-backed companies. *Financial Management* **39**: 129–152.

Kann A. 2000. Strategic venture capital investing by corporations: a framework for structuring and valuing corporate venture capital programs. Ph.D. diss. Stanford University, Stanford, CA.

Kaplan SN, Strömberg P. 2003. Financial contracting theory meets the real world: an empirical analysis of venture capital contracts. *Review of Economic Studies* **78**: 281–315.

Katila R, Rosenberger JD, Eisenhardt KM. 2008. Swimming with sharks: technology ventures, defense mechanisms and corporate relationships. *Administrative Science Quarterly* **53**: 295–332.

Keats BW, Hitt MA. 1988. A causal model of linkages among environmental dimensions, macro-organizational characteristics, and performance. *Academy of Management Journal* **31**: 570–598.

Keil T, Zahra SA, Maula M. 2004. Explorative and exploitative learning from corporate venture capital: a model of program level determinants. Paper presented at the annual meeting of the Academy of Management, New Orleans, LA.

Kerlinger F. 1986. *Foundations of Behavioral Research* (3rd edn). Holt, Rinehart, & Winston: New York.

Leiblein MJ, Reuer JJ, Dalsace F. 2002. Do make or buy decisions matter? The influence of organizational governance on technological performance. *Strategic Management Journal* **23**(9): 817–833.

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

Monteverde K. 1995. Technical dialog as an incentive for vertical integration in the semiconductor industry. *Management Science* **41**(10): 1624–1638.

Neter J, Kutner MH, Nachtsheim CJ, Wasserman W. 1996. *Applied Linear Statistical Models* (4th edn). Irwin: Chicago, IL.

Nickerson JA, Silverman BS. 2003. Why firms want to organize differently and what keeps them from doing so: inappropriate governance, performance, and adaptation in a deregulated industry. *Administrative Science Quarterly* **48**: 433–465.

Norton EC, Wang H, Ai C. 2004. Computing interaction effects and standard errors in logit and probit models. *STATA Journal* **4**(2): 154–167.

Pisano GP. 1990. The R&D boundaries of the firm: an empirical analysis. *Administrative Science Quarterly* **35**: 153–176.

Rothaermel FT, Hill CWL. 2005. Technological discontinuities and complementary assets: a longitudinal study of industry and firm performance. *Organization Science* **16**: 52–70.

Sahaym A, Steensma HK, Schilling MA. 2007. The influence of information technology on the use of loosely coupled organizational forms: an industry-level analysis. *Organization Science* **18**: 865–880.

Sahlman WA. 1990. The structure and governance of venture capital organizations. *Journal of Financial Economics* **27**: 473–521.

Sampson RC. 2004. The cost of misaligned governance in R&D alliances. *Journal of Law, Economics & Organization* **2**: 484–526.

Sanchez R, Mahoney JT. 1996. Modularity, flexibility, and knowledge management in product and organization design. *Strategic Management Journal*, Winter Special Issue **17**: 63–76.

Schilling M, Steensma HK. 2001. The use of modular organizational forms: an industry-level analysis. *Academy of Management Journal* **44**: 1149–1169.

Shane S, Stuart TE. 2002. Organizational endowments and the performance of university start-ups. *Management Science* **48**: 364–381.

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

Sørenson M. 2007. How smart is smart money? A two-sided matching model of venture capital. *Journal of Finance* **62**: 2725–2762.

Sorenson O, Stuart TE. 2001. Syndication networks and the spatial distribution of venture capital investments. *American Journal of Sociology* **106**: 1546–1588.

Spivak S, Brenner FC. 2001. *Standardization Essentials: Principles and Practice*. Marcel Dekker: New York.

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

DOI: 10.1002/smj

Suarez F. 2005. Network effects revisited: the role of strong ties in technology selection. *Academy of Management Journal* **48**: 710–720.

Teece DJ. 1980. The diffusion of an administrative innovation. *Management Science* **26**: 464–470.

Teece DJ. 1986. Profiting from technological innovation: implications for integration, collaborating, licensing, and public policy. *Research Policy* **15**: 285–305.

Teece DJ, Pisano G, Shuen A. 1997. Dynamic capabilities and strategic management. *Strategic Management Journal* **18**(7): 509–533.

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

Wadhwa A, Kotha S. 2006. Exploration and knowledge creation through external venturing: evidence from the telecommunications equipment manufacturing industry. *Academy of Management Journal* **49**: 819–835.

Waguespack D, Fleming L. 2009. Scanning the commons? Evidence on the benefits to startups participating in open standards development. *Management Science* **55**(2): 210–223.

Weick KE. 1976. Educational organizations as loosely coupled systems. *Administrative Science Quarterly* **21**(1): 1–19.

Williamson OE. 1985. *The Economic Institutions of Capitalism.* Free Press: New York.

Williamson OE. 1988. Corporate finance and corporate governance. *Journal of Finance* **43**: 567–591.

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

Winters TE, Murfin DE. 1988. Venture capital investing for corporate development objectives. *Journal of Business Venturing* **3**(3): 207–222.

Wooldridge JM. 2002. *Econometric Analysis of Cross Section and Panel Data.* MIT Press: Cambridge, MA.

DOI: 10.1002/smj