

Serial Entrepreneurs and Venture Performance: Evidence from U.S. Venture-Capital-Financed Semiconductor Firms

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ABSTRACT

How does prior firm-founding experience affect subsequent startup firm performance? In this study, I examine the effect of prior firm-founding experience on subsequent startup firm's probability of survival, which is an often-used measure of firm performance. Estimates of this relationship take into account self-selection by founders into serial entrepreneurship and two roles of venture capitalists (VC)—evaluating start-up quality (i.e., screening deals) and mentoring/monitoring (i.e., adding value to the firms). Analysis of the survival of U.S. venture-capital-financed semiconductor firms that entered the market during 1995-1999 does not show evidence of self-selection of highly-capable entrepreneurs into serial entrepreneurship and indicates that the hazard rate of firms founded by serial entrepreneurs is substantially lower than firms founded by novice entrepreneurs. This implies that prior firm-founding experience improves subsequent venture performance. The findings should help researchers as well as practitioners better understand the value of prior firm-founding experience and of VCs.

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1. INTRODUCTION

Recently, entrepreneurship has received attention by many scholars from a number of different disciplines. Economists believe that entrepreneurship promotes innovation, brings sustained economic growth, and creates more employment opportunities, especially by innovative firms (Baumol 2007, Acs and Armington, 2006, Audretsch et al., 2006). Governments around the world are eager to emulate the successful entrepreneurial firms of Silicon Valley, and, to do so, have pushed efforts to understand entrepreneurship. To really learn about entrepreneurship, MacMillan (1986) recommended that researchers study “habitual” or “experienced” entrepreneurs.

How does prior firm-founding experience affect subsequent startup firm performance? In this study, I examine the effect of prior firm-founding experience on subsequent startup firm’s probability of survival, which is an often-used measure of firm performance. Estimates of this relationship take into account self-selection by founders into serial entrepreneurship and two roles of venture capitalists (VC)—evaluating start-up quality (i.e., screening deals) and mentoring/monitoring (i.e., adding value to the firms). Analysis of the survival of U.S. venture-capital-financed semiconductor firms that entered the market during 1995-1999 does not show evidence of self-selection of highly-capable entrepreneurs into serial entrepreneurship and indicates that the hazard rate of firms founded by serial entrepreneurs is substantially lower than firms founded by novice entrepreneurs. This implies that prior firm-founding experience improves subsequent venture performance. The findings should help researchers as well as practitioners better understand the value of prior firm-founding experience and of VCs.

Firm survival is related to the post-entry performance of new firms and is also related to other measures of performance such as profitability, size, and growth. Arguably, firm survival is the most comprehensive of the group (Klepper 2002, Stigler 1958). A longer period of survival by innovative firms implies that new products and/or services are delivered to consumers, or existing products and/or services are delivered at a lower cost for a longer period of time.

To start a firm, entrepreneurs put together teams of people and assemble resources and capital to develop and market a new product or service. The entrepreneurial process requires founders to exercise a variety of skills, such as writing an effective business plan, securing funding from investors, working with lawyers and accountants, and developing a marketing plan and sales force. In addition, entrepreneurs must have sufficiently good knowledge in a wide variety of areas to hire the right personnel or to outsource to the right vendors. As Lazear (2004, 2005) points out, an entrepreneur has to be a “generalist,” a “jack-of-all-trades.” Entrepreneurs may be endowed with a broad set of skills (Lentz and Laband 1990) that are then supplemented by investing in human capital such as formal schooling (Bates 1985, 1990). Entrepreneurs can also augment skills through “learning-by-doing” in the process of building a firm, which may be particularly important given that some entrepreneurial skills are subtle and hard to teach in a classroom setting. Because of the importance of learning-by-doing, experienced founders are expected to have an advantage over first-time entrepreneurs in their subsequent ventures, and this advantage should manifest in terms of firm survival at an early stage when the skill set of the founder is most relevant.

When entrepreneurs start an innovative firm, they raise capital from VCs. In this process, VC firms provide capital to the startup firm and also contribute to entrepreneurship in other ways. The two main roles of VCs are i) screening deals and ii) mentoring/monitoring. Screening deals by VC firm is the process of selecting the most promising business operation amongst many entrepreneurial firms by evaluating startup firm quality, which includes its business plan and its team members. VC firm’s screening ability is necessary to ensure efficient allocation of scarce capital to the most viable projects. Mentoring/monitoring by a VC firm is the process of actively adding value to the startup firm through mentoring activities such as providing input into their business plan or discussing marketing strategy, and also by monitoring the startup firm’s progress by imposing deadlines for tasks before funding in subsequent rounds. Entrepreneurs would prefer to raise capital from VCs with better mentoring/monitoring ability because they expect this assistance to translate into better firm performance (Hsu 2004). Once a startup

firm is selected for funding, we would expect entrepreneurial firms funded by VCs with better mentoring/monitoring ability to have a lower probability of exit.

To test these hypotheses, I study the survival of U.S. venture-backed semiconductor firms that entered the market during 1995-1999. For the purpose of this study, the date a startup company secured its first round of VC-financing is considered as the entry date. I define entrepreneurs as those individuals who are founders of a startup firm. I compare firms that were founded by experienced founders (i.e. those who have founded firms multiple times), which I refer to as “serial entrepreneurs,” and firms that were founded by first-time founders, which I refer to as “novice entrepreneurs.”

I focus on the semiconductor industry, since it provides a relatively homogeneous group of early-stage firms with some useful properties. First, the semiconductor industry is an investment-intensive industry because of the cost of EDA tools, chip designers, and contract manufacturing, and so usually requires capital from VCs before market entry. Therefore, venture-backed firms well represent new firms created in the industry. Second, few entrepreneurs have founded more than two semiconductor firms during their lifetimes in this industry, most likely because the fabless model that facilitated entry by new firms, was not practical until the late 1980s, and so serial entrepreneurs are usually in their second venture during this period, which makes the comparison with novice entrepreneurs more straightforward. Third, since the survival probability of firms varies across industrial sectors (Geroski, 1995; Audretsch *et al.*, 1999; Audretsch *et al.*, 2000), focusing only on the semiconductor industry eliminates heterogeneity across industries. In addition, I limit the time period to 1995-1999 in order to have a fairly constant macro-economic environment and also to allow at least seven years of observing firm survival.

A related study to the current one is Gompers et al (2006), which indicates that a large component of success in entrepreneurship and venture capital can be attributed to skill rather than luck. They show that entrepreneurs with a track record of success are more likely to succeed than novice entrepreneurs and those who have previously failed. They also find that funding by more experienced VCs enhances the chance of success, but only for entrepreneurs without a track record of success. As the authors point out, the finding

that skill matters for entrepreneurial success still leaves us wondering how entrepreneurs develop entrepreneurial skills. I expand this line of research in two directions. First, my study looks into how entrepreneurial skills are enhanced in the previous founding process, whether it was VC-financed or not, through acquisition of human capital and social capital, and explore how these enhanced skills are related to subsequent venture performance. Second, I decompose the two main roles of VCs into screening ability and mentoring/monitoring ability and thereby take into account the unobserved heterogeneity of startup firms and that of value-adding ability of VCs.

In this study, I hypothesize that a firm-founding experience enhances entrepreneurs' human and social capital, which augments entrepreneurs' endowed skill. I explore the effect of entrepreneurs' prior firm-founding experience on subsequent venture performance by taking an approach that extends our understanding of entrepreneurial experience beyond the findings of Gompers et al (2006). I decompose the role of VC firms into two parts – *ex ante* screening ability and *ex post* monitoring ability. By doing so, I am able to control for the unobserved heterogeneity among startup firms in addition to accounting for the observed characteristics, thereby correcting for a potential selection bias. Moreover, I consider both serial entrepreneurs that have prior firm-founding experience in VC-financed firms *and* non-VC-financed firms, and study the effect of firm-founding experience itself. It is not clear in Gompers et al (2006) how entrepreneurs with multiple prior experiences are handled in their study. However, this would matter because if one had success out of multiple attempts, which would be classified as a successful serial entrepreneur in their study, we would not be able to tell whether the subsequent firm performance reflects the effect of multiple founding experiences or the quality of the serial entrepreneur signaled by the track record of success. Because the focus of this study is assessing the effect of firm-founding experience, I make the comparison more straightforward by studying the semiconductor industry since the sample includes very few entrepreneurs with more than two firm-founding experiences.

The remainder of the paper is organized as follows. Section 2 reviews the related literature based on which testable hypotheses are formulated. Section 3 describes the

dataset used in this study. Section 4 presents the empirical strategy. Section 5 presents the results and Section 6 concludes with possible extensions.

2. THEORETICAL BACKGROUND AND HYPOTHESES

What distinguishes serial entrepreneurs from novice entrepreneurs is that they have prior experience in “founding” firms. Regardless of the prior venture outcome, a firm-founding experience gives serial entrepreneurs the opportunity of developing human capital through “learning-by-doing,” and the opportunity to build social capital by interacting with a variety of different people such as suppliers, financiers, lawyers, accountants and the like. Furthermore, serial entrepreneurs in previously VC-backed startup firms will have further enhanced their human capital and social capital through the interaction with VCs compared to serial entrepreneurs who do not have such prior experience. In addition, startup firms funded by VC firms with better value-adding ability will have better firm performance and this should manifest in lower probability of exit. I outline my main assumptions below to develop a framework and derive my hypotheses.

First, I assume learning-by-doing from a prior firm-founding experience augments entrepreneurial skills thereby enhancing human capital (HC_p). Jovanovic (1982) stresses that there is passive learning by a firm about its own ability and efficiency after it enters the market. However, I also incorporate the view suggested by Audretsch et al. (2005) that there is also active learning by entrepreneurs. According to Audretsch et al. (2005), an entrepreneur can utilize his capacity to absorb and learn from the initial entrepreneurial experience, thereby augmenting his initial endowment of entrepreneurial skills. This would suggest that there are two types of learning gained from entrepreneurship—both passive learning, and also active learning in that the entrepreneur learns about starting and running a business. Specifically, firm-founding experience provides information about two activities, among others: opportunity identification and evaluation, and management. Ucbasaran et al. (2007) find that serial entrepreneurs identify more business opportunities than novice entrepreneurs and conclude that serial entrepreneurs are more effective in translating information into opportunities. Brüderl et al. (1992) points out that

entrepreneurship is a kind of “trial-and-error” process and provides tacit knowledge of organizing routines and leadership skills, which can be transferred to the new venture. Thus, firm-founding experience provides a particular type of human capital that cannot be acquired easily through other means. Previous studies find human capital, where human capital is defined to include various measurements of education and experience of firm members, to be a good predictor of firm survival (Bates 1990, Mata and Portugal 2002, Cooper, Gimeno-Gascon and Woo 1994, Gimeno et al. 1997), and so we would expect human capital enhanced by firm-founding experience to have a similar effect.

Second, I assume that prior firm-founding experience helps establish social connections, which increases the entrepreneur’s stock of social capital (SC_P)¹. For the purpose of this study, I adopt the definition of social capital used in Glaeser et al (2002): “a person’s social characteristics – including social skills, charisma, and the size of his Rolodex – which enables him to reap market and non-market returns from interactions with others.” Social ties are an important lubricant for economic activity (Arrow 1974), and there has been much research on the relationship between social capital and various economic outcomes. Studies by Hsu (2007) and Zhang (2007) find that social connections with VCs help entrepreneurs secure venture capital more quickly. Shane and Stuart (2002) focus on the role of founders’ social capital as a determinant of new venture firm performance. They find that founders having direct and indirect relationships with venture investors are most likely to receive venture funding and are less likely to fail. Social connections can be an important resource in recruiting talented executive officers and technical staff and can facilitate the formation of a new venture. Thus, social capital of founders helps the firm acquire financial resources and talent. Social connections with customers and suppliers from the previous venture also provide an advantage when starting a new firm.

Third, I assume VCs are an important source of providing social capital to entrepreneurs (SC_{VC}) and also VCs directly enhance entrepreneur’s human capital through

¹ Adler and Kwon (2002) provides a review of the social capital literature and different concepts of social capital used in different academic disciplines.

advice and discussion (HC_{VC}). This is the value-added role of VCs that contributes to startup firm performance. A higher social capital results because VCs not only provide financial capital to the firm but also provides direct social connections, such as filling in key positions in the firm and making introductions to key suppliers and potential customers. A higher human capital results because VCs constantly interact with the founders, usually sit on the board, provide advice on their business plans, formulate strategies, and guide them on how to grow their business (Sahlman 1990; Lerner, 1995; Hellmann and Puri, 2002). During this interaction, both passive and active learning by entrepreneurs are accelerated. This idea is echoed by Coleman (1988), who stresses that social capital has an important effect on the creation of human capital. In fact, Hsu (2004) empirically evaluates the value-added roles of reputable VCs by analyzing a unique sample of entrepreneurial start-ups with multiple financing offers and finds that offers made by VCs with a high reputation are three times more likely to be accepted, and high-reputation VCs acquire start-up equity at a 10–14% discount. This would suggest that entrepreneurs actually pay to work with VCs with higher reputation, which in turn depends on their experience, information network, and direct assistance to the portfolio firms. Early field research by Gorman and Sahlman (1989) and Sahlman (1990) suggests that the value of venture capital lies in providing not only money but also these ancillary services thereby “professionalizing” companies. There are some serial entrepreneurs who were backed by VCs in their previous ventures and some who were not. In both cases, whether a serial entrepreneur was backed by a VC or not, the serial entrepreneur would have enhanced both human capital and social capital as the above discussion suggests (HC_P , SC_P from prior firm-founding experience). However, those who were backed by VCs will have further increased both human capital (HC_{VC}) and social capital (SC_{VC}). In this study, I use prior VC-backed experience as a proxy for VC-added social and human capital (SC_{VC} and HC_{VC} , respectively).

Enhanced social capital in the form of ties with previous VCs should matter for securing capital from current VCs (Hsu 2007, Zhang 2007). However, once a firm is venture backed, I assume the current VC provides the necessary social connections (current

SC_{VC}) to the current venture thereby enhancing social capital before any outcome of the venture is realized. This assumption seems reasonable since the earliest observed outcome in the sample took at least 1 year after the first VC funding. In contrast, I assume that the enhancement of human capital from the ongoing firm-founding process does not develop as quickly as social capital. For simplicity, I assume the ongoing human capital enhancement is nil until a venture outcome is realized (current $HC_{VC} \approx 0$). In addition, I assume the marginal contribution to human capital and social capital from additional prior firm-founding experience (duplicate HC_P , SC_P) or additional VC-backed experience (duplicate HC_{VC} , SC_{VC}) is negligible compared to that from the first such experiences². Similarly, social capital enhancement from two or more previous VC-backed experience will be treated as having an equivalent social capital enhancement from one such VC-backed experience³.

Fourth, I assume the value-adding role of VCs can be characterized by that of a startup firm's first round VC investor or the lead VC investor when there is syndication. As mentioned above, VC firms can contribute to entrepreneurship by evaluating start-up quality (i.e., screening deals) and mentoring (i.e., adding value to the firms) in addition to investing capital. I focus on the lead VC investor of the first round, because the lead VC usually plays an active role in monitoring and mentoring the startup company after screening the deal. The lead VC firm also selectively invites other VC firms to form syndicates, which is part of the active role the lead investor plays. Casamatta and Haritchabalet (2003) and Cestone, Lerner, and White (2006) provide theoretical analyses about the motivations of VCs to form syndicates. Both studies imply that a "second opinion" on deal selection is the main driving force for rationalizing VC syndicates and argue that a lead VC firm balances the benefit of a more accurate evaluation of the project (Sah and Stiglitz, 1986) with the cost of potential competition by the syndicate partners. Using surveys of venture capital firms and examination of syndication documents, Wright and Lockett (2003) find that lead investors typically have larger equity stakes than non-lead VC investors and lead venture

² This assumption pertains to only 2 firms (out of 181) in the sample that were founded by serial entrepreneurs, both of which were their 3rd ventures respectively.

³ This assumption is not binding since there are no such firms in the sample.

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capital investors' residual and specific powers are important in ensuring timely decision-making. The lead VC firm also typically sets the terms and conditions when funding a startup company that may have a persistent effect that is hard to change. The following statement of one VC firm conveys this idea.

“Lead investing allows Union Square Ventures to establish the capital and governance structures for our portfolio companies. Once these are set, they are hard to change. And every firm has a preferred way to approach governance and capital structures. So the best way to get them the way you want them is to be there when they are set up. That means leading the first venture capital round.” - Union Square Ventures –⁴

Hence, for analytical purposes, I focus on the lead VC investor when identifying which VC firm is funding the startup company. The experience as well as value-adding ability of VCs funding a startup firm varies across VC firms. These variables affect the startup firm performance and should manifest in lower probability of exit of the firm. Hence, we take these into account when we conduct our firm survival analysis.

Given that this study is an analysis of VC-backed firms with and without serial entrepreneurs, and that entry into the dataset is the date when a firm secures its first VC funding, all firms can be categorized into one of the following groups subsequent to market entry. When there are multiple founders, I assume a firm can be characterized by its most experienced founder.

Group SEVC: Firms founded by serial entrepreneurs *with* VC-backed prior experience

Group SEnVC: Firms founded by serial entrepreneurs *without* VC-backed prior experience

Group NE: Firms founded by novice entrepreneurs

Firm performance as measured by its probability of survival is a function of the firm characteristics of the founder's human and social capital and the variation in VC ability to

⁴ http://www.unionsquareventures.com/2006/10/lead_investor.html (accessed April 23, 2008)

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add value to the startup firm. Using the notations defined above, the three groups of firms' probability of survival can be characterized as the following, according to the founder's prior experience:

$$\text{Probability of Firm Survival} = F(HC_P, SC_P, HC_{VC}, SC_{VC}, VC \text{ Ability}, VC \text{ Experience})$$

$$\text{where } \frac{\partial F}{\partial X_i} > 0 \text{ for } \forall X \in \{HC, SC\} \text{ and } \forall i \in \{p, vc\}$$

By comparing Groups SEVC and SEnVC, we see the relationship of the role of VCs and firm survival; by comparing Group SEnVC and NE, we see the relationship of prior firm-founding experience and firm survival. The framework developed above leads to the following hypotheses:

Hypothesis 1: Firms founded by serial entrepreneurs with VC-backed prior experience (Group SEVC) have a lower probability of exit than firms founded by novice entrepreneurs (Group NE).

Hypothesis 2: Firms founded by serial entrepreneurs without VC-backed prior experience (Group SEnVC) have a lower probability of exit than firms founded by novice entrepreneurs (Group NE).

Hypothesis 3: Firms founded by serial entrepreneurs with VC-backed prior experience (Group SEVC) have a lower probability of exit than firms founded by serial entrepreneurs without VC-backed prior experience (Group SEnVC).

Hypothesis 4: Firms funded by more experienced VC firms have a lower probability of exit.

Hypothesis 5: Firms funded by VCs with better value-adding ability *ex post* investment have a lower probability of exit.

3. DATA

This study will primarily rely on Dow Jones' *VentureSource* (previously called *VentureOne*). *VentureSource* was established in 1987 and tracks firms that have received venture capital financing. The firms are initially identified from a wide variety of sources, including trade publications, company websites, and personal contacts with investors. *VentureSource* then surveys the firms and investors, and updates and verifies the data monthly. Variables include the names and previous employers of the company executives, date joining the firm, industry sector, business strategy, names of investors and some limited financial information about the new venture (Gompers and Lerner, 2004).

I construct my own dataset using *VentureSource* augmented by other web-based information (described below). My dataset includes U.S. venture-backed semiconductor firms in *VentureSource* database that received their first venture capital financing between 1995 and 1999. These firms can be considered as new firms that entered the market during this time period. I restrict my dataset to include only those firms that secured their first round of VC-financing during this period in order to allow sufficient time before a startup firm goes through a liquidity event, while excluding a time period when there was an economic downturn in the early 2000.

The variables in my dataset include company name, founding date, founder name(s), founder's background, lead VC investor, financing history by date, current business status, and basic information about the lead investor. I identify entrepreneurs as those individuals who are reported as the "founders" of the startup firm in *VentureSource* or, when this was not explicitly stated, as the executive (current or former board member) who joined the firm at the same time as (or prior to) the founding date. Then, if an entrepreneur's background includes being a founder of another firm, that entrepreneur is considered a serial entrepreneur. I check various websites (e.g. BoardEx, ZoomInfo, LinkSV etc.), including company websites and business articles, to confirm whether these executives indeed have prior firm-founding experience. When there were multiple founders, I regard a firm being founded by a serial entrepreneur if any of the founders were serial entrepreneurs. If none of

the founders were serial entrepreneurs, the startup company is regarded as a firm founded by a novice entrepreneur. Hence the unit of analysis for this study is the firm.

I then identify which VC firm funded the new startup company in its first round of financing. If there was a syndication of VC firms in the first round, I focus on the lead VC investor (identified from *VentureSource*) of the first round, because the lead VC usually plays an active role in monitoring and mentoring the startup company after the deal. When the lead VC investor was not explicitly identified from *VentureSource*, I assume the lead investor is the VC firm that committed the greatest amount of capital within the syndication or participated in the greatest number of rounds.

4. METHODOLOGY

In order to conduct a firm survival analysis, we need the startup firm's entry date and exit date. Entry is defined as the date a startup firm acquired its first round of funding from a venture capitalist. Exit is defined as the date a startup firm no longer exists as an independent entity in the market. This is identified by the date a startup firm is recorded as "Out of Business" or "Acquired or Merged" by the *VentureSource* database. I also verify whether those firms that are public and are no longer tracked by *VentureSource* are still in operation by looking up the listings of public firms. A small number of these firms were acquired shortly after it going public. In these cases, I record the acquisition date from the U.S. SEC (Securities and Exchange Commission) filings as the firm's exit date.

Table 1 shows the number of firms surviving by firm age up to 90 months. After 90 months, the survival time is right-censored⁵. Figure 1 is a graphical representation of Table 1. The first row of Table 1 shows that 41% of all firms in the sample survived at least 90 months (7.5 years). The second shows that firms founded by serial entrepreneurs with VC-backed prior experience (Group SEVC) had a survival rate of 64%, and firms founded by serial entrepreneurs without VC-backed prior experience (Group SEnVC) had a survival rate of 85%, and novice entrepreneurs had a survival rate of 28% for the same period. This suggests that there is a distinctive survival pattern among groups, and firms founded by

⁵ Hereafter, I use the word censoring to refer right-censoring, since there is only right-censoring in this study.

serial entrepreneurs who have prior firm-founding experience survive longer in general than firms founded by novice entrepreneurs. Graphical representations of the estimated hazard rate for the entire sample and by group are shown in Figure 2a and 2b, respectively. It shows that the hazard rate of Group NE peaks before Group SEVC and Group SEnVC. The hazard rate of Group NE is also greater than the other two groups for the entire analysis time, which is measured in months.

Although Table 1 suggests that firms founded by serial entrepreneurs perform better as measured by the survival rate, the reasons for this relationship are not known. Three possible explanations are self-selection into serial entrepreneurship, serial entrepreneurs' prior firm-founding experience, and the role of VCs. I explore each of them in the following subsections.

4.1 SELF-SELECTION AND SERIAL ENTREPRENEURSHIP

In order to investigate whether firm-founding experience has any effect on subsequent venture performance, we should first explore whether serial entrepreneurs are a self-selected group of highly-capable entrepreneurs compared to all entrepreneurs. One way to explore this is to compare the venture outcome of serial entrepreneurs' 1st venture and the novice entrepreneurs' venture outcome in the sample. From a founder's perspective, it is the ultimate liquidity event upon which he or she bases the success of the venture. Therefore, the outcome of a venture is used to see if self-selection into serial entrepreneurship is in effect.

All firms are privately-held when they first enter the market and then eventually undergo one of three mutually exclusive liquidity events that define the outcome of a venture – IPO, Acquired/Merged, and Out of Business. Arguably, an “IPO” brings the greatest financial success to the founders, and then “Acquired/Merged,” and, lastly, “Out of Business”, which is a failure. When tracking the serial entrepreneurs' 1st venture outcome, I can identify the outcome distribution only if it is VC-backed. Non-VC-backed firms are mostly privately-held technology service firms, which do not need to raise large amounts of capital. Since these firms are not VC-backed, they are not obligated to liquidate their

investment if they fold the company. Serial entrepreneurs who previously founded these non-VC-backed firms are first-timers as founders of VC-backed semiconductor firms. I assume the ability distribution for these entrepreneurs are not statistically different from that of novice entrepreneurs, and below I test the validity of this assumption.

Table 2 shows the outcome distribution of serial entrepreneur's 1st venture and that of the novice entrepreneur in the sample. Assuming the probability of each outcome is constant over time for the period of study, we can test whether the two distributions are statistically different. Using a chi-square test, we cannot reject the null hypothesis that the two columns have an identical distribution (p-value = 0.72)⁶. This would suggest that serial entrepreneurs are not a self-selected group of highly-capable entrepreneurs compared to entrepreneurs more generally, and self-selection is not the driving force of the pattern showed in Table 1. Hence, the difference in Table 1 between firms founded by serial entrepreneurs and firms founded by novice entrepreneurs should be coming from the difference in firm-founding experience, controlling for all other observables.

Table 3 shows the sequence of venture outcomes of the 26 serial entrepreneurs, which includes the serial entrepreneur that did not go through a liquidity event in the 1st venture. Not surprisingly, the majority of serial entrepreneurs had an outcome at least as good as their 1st ventures. Among the 18 firms that had an outcome in their later ventures, including the 2 serial entrepreneurs that were in their 3rd venture (bottom row), only 2 serial entrepreneurs (11.1%) did no better than their 1st venture outcome (marked as “*” in Table 3). This also suggests that prior entrepreneurial experience improves the performance of an entrepreneur, given ability.

The outcome of an entrepreneur's 1st venture might have been an important factor when making a decision to become a serial entrepreneur. Based on this observable outcome, we showed that there is no statistical difference between serial entrepreneurs and novice entrepreneurs. However, other unobservable characteristics may affect the decision to become a serial entrepreneur and may affect subsequent firm performance. If we could

⁶ There was 1 firm (3.8%) from a serial entrepreneur's 1st venture that did not have an outcome yet – i.e. still a “privately-held” company. There were 19 firms (14.73%) from the novice entrepreneurs' firm that did not have an outcome as of July 2007.

directly observe the individual characteristics that matter, then we would be able to use the standard technique for correcting this kind of selection bias (Heckman, 1979). However, we cannot use Heckman's (1979) two-step estimation procedure here because the *VentureSource* founder data provide no information about an entrepreneur's individual characteristics. The educational backgrounds of founders of VC-backed semiconductor startup firms might not be useful, since arguably their education does not display much variation. They all have college degrees or advanced degrees. So, the educational level is fairly homogeneous.

Self-selection into serial entrepreneurship is one thing, but being selected by a VC firm is another. VCs select the startup firms that they believe will generate the highest return according to their own selection criteria. They perform due diligence prior to selecting a deal, which provides the opportunity to observe the factors that the VCs think matter in predicting firm performance. Hence, dealing with this possible omitted variable bias can be resolved if we measure the screening ability of VCs. This will be discussed next.

4.2 ACCOUNTING FOR THE ROLE OF VENTURE CAPITAL FIRMS

If the pattern observed in Table 1 is not driven by self-selection, there is still concern that this may be a result of the role of VCs rather than the effect of "firm-founding experience," *per se*. VCs have two main roles that may be the driving force for the pattern observed in Table 1 – VCs conduct both *ex ante* deal screening and *ex post* investment monitoring and mentoring. These two abilities will vary across VC firms. In order to address this issue, I construct a measure of VC ability that distinguishes these two components.

As discussed in Section 3, typically a lead VC plays a more active role than non-lead VCs do, if a syndicate is formed. This active role includes the decision to form a syndicate and selecting the syndicate partners. The syndicate partner would, of course, conduct its own due diligence on the startup firm before deciding to fund it. Using surveys of VC firms that had acted both as lead and non-lead investors, Wright and Lockett (2003)

document that lead investors were more likely to be represented on the board, more hands-on in their monitoring and more likely to have more frequent formal and informal contact with portfolio company management than a non-lead investor. From a VC firm's perspective, managerial talent and time is a scarce resource (Freeman 1999, Kuan 2005). Therefore, the lead VC arrangement allows other VCs to invest in start-ups that they cannot actively manage (Kuan 2005) and provides a means for portfolio diversification .

As mentioned earlier, I focus on the lead VC investor for each startup company and track all portfolio firms the VC firm invested in prior to funding the current startup firm. By looking into the portfolio of the current VC investor, I distinguish between deals where the VC was a lead investor and a non-lead investor. I do this for each VC firm funding a startup firm, which requires documenting 11,674 deals. I construct two variables: *VC_non_lead* and *VC_lead*. I measure *VC_non_lead* by the success rate when the VC was involved only as a non-lead investor and *VC_lead* by the success rate when the VC was involved only as a lead investor, where success is defined as a portfolio company going public (i.e. IPO). I use this definition because a portfolio company going public is regarded as success from a VC perspective as is assumed to be the main goal of VC-financing investment when funding a portfolio company. Specifically, *VC_non_lead* is the ratio of the number of portfolio companies that went public to the number of total portfolio companies when the VC was a non-lead investor. Similarly, *VC_lead* is the ratio of the number of portfolio companies that went public to the number of total portfolio companies when the VC was a lead investor. In my regression analysis, I use these two variables to account for the variation in VC ability.

VC_non_lead reflects the variation in due diligence ability, or equivalently *ex ante* deal screening ability, of VC firms. This includes the VC's evaluation of the unobservable characteristics of the startup firm and founders that could matter for firm performance. Assuming that VC firms with better deal screening ability is matched with startup firms with better unobserved factors that matter for firm performance, the variation in deal screening ability is equivalent to the variation in unobserved firm heterogeneity. Here, the assumption is that VC firms observe all factors (observable to VC investors) that would

matter for firm performance before making an investment decision, which includes factors unobservable to the researcher.

VC_lead reflects the variation in *ex post* monitoring and mentoring ability, in addition to the variation in deal screening ability. The higher the *VC_lead*, the better the VC is in its value-adding role as a VC firm. Inclusion of this variable separate from *VC_non_lead* in our regression analysis would allow us to estimate the relative effect of screening ability and monitoring/mentoring ability of VCs on startup firm performance.

Table 4 shows summary statistics of these variables for the entire sample and also by group. The first row of each group is the total number of deals a VC firm has invested in prior to investing in the current startup firm. The second and third row of each group is *VC_non_lead* and *VC_lead* respectively. When we compare group SEVC with group NE, the mean of the ratio of the number of portfolio companies that went public to the number of total portfolio companies when the VC was a lead investor, i.e. *VC_lead*, for the two groups is 0.267 and 0.167 respectively and is statistically different at the 1% significance level (p-value = 0.0037). When we compare group SEnVC with group NE, *VC_lead* for the two groups is 0.299 and 0.167 respectively and is statistically different at the 1% significance level (p-value = 0.0009). In addition, the mean of total number of deals done by a VC firm prior to investing in the current startup firm is 88.815 and 58.884 respectively and is statistically different at the 10% significance level (p-value = 0.0713)⁷. Therefore, we see that VC firms funding startup firms founded by serial entrepreneurs with and without prior VC-backed experience is on average better in actively adding value to the startup firm compared to VC firms funding firms founded by novice entrepreneurs. VC firms funding startup firms founded by serial entrepreneurs without VC-backed experience also is more experienced on average in terms of total number of deals done by the VC firm compared to VC firms funding firms founded by novice entrepreneurs. Hence, this suggests that the role of VC firms is partly responsible for the distinct pattern we observe in Table 1. Therefore, I use the two variables in my regression to take this into account.

⁷ When comparing means of any other corresponding pairs, we cannot reject the null hypothesis that the two means are identical at any conventional significance level.

4.3 EMPIRICAL MODEL

I use a Cox proportional hazard model (Cox, 1972) to test my hypotheses. Let T denote the time from entry to an exit measured in months. Its cumulative distribution function is $F(t) = \Pr(T \leq t)$ and its survival function is $S(t) = 1 - F(t) = \Pr(T > t)$. The density function is obtained from $S(t)$ as it can be from $F(t)$,

$$f(t) = \frac{dF(t)}{dt} = \frac{d\{1 - S(t)\}}{dt} = -S'(t)$$

The hazard rate or the hazard of exit is the instantaneous rate of failure, defined as follows:

$$h(t | X) = \lim_{\Delta t \rightarrow 0} \frac{\Pr(t < T < T + \Delta t | T > t, X)}{\Delta t}$$

where X is a vector of explanatory variables. I model this hazard function as a function of the baseline hazard $h_0(t)$ at time t , and the effects of observed covariates X ,

$$h(t) = h_0(t) \exp(X' \beta) \quad (1)$$

I obtain a partial maximum likelihood estimator for β that does not require estimating $h_0(t)$. Equation (1) can be rewritten as the following with the variables constructed and by taking logs on both sides of equation (1):

$$\begin{aligned} \log h(t) = & \log h_0(t) + \beta_1 \delta_1 + \beta_2 \delta_2 + \beta_3 \cdot VC_lead + \beta_4 \cdot VC_non_lead \\ & + \beta_5 \delta_1 \cdot VC_non_lead + \beta_6 \delta_2 \cdot VC_non_lead \\ & + \beta_7 \cdot VC_Experience \end{aligned} \quad (2)$$

δ_1 is a dummy equal to 1 if the firm is in Group SEVC, 0 otherwise; and δ_2 is another dummy equal to 1 if the firm is in Group SEnVC, 0 otherwise; β_j measures the semielasticity of the hazard rate with respect to x_j . VC_lead is the *ex post* value added by the VC and VC_non_lead is the *ex ante* screening ability discussed in the previous section.

Log of total number of deals ($VC_Experience$) is used to measure the experience of VC firms. I use the log of total number of deals instead of the absolute number of deals to reflect that there is diminishing marginal returns to experience. I also add year dummies to control for the macro-environment during the period of study.

By adding an interaction term between δ_i ($i = 1, 2$) and VC_non_lead , I also test whether there is any systematic difference in unobserved heterogeneity among different groups of firms. Recall, VC_non_lead is a proxy for unobserved firm heterogeneity.

Differentiating (2) with respect to VC_non_lead , we get $\beta_4 + \beta_5\delta_1 + \beta_6\delta_2$, so I test whether $\beta_5 = 0$ and whether $\beta_6 = 0$. If β_5 is statistically different from 0, then depending on the sign of β_5 , we will be able to see whether there is self-selection into serial entrepreneurship of high-ability entrepreneurs ($\beta_5 < 0$), or low-ability entrepreneurs ($\beta_5 > 0$). Similar interpretation can be done for β_6 .

5. RESULTS

Table 5 shows the regression results. All reported coefficients are the exponential of betas. Hence, if the reported coefficient is greater than 1, then an increase in the relevant variable increases the hazard rate, and if it is less than 1, then an increase in the relevant variable decreases the hazard rate. For all specifications (1) – (8), the coefficients of Group SEVC and Group SEnVC are less than 1 and statistically significant. This implies that being in Group SEVC or Group SEnVC substantially reduces the probability of exit relative to Group NE, which is the group of firms founded by novice entrepreneurs. For example, specifications (1) – (4) suggest that the probability of exit of firms founded by serial entrepreneurs with prior VC-backed experience is approximately 35% ~ 38% of that

of firms founded by novice entrepreneurs. The probability of exit of firms founded by serial entrepreneurs without prior VC-backed experience is even further reduced to approximately 16% of that of firms founded by novice entrepreneurs. In specifications (5) – (8), none of the coefficients on the interaction terms are statistically significant. This implies that there is no systematic difference in unobserved factors amongst groups, and that self-selection of highly-capable entrepreneurs into serial entrepreneurship is not a driving force. The interpretation of coefficients on Group SEVC and Group SEnVC needs to be evaluated at a given value of *VC_Non_Lead* because of the interaction terms. If we use the mean value of *VC_Non_Lead* (0.305) presented in Table 4, the estimated coefficients for Group SEVC and Group SEnVC in specifications (5) – (8) are consistent with specifications (1) - (4). Specifically, the probability of exit of firms founded by serial entrepreneurs with prior VC-backed experience is approximately 35% ~ 37% of that of firms founded by novice entrepreneurs in specifications (5) – (8). The probability of exit of firms founded by serial entrepreneurs without prior VC-backed experience is approximately 15% ~ 16% of that of firms founded by novice entrepreneurs.

Overall, Hypotheses 1 and 2 are supported by the statistical analysis. However, Hypothesis 3 is not supported by the results since Group SEnVC has a lower probability of exit than Group SEVC in all model specifications. This implies that firms founded by serial entrepreneurs with prior VC-financing experience have a higher probability of exit relative to firms founded by serial entrepreneurs with no prior VC-financing experience. Hypothesis 4 is also not supported by the results. In specifications (3), (4), (7), and (8), VC firms with more experience (i.e., total number of deals done before the current investment) actually increases the probability of exit and is statistically significant at the 10% level. The explanation for this is not obvious, and the results may point to a need for a richer analysis of firm survival and exit. For example, one possible explanation is that experienced VCs and experienced entrepreneurs (i.e., they have worked with VCs before) are more likely to be associated with exit via acquisition with favorable financial returns. If serial entrepreneurs with VC-backed experience have greater financial success via acquisition relative to serial entrepreneurs without VC-backed experience, then in a firm

survival analysis the former appears to be a short-lived failure and the latter appears to be a long-lived success. Alternatively, if more experienced VCs help entrepreneurs realize a higher financial return via acquisition and less experienced VCs are likely to have the venture survive as a privately-held firm rather than liquidate their investment, then in a firm survival analysis the former appears to be a short-lived failure and the latter appears to be a long-lived success. Future research should focus on developing a richer measure of firm exit.

It is also interesting to note that both *VC_non_lead* and *VC_lead* lower the probability of exit, though not statistically significant. Therefore, Hypothesis 5 is at best weakly supported by the statistical analysis. In all specifications, monitoring ability consistently lowers the probability of exit further than the screening ability of VC firms. Although it is not reported in the table, the p-value is 0.12 ~ 0.25 for these variables, so it is only marginally significant (if at all). The fact that monitoring ability has a greater impact on firm survival relative to screening ability might shed light on why VC firms actively become involved with their portfolio companies *ex post* investment. In future research, it should be worthwhile to develop a more precise measure of screening ability and monitoring ability.

6. CONCLUDING REMARKS

The firm survival analysis used in this study has some limitations on analyzing firm performance. Longer existence in the market by an innovative firm may result in more innovative products or processes in the economy. This justifies measuring a firm's performance by its probability of survival in the market as a first step.

However, while a firm's longer post-entry survival implies better performance than short-lived firms in some cases, there is still a difference in performance among surviving firms and even among short-lived firms that the firm survival analysis does not show. For example, if a firm goes public, it is considered a big financial success to both VC investors, who liquidate their investment, and the founders of the firm. Privately-held firms, though still existing in the market, would be considered differently from public firms in terms of

firm performance in this sense. Yet, both types of firms are treated equivalently when we conduct a firm-survival analysis because they both show up as surviving firms. Similarly, firms that go out of business and firms that are acquired by another firm are treated equivalently because they show up as non-surviving firms in the firm survival analysis, even though their performance in terms of financial returns to investors and founders are clearly different. The actual value of exiting firms is an important measure that should be developed in future research.

The contribution of this study to the literature is estimating the value of prior firm-founding experience and the role of VCs by taking into account self-selection of serial entrepreneurs and decomposing the role of VCs into two parts – *ex ante* deal screening and *ex post* startup firm monitoring and mentoring. Estimating the effect of the two roles of VCs separately may shed light on whether *ex ante* screening or *ex post* monitoring and mentoring matters more. The result of this study weakly suggests that while both matter in improving firm performance, *ex post* monitoring and mentoring may matter relatively more so than *ex ante* screening.

Assessing the relationship of prior firm-founding experience with firm performance sheds light on the potential deadweight loss that might have been imposed on the economy if the serial entrepreneurs had not been funded. Given the low success rate of entrepreneurship, this has implications for economies where failed entrepreneurs rarely get a second chance.

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Table 1. Number and proportion of new-firms (1995-1999) remaining in the market over time in the semiconductor industry⁸

Time (months)	12	18	24	30	36	42	48	54	60	66	72	78	84	90
	< 1yr		< 2yr		< 3yr		< 4yr		< 5yr		< 6yr		< 7yr	
All Firms (181)	180	171	160	152	148	138	134	125	115	105	93	84	80	75
	99.4%	94.5%	88.4%	84.0%	81.8%	76.2%	74.0%	69.1%	63.5%	58.0%	51.4%	46.4%	44.2%	41.4%
Group SEVC (25)	25	24	24	24	23	23	23	23	22	21	19	17	17	16
	100.0%	96.0%	96.0%	96.0%	92.0%	92.0%	92.0%	92.0%	88.0%	84.0%	76.0%	68.0%	68.0%	64.0%
Group SEnVC (27)	27	27	27	27	27	27	27	27	27	27	25	25	25	23
	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	92.6%	92.6%	92.6%	85.2%
Group NE (129)	128	120	109	101	98	88	84	75	66	57	49	42	38	36
	99.2%	93.0%	84.5%	78.3%	76.0%	68.2%	65.1%	58.1%	51.2%	44.2%	38.0%	32.6%	29.5%	27.9%

⁸ The number and proportion of startup firms remaining in the market are not tabulated beyond 90 months because of censored observations.

Figure 1. Graphical representation of the proportion of startup firms remaining in the market over time.

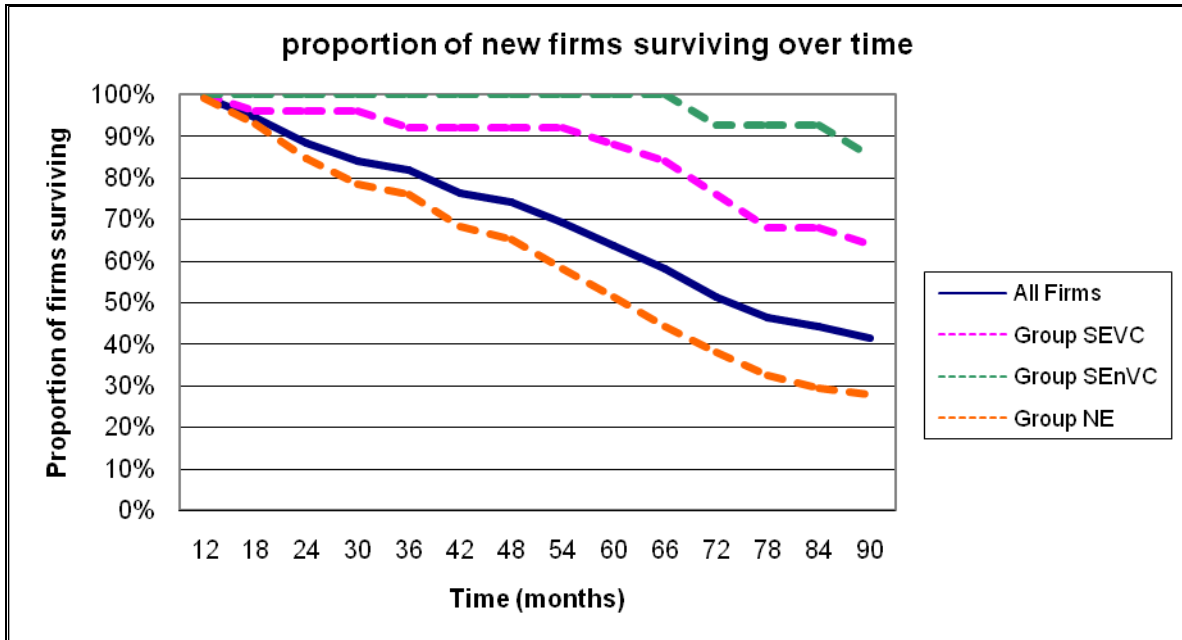


Figure 2a. Graphical representation of the hazard rate for the entire sample

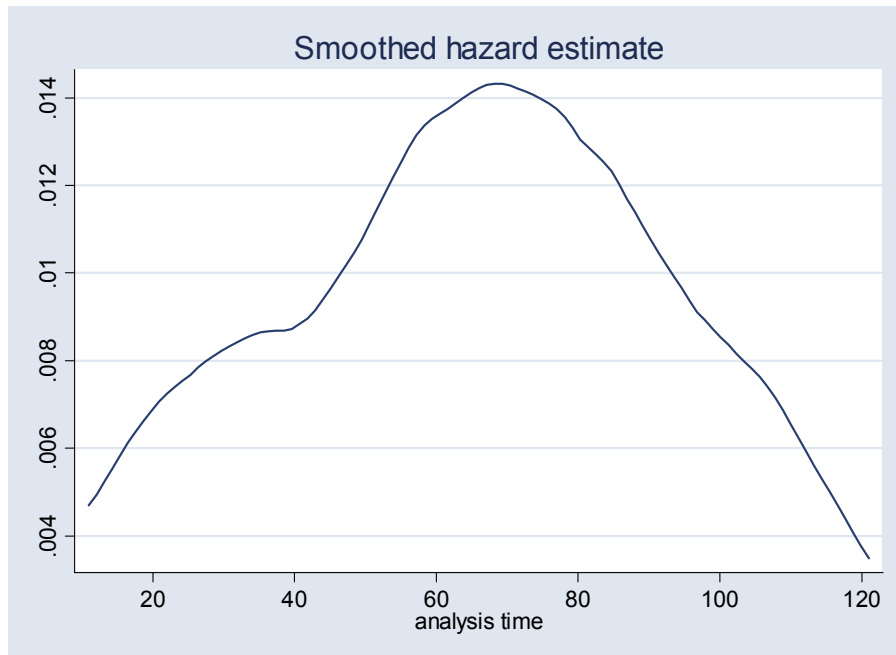
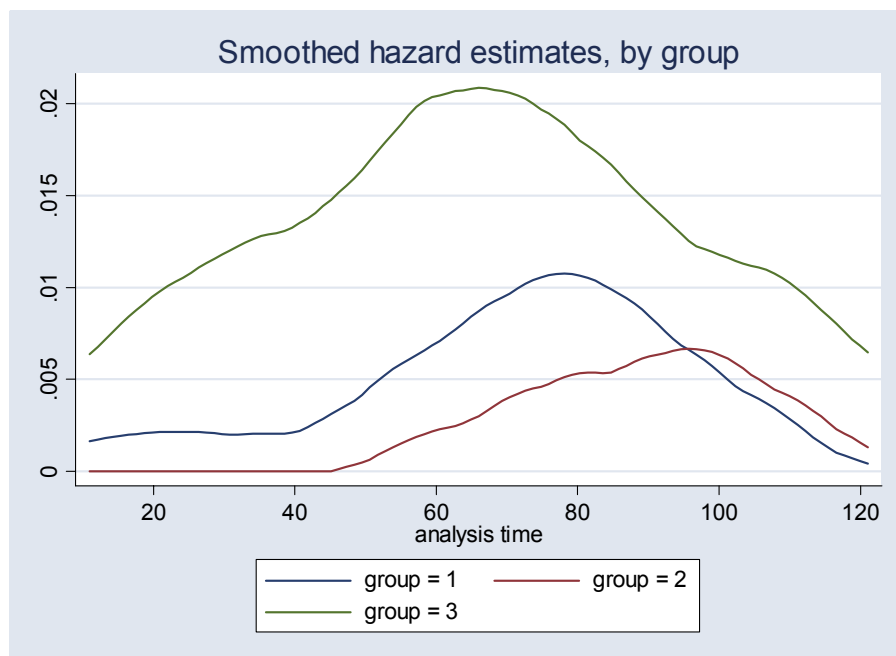


Figure 2b. Graphical representation of the hazard rate by group⁹



⁹ Groups 1, 2, and 3 correspond to Groups SEVC, SEnVC, and NE respectively.

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Table 2. Outcome distribution of serial entrepreneurs' 1st venture and that of novice entrepreneurs' in the sample.

	Serial entrepreneurs' 1 st venture outcome	Novice entrepreneurs' current venture eventual outcome
Total	25 (100%)	110 (100%)
IPO	4 (16%)	12 (10.9%)
Acquired/Merged	15 (60%)	70 (63.6%)
Out of Business	6 (24%)	28 (25.5%)

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Table 3. Sequence of venture outcomes by individual serial entrepreneurs.

1 st venture outcome	2 nd venture outcome
Out of Business (2)	IPO (4)
Acquired/Merged (1)	
IPO (1)	
Out of Business (2)	Acquired/Merged (10)
Acquired/Merged (7)	
IPO (1)*	
Out of Business (1)	Out of Business (2)
Acquired/Merged (0)	
IPO (1)*	
Out of Business (0)	Privately-held (8)
Acquired/Merged (6)	
IPO (1)	
Privately-held (1)	
Acquired – Acquired – IPO (1)	
Out of Business – IPO – Privately-held (1)	

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Table 4. VC summary statistics by group

		Obs.	Mean	Std. Dev.	Min	Max
All Firms	# of deals	181	64.497	78.367	1	359
	# IPO / # of Non-Lead deals	181	0.305	0.202	0	1
	# IPO / # of Lead deals	181	0.201	0.188	0	1
Group SEVC	# of deals	25	67.200	79.392	2	268
	# IPO / # of Non-Lead deals	25	0.310	0.200	0	0.609
	# IPO / # of Lead deals	25	0.267	0.157	0	0.667
Group SEnVC	# of deals	27	88.815	100.383	1	356
	# IPO / # of Non-Lead deals	27	0.322	0.181	0	0.538
	# IPO / # of Lead deals	27	0.299	0.287	0	1
Group NE	# of deals	129	58.884	72.454	1	359
	# IPO / # of Non-Lead deals	129	0.301	0.208	0	1
	# IPO / # of Lead deals	129	0.167	0.155	0	0.500

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Table 5. Cox proportional hazard model regression.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
<i>Group SEVC (dummy=1)</i>	0.358*** (0.116)	0.352*** (0.115)	0.376*** (0.122)	0.367*** (0.120)	0.283** (0.172)	0.281** (0.167)	0.321* (0.200)	0.314* (0.192)
<i>Group SEnVC (dummy=1)</i>	0.157*** (0.067)	0.156*** (0.067)	0.155*** (0.066)	0.155*** (0.066)	0.134** (0.126)	0.132** (0.125)	0.168* (0.163)	0.169* (0.165)
<i>VC_non_Lead</i>	0.789 (0.343)	0.887 (0.435)	0.606 (0.298)	0.630 (0.350)	0.730 (0.338)	0.814 (0.426)	0.587 (0.301)	0.609 (0.352)
<i>VC_Lead</i>	0.650 (0.367)	0.881 (0.522)	0.312 (0.235)	0.395 (0.318)	0.639 (0.368)	0.868 (0.525)	0.309 (0.232)	0.391 (0.314)
<i>Log of total # of deals</i>			1.157* (0.095)	1.161* (0.099)			1.155* (0.095)	1.159* (0.100)
<i>Group SEVC * VC_Non_Lead</i>					2.141 (3.443)	2.094 (3.293)	1.655 (2.756)	1.656 (2.677)
<i>Group SEnVC * VC_Non_Lead</i>					1.669 (4.182)	1.675 (4.203)	0.792 (2.086)	0.783 (2.067)
<i>Year Fixed Effects</i>	N	Y	N	Y	N	Y	N	Y
<i># of observations</i>	181	181	181	181	181	181	181	181
<i># of failures</i>	119	119	119	119	119	119	119	119

Note: reported coefficients are hazard ratios. *, **, *** represent statistical significance at the 10%, 5%, 1% level, respectively.