The Interaction Between Product Market and Financing Strategy: The Role of Venture Capital

Thomas Hellmann
Manju Puri
Stanford University

Venture capital financing is widely believed to be influential for new innovative companies. We provide empirical evidence that venture capital financing is related to product market strategies and outcomes of start-ups. Using a unique hand-collected database of Silicon Valley high-tech start-ups we find that innovator firms are more likely to obtain venture capital than imitator firms. Venture capital is also associated with a significant reduction in the time to bring a product to market, especially for innovators. Our results suggest significant interrelations between investor types and product market dimensions, and a role of venture capital for innovative companies.

Venture capital is widely believed to contribute to the competitive strength of the U.S. economy by promoting the development of innovative start-ups. Yet little is known about what kind of companies are most likely to receive venture capital and what its impact is on these companies. It is commonly argued that a distinguishing feature of venture capital is the close involvement of investor's with the companies they finance. If one thinks of financial institutions on a spectrum from "arm's length" to "relational" investors, venture capital is typically viewed as lying at the latter extreme. It is generally believed that venture capitalists are extensively involved in the businesses they finance, not only closely monitoring their activities, but also providing valuable support and governance. The natural question to ask then is whether the involvement of a venture capitalist makes a difference in the development path of the entrepreneurial companies.

We thank Anat Admati, Bill Barnett, Chris Barry, Jim Brander, Bruno Cassiman, Darrell Duffie, Paul Gompers, Steve Kaplan, Josh Lerner, Robert McDonald, Paul Pfleiderer, William Sahlman, Andrea Shepard, Jim Van Horne, and seminar participants at the American Finance Association, New York, Arizona State University, Bocconi University in Milano, Humbolt University in Berlin, University of British Columbia, University of Chicago, University of Dresden, University of Maryland, University of Munich, Stanford University, Tilburg University, and the Western Finance Association, Monterey, for helpful comments. We received particularly helpful and insightful comments from Sheridan Titman (the editor) and an anonymous referee. We also thank Jim Baron, Diane Burton, and Michael Hannan for their generous permission to access their data, and Ali Hortacsu, Vlasta Pokladnik, Shu Wu, Mu Yang, and Muhamet Yildiz for excellent research assistance. We thank the Center for Entrepreneurial Studies at the Stanford Graduate School of Business for financial support. All errors are ours. Address correspondence to Manju Puri, Graduate School of Business, Stanford University, Stanford, CA 94305-5015, or e-mail: mpuri@gsb.stanford.edu.

The Review of Financial Studies Winter 2000 Vol. 13, No. 4, pp. 959–984

The issue of what kind of investor might help to promote innovative firms is also important in the context of the emerging literature on the interaction between financing and product market behavior. This literature has focused mainly on the relationship between debt levels and product market behavior.[1] However, the impact of equity investors, or more broadly, the importance of the investor type has received little attention. Hence the role of involved equity investors, such as venture capitalists, on product market dimensions is an interesting but unexplored avenue for research.

A large informal literature discusses the benefits and costs of venture capital financing. Venture capitalists are said to benefit their companies through a variety of activities such as mentoring, strategic advice, monitoring, certification to outside stakeholders, corporate governance, professionalization of the company, and recruitment of senior management. On the other hand, obtaining venture capital financing also has its costs. The close involvement of the venture capitalist can be time consuming for the entrepreneurs and the entrepreneurs can also experience a significant loss of control. Moreover, venture capital is said to be an expensive source of capital (which in turn reflects the benefits of having an involved investor).

In thinking about the product market dimension, we can draw on the large industrial organization literature. Among the competitive strategies of new companies, an important distinction is made in this literature between innovator and imitator strategies. Innovators are those firms that are the first to introduce new products or services for which no close substitute is yet offered in the market. Imitators are also engaged in relatively new products and technologies, but they are not the first movers in their markets, and therefore tend to compete on aspects other than innovation.[2] There is no general presupposition that one strategy is systematically better than the other.[3] However, the choice of an innovator or imitator strategy has implications for the relative importance of strategic actions, such as the importance of being a first-mover or being quick to market.

---

[1] Brander and Lewis (1986), for example, examine the relationship between capital structure and pricing of an oligopolist. Other important theoretical contributions to this literature include Poitevin (1989) and Bolton and Scharfstein (1990), who examine endogenous financial constraints in predatory action games, Maksimovic and Titman (1991), who examine how financial policy affects firms' incentive to maintain their product reputation; and Gertner, Gibbons, and Scharfstein (1988), who examine signaling across markets. Chevalier (1995a,b), Philips (1995), and Allen and Phillips (1999) provide some empirical evidence. See Ravid (1988) for a survey. Investors can be either equity or debt investors. Further, they can be arm's length or relational investors [see, e.g., Fama (1985), Sharpe (1990), Diamond (1991), and Rajan (1992)].

[2] In a survey of the theoretical and empirical literature, Lieberman and Montgomery (1988) broadly classify the advantages of being a first-mover in terms of leadership in product and process technology, preemption of assets, and the development of buyer switching costs; the disadvantages of being a first-mover relate mainly to free-rider problems and to lock-in effects and sluggish responses of first-movers. See Fudenberg and Tirole (1996) and Tirole (1988) for some of the game-theoretic foundations of the first-mover advantages.

[3] Maggi (1996) shows that even with identical players there may be asymmetric equilibria where some firms pursue innovator and other firms pursue imitator strategies; expected profits, however, are equalized across companies. A similar conclusion emerges from the literature on the endogenous timing of innovation, summarized in Reinganum (1989).

With this distinction between innovator and imitator strategies, a number of questions arise relating to venture capital financing. First, does the choice of a product market *strategy* influence the type of financing obtained by a start-up company? There are a number of alternative hypotheses. For example, one alternative would be that the marginal value of obtaining venture capital is greater for innovator companies so that innovators obtain venture capital in equilibrium. This could be because innovators have a wider set of challenges on many fronts (e.g., development of new business concepts, product and technological innovation, and development of new markets) and the business expertise provided by venture capitalists can be particularly helpful in addressing some of these issues. An alternative hypothesis would be that innovators have greater difficulties in attracting venture capital, because venture capitalists themselves are accountable to a set of investors who prefer more easily understood products. Second, does the choice of an investor affect *outcomes* in the product market? For instance, venture capitalists may affect the time it takes a company to bring its product to market. Again, a number of alternative hypotheses are possible. One alternative would be that venture capitalists focus the entrepreneurs on the key strategic challenges and exert influence in order to speed up the time to market. Alternatively, venture capitalists could be more patient investors that provide the entrepreneurs with additional breathing room, thus slowing down time to market. Because the theoretical considerations suggest that there might be various interaction effects pointing in different directions, it is appropriate to submit these questions to an empirical analysis.

One of the difficulties that typically plagues this line of research is the dearth of available datasets. In order to research these questions we use a unique hand-collected dataset of high-technology companies in Silicon Valley, where the high incidence of entrepreneurial activity provides a rich setting for studying our hypotheses. We use a variety of instruments, including surveys, interviews, and commercial databases, as well as any publicly available information. The sample design enables us to observe a timeline of events for each company, including whether it obtains venture capital, and if so, when, and how long it takes to bring its product to market. In our data we can hence compare venture capital- and non-venture capital-backed companies. Through interviews, we are also able to obtain product market information that is usually not available, such as a founder's initial product market strategy. Companies are classified into two groups according to whether their initial strategy is best described as an innovator strategy or an imitator strategy. The criterion for being an innovator is that the company is either creating a new market, is introducing a radical innovation in an existing market, or is developing a technology that will lead to products that satisfy either of the above criteria.[4]

[4] Imitators typically still have a certain amount of inventiveness, but they seek their competitive advantages not through innovation itself, but rather through differentiation, typically in terms of product features or marketing.

The first part of the analysis examines the relationship between the product market strategy and the investor type. In a probit model, controlling for age and industry effects, we find that innovators are more likely to be financed by venture capital than are imitators.[5] In a Cox proportional hazard duration model we also find that innovators obtain venture capital earlier in the life cycle than do imitators. These results refute the sometimes voiced criticisms that venture capital does not support the most innovative start-ups, or that venture capitalists invest in innovative companies only when they are already older and less risky.

In the second part of the analysis, we examine the relationship between venture capital financing and the time it takes a company to bring its product to market. In a duration model with time-varying covariates that keeps track of when a company obtains venture capital, we find that the presence of venture capital is associated with faster time to market. This effect is particularly strong for innovators but statistically insignificant for imitators. One interpretation of these results is that venture capitalists influence companies to bring their product to market faster, and this effect is more pronounced for innovators, for whom this might be particularly valuable. This also explains our first finding, that innovators are more likely to obtain venture capital.

The third part of the analysis considers some alternative interpretations and additional robustness checks. First, we ask whether firms themselves considered obtaining venture capital important. In surveys, firms were asked to list significant milestones in the company's history. We find that firms are more likely to consider venture capital a milestone event than obtaining financing from some other kind of financier. Second, we then examine whether our finding of a faster time to market could be due to only companies with certain characteristics obtaining venture capital in equilibrium. It could be that venture capitalists select firms with certain characteristics, or that firms with certain characteristics select venture capital. Because we examine equilibrium outcomes, the same basic estimation procedure applies irrespective of who selects whom. However, for ease of exposition, in what follows we word the selection effect as selection by venture capitalists. We test for selection by venture capitalists based on observable information, selection based on expert (predictive) industry knowledge by venture capitalists, and selection based on product announcements, either publicly known or anticipated within the year. In all cases, we find that after controlling for these effects, venture capital is still associated with a faster time to market, particularly for innovators, suggesting that selection based on these aspects is not driving the results. Finally, we ask why imitators obtain venture capital, given that there

[5] Insofar as ex ante measures of innovation are likely to be correlated to ex post measures, our results are consistent with Kortum and Lerner (1998), who, in a somewhat different context, find that venture capital-backed firms are more likely to innovate (through ex post patenting activity) than are non-venture capital-backed firms.

are also costs associated with venture capital, as discussed above. We find that venture capital is associated with significantly greater amounts of external financing for imitators, but not for innovators. This result suggests that venture capital can play different roles in different companies. For imitators the provision of funds may be the more important aspect of venture capital, whereas for innovators, the product market dimension can be more important.

The remainder of the article is organized as follows. Section 1 provides some institutional background on venture capital. Section 2 lays out the hypotheses. Section 3 describes the data. Section 4 examines the effect of the founding strategy on the type of financing. Section 5 examines the relationship between venture capital financing and product market outcomes. Section 6 discusses alternative interpretations and robustness checks. Section 7 concludes.

1. Institutional Background

It is frequently argued that venture capitalists are a distinct type of investor for entrepreneurial companies. In this section we give a brief description of venture capitalists, and the alternatives to venture capital.

Venture capitalists are full-time professional investors who invest for their partnership funds. Venture capitalists tend to closely follow the technology and market developments in their area of expertise in order to stay in the deal flow and to be able to make an informed investment decision [Fenn, Liang, and Prowse (1995)]. Before making an investment, they carefully scrutinize the founders and their business concepts [Fried and Hisrich (1994), Garmaise (1999)]. When making the investment, they bring financial expertise to structuring the deal and setting appropriate incentive and compensation systems [Sahlman (1988, 1990), Kaplan and Stromberg (1999)]. After the initial investment, venture capitalists tend to be very active in the process of raising additional funds for their portfolio companies [Gorman and Sahlman (1989)]. They also continuously monitor their companies, both formally through participation at the board level and informally [Rosenstein (1988), Lerner (1995)]. As monitors and through their access to private information, like banks, they can help provide certification to outside stakeholders [James (1987), Puri (1996, 1999), *The Economist* (1997)]. They can provide valuable mentoring and strategic advice for the entrepreneurs and they frequently assist companies in providing business contacts and recruiting senior managers [Bygrave and Timmons (1992)]. They tend to play an important role in corporate governance, frequently replacing the original founder as CEO [Hellmann (1998)]. They help professionalize the company, both within the organization and at the CEO level [for empirical evidence, see Hellmann and Puri (2000)]. Finally, they often take an active role in guiding the exit decision, such as influencing a company's initial public offering [Lerner (1994), Gompers (1995)].

The main alternatives to venture capital financing are so-called angels (i.e., private individuals), corporations, banks, government, and self-financing. Sahlman (1990) emphasizes the high-powered incentives of venture capitalists and their high degree of specialization to the financing of young companies, often within only a very limited number of industry segments. Angel investors are independently wealthy individuals who diversify part of their wealth by investing in young companies. Typically they do not have any staff for supervising their investments and tend to rely on their preexisting networks to find new deals. Although there is considerable heterogeneity within the angel community, many exercise some other position as their main professional activity [Benjamin and Sandles (1998), Fenn, Liang and Prowse (1998)]. Corporations also invest in entrepreneurial companies, either as part of an organized venture capital fund, or on an ad hoc basis. In addition to seeking financial gains, they frequently also pursue strategic objectives. Hellmann (1997a) shows that entrepreneurs may be quite reluctant to receive funding from corporations if there are potential conflicts of interest. More generally, while a corporate investor may, in principle, be in a good position to add value to an entrepreneurial company, incentive problems and bureaucracy are frequently believed to limit the usefulness of a corporate investor [Block and McMillan (1993), Gompers and Lerner (1998)]. Commercial banks are an infrequent provider of funding to entrepreneurial companies. Apart from occasional loan commitments, banks sometimes engage in venture capital investments through wholly owned subsidiaries. Regulatory constraints tend to make banks more conservative investors [Fiet and Fraser (1994), Hellmann (1997b)]. Some investment banks also make venture capital investments, typically with an eye on future transactions, such as underwriting the initial public offering (IPO). Puri (1996, 1999), Gande et al. (1997), and Gompers and Lerner (1999) examine the potential conflict of interest when investors are also underwriters. Government financing is entirely passive by nature and consists mainly of grants [Lerner (1996)]. Self-financing comprises financing from the founders, their families, and their friends [Fluck, Holtz-Eakin, and Rosen (1998)]. Hence it seems reasonable to conjecture that venture capitalists are a somewhat distinct type of investor who specialize in the financing of entrepreneurial companies.

2. The Hypotheses

In this section we briefly outline the hypotheses that underlie our analysis. Very little is known about the interaction between the product market attributes and the type of investor, particularly in the financing of start-up companies. Therefore an important question is whether any such interactions exist. In testing for interactions we will be careful to account for the timing structure of events. In particular, we distinguish between ex ante strategy prior to financing, the financing itself, and the ex post product market outcome. Thus we examine the interrelationship of the ex ante strategy

(innovator or imitator) and the type of financing (venture capital or other) on the one hand, and the interrelationship of the type of financing and subsequent product market outcomes (in particular time to market) on the other.

Our first null hypothesis is that the type of financing is independent of product market strategy, that is, there is no relationship between the ex ante strategy and the type of financing of a start-up company. There are at least two alternative hypotheses. The first alternative is that venture capitalists prefer to invest in innovator companies, because they have a comparative advantage in identifying and then assisting innovator companies. In particular, their business experience may be particularly helpful to sort through the greater ambiguity that surrounds an innovator company. A second alternative is that venture capitalists, being accountable to their own investors, may prefer to invest in imitator companies, for which the business concepts are easier to comprehend and communicate. Under this view, venture capitalists may shy away from the uncertainty of an innovator company, but are eager to free ride on the learning of other companies by funding mainly imitator companies.[6]

Our second null hypothesis postulates that the type of financing is product market neutral, that is, there is no relation between the type of financing and product market outcomes of a start-up company. Arguably for start-ups one of the most important product market outcomes is the time it takes to bring a product to market. The null hypothesis would then argue that the type of financing (or investor type) does not affect time to market. Again there are at least two alternate hypotheses. The first alternative is that the knowledge and the involvement of venture capitalists allow them to better identify promising companies and then assist them in their quest to quickly bring a product to market. Here we would then find venture capital being associated with faster time to market. This effect might be particularly strong for innovators whose strategy is predicated on being a first mover. Alternatively, it could be the case that venture capitalists are patient investors with a higher tolerance for long development cycles that would slow down entrepreneurs. In this case, venture capitalists would be associated with a longer time to market.

3. The Data

In order to test our hypotheses we need a sample of firms chosen independently of financing (so that we have both venture and non-venture capital-backed firms). Further, we need data on ex ante strategies of firms, the kind and timing of financing (venture capital or not) received, and the timing of bringing a product to market. Our task is complicated by the fact that existing commercial databases such as Venture Economics and Venture One contain data only on venture capital-backed firms, hence we cannot use these

[6] Bylinsky (1995) and Deger (1996) suggest such behavior for the venture capital industry.

databases to identify a sample of firms to study. Further, these databases have scant data on the timeline of events and ex ante strategies of firms.

To conduct this study we therefore use a unique hand-collected dataset of start-ups in Silicon Valley culled from a combination of survey data as well as from publicly available data. This dataset is collated from combining two independent research efforts conducted over a period of several years, starting in 1994. The initial sample selection of Silicon Valley firms and data collection was organized by Baron, Burton, and Hannan (1996a,b) which we supplemented in 1996 and 1997 with an additional financing survey and related data collection.[7] To generate the initial list of companies three main datasources were used. The first two databases that listed firms in Silicon Valley were *Rich's Everyday Sales Prospecting Guide,* published by Rich's Guide, and *Technology Resource Guide to Greater Silicon Valley,* published by CorpTech. A stratified random sample was selected in which firms could have a legal age no older than 10 years and had to have more than 10 employees. Moreover, young and large firms were oversampled and foreign firms were excluded. The Silicon Valley business press was used as a third data source to identify very young firms that were not even listed in the two databases mentioned above. The purpose of doing this was to alleviate concerns that relying exclusively on guidebooks such as Rich's and CorpTech to construct the sample might underrepresent new start-ups since there is sometimes a considerable time lag before newly created firms appear in these guidebooks. Hence the sample was supplemented by adding on 22 very young firms identified through the Silicon Valley business press.

Our sample consists of 173 start-up companies that are located in California's Silicon Valley. In order to collect the data, a number of surveys were sent to key people in each firm, covering a wide range of questions about historic and current aspects of the companies. The overall response rate was 80%. Further, trained MBA and Ph.D. students conducted semistructured interviews with key informants of the sample companies. An effort was made to interview the founders, the current CEO, and a human resource manager for each company. This data was then augmented with any information provided by the company. In addition, publicly available information about each of the firms in the study was gathered from on-line data sources such as Lexis/Nexis, Dialog, Business Connection, or ABI Inform. Further, for firms that had gone public, annual reports and 10-K or IPO prospectuses (where available) were also collected and used to augment the data. To obtain financing data, between autumn 1996 to October 1997 we sent out

[7] A more detailed description of the sampling procedures and their rationale can be found in Burton (1996) and in Baron, Burton, and Hannan, (1996a,b). These articles are based on a first round of interviews of some 100 companies that were performed in the summer of 1994. A second round of interviews was conducted in the summer of 1995, and follow-up interviews were conducted in the summer of 1996. This article obviously uses the updated information. Where possible, we also augmented the publicly available information up to the end of our observation period, which we defined to be October 1997.

a survey addressed to the most senior member of the company in charge of finance. The survey asked for a complete financing history of the company since the time of founding. The information was augmented with data available from two commercial databases, Venture Economics and Venture One, largely for the purpose of ascertaining which firms in our sample received venture capital.[8] We performed additional cross checks on the data by using the interview transcripts, researching public sources, and placing calls to the companies to resolve remaining ambiguities. We also continued to augment the data coming in from the companies, again using public information as well as the interview and survey material. Considerable emphasis was put on measuring the timing of events such as the date of founding, the date of the first product sale, and the timing of all financing rounds.

This experiment design has three distinct advantages. First, the sampling is independent of the form of financing. One-third of the sample is non-venture-backed firms, allowing us to compare and contrast the behavior of venture-backed firms with non-venture-backed firms. Second, we obtain a clear timeline of events. The design of the study allows us to observe companies over time, including retrospective data all the way back to the founding events. Third, the use of surveys and interviews, though imperfect for the usual reasons, allows us to obtain data, such as the founding strategy, that is normally not available to researchers. In addition, Silicon Valley is an interesting environment to study since it has the highest start-up activity in the United States. The narrow focus of our sample, specifically technology companies in Silicon Valley, has the advantage that we can control for common economic conditions, such as geography, labor markets, or regulation. The disadvantage is that the results may, obviously, have limited applicability for companies under different economic base conditions.

3.1 The variables

In what follows, we describe the main variables and the way they are defined and collated. Table 1 shows the descriptive statistics.

AGE is the age of the company in October 1997 measured from the birth date of the company. The date of legal incorporation is often taken as the birth date for companies and would appear to be a natural choice. However, for entrepreneurial firms this is far from obvious. In particular, in our sample, over half of the companies had some other significant event that preceded the date of incorporation, such as the beginning of normal business operations or the hiring of a first employee. Moreover, there does not appear to be any clear sequence of events that these companies follow in this initial period of creation. In this article we therefore take a conservative approach and use the

[8] See Lerner (1994, 1995) for a discussion of the Venture Economics database and Gompers and Lerner (1997) for a discussion of the Venture One database. We found 107 of the sample companies in Venture One and 95 in Venture Economics. Some 66 companies (38%) replied to our financing survey.

Table 1
Descriptive statistics

Variable	Number of observations	Mean full sample	Mean innovator sample	Mean imitator sample
INNOVATOR	149	0.5033557	1	0
VC	149	0.6912752	0.7866667	0.5945946
VC(P)	149	0.4228188	0.4933333	0.3513514
TIME-TO-VC	103	2.626462	2.461966	2.847038
TIME-TO-MARKET	132	2.588798	2.832472	2.337626
AMOUNT	91	8.107369	11.05957	4.663135
COMPUTER	149	0.4765101	0.4666667	0.4864865
TELECOM	149	0.2147651	0.1466667	0.2837838
MEDICAL	149	0.147651	0.24	0.0540541
OTHER	149	0.1610738	0.1466667	0.1756757
SAMPLE-AGE	149	6.74506	6.366528	7.128707
AGE	149	10.12593	9.703195	10.55438

INNOVATOR is a dummy variable which takes the value 1 if the founding strategy of the firm was an innovator strategy, 0 otherwise. VC is a dummy variable that takes the value 1 if a firm has received venture capital, 0 otherwise. VC(P) is a dummy variable that takes the value 1 if the company obtained venture capital before the date of first product sale. TIME-TO-VC measures the time in years from the birth of the company to the date of obtaining venture capital for the first time. TIME-TO-MARKET measures the time in years from the birth of the company to the date of first product sale. AMOUNT measures (in $ millions) the amount of financing that a company obtains prior to bringing its product to market. COMPUTER, TELECOM, and MEDICAL are dummy variables that take the value 1 if the firm is in the computer, telecommunications, or medical-related industry respectively, 0 otherwise. OTHER is a dummy variable for other industries. SAMPLE-AGE is the age of the company at the time of sampling. AGE is the age of the company in October 1997.

earliest date recorded in any of our data sources corresponding to the earliest evidence of firm activity as the date of birth.

SAMPLE-AGE is the age of the company at the time of sampling, measured from the date of birth of the company.

VC is a dummy variable that takes the value 1 if a firm has received venture capital, and 0 otherwise. From the interviews, surveys, and commercial databases we identify which firms are financed by venture capitalists and the timing of such financing. Venture capitalists are professional investors who specialize in the financing of young private companies. We also create other venture capital-related variables based on the timing of the venture capital. Thus, VC(P) is a dummy variable that takes the value 1 if the company obtained venture capital before the date of first product sale.

TIME-TO-VC measures the time from the birth of the company to the date of obtaining venture capital for the first time.

TIME-TO-MARKET measures the time from the birth of the company to the date of first product sale. This is an important strategic variable. We obtain this variable from informants' interviews at the company. These interviews included a targeted question of when the company brought its product to market. We augment this information with publicly available data on the company's product, using in particular the earliest product mentioned in Rich's guide or other public sources.

COMPUTER, TELECOM, and MEDICAL are dummy variables that take the value 1 if the firm is in the computer, telecommunications, or medical-related industry, respectively, 0 otherwise. OTHER is a dummy vari-

able that takes the value 1 if the firm is in another industry (mostly semiconductors), 0 otherwise.

INNOVATOR is a dummy variable that takes the value 1 if the founding strategy of the firm was an innovator strategy, 0 otherwise. This is an important strategic variable as we are interested in measuring ex ante strategies. There is no easy way of obtaining this data, hence this variable deserves some discussion.[9] The founders' interviews contained a specific section that asked about their perceived "distinctive competence and competitive advantage." Whenever possible, the same questions were asked of other people involved in the founding of the company to cross-check the information. The classification was then done based on content analyses of their answers. Further, this classification was supplemented by other objective measures. These include secondary sources (e.g., newspaper articles and industry analyst reports) and other material provided by the firm (such as a business plan). Two trained coders were then asked to separately read through all the interview transcripts as well as all the other collected material to assign a company to a strategy.[10] Both of the coders coded all of the sample companies independently. In cases in which they disagreed, a third person was asked to resolve the differences. Conceptually the coding of the innovator variable captures the notion of firms that introduce a new product that is considered not to be a close substitute to any product or service already offered on the market; firms that introduce a new product or service that is considered to perform an order of magnitude better than any substitute products already offered in the market; or firms that are developing new technologies that could lead to products satisfying either of the two criteria above.[11] We put the remaining companies into a single category of imitators.[12] Although these firms may still have some degree of

[9] This coding was performed under the supervision of Baron, Burton, and Hannan. They actually used a more fine-grained strategy coding that further subdivided the group of what we call imitators. Details can be found in Burton (1996) and Burton, Lam, and Sellars (1996).

[10] The instructions included "buzzwords" that the coders were asked to look out for. Buzzwords for innovators include new technology, forefront, new paradigms, brand new discovery, patented technology, pioneer, unique, no competition, first in the field, first-mover advantage, technological breakthrough, new idea, and technological innovation. Buzzwords for imitators include feature-rich, integration, me-too, better design, outperform existing competitors, improvements in quality and features, second source, superior sales/marketing, clone, and cheap, low-cost assembly.

[11] Some typical quotes from the interviews that were associated with innovators are

- *"[A] new and unique introduction without a defined market."*
- *"It was a brand new discovery that could be patented."*
- *"[A] completely new idea, so there was no competition in the area."*
- *"There is intense competition in the drug delivery business; they are clearly in a technological race with many companies."*
- *"They appear to be at the forefront of developing technology for the information superhighway. . . Initial core competence was technology developed at Stanford."*

[12] Representative quotes for imitators include

- *"The initial competence of the company was a customer focus."*
- *"Understanding technology, customers' needs and how to apply the former to the latter."*

novelty in their product offering, this is typically not the main source of their perceived competitive advantage. We were able to obtain founding strategies for 149 companies and hence this is our effective sample size.

3.2 Robustness checks on the data

We next discuss some potential limitations of the data and a number of robustness checks we performed to deal with these concerns. A common issue with the use of survey data is the use of retrospective data and the bias such data can impose. Although the innovator variable measures the initial strategic intent, it still relies on retrospective information and could be subject to retrospective biases. Some argue [Bhide (1998)] that entrepreneurs may have a tendency to distort or dramatize their company's history. To avoid such problems, a number of measures were taken, both during the data-gathering stage and afterwards.

First, the interview subjects were not asked to classify themselves as innovators or imitators. Instead, this information was extrapolated from a variety of information sources that included not only the founders' technical descriptions, but also the descriptions of other parties involved in the founding of the company and other available information about the company. Second, if there is retrospective bias it is likely to be stronger for older companies, so that older firms are more likely to portray themselves as innovators. Hence we examine the age composition of the innovator variable. We divide the sample into its younger and older halves and perform a test to determine whether older firms are more likely to be classified as innovators. Table 2, panel A, performs a chi-sqaured test and reveals no significant differences, suggesting that retrospective biases are unlikely to be driving this result. Third, we examine whether companies formalized the strategies that they intended to pursue at the time of receiving venture capital, in terms of a written detailed business plan.

Table 2, panel B, shows some descriptive statistics of how many entrepreneurs had a business plan at the time of obtaining venture capital. Although the number of observations is somewhat low, two messages emerge from this table. Most entrepreneurs have a business plan at the time of receiving venture capital. And innovators are more likely to have a business plan than imitators (the chi-squared test is statistically significant at 1%). Venture capitalists typically use the business plan to carefully scrutinize a company's plans before investing in it. This is particularly important for an innovator company, because it is likely to be inherently more difficult to evaluate. The writing of a business plan also forces entrepreneurs to define

---

- *"Competitive advantage is providing both hardware and software expertise. . . [their] product is the most feature-rich in the industry."*
- *"[T]hey knew that there was a market for optical character recognition and they wanted to outperform their existing competitors on accuracy and speed. It was a me-too approach."*
- *"[It was a] service industry emphasizing quality and low cost. Hard working, long hours, low margins."*

Table 2
Some differences in innovators and imitators

Panel A

AGE	INNOVATOR	IMITATOR	Total
Above median	38	45	83
Below median	37	29	66
Total	75	74	149
p-value	.213		

Panel B

BUSINESS-PLAN	INNOVATOR	IMITATOR	Total
YES	39	19	58
NO	4	7	11
Total	43	26	69
p-value	.053		

Panel C

PATENT	INNOVATOR	IMITATOR	Total
YES	48	37	85
NO	27	37	64
Total	75	74	149
p-value	.084		

Panel D

NUMBER OF PATENTS	Number of observations	Mean	Standard deviation
INNOVATOR	75	1.2838	1.311502
IMITATOR	74	0.8838137	1.112151
p-value	.0948		

Panel A provides descriptive statistics and a chi-squared test for the breakdown of AGE into innovators and imitators. Panel B provides descriptive statistics and a chi-squared test for the breakdown of BUSINESS-PLAN into innovators and imitators. The variable BUSINESS-PLAN is a dummy variable that takes the value 1 if a company had a business plan at the time that it first raised venture capital, 0 otherwise. Panel C provides descriptive statistics and a chi-squared test for the breakdown of PATENT into innovators and imitators. The variable PATENT is a dummy variable that takes the value 1 if a company had received a patent, 0 otherwise. Panel D provides descriptive statistics and a t-test for the difference in means for the number of patents. The variable, NUMBER OF PATENTS, is the natural logarithm of (1 + the number of patents).

their strategy more explicitly. The fact that these companies formalize their intention in writing would also limit the extent to which their recollections become distorted.

Last, but not least, while a measurement of the ex ante intent is most relevant to our hypothesis, the question arises whether this intent is reflected in the realized behavior of these companies. It is reasonable to expect that ex ante strategies are correlated with ex post outcomes. We examine this by analyzing the firm's patenting behavior, because patenting data reveals information about the ex post behavior of the companies. [See Griliches (1990) and Kortum and Lerner (1998) for a detailed discussion of the advantages and disadvantages of using patenting data as a measure of innovation.] We gathered additional data to examine patenting behavior of the firms in our sample. We identify patent activity by using the Lexis/Nexis on-line database.

For each individual firm, we identify all patents for which that particular firm is defined as the assignee-at-issue over the entire sample period, that is, from the birth of the company until October 1997. We classify companies by whether or not they receive patents. We create a dummy variable PATENT that is 1 if the company received a patent, 0 otherwise. Table 2, panel C, shows the relationship between an innovator strategy and the propensity to patent. The chi-squared test finds that innovators are indeed more likely to obtain patents, showing that more often than not, ex ante intent is translated into a realized measure of innovation. Furthermore, we examine the natural logarithm of the number of patents, which is a widely used measure of innovation [see, e.g., Kortum and Lerner (1988)]. Table 2, panel D, shows a t-test of the equality of means between the innovator and the imitator sample. We find that innovators do have a significantly higher number of patents than do imitators. Thus both of our ex post measures (of innovation based on patents) correlate well with our ex ante measure of innovation.

Another concern with the data is the potential survivorship bias, because companies are not sampled at birth. A number of arguments, however, suggest that this survivorship bias is relatively minor. First, a particular effort was made to include many young companies, precisely to reduce any survivor bias. As a consequence, our sample captures firms at a much earlier stage than do most other databases.[13] Second, unlike many other studies in finance relating to venture capital, we are able to sample companies independent of their financial choices. In fact, our sampling criterion is essentially based on the existence of the company, and not on any endogenous financial measure. In particular, our sampling criteria are not affected in any way by the firm getting venture capital. Finally, a number of companies fail within our sample and we estimate a probit to see whether the probability of failing is systematically related to any known characteristic. We find that the strategy (innovator or imitator), the presence of venture capital, the age of the firm, or any industry effects are not statistically significant in predicting exit from the sample. The within-sample behavior thus suggests that selection issues are unlikely to have a major effect on our results.

Finally, although we had a high overall response rate, we were still unable to code every company in the sample. We identified a strategy for 149 companies in the sample. This raises the question whether there are response biases. We test for response biases by estimating a probit in which the dependent variable is whether we obtain an ex ante strategy for the firm. We find that the presence of venture capital, the age of the firm, and any industry effects are not statistically significant in predicting responses received. This suggests that there is little systematic response bias.

[13] An interesting issue that emerged in this research is that even at a conceptual level, it is not clear how one could eliminate all survivorship bias. As we discussed, there is no objective date at which a company is born. Given this inherent ambiguity about if and when entrepreneurial activities should be considered a new company, it seems conceptually impossible to eliminate all survivor bias.

4. Does Strategy Affect the Type of Financing?

In this section we examine the first null hypothesis that concerns the relationship between initial product market strategy and the type of financing. A univariate chi-squared test was conducted to test for independence between innovators and venture capital. This was rejected at the 2% level, with more innovators taking venture capital. Although the univariate test is suggestive, we clearly need to control for other characteristics of the firm. Hence we estimate a probit regression in which the dependent variable is a dummy variable, VC, that measures whether a firm has obtained venture capital financing. The main independent variable is whether a company is an innovator or imitator, and we control for factors such as the age of the firm and the industry the firm is in. Table 3 reports the probit regression results. We find that innovators are more likely to receive venture capital financing, and this result is statistically significant at the 5% level.

The probit model estimates the overall likelihood of a company receiving venture capital financing, but it does not use information on the timing of the venture capital investment. We are interested in the length of time it takes to obtain venture capital and the influence of the strategy on that duration. A standard procedure for dealing with duration data is to employ a hazard model [Kalbfleisch and Prentice (1980), Kiefer (1988)]. To proceed we must specify the exact nature of our hazard model. We can choose from a number of parametric models (such as Weibull) or we can use a semiparametric model. The parametric models are attractive because of their simplicity, but by imposing as much structure as they do, the models can distort the estimated hazard rate. Because fewer restrictions can result in a more accurate

Table 3
Determinants of venture capital financing

Dependent variable: venture capital

Independent variables	Marginal increase in probability	Coefficients	T-ratio
CONSTANT	N/A	−0.3696116	−0.405
INNOVATOR	0.1894893**	0.5573478**	2.304
LNAGE	0.017164	0.0500831	0.134
COMPUTER	0.1276939	0.3759489	1.244
TELECOM	0.2706599***	0.9673541***	2.561
MEDICAL	0.2531136**	0.9464507**	2.214
Number of firms = 149		Pseudo $R^2 = 0.0880$	
$\chi^2(5) = 15.34$		Model p-value = .0090	

The table presents the results of a probit. The dependent variable is VC, which is a dummy variable taking the value of 1 if a company has ever received venture capital, 0 otherwise. The independent variables are INNOVATOR, which is a dummy variable taking the value of 1 if the founding strategy of the company was an innovator strategy, 0 otherwise; LNAGE, which is the natural logarithm of the company's age; and COMPUTER, TELECOM, and MEDICAL, which are dummy variables that take the value 1 if the firm is in the computer, telecommunication, or medical industry, respectively, 0 otherwise. Pseudo $R^2 = 1 - \log L / \log L_o$, where $\log L$ is the maximized value of the log-likelihood function, and $\log L_o$ is the log-likelihood computed only with a constant term. Model p-value reports the joint significance of the coefficients of the independent variables. T-ratios are computed using White's heteroskedasticity-adjusted standard errors. *, **, or *** mean the coefficient is significant at the 10%, 5%, or 1% level, respectively.

representation, we use the proportional hazard model—a common choice among researchers for modeling duration. The formal model is

$$h(t) = h_0(t) \exp\{\beta' X\}.$$

The Cox proportional hazard model does not impose any structure on the baseline hazard $h_0(t)$. Cox's partial likelihood estimator provides a way of estimating β without requiring estimates of $h_0(t)$. Suppose the complete durations are ordered $t_1 < t_2 < \cdots < t_n$. The risk set with respect to any moment of time is the set of firms that have not yet exited just prior to that time. The conditional probability that observation i exits at time t_i given that any of the observations in the risk set R_i could have been concluded at duration t_i is

$$\frac{\exp\{\beta' \mathrm{X}_i\}}{\sum_{j \in R_i} \exp\{\beta' \mathrm{X}_j\}}.$$

This conditional probability is independent of the baseline hazard function.[14] A distinguishing feature of our duration data is that some of the observations are right censored; that is, at the end of the sample period the firm has not obtained venture capital, yet there is a positive probability of such an event occurring. Our hazard model explicitly takes such censoring into account.

We report both the coefficients and the hazard ratios (i.e., the relative risks). A positive coefficient on x implies a higher x is linked to a higher hazard rate and thus a lower expected duration. For ease of interpretation, we also give the hazard ratios. The hazard ratio tells us how much the hazard (i.e., the instantaneous risk) of the event increases for a unit change in the independent variables. In the case of a dummy variable, this is equal to the ratio of the (instantaneous) probabilities of the two possible states.

Table 4 shows the results from the Cox regression. The dependent variable is TIME-TO-VC, that is, the time to obtaining venture capital.[15] We control for industry effects. The regression shows that the INNOVATOR variable is significant. Innovators are faster to obtain venture capital, with an estimated hazard ratio of 1.69. This says that, relative to imitators, innovators are 1.69 times more likely to obtain venture capital in any given period of time. This result is statistically significant at 1%.

These two results reject the first null hypothesis that there is no relationship between an entrepreneurial company's strategy and its propensity to obtain venture capital financing. Firms pursuing an innovator strategy are

[14] The partial log likelihood is $\ln L = \sum_{i=1}^{n} [\beta' X_i - \sum_{j \in R_i} \exp\{\beta' X_j\}]$.
Technically this is for the simplest case where exactly one firm exits at each distinct time and there are no censored observations. The partial log-likelihood can handle censoring easily. Censored observations enter the risk set at each observation (in the denominator) but do not enter in the numerator of the partial likelihood.

[15] There may be some intervening events that imply that a company will no longer obtain any venture capital, namely, if it goes public, out of business, or gets acquired. We model this as a standard competing risk, so that either of these events constitutes a terminal noncensored event.

Table 4
Cox estimations for time-to-venture capital

Dependent variable: Time-to-VC

Independent variable	Hazard ratio	Coefficient	T-ratio
INNOVATOR	1.695095**	0.5277389**	2.532
COMPUTER	1.334181	0.2883178	0.889
TELECOM	2.375416**	0.8651728**	2.468
MEDICAL	2.094569**	0.7393477**	1.970
Number of firms = 149		$\chi^2(4) = 16.65$	Model p-value = .0023

The table presents the results of a Cox regression. The dependent variable is TIME-TO-VC, which measures the time from the birth of a company to the date of obtaining venture capital for the first time. The independent variables are INNOVATOR, which is a dummy variable taking the value of 1 if the founding strategy of the company was an innovator strategy, 0 otherwise; and COMPUTER, TELECOM, and MEDICAL, which are dummy variables that take the value 1 if the firm is in the computer, telecommunication, or medical industry, respectively, 0 otherwise. Model p-value reports the joint significance of the coefficients of the independent variables. *, **, or *** mean the coefficient is significant at the 10%, 5%, or 1% level, respectively.

more likely to obtain venture capital and to obtain it more quickly. This suggests that venture capitalists are not shying away from the uncertainty of innovative business concepts, but rather seem to embrace them. Nor does it seem to be true that if they invest in innovator companies they invest at a later stage when much of the uncertainty may already have been resolved. Instead we find that innovators are faster to obtain venture capital. The natural question to ask is, what is it that attracts innovators and venture capitalist to each other? Is there any particular role that venture capitalists can play in the development of innovator companies? To examine this we will now turn to the relationship between venture capital and product market outcomes.

5. Type of Financing and Product Market Outcomes

In this section we examine the second null hypothesis, that the presence of a venture capitalist does affect product market outcomes. We consider the effect of venture capital on the time it takes a company to bring its product to market. We estimate a Cox duration regression. The dependent variable is TIME-TO-MARKET, which measures the time from founding up to the date of the first product sale.

When we examine duration data with respect to the length of time it takes to get a product to market, we have an additional complication. We are interested in the influence of venture capital on the time to product market, and venture capital is obtained by firms at different points of time. We therefore modify the original Cox proportional hazard model to allow for time-varying covariates. The model being estimated now takes the form of

$$h(t, X(t)) = h(t, 0) \exp[(\beta' X(t)],$$

where $h(t, X(t))$ is the hazard rate at time t for a firm with covariates $X(t)$. The Cox regression estimates the coefficient vector β. Again, our model also takes into account the right censoring of our data.

Hence, apart from the usual industry controls, the main independent variable is a dummy variable VC(t), that indicates whether the firm has received any venture capital financing by time t. Companies do not necessarily start with venture capital, but obtain venture capital after variable lengths of time. A company may thus change its status from not being venture capital backed to being venture capital backed. Note that depending on strategy and industry, a company may have a shorter or longer time to market, which is a function of the underlying technological parameters. Indeed, from Table 1 we see that on average innovators take more time to bring a product to market than imitators. The question we are interested in here is, for a company with a given technology, whether venture capital *reduces* the time to market.

Table 5 reports the coefficients and the hazard ratios of the estimated models. Looking first at the entire sample, we see that the likelihood of the first product sale increases by a factor of 1.88 with the advent of a venture capitalist. This is statistically significant at the 1% level. Table 5 also shows the results of the Cox regression for the subsample of innovators and imitators. The presence of a venture capitalist increases the likelihood of a first product sale by a factor of 3.37 in the innovator sample (this is again statistically significant at the 1% level), while it has no statistically significant effect in the imitator sample.

As a robustness check we reran all of our duration models as Weibull regressions, which is a standard fully parametric model (and which takes time dependency into account in the same way as does the Cox model). All of our results are very similar, and the significance levels were frequently even stronger.[16]

These results reject the second null hypothesis that venture capital is product market neutral. We find that venture capital is associated with faster time to market. This association is particularly strong for innovator companies. These results tie in with the findings in the previous section. We found that innovators are more likely to take venture capital. We then asked the question, what is it that attracts innovators to venture capital? An interpretation consistent with the results of this section is that the presence of a venture capitalist helps companies in their quest to be faster to market, especially for innovators, whose strategy is predicated on first-mover advantages. This interpretation helps explain why innovators are more likely to take venture capital in the first place.

6. Extensions

One of the main advantages of the use of this dataset is the existence of a clear timeline of events that allows us to establish whether preceding events

[16] As another robustness check, we reran all of our regressions dropping those companies that received no external financing at all. We also classified companies in the computer industry into hardware and software firms, gave them a separate industry dummy, and reran our regressions. Again, for all of these our qualitative results are unaffected.

Table 5
Cox estimations for time to market

Independent variables	Hazard ratio	Coefficients	T-ratio
Panel A: Full sample			
Dependent variable: TIME-TO-MARKET			
VC(t)	1.88499	0.6339223***	3.185
COMPUTER	1.278382	0.2455951	0.972
TELECOM	0.8627586	−0.1476204	−0.502
MEDICAL	0.4970323	−0.6991003**	−2.140
Number of firms = 149		$\chi^2(4) = 18.09$	Model p-value = 0.0012
Panel B: Innovator sample			
Dependent variable: TIME-TO-MARKET			
VC(t)	3.371708***	1.215419***	4.282
COMPUTER	2.38884**	0.8708079**	2.257
TELECOM	2.533499**	0.9296012**	1.969
MEDICAL	0.4268758*	−0.8512621*	−1.884
Number of firms = 75		$\chi^2(4) = 32.78$	Model p-value = 0.0000
Panel C: Imitator sample			
Dependent variable: TIME-TO-MARKET			
VC(t)	1.479275	0.3915523	1.269
COMPUTER	0.7754147	−0.2543572	−0.746
TELECOM	0.4915214*	−0.7102497*	−1.837
MEDICAL	0.7624329	−0.2712407	−0.467
Number of firms = 74		$\chi^2(4) = 4.64$	Model p-value = .3261

The table presents results from a Cox regression with time-varying covariates. The dependent variable is TIME-TO-MARKET, which measures the time from the birth of a company to the date of first product sale. The independent variables are VC(t), which is a time-dependent dummy variable that takes the value 0 as long as a firm has not received venture capital and 1 thereafter; and COMPUTER, TELECOM, and MEDICAL, which are dummy variables that take the value 1 if the firm is in the computer, telecommunication, or medical industry, respectively, 0 otherwise. Panel A reports the results when the regression is run for the full sample, panel B reports the results for the innovator subsample, and panel C reports results for the imitator subsample, respectively. Model p-value reports the joint significance of the coefficients of the independent variables. *, **, or *** mean that the coefficient is significant at the 10%, 5%, or 1% level, respectively.

are correlated with subsequent events. This is advantageous over standard cross-sectional analysis, in which two variables are observed at the same point in time, and disentangling the impact of one on the other can be difficult. Our results indicate that an engagement of venture capital leads to a subsequent increase in the likelihood that a company brings its product to market. Therefore a natural interpretation is that the presence of venture capital helps these companies to bring their product to market. Nonetheless, other explanations are possible. In this section we discuss the robustness of our results and some alternative interpretations.

We first ask whether firms themselves believe that venture capital is important to them. Companies were asked in surveys to list the events that they considered milestones in the development of their firm. We consider all the firms that replied to this part of the survey and that received some kind of external financing. For the venture capital-backed companies we find that 59% list obtaining venture capital as a milestone. For the other companies we find that 27% list obtaining financing (from some source other than venture capital) as a milestone. This difference is significant at the 5% level. This is an interesting and significant result. It shows that entrepreneurs consider

obtaining venture capital a more significant event than obtaining finance from other sources.[17]

Although our results are consistent with venture capitalists influencing firms to bring their product to market earlier, an alternative interpretation of our results could be that venture capitalists select companies with faster time to market. Given that we have already taken into account the timeline of events (i.e., we have already established Granger causality), it would have to be the *anticipation* of a faster time to market that would lead to such an equilibrium. The informal literature typically suggests that venture capitalists are involved both in selecting good companies and in adding value to them, and theory suggests that these may well be complementary activities.[18] As such, it is unlikely that one would be operating to the exclusion of the other. Nonetheless, we conduct some preliminary tests to rule out some potential explanations. Note that since we examine equilibrium outcomes, the same basic estimation procedure applies irrespective of whether venture capitalists select firms with certain characteristics, or firms with certain characteristics select venture capital. However, for expositional ease, in the rest of the article, when we talk of selection, we describe it as selection by venture capitalists, though the estimation procedure is the same if firms select venture capitalists.

First, venture capitalists may be selecting firms based on particular observable characteristics, suggesting that a two-stage regression approach might be appropriate [see Puri (1996) for an application]. For that, our probit analysis provides the first step. Table 3 shows that only firm strategy and industry affect selection. The cleanest way to control for these in the second step is simply to rerun the duration model within the respective subsamples of innovators and imitators, as in Table 5. We also rerun our results within the computer industry (which accounts for about 50% of our sample). We obtain qualitatively similar results, with venture capital being associated with faster time to market for innovators. These findings effectively rule out selection of venture capital based on observable information as an explanation for the reduced time to market.

Second, we test for selection of firms based on the notion that venture capitalists have expert knowledge of industry conditions, which helps them to pick the right industries at the right time. We augment the duration model by adding as an independent variable the P/E ratio of the industry at the birth of the company, where the P/E ratio is taken to be a price-based measure of the

[17] Further, in the venture capital-backed companies we find that 66% (21 of 32) of the innovators and 50% (11 of 22) of the imitators considered obtaining venture capital to be a milestone. Although the sample is too small to obtain statistical significance, the numbers nonetheless suggest that innovators are also more likely to consider obtaining venture capital to be a significant milestone.

[18] In particular, the marginal return to assisting a company should increase in the expected quality of the company, which is an increasing function of the amount of screening.

market expectations for the industry.[19] Our results are qualitatively similar. We further model the venture capitalists as having perfect foresight about future industry attractiveness by replacing the P/E ratio of the industry at the time of birth with the P/E ratio at the time of exit for the firm (as measured by the time of the IPO, acquisition, or the end of the sample period) if and when a venture capitalist invests. Our results remain qualitatively similar. These results rule out selection by venture capitalists based on their picking the right industries at the right time.

Third, we examine whether our result of faster time to market for innovators is driven by venture capitalists investing in firms that are known to be bringing a product to market soon. Prior to selling its product, a company often makes an announcement about its expected product release. We rerun our time to market regression, examining those cases in which venture capitalists invest before product announcements, as well as those cases in which venture capitalists invest shortly before the announcement (6 months or 1 year prior). Table 6 shows that we find that the impact of venture capital on time to market continues to be significant for innovator companies, suggesting that selection based on product announcements that are either publicly known or anticipated within the year is not driving our results.[20]

Although our results suggest a role for venture capital for innovators, it does raise the question as to what role, if any, venture capital plays for imitators. An important potential role of venture capital is the provision of financing. Moreover, if venture capitalists actually were only to select companies without adding value to them, then one reason why entrepreneurs would choose to go to venture capitalists would be the provision of capital. We collect information on the amount of funds that companies raise up to the point of their product launch. Table 7 reports the results from an OLS regression. The dependent variable is the amount of funds raised up to the time of the first product sale, and the main independent variable is a dummy variable, VC(P), that indicates whether the company received any venture capital by the time of the product launch. We find that the presence of venture capital increases the amount of funds raised by imitators, but not by innovators. This provides one possible explanation for why some imitators select venture capital. It also suggests that for innovator companies, the distinguishing

[19] The P/E ratio for the industries is obtained from the 1998 Standard and Poor's *Analysts' Handbook* and is the average of the annual high and low P/E ratios for the corresponding industry categories within the S&P 500.

[20] One may also be concerned that the faster time to market is related to some kind of incentives for venture capitalists to "grandstand" their innovator companies. Gompers (1996) provides evidence that younger venture capitalists are more likely to bring companies to the IPO market early, in order to showcase their successes. Companies pay for this grandstanding as they experience larger underpricing. In addressing whether our result can be explained by similar concerns that venture capitalists want to showcase successful innovators, we examined the underpricing of the venture capital-backed IPOs in our sample. In unreported regressions, we find no differences in the underpricing of innovator and imitator companies. This suggests that our product market results are unlikely to be driven by concerns about grandstanding.

Table 6
Cox estimations of time to market taking product announcements into account

Independent variable	Innovator sample			Imitator sample		
	Hazard ratio	Coefficient	T-ratio	Hazard ratio	Coefficient	T-ratio
Panel A: VC occurs before product announcement Dependent variable: TIME-TO-MARKET						
VC(t)	2.98809***	1.094634***	3.759	1.479275	0.3915523	1.269
COMPUTER	2.254052*	0.8127294**	2.100	0.7754147	−0.2543572	−0.746
TELECOM	2.441519*	0.8926204*	1.891	0.4915214*	−0.7102497*	−1.837
MEDICAL	0.4238518	−0.8583715	−1.864	0.7624329	−0.2712407	−0.467
	$\chi^2(4) = 27.66$	p-value = 0.0000	$N = 72$	$\chi^2(4) = 4.64$	p-value = .3261	$N = 74$
Panel B: VC occurs 6 month prior to product announcement Dependent variable: TIME-TO-MARKET						
VC(t)	2.634752***	0.9687892***	3.221	1.479275	0.3915523	1.269
COMPUTER	2.147199**	0.761644**	1.965	0.7754147	−0.2543572	−0.746
TELECOM	2.236849*	0.8050684*	1.665	0.4915214*	−0.7102497*	−1.837
MEDICAL	0.4385352*	−0.8243152*	−1.788	0.7624329	−0.2712407	−0.467
	$\chi^2(4) = 22.73$	p-value = .0001	$N = 69$	$\chi^2(4) = 4.64$	p-value = .3261	$N = 74$
Panel C: VC occurs 1 year prior to product announcement Dependent variable: TIME-TO-MARKET						
VC(t)	2.45034***	0.8962267***	2.838	1.255881	0.2278376	0.677
COMPUTER	2.086522*	0.7354984*	1.873	0.7936273	−0.2311414	−0.668
TELECOM	2.237684*	0.8054413*	1.663	0.5088823*	−0.6755385*	−1.744
MEDICAL	0.4106908*	−0.8899146*	−1.894	0.8040182	−0.2181334	−0.336
	$\chi^2(4) = 21.09$	p-value = .0003	$N = 66$	$\chi^2(4) = 3.52$	p-value = .4749	$N = 70$

This table presents results from a Cox regression with time-varying covariates. The dependent variable is TIME-TO-MARKET, which measures the time from the birth of a company to the date of first product sale. The independent variables are VC(t), which is a time-dependent dummy variable that takes the value 0 as long as a firm has not received venture capital and 1 thereafter; and COMPUTER, TELECOM, and MEDICAL, which are dummy variables that take the value 1 if the firm is in the computer, telecommunication, or medical industry, respectively, 0 otherwise. In panel A, we drop an observation if a company received venture capital, but not before the date of product announcement. In panel B, we drop an observation if a company received venture capital but not 6 months prior to the product announcement. In panel C, we drop an observation if a company received venture capital but not 1 year prior to the product announcement. p-value reports the joint significance of the coefficients of the independent variables. *, **, or *** mean that the coefficient is significant at the 10%, 5%, or 1% level, respectively.

feature of venture capital is not the provision of funds. All together, this evidence suggests that venture capital provides different things to different companies: for imitators, venture capital matters in terms of providing financial resources, and for innovators, it matters in other dimensions, such as for product market aspects.

7. Conclusion

In this article we use a unique dataset of Silicon Valley start-up companies to explore the role of venture capital financing. We believe we are the first to empirically examine and document the interrelationship between the type of investor (in particular, equity investors such as venture capitalists versus other investors) and aspects of the product market behavior of start-up firms. We find that firms pursuing an innovator rather than an imitator strategy are more likely to obtain venture capital financing. We also find that obtaining venture capital is associated with faster time to market, especially for innovators.

Table 7
Amount of financing received by firms

Dependent variable: AMOUNT Independent variable	Full sample	Innovator sample	Imitator sample
CONSTANT	29.24691	55.33423*	−1.068363
	(1.526)	(1.750)	(−0.193)
VC(P)	−0.6630899	−9.309727	4.177051**
	(−0.166)	(−1.063)	(2.078)
LNAGE	−7.225776	−13.36145	1.915676
	(−1.351)	(−1.617)	(0.590)
COMPUTER	−7.516981	−14.5908	−0.3533606
	(−1.027)	(−1.246)	(−0.097)
TELECOM	−8.466668	−15.39738	−1.609893
	(−1.260)	(−1.338)	(−0.475)
MEDICAL	1.2652	−0.7526487	−2.608425
	(0.185)	(−0.075)	(−0.699)
Number of firms	91	49	42
R^2	0.1020	0.2082	0.1171
Model p-value	0.0558	0.1466	0.1572

This table presents results from an OLS regression. The regressions are run using the whole sample, the innovator subsample, and imitator subsample, respectively. The dependent variable, AMOUNT, is the amount of money received by the company before the first date of its product sale. Independent variables include VC(P), which is a dummy variable taking value 1 if the company had received venture capital before the first date of its product sale; LNAGE, which is the natural logarithm of company's age; industry dummy variables; and COMPUTER, TELECOM, and MEDICAL, which are dummy variables that take the value 1 if the firm is in the computer, telecommunications, or medical industry, respectively, 0 otherwise. Numbers in the parenthesis are t-ratios using White's heteroskedasticity-adjusted standard errors. Model p-value reports the joint significance of the coefficients of the independent variables. *, **, or *** mean that the coefficient is significant at the 10%, 5%, or 1% level, respectively.

Our results have implications for several branches of the literature. From a finance perspective, our results suggest that the appropriateness of choosing an involved investor depends on the strategic objectives of the company. From an industrial organization perspective, our results suggest that a firm's choice of financing seems to affect its ability to secure first-mover advantages. Our results also make a direct contribution to the emerging literature on venture capital, suggesting that venture capital financing can have an impact on the development path of a start-up company, and in particular on its product market position.

References

Allen, J., and G. Philips, 1999, "Corporate Equity Ownership and Product-Market Relationships," forthcoming in *Journal of Finance*.

Baron, J., D. Burton, and M. Hannan. 1996a. "Inertia and Change in the Early Years: Employment Relations in Young Technology Firms," in *Industrial and Corporate Change,* Oxford University Press, New York, 503–535.

Baron, J., D. Burton, and M. Hannan, 1996b, "The Road Taken: Origins and Evolution of Employment Systems in Emerging Companies," in *Industrial and Corporate Change,* Oxford University Press, New York, 239–275.

Benjamin, G., and W. Sandles, 1998, "Angels Investors: Culling the Waters for Private Equity," *Journal of Private Equity,* 1(3), 41–59.

Bhide, A., 1998, *The Origins and Evolution of New Businesses,* Harvard Business School Press, Boston.

Block, Z., and I. McMillan, 1993, *Corporate Venturing,* Harvard Business School Press, Boston.

Bolton, P., and D. Scharfstein, 1990, "A Theory of Predation Based on Agency Problems in Financial Contracting," *American Economic Review,* 80, 93–106.

Brander, J., and T. Lewis, 1986, "Oligopoly and Financial Structure," *American Economic Review,* 76, 956–970.

Burton, D., 1996, *"The Emergence and Evolution of Employment Systems in High-Technology Firms,"* unpublished Ph.D. dissertation, Stanford University.

Burton, D., D. Lam, and J. Sellars, 1996, "SPEC Strategy Coding Methodology," mimeo, Stanford University.

Bygrave, W., and J. Timmons, 1992, *Venture Capital at the Crossroads,* Harvard Business School Press, Boston.

Bylinsky, G., 1995, "Who will Feed the Start-ups?" *Fortune,* June 26, 98–106.

Chevalier, J., 1995a, "Capital Structure and Product Market Competition: Empirical Evidence from the Supermarket Industry," *American Economic Review,* 85, 415–435.

Chevalier, J., 1995b, "Do LBO Supermarkets Charge More? An Empirical Analysis of the Effects of LBOs on Supermarket Pricing," *Journal of Finance,* 50, 1095–1112.

Deger, R., 1996, "Where Angels Dare to Tread," *Venture Capital Journal,* March, 40–42.

Diamond, D., 1991, "Monitoring and Reputation: The Choice Between Bank Loans and Directly Placed Debt," *Journal of Political Economy,* 99, 689–721.

The Economist, 1997, "Venture Capitalists: A Really Big Adventure," January 25.

Fama, E., 1985, "What's Different about Banks?" *Journal of Monetary Economics,* 15, 29–39.

Fenn, G., N. Liang, and S. Prowse, 1995, "The Economics of Private Equity Markets," Staff Study 168, Board of Governors of the Federal Reserve System.

Fenn, G., N. Liang, and S. Prowse, 1998, "The Role of Angel Investors in Financing High-Tech Start-Ups," mimeo, Milken Institute.

Fiet, J., and D. Fraser, 1994, "Bank Entry into the Venture Capital Industry," *Managerial Finance,* 20, 31–42.

Fluck, Z., D. Holtz-Eakin, and H. Rosen, 1998, "Where Does the Money Come From? The Financing of Small Entrepreneurial Enterprises," working paper, New York University Salomon Center.

Fried, V., and R. Hisrich, 1994, "Toward a Model of Venture Capital Investment Decision Making," *Financial Management,* 23(3), 28–37.

Fudenberg, D., and J. Tirole, 1986, "A 'Signal-Jamming' Theory of Predation," *Quarterly Journal of Economics,* 17, 366–376.

Gande, A., M. Puri, A. Saunders, and I. Walter, 1997, "Bank Underwriting of Debt Securities: Modern Evidence," *Review of Finanacial Studies*, 10(4), 1175–1202.

Garmaise M., 1999, "Informed Investors and the Financing of Entrepreneurial Projects," working paper, University of Chicago.

Gertner, R., R. Gibbons, and D. Scharfstein, 1988, "Simultaneous Signaling to the Capital and Product Markets," *Rand Journal of Economics,* 19(2), 173–190.

Gompers, P., 1995, "Optimal Investment, Monitoring, and the Staging of Venture Capital," *Journal of Finance,* 50, 1461–1489.

Gompers, P., 1996, "Grandstanding in the Venture Capital Industry," *Journal of Financial Economics,* 42, 133–156.

Gompers, P., and J. Lerner, 1997a, "Conflict of Interest and Reputation in the Issuance of Public Securities: Evidence from Venture Capital," mimeo, Harvard Business School.

Gompers, P., and J. Lerner, 1997b, "The Valuation of Private Equity Investments," paper presented at the Stanford Conference on the Economic Foundations of Venture Capital, March 22.

Gompers, P., and J. Lerner, 1998, "The Determinants of Corporate Venture Capital Success: Organizational Structure, Incentives, and Complementarities," working Paper, NBER.

Gompers, P., and J. Lerner, 1999, "Conflict of Interest and Reputation in the Issuance of Public Securities: Evidence from Venture Capital," *Journal of Law and Economics*, 42, 53–80.

Gorman, M., and W. Sahlman, 1989, "What Do Venture Capitalists Do?" *Journal of Business Venturing,* 4, 231–248.

Griliches, Z., 1990, "Patent Statistics as Economic Indicators: A Survey," *Journal of Economic Literature,* 28, 1661–1707.

Hellmann, T., 1997a, "A Theory of Corporate Venture Capital," Working Paper 1452, Stanford Graduate School of Business.

Hellmann T., 1997b, "Venture Capital: A Challenge for Commercial Banks," *Journal of Private Equity,* 1, 49–55.

Hellmann, T., 1998, "The Allocation of Control Rights in Venture Capital Contracts," *Rand Journal of Economics,* 29, 57–76.

Hellmann, T., and M. Puri, 2000, "Venture Capital and the Professionalization of Start-up Firms: Empirical Evidence," working paper, Stanford Graduate School of Business.

James, C., 1987, "Some Evidence of Uniqueness of Bank Loans," *Journal of Financial Economics,* 19, 217–235.

Kalbfleisch, J. D., and R. L. Prentice, 1980, *The Statistical Analysis of Failure Time Data,* Wiley, New York.

Kaplan, S., and P. Stromberg, 1999, "Financial Contracting Meets the Real World: An Empirical Study of Venture Capital Contracts," working paper, University of Chicago.

Kiefer, N. M., 1988, "Economic Duration Data and Hazard Functions," *Journal of Economic Literature,* 26, 646–679.

Kortum, S., and J. Lerner, 1998, "Does Venture Capital Spur Innovation?" mimeo, Harvard Business School.

Lerner, J., 1994, "Venture Capitalists and the Decision to Go Public," *Journal of Financial Economics,* 35, 293–316.

Lerner, J., 1995, "Venture Capitalists and the Oversight of Private Firms," *Journal of Finance,* 50, 301–318.

Lerner, J., 1996, "The Government as Venture Capitalists: the Long-Run Impact of the SBIR Program," Working Paper 5753, NBER.

Lieberman, M., and D. Montgomery, 1988, "First-mover Advantages," *Strategic Management Journal,* 9, 41–58.

Maggi, G., 1996, "Endogenous Leadership in a New Market" *Rand Journal of Economics,* 27, 641–659.

Maksimovic, V., and S. Titman, 1991, "Financial Policy and Reputation for Product Quality," *Review of Financial Studies,* 4, 175–200.

Phillips, G., 1995, "Increased Debt and Industry Product Markets: An Empirical Analysis," *Journal of Financial Economics,* 37, 189–238.

Poitevin, M., 1989, "Financial Signaling and the 'Deep Pocket' Argument," *Rand Journal of Economics,* 20, 26–40.

Puri, M., 1996, "Commercial Banks in Investment Banking: Conflict of Interest or Certification Effect?" *Journal of Financial Economics,* 40, 373–401.

Puri, M., 1999, "Commercial Banks as Underwriters: Implications for the Going Public Process," *Journal of Financial Economics,* 54, 133–163.

Rajan, R., 1992, "Insiders and Outsiders: The Choice Between Informed and Arm's-Length Debt," *Journal of Finance,* 47(4), 1367–1400.

Ravid, A., 1988, "On the Interactions Between Product and Financial Decisions," *Financial Management,* Autumn, 87–99.

Reinganum, J., 1989, "The Timing of Innovation: Research, Development, and Diffusion," in R. Schmalensee and R. Willig (eds.), *Handbook of Industrial Organization,* vol. 1, Elsevier Science, Amsterdam.

Rosenstein, J., 1988, "The Board and Strategy: Venture Capital and High Technology," *Journal of Business Venturing,* 3, 159–170.

Sahlman, W., 1988, "Aspects of Financial Contracting in Venture Capital," *Continental Bank Journal of Applied Corporate Finance,* 1(2), 23–36.

Sahlman, W., 1990, "The Structure and Governance of Venture Capital Organizations," *Journal of Financial Economics,* 27, 473–521.

Sharpe, S., 1990, "Asymmetric Information. Bank Lending, and Implicit Contracts: A Stylized Model of Customer Relationships," *Journal of Finance,* 45, 1069–1087.

Tirole, J., 1988, *The Theory of Industrial Organization,* MIT Press, Cambridge.

White, H., 1980. "A Heteroskedasticity-Consistent Covariance Matrix Estimator and a Direct Test for Heteroskedasticity," *Econometrica,* 48, 817–838.