ELSEVIER

Journal of Business Venturing 18 (2003) 689–708

JOURNAL of BUSINESS VENTURING

Venture capital financing and the growth of startup firms

Antonio Davila[a,*], George Foster[a,1], Mahendra Gupta[b,2]

[a]*Graduate School of Business, Stanford University, 518 Memorial Way, Stanford, CA 94305-5015, USA*
[b]*John M. Olin School of Business, Washington University, Campus Box 1133, One Brookings Drive, St. Louis, MO 63130-4899, USA*

Received 1 August 2001; received in revised form 1 July 2002; accepted 1 July 2002

Abstract

This study examines the association between the presence of venture capital (VC) and the employee growth of startups. Grounded in signaling theory, it investigates the impact, if any, of VC financing events upon the growth of these companies and whether the amount of funding affects the intensity of the signal. It further explores whether VC leads to growth or, alternatively, whether growth signals the need for VC. Finally, it documents the relationship between growth in startup financial valuation and changes in the number of employees over successive rounds of financing.

Keywords: Entrepreneurship; Venture capital; Growth of the firm; Private equity

1. Executive summary

This paper investigates the impact of venture capital (VC) funding on the growth of startups. Grounded in signaling theory, it examines the evolution of employee growth around the time of a round of financing. Our findings indicate that the number of employees increases in the months prior to the VC funding round and further increases during the months after the event. Thus, VC funding events are important signals about

* Corresponding author. Tel.: +1-650-724-5060; fax: +1-650-725-0468.
E-mail addresses: adavila@stanford.edu (A. Davila), Foster_George@gsb.stanford.edu (G. Foster), guptam@olin.wustl.edu (M. Gupta).
[1] Tel.: +1-650-723-2821; fax: +1-650-725-0468.
[2] Tel.: +1-314-935-4565; fax: +1-314-935-4565.

0883-9026/03/$ – see front matter
doi:10.1016/S0883-9026(02)00127-1

the quality of the startup. Moreover, the credibility of the signal builds up prior to the actual event as the probability of the event increases. The relevance of a funding event to the evolution of employee growth suggests that startups may have to delay their growth because of lack of timely funds. The strategy of high-growth startups often relies on a timely execution to take advantage of early mover advantages; delayed execution may have significant negative consequences in the ability of the startup to be successful. This finding indicates that both VC firms and entrepreneurs may benefit from a better financing process that provides funds in a timelier manner. However, the results are not informative about the sources of this lack of coordination, a question open to future research.

We also examine whether VC firms use high growth as a signal to identify startups amenable to VC funding. Given that venture-backed startups grow faster than their non-venture-backed counterparts, we examine whether this distinctive growth path is already identifiable before the first round of VC funding. Our results indicate that the growth path of venture- and non-venture-backed firms cannot be distinguished before the former companies receive their venture funding. Thus, while VC funding events provide a credible signal to the labor market, previous startup growth does not appear to provide a useful signal to decrease the information asymmetry between venture capitalists and startups. Given that venture capitalists appear not to use growth as a significant selection criterion, following a growth strategy to attract VC may not be an effective strategy.

We also examine whether growth in number of employees, our proxy for growth throughout the paper, is associated with an alternative measure of growth—the change in the equity value of the startup over successive rounds of funding. Our results indicate that larger changes in the number of employees are positively and significantly associated with changes in equity value. This finding is important for research in entrepreneurship. It indicates that growth in employees—a variable that is typically more accessible and updated than equity valuation—may be a good proxy for changes in the value of a startup.

A final word of caution is relevant in interpreting the results. The data supporting the study were gathered in the period 1994–2000 mostly from Silicon Valley (SV)-based companies. This period has been characterized as unique and, accordingly, generalizing the results to other time periods should be done with care until the findings have been replicated.

2. Introduction

The growth path of recently formed companies (startups) is important to management theory. Since the original "theory of the growth of the firm" in Penrose (1959), where managerial resources played a pivotal role, several factors have been suggested as affecting growth. Some factors (such as environmental carrying capacity or market forces) are external to the organization (Aldrich, 1990; Singh and Lumsden, 1990). Others are internal (capabilities, culture, or strategy) and have been addressed from the resource-based view of the firm (Wernerfelt, 1984; Teece et al., 1997; Boeker, 1997; Zahra et al.,

2000; Canals, 2000). Within the field of entrepreneurship, previous research has examined additional resource endowments relevant to explain firm growth that are unique to entrepreneurial firms (Shane and Venkatarman, 2000). VC is an important internal factor in the early stages of a startup. Existing evidence indicates that the presence of VC funding is relevant to explaining differences across startup companies (Hellmann and Puri, 2000).

VC has characteristics that set it apart from more traditional capital markets or debt financing alternatives (Gompers and Lerner, 1999, Chap. 7). VC firms devote significant management resources to understanding new technologies and markets, finding promising startups in those spaces, providing them with financial resources, and coaching them through the early part of their lives. High information asymmetry (Petersen and Rajan, 1995) and high uncertainty documented in the organizational ecology literature and reflected in the liabilities of newness and smallness (Hannan and Freeman, 1989) typically limit a startup's access to traditional financing sources. In contrast, VC firms have the capabilities required to deal with these factors and contribute to the management of startups.

The purpose of this study is to present evidence on headcount growth of VC-backed and non-VC-backed companies and the role of VC in explaining this growth. Our database covers employees in 494 mainly Silicon Valley based startups. The sample includes venture-backed as well as non-venture-backed startups within the same industries, primarily technology industries. Grounded on signaling theory, our results indicate that VC funding events are important signals internally and to the labor markets about the quality of the startup. Moreover, the intensity of the signal increases with the amount of funding and builds up prior to the actual event as the probability of the event increases. While VC funding events provide a credible signal to the labor market, our results suggest that previous startup growth does not provide a useful signal to decrease the information asymmetry between venture capitalists and startups. We also find that increases in headcount of VC-based startups are positively correlated with increases in the valuation of startups in their successive rounds of financing.

3. Theory and hypotheses

Multiple rationales have been proposed for expecting VC-backed firms to have higher average growth rates than startups not receiving this type of financing including: (1) self-selection of venture capitalists into startups that both have the potential to have high growth and a management pursuing high growth (Zacharakis and Meyer, 1998, 2000), (2) from a governance perspective (Sapienza and Gupta, 1994), they take an active role in the board and in monitoring the evolution of the firm (Fried et al., 1998) as well as in structuring top managers' compensation (Kaplan and Stromberg, 1999), (3) venture capitalists bring a network of contacts with experienced infrastructure providers (such as accounting firms, law firms, and executive search firms) and potential professional managers, and (4) venture capitalists themselves bring a reputation effect that facilitates

growth. Their due diligence process requires detailed analysis of the management team, their technology, products and the viability of their business plan (Gorman and Sahlman, 1989; Fried and Hisrich, 1995).

Our basic theoretical premise is that uncertainty and information asymmetry governs the relationship between startups and external markets—labor and financial markets. This premise is consistent with previous work that has adopted an agency perspective (Sapienza and Gupta, 1994) or risk perspective (Fiet, 1995). However, we adopt a signaling theory framework. We argue that the presence of uncertainty about the future of the startup and asymmetry of information among the players in the game enhances the value of particular events—funding rounds—as potentially valuable signaling mechanisms. Building on this argument, we develop hypotheses relating firm employee growth with funding events. We also examine the association between growth in human capital and firm valuation.

3.1. Timing of financing and startup growth

Venture-backed startup companies face high levels of uncertainty (Venkataraman, 1997). In addition to the inherent uncertainty of the business, information asymmetry also affects the relationship between startups and labor markets. High-quality startups face the problem of separating themselves from the rest of the companies in the market. A large literature has examined the impact of information asymmetry in markets and the role of signals as mechanisms that lead to a separating equilibrium among different types of companies. In some product markets such signals may not exist and the market may simply break down (Akerlof, 1970). Alternatively, signaling mechanisms may exist to separate companies of different quality (Spence, 1974; Kreps, 1990).

Signaling theory can be extended to the information asymmetry that exists between startups and the labor market. Without a credible signal, potential employees are unable to identify high-quality startups and these startups are unable to separate themselves from their lower-quality counterparts. The existence of a round of VC can provide such a signal to the labor market (Gompers and Lerner, 1999). This signal can also impact the startup itself. A round of funding confirms the quality of the company and decreases the uncertainty about its potential success. In deciding to fund a startup, VC firms bring their expertise in dealing with similar types of companies and their knowledge about the industry; they also have access to internal information through the due diligence process to assess the quality of the company (Hall and Hofer, 1993). The background and experience of venture capitalists mean that they have access to a richer information set than potential employees and which is also complementary to current employees. The credibility associated with a funding event—emanating from the information available to the VC firm as well as its reputation—gives a strong signal about the quality of the startup. In a market with high uncertainty, the relevance of this signal is likely to be significant in reducing the perceived uncertainty of being associated with a particular company.

The previous argument posits that a funding event provides a strong signal that reduces the risks that potential employees may perceive and, accordingly, enhance their likelihood of

joining the company. It also reduces the uncertainty that startup managers may perceive about the future of the company and facilitate the implementation of their growth plans. An additional empirical question to which theory provides little guidance is the time when this signal becomes credible. At the latest, the signal becomes credible when the startup physically receives the financial resources; if this is the case, the human capital of the startup is expected to grow from this point in time. Signaling theory together with this empirical assumption lead to the following hypothesis:[3]

Hypothesis 1a: Growth in number of employees is higher in the month of a VC funding event and in immediate subsequent months compared to months without this event.

Alternatively, the credibility of the signal may increase as the physical event approaches. During the negotiation period, information about the progress towards an acceptable term sheet may be shared with the current and potential employees. If the likelihood of receiving venture funding increases as the actual date approaches and this change in likelihood can be credibly communicated, then we expect human capital to grow before the physical event takes place and we expect:

Hypothesis 1b: Growth in number of employees is higher in the months immediately prior to a VC funding event compared to months without this event.

Signaling theory is consistent with both these hypotheses.[4] The distinction between Hypotheses 1a and 1b turns on an empirical question associated with the credibility of the signal. A further implication of the above two hypotheses is that a mismatch exists between startups' financing needs and the actual provision of these funds. The above hypotheses would not hold if financial resources behaved as commodities and were supplied as needed; in this case, funding events would not impact firm growth. This timing is especially important in a market where fast movers have a competitive edge over their slower competitors (Saloner et al., 2000). If continuous growth maximizes company value, then financing should happen in a timely, seamless fashion without disrupting the growth path of the startup. Several forces may act against such a seamless provision of venture finance: (1) the role of funding events as control mechanisms that venture capitalists use (Gompers and Lerner, 1999, p. 139) and (2) management optimism about timing of revenues, underestima-

[3] A relevant assumption underlying this argument is that startups perceive growth in human capital as relevant to their value creation process. The power of the research design decreases if there are an increasing number of companies where the assumption does not hold. We want to thank one of the reviewers for pointing out this assumption.

[4] Both hypotheses assume that startups have enough resources to grow before the actual funds become available. In other words, the company has enough resources to start growing as the signal associated with the VC funding round becomes credible (even if the additional funds are not yet available). Without this assumption, we may accept Hypothesis 1a and reject Hypothesis 1b because startups do not have the resources to grow even if the signal is credible. Results indicate that the assumption is valid.

tion of the magnitude and timing of costs, and the length of the funding process (Zacharakis and Meyer, 2000).

3.2. Initial growth and subsequent venture funding

The previous section identifies the venture funding of a startup as a signal that informs about the quality of the company financed. One potential explanation for the value of this signal is that venture capitalists add value through the services that they provide after they have invested in a startup (such as access to a network). An alternative rationale is that venture capitalists have the skills to select startups with high growth potential. This rationale relies on an adverse selection process (previous to the venture financing itself). Thus, a related question is how venture capitalists manage the information asymmetry that exists between them and the startups that they invest. An analysis of the parameters that venture capitalists use to screen the companies they invest in (Hall and Hofer, 1993) is beyond the scope of this paper. However, we examine whether venture capitalists use growth prior to the VC investment as a signal of a startup that is more amenable to venture funding. We test whether previous growth funded through personal savings, seed/angel investors, or debt explains subsequent provision of VC financing (and therefore proxies for some of the selection criteria that venture capitalists use).

This argument separates two potential explanations for the relationship between startup growth and the presence of VC: (a) the presence of venture funds facilitates growth, or (b) growth makes a startup more likely to receive VC funds. The next hypothesis relates the initial growth of the firm with receiving VC funds.

Hypothesis 2: VC firms fund startups that have higher prior growth rates compared to firms that are not venture funded.

4. Methods

Several proprietary databases are used in the research. Data on headcount growth for venture-backed and non-venture-backed companies are obtained from Trinet, which is a leading professional employer organization (PEO).[5] Data on the financing rounds are obtained from VentureOne (Reuters) and Venture Source (Venture Economics). These two firms track the evolution of companies that receive venture financing.

The sample of startups in the database is similar in that they all find Trinet's value proposition attractive, they have similar size at the outset, the industries they choose to compete in as well as their geographical location are comparable (see descriptive statistics below). One caveat is that the sample is not a random sample of startups, but restricted to

[5] By nature of the PEO relationship, Trinet is a co-employer of the individuals on each firm's payroll. The payroll includes executives as well as other employees of the firm.

startups that choose to outsource their human resource needs. While this bias leads to a relatively homogeneous sample of startups, it limits the external validity of the results. Another potential bias of the database is survivorship. A number of companies leave the database, either because they went out of business or found Trinet's proposition not to be attractive anymore—either because they outgrew the services available or simply decided to change their human resources' strategy.[6]

The headcount database includes headcount for more than 500 companies between January 1994 and December 1999. For each of these startups, we collected monthly headcount from January 1994 through May 2000. The database includes companies that used Trinet's services at any time during this period. Thus, companies that ceased using Trinet's services at any time after January 1994 are included in our research. The number of companies in the sample grew over the 6-year period from 52 at the end of 1994 to 327 at the end of 1999. The total number of employees in the system at some point during the period was 27,226. We restricted the sample to include industries in which there was at least one firm in both the venture-backed and the non-venture-backed sample. We ended up with a sample of 494 startups—193 venture-backed startups and 301 non-venture-backed startups. The industry composition is presented in Table 1 as well as the main descriptive statistics for the companies in the sample. The high-tech focus of the predominantly Silicon Valley based sample is evident in both startup groups.

Two databases were used to identify venture-backed startups within the headcount database: VentureOne and Venture Source. Both are described by Gompers and Lerner (1999, pp. 335 and 337, respectively) and, according to these authors, include most VC-related transactions. Both databases are standard sources for VC research. We identified 169 companies that were in both the Trinet and the VentureOne databases. For these companies, information on the founding date, the dates and amounts of the various funding events (rounds of financing), and liquidity event if it had happened (IPO, acquired, or out-of-business) were collected. The second database to identify venture-backed companies was Venture Source. This database also tracks the financing milestones during the life of venture-backed startups. We identified 147 companies in the Venture Source database, 24 of which were in addition to the 169 already identified in VentureOne. Both of these databases have a broad coverage of the VC industry; however, it may be possible that some venture-backed companies in the Trinet database are not included in these two databases and hence inaccurately classified as non-venture-backed. This potential bias would work against obtaining any results in our empirical specifications.

[6] The exit pattern seems to reflect two different types of startups. Smaller companies are more likely to exit the database. However, this observation should be read with care. Some companies leaving the database do not shift their payroll at once but rather do it over several months. If this behavior is commonplace, then the smallness of companies exiting is overstated. The other group is companies that have been in the database longer (probably older companies) and are more likely to exit. This is consistent with the firm's age increasing the likelihood of human resource activities being sourced internally rather than outsourced (Baron et al., 1996). If becoming larger increases the likelihood of a company exiting the Trinet database, companies that survive in the sample over long periods of time may be companies with lower growth rates.

Table 1
Descriptive statistics from Trinet database

Panel A: Industry statistics

	Venture-backed firms	Non-venture-backed firms
Communications and networking	29	38
Electronics and computer hardware	9	12
Semiconductors	8	11
Software	60	47
Information services	38	82
Healthcare and biotechnology	22	37
Business and consumer services and products	27	74
Total	193	301

Panel B: Venture-backed firms

	Mean	S.D.	Minimum	Maximum	Median
Employee growth (per month)	1.80	5.68	− 82	96	1
Number of employees	31.76	35.06	1	367	21
Time in the sample (months)	18.5	15.0	1	77	14

Panel C: Non-venture-backed firms

	Mean	S.D.	Minimum	Maximum	Median
Employee growth (per month)	0.68	3.65	− 37	123	0
Number of employees	15.95	30.05	1	397	6
Time in the sample (months)	18.3	16.5	1	77	13

Table 2 provides descriptive statistics on 170 venture-backed startups for which we have the founding date. Panel A reports the rounds of financing. Startups founded in later years in the 1994–2000 period have received less rounds of financing up to the research cutoff date (in part, due to there being less elapsed time from a first round of financing). Panel B indicates that the mean time to first round of financing is 4.36 quarters (median: 2 quarters). Panel C describes the average amount of financing and average company post-money valuation for different rounds. As expected, later rounds are larger and are associated with larger company valuations. The number of startups in the sample that exited the private stage through IPO, acquisition, or out-of-business as well as the timing of exit is reported in panel D.

Table 2
Descriptive statistics on venture-backed startups in the database

Panel A: Number of financing rounds

Founded	Mean	Median	Minimum	Maximum	S.D.	Number of companies
Before 1994	3.10	3	1	7	1.97	20
1994–1995	3.41	3.5	1	6	1.28	34
1996–1997	3.00	3	1	6	1.49	62
1998–1999	1.93	2	1	5	0.93	54
Total	2.75	2	1	7	1.47	170

Panel B: Time (months) from founding to first round of financing

Founded	Mean	Median	Minimum	Maximum	S.D.	Number of companies
Before 1994	12.15	5	1	38	13.64	20
1994–1995	4.88	3	1	18	5.13	34
1996–1997	3.61	2	1	12	3.18	62
1998–1999	2.08	2	0	7	1.40	54
Total	4.36	2	0	38	6.29	170

Panel C: Valuation

Rounds of financing	Amount (in millions of US$)			Postmoney valuation (in millions of US$)			Number of rounds
	Mean	Median	S.D.	Mean	Median	S.D.	
Seed	1.50	1.23	1.31	3.34	3.00	1.70	63
1	5.58	3.88	7.38	13.62	10.50	13.73	178
2	9.39	6.90	8.64	46.58	29.50	50.58	131
3	13.99	9.13	16.62	57.00	49.00	44.90	72
4	15.87	10.00	18.96	112.40	66.00	149.16	40
5	29.12	25.00	25.94	147.70	135.37	70.06	17
6	18.61	12.13	22.66	347.84	347.84	172.76	4
Overall	9.00	5.00	12.78	45.90	20.00	74.07	505

Panel D: Exit strategies

Rounds of financing	IPO	Acquisition	Ceased operations
1	3	9	2
2	4	8	3
3	5	9	0
4	5	5	1
5	10	3	0
6	2	1	0
Total	29	35	7

As an additional descriptive statistic, Fig. 1 plots the mean size of VC-backed and non-VC-backed startups in our sample for those months with at least 35 observations in at least one of the two samples. We use the date in which companies entered the Trinet system as date

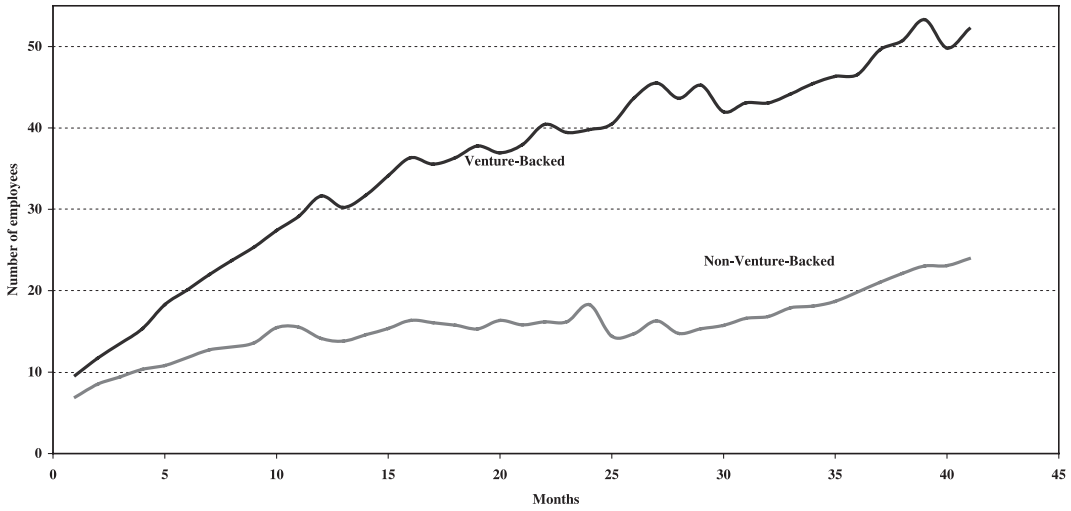

Fig. 1. Growth for venture-backed and non-venture-backed firms (mean number of employees). The plot shows the mean size of the companies in the PEO sample. For every month the mean size of VC-backed firms is significantly larger than non-VC-backed firms (two-tailed *t* test, 1% significance). A plot of the median shows a similar pattern but the non-venture-backed line is flatter.

zero. In Month 1, VC-backed firms have a mean size of 9.6 people compared to 6.9 for non-VC-backed firms (significant at 1% level). Fig. 1 highlights how this difference becomes larger over time.[7]

4.1. Measurement of variables

4.1.1. Growth

A headcount variable is used as proxy for growth. Headcount is operationally defined as the number of people in a company's payroll. The measure of growth is the change in headcount over a month. While employee growth is a frequently used approach (Evans, 1987; Hall, 1987), it captures only one aspect of growth, albeit an important one. To assess the relevance of employee growth to the value of the company, we also explore the relationship between changes in the value of equity postmoney valuation and headcount growth. We find that changes in valuation have a significant positive relationship with changes in employee headcount of the startup (see next section).

4.1.2. Rounds of financing and amount raised from VC firms

The VC databases are the primary source on venture-financing round information—date of a round, amount raised, and postmoney valuation. We identified 275 VC financing events. In addition, 12 companies remained using the PEO service after their IPO liquidity event. The

[7] We also run multivariate tests of headcount growth and presence of VC controlling for industry, previous growth, age, and size. Presence of VC was highly significant.

amount raised is disclosed in 95.3% of the financing rounds and the postmoney valuation in 80.4%. Not enough is known about those nondisclosing companies to ascertain whether there is bias due to the voluntary nature of these VC round disclosures.

4.1.3. Age

We control for age as a proxy for newness. Age is the time since founding.

4.1.4. Size

We control for size, measured as headcount, as a proxy for smallness.

4.1.5. Industry dummies

Finally, we include different intercepts for the various industries identified in our database to capture any differences that may exist across industries.[8]

5. Results

5.1. Headcount growth and changes in valuation

Headcount measures are only one potential way of measuring growth. Alternative measures include equity valuation or accounting-based measures. Venture-backed companies typically are only revalued at funding events and this type of growth measure is not as frequently available as for public companies. Accounting data is typically unavailable because of the private nature of these startups. Headcount measures are the main indicator of growth examined in this paper. To examine the relevance of headcount growth, we first study its relationship with changes in the value of equity. Equity valuation data for successive rounds of funding (postmoney valuation) available from VentureOne and Venture Source allow us to estimate the growth in the market value of equity over successive rounds.

Headcount measures are only one potential way of measuring growth. Alternative measures include equity valuation or accounting-based Each time a startup receives a venture round of funding, a valuation event occurs. To be able to estimate changes in value we need to have access to two successive valuation points (two successive rounds of financing). We have 148 of these sequential events for which we also have headcount for a total of 74 data points. Spearman's rank correlation between percentage change in value and percentage change in employees is .24 (significant at the 3.5% level, one-tailed), indicating an association between both measures. Our model uses the absolute magnitude of change in value as its dependent variable and the absolute change in the number of employees as one of the independent

[8] We used Trinet's industry coding, which are closely related to alternative coding used in the VC industry and in particular VentureOne and Venture Source. We chose the Trinet classification because it includes venture-backed and non-venture-backed firms.

Table 3
Employee growth and company valuation

	Change in value	
	Coefficient	*t* statistic
Constant	− 11.85	− 1.20
Growth in number of employees between rounds	0.89**	4.13
Number of employees	0.66**	2.70
Communication and networks	11.28	1.48
Semiconductors	42.21†	1.92
Software	4.44	0.46
Information services	− 0.62	− 0.06
Health and biotechnology	16.20	1.20
R^2	.32	
Number of observations	74	

The reference industry is business and consumer services and products. Electronics and computer hardware do not have any observation. Number of employees is in the month of the first round of the two rounds used to estimate the change in value. Standard errors are White-adjusted.

** The coefficient is significant at the 1% level (two-tailed).

† The coefficient is significant at the 10% level (two-tailed).

variables. If growth in headcount and change in valuation are related, then we expect the coefficient on employee growth to be positive and significant. Table 3 reports the results. The coefficient for growth in the number of employees is positive and significant suggesting a positive relationship between changes in equity value and changes in the number of employees.[9]

5.2. Timing of financing events and the growth path of startups

We use an event study research design to probe Hypotheses 1a and 1b. For each of the 275 VC financing events in our sample, we identify the month in which the event happened (termed Month 0). We restrict our study to the 6 months surrounding this event month (3 months prior and 3 months post) when we expect the impact of funding to be most significant to the growth of the firm. The 3 months prior to the financing event are designated Months − 3, − 2, and − 1 and the 3 months after the event as Months + 1, + 2, and + 3. Fig. 2 plots the mean change in employees around the date a financing event happens (Month 0) compared to the growth in the same date of venture-backed startups that do not receive VC funding during these 7 months. Also included are the confidence

[9] We also run a second model using percentage changes in value on employee growth (relative to size). Because the size of the companies in some months is very small, the relative growth is much larger for smaller companies because of the denominator (size) rather than the numerator (growth). To reduce the impact that these extreme observations may have, we used nonparametric statistic methods (rank regression) that are not influenced by the magnitude but only by the rank of the observations. (Fox, 2000). The conclusions remain unchanged.

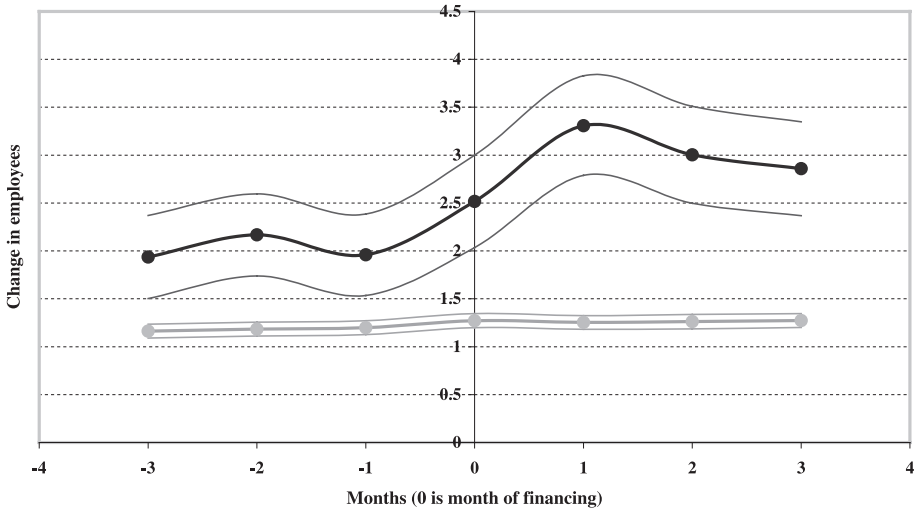

Fig. 2. Mean change and confidence intervals in growth around month of financing event. The plot shows the mean change in number of employees around the month when VC-backed companies received external financing (upper line) compared to venture-backed firms that did not receive funding on the same dates (lower line). The thinner lines plot the confidence interval defined by 2 standard deviations.

intervals defined by 2 standard deviations. We aligned all funding events in our database as Month 0 and plotted the evolution of employee growth from 3 months prior to the event to 3 months after the event. Fig. 2 suggests that the growth of startups increases before but mainly after they receive new funds (relative to startups not receiving venture money in that same calendar time period).

Using the venture-backed subsample, we regress growth per company per month against dummies for each of the months around the financing event. Month $_{-3}$ is a dummy that takes the value of one if 3 months later the company receives venture funds and zero otherwise. We define the dummies for the other 6 months in a similar way. The amount of funds raised in a VC round may affect the relevance and intensity of the signaling mechanism. We examine this effect by interacting the amount of funds raised in each round—that captures both the intensity of the signal and the magnitude of the financial resources provided—with the month dummies. We control for the natural logarithm of age, the natural logarithm of size at the beginning of the month, growth in the previous month,[10] and IPO month.[11]

Panel A in Table 4 presents the results. Growth before but mainly after the financing event is significantly greater than in other months (consistent with Hypothesis 1a). That is, there is a

[10] We control for growth the previous month because of the autocorrelation that growth exhibits (see Fig. 1). We run an auxiliary regression of lagged growth on size and age lagged one period and use the predicted value as an instrumental variable. We also control for autocorrelation in the residual terms.

[11] Some of the companies in the sample were acquired. However, headcount data are not available for the months after the acquisition. Furthermore, the results do not change if the IPO variable is not included.

Table 4
Financing events and the growth of startups

Panel A: Employee growth and the occurrence of financing events

Dependent variable	Employee growth in the current month	
Independent variables	Coefficient	*t* statistic
Constant	0.297	0.53
Employee growth in the previous month	1.006**	4.41
Ln (time since joining the sample)	−0.391	−1.17
Ln (number of employees at the end of previous month)	0.389	1.30
$Month_{-3}$	0.444*	2.03
$Month_{-2}$	0.684**	2.96
$Month_{-1}$	0.392†	1.66
$Month_0$	0.981**	3.87
$Month_{+1}$	1.783**	6.46
$Month_{+2}$	1.375**	5.26
$Month_{+3}$	1.020**	4.61
IPO month	0.598	0.90
Communication and networks	−0.873*	−2.32
Electronics and computer hardware	−0.313	−0.63
Semiconductors	−1.071**	−2.80
Software	−0.889*	−2.48
Information services	−0.616	−1.43
Health and biotechnology	−1.158**	−3.36
R^2	.08	
Estimated autocorrelation coefficient	.42	
Number of observations	3960	

Panel B: Difference across coefficients

F test	$Month_{-3}$	$Month_{-2}$	$Month_{-1}$	$Month_0$	$Month_{+1}$	$Month_{+2}$	$Month_{+3}$
$Month_{-3}$		1.03	0.04	3.06†	16.37**	8.38**	3.90*
$Month_{-2}$			1.49	1.02	11.28**	4.60*	1.29
$Month_{-1}$				5.48*	19.62**	9.55**	4.47*
$Month_0$					8.10**	1.54	0.02
$Month_{+1}$						2.12	5.99*
$Month_{+2}$							1.80

The reference industry in Panel A is business and consumer services and products. *T* ratios are computed using White's heteroskedasticity-adjusted standard errors. Panel B presents the *F* test of equality of coefficients.

* The coefficient is significant at the 5% level (two-tailed).

** The coefficient is significant at the 1% level (two-tailed).

† The coefficient is significant at the 10% level (two-tailed).

strong positive signal about the startup associated with a funding round. This signal facilitates growth of the startup both before and after the funding event.[12] The first month after receiving funding ($Month_{+1}$) is the one that has the largest coefficient (1.783 with *t* statistic = 6.43)

[12] The increase in employee growth prior to the actual funding event suggests enough credibility built to attract new employees as well as for the CEO to feel comfortable about hiring. As pointed out by a referee, the term sheet is signed 30 to 60 days prior to the round of funding being finalized and may account for this credibility.

consistent with the descriptive results in Fig. 2. As soon as companies receive funding, the slope of their growth path increases.[13]

Table 5 presents a similar specification but controlling for the amount of funds received. The increase in R^2 suggests that the amount of funds enhances the intensity of the signal.

5.3. Initial growth and the attracting VC

Hypothesis 2 examines this issue of whether the differential growth observed in Fig. 1 reflects a differential growth that already existed before companies received venture funding or whether it only happens after companies receive these funds. To perform this test, we collect the date of the first VC inflow from the venture data (through a seed round or first round of financing). We divide the overall sample into three groups:

1. Startups that already have venture funding when they join Trinet—148 companies,
2. Startups that join the sample before they get their first round of venture financing but that subsequently receive venture funds—36 companies are in this new group, and
3. Non-venture-backed startups during our research period—290 companies.

We lost nine venture-backed companies that did not disclose the date of their first VC funding event. We also lost 11 non-venture-backed startups for which we only had 1 month of data. For subsamples 2 and 3—startups without venture funding when they joined the sample—we ran a logit model. The dependent variable is a dummy variable that takes the value of 1 for Group 2 and 0 for Group 3. The independent variables include growth during the first month, natural logarithm of the size when the company enters the database, and industry dummies.[14] If VC is attracted to growing startups (Hypothesis 2), then we expect the coefficient on growth in the first month to be positive. The significance of this coefficient would indicate that growth is a predictor of future VC funding.

Panel A in Table 6 presents the results. The coefficient on growth in the first month is not significant, which is inconsistent with growth being a predictor of whether the company will get venture financing. This finding suggests that VC firms are not selecting startups with a differential level of headcount growth prior to the first round of funding.[15] To check the

[13] The model explains 8% of the variation indicating that, while relevant, the variables included only account for a small fraction of the variation. This is not surprising as growth is also affected by market variables—demand, competition, product positioning, and execution—development, manufacturing, distribution marketing.

[14] We use growth in the first month because the companies in subsample 2 receive venture funding soon after they join the database—as soon as the following month. All 36 companies received funding within a year of joining the database.

[15] The R^2 for this regression is 2% and only one coefficient is significant at 10%. This low explanatory power suggests that the model does not capture factors predicting future venture funding and in particular past growth in not one of such factors. Past research has examined alternative investment criteria that VC firms use (Elango et al., 1995; Gupta and Sapienza, 1992).

Table 5
Financing events, the growth of startups, and amount of funds raised

Panel A: Employee growth and the occurrence of financing events

Dependent variable	Employee growth in the current month	
Independent variables	Coefficient	*t* statistic
Constant	1.970**	4.53
Employee growth in the previous month	0.593**	4.11
Ln (time since joining the sample)	−0.421**	−2.88
Ln (number of employees at the end of previous month)	0.091	0.53
Month$_{-3}$*Amount of funds raised	0.033	1.46
Month$_{-2}$*Amount of funds raised	0.082**	3.34
Month$_{-1}$*Amount of funds raised	0.052**	2.72
Month$_0$*Amount of funds raised	0.126**	5.59
Month$_{+1}$*Amount of funds raised	0.163**	6.13
Month$_{+2}$*Amount of funds raised	0.147**	5.04
Month$_{+3}$*Amount of funds raised	0.139**	5.67
IPO month	0.587	1.01
Communication and networks	−0.793*	−2.24
Electronics and computer hardware	0.182	0.38
Semiconductors	−1.064**	−2.97
Software	−0.433	−1.26
Information services	−0.371	−0.92
Health and biotechnology	−1.044**	−3.23
R^2	.12	
Estimated autocorrelation coefficient	.37	
Number of observations	3974	

Panel B: Difference across coefficients

F test	Month$_{-3}$	Month$_{-2}$	Month$_{-1}$	Month$_0$	Month$_{+1}$	Month$_{+2}$	Month$_{+3}$
Month$_{-3}$		3.34*	0.54	9.60**	15.00**	10.18**	10.53**
Month$_{-2}$			1.81	2.26	5.72*	3.22†	2.91†
Month$_{-1}$				10.10**	13.93**	8.27**	8.43**
Month$_0$					1.80	0.40	0.17
Month$_{+1}$						0.24	0.53
Month$_{+2}$							0.08

The reference industry in Panel A is business and consumer services and products. *T* ratios are computed using White's heteroskedasticity-adjusted standard errors. Panel B presents the *F* test of equality of coefficients.

* The coefficient is significant at the 5% level (two-tailed).

** The coefficient is significant at the 1% level (two-tailed).

† The coefficient is significant at the 10% level (two-tailed).

robustness of the results, we used quarterly rather than monthly growth to capture headcount growth over a longer window; the interpretation of the results does not change. We also used as dependent variable a dummy taking the value of one if the company received venture funding within 3 (nine companies) and 6 months (17 companies) of joining the Trinet database; the results were again comparable.

Table 6
Growth and the availability of VC funding

Panel A: Growth as a predictor of future VC funding		
Dependent variable	Future venture financing	
Independent variables	Coefficient	*Z* ratio
Constant	− 2.467	− 5.07
Growth in the first month	− 0.035	− 0.63
Ln (number of employees at the time of joining the sample)	0.032	0.21
Communication and networks	0.260	0.38
Electronics and computer hardware	− 0.043	− 0.04
Semiconductors	0.848	0.96
Software	0.991†	1.82
Information services	0.197	0.35
Health and biotechnology	0.271	0.40
Pseudo R^2	.02	
Number of observations	326	

Panel B: VC funding and the growth of the firm over the first month		
Dependent variable	Growth in first month	
Independent variables	Coefficient	*t* ratio
Constant	0.313	0.92
Presence of VC	0.846 *	2.41
Ln (number of employees at the time of joining the sample)	0.757* *	4.11
Communication and networks	− 0.254	− 0.48
Electronics and computer hardware	− 1.076*	− 2.50
Semiconductors	− 0.661	− 1.20
Software	− 0.162	− 0.35
Information services	0.616	1.53
Health and biotechnology	− 0.997*	− 2.27
R^2	.13	
Number of observations	472	

The sample in Panel A is startups that have not received venture financing as of the end of the first quarter in the sample. The sample in Panel B are all firms with growth information in the first quarter. The reference industry is business and consumer services and products. *T* ratios are computed using White's heteroskedasticity-adjusted standard errors.

* The coefficient is significant at the 5% level (two-tailed).

** The coefficient is significant at the 1% level (two-tailed).

† The coefficient is significant at the 10% level (two-tailed).

We further test whether companies with VC funding when they joined the sample (Group 1) grew faster than those without venture funding (Groups 2 and 3) or alternatively, the results in Panel A are driven by lack of growth for all companies (venture-backed and non-venture-backed) in the first month of joining the sample. Panel B in Table 6 reports the results. Companies that received venture financing before they entered the sample grew faster than the ones that did not have this type of financing. We obtained similar results when we studied growth over the first quarter rather than the first month.

6. Discussion

The objective of our study was to understand the role of VC funding in explaining the growth of startup companies. Grounded in signaling theory, we examine how headcount growth evolves around the time of VC funding. Our results identify a significant shape that grows before the event and accelerates in the months after the event. These results are informative about the signaling value of VC funding events as well as the credibility of the signal. Potential employees face significant information asymmetry because of the lack of public information about startups. The support of VC—through the funding event—provides a relevant signal to separate startups with different quality. The existence of growth before the event happens indicates that the signal has some credibility before the event and this credibility builds up as the event approaches. However, the date of the event (and the month after) has significant higher growth suggesting that the physical transaction still brings the most credibility. The evidence of a relationship between growth and funding events is also informative in suggesting that startup companies may delay their growth beyond what would be strategically best because of the lack of financial resources. Exploring the forces driving this phenomenon is a fruitful research line.

Our study also examined whether venture capitalists use growth as a signal to separate startups. If growth is associated with the quality of a startup as a potential VC investment, then we expect venture capitalists funding companies that exhibit larger growth. Our results indicate that this is not the case and growth is not a predictor of receiving venture funding in the future. If venture capitalists use consistent criteria to select their investments, these results suggest that growth is not one of the criteria; future research can examine these predictors of receiving venture funding.

The paper also provides evidence on a positive association between headcount growth and value creation. While headcount growth is an important measure of growth in itself, this evidence indicates that it is also relevant because of its positive association with changes in the value of startup companies. Finally, the paper gives descriptive evidence and, in particular, describes how VC is significantly associated with high growth startups.

The results of the paper contribute to academic understanding of the signaling role of VC funding events on labor markets and highlight their role in separating different types of startups in a market characterized by high levels of information asymmetry. The practical consequences of this theoretical grounding are that VC may not only act as a source of financial resources, but as a powerful mechanism to communicate the quality of a startup. The relevance of this finding reinforces the reputation effect that VC firms have on startup valuation (Sepa and Maula, 2001).

Future research can address the importance of these different forces looking at alternative measures of growth or employee turnover as a proxy for the signaling role of venture funding. If funding has a positive signal to people external to the startup, current employees may also view it as a positive event and increase the attractiveness of their staying in the company. Another potential extension of this research is examining how the venture funding events affect startups' employee compensation. This research can also be extended to study the relationship between valuation and growth in the number of employees according to the skills

that they bring to the startup and investigate their impact on the value of equity. Finally, the period of our study (1994–1999) has been characterized as unique in the VC industry (Perkins and Perkins, 1999); future research can confirm or refute these findings in a different time period more characteristic of a traditional VC process.

Acknowledgements

The assistance of Trinet and VentureOne for this research is gratefully appreciated. We are grateful for the comments of Martin Babinec, participants in the Stanford University research workshop, and the reviewers of the paper. Financial support is from The Center for Entrepreneurial Studies at the Graduate School of Business, Stanford University. Research assistance was provided by Nicole Ang, Jiangyun Liu, Barbara Lubben, and Jakub Wilsz.

References

Akerlof, G.A., 1970. The market for 'lemons': qualitative uncertainty and the market mechanism. Q. J. Econ. 84, 488–500.

Aldrich, H., 1990. Using an ecological perspective to study organizational founding dates. Entrep. Theory Pract., 7–24 (Spring).

Baron, J.N., Burton, D.M., Hannan, M.T., 1996. The road taken: origins and evolution of employment systems in emerging companies. Ind. Corp. Change 5, 239–275.

Boeker, W., 1997. Strategic change: the influence of managerial characteristics and organizational growth. Acad. Manage. J. 40 (1), 152–170.

Canals, J., 2000. Managing Corporate Growth. Oxford Univ. Press, New York.

Elango, B., Fried, V.H., Hisrich, R.D., Polonchek, A., 1995. How venture capital firms differ. J. Bus. Venturing 10, 157–180.

Evans, D.S., 1987. The relationship between firm growth, size, and age: estimates for 100 manufacturing industries. J. Ind. Econ. 35, 567–581.

Fiet, J.O., 1995. Risk avoidance strategies in venture capital markets. J. Manage. Stud. 32, 551–575.

Fox, J., 2000. Multiple and Generalized Nonparametric Regression. Sage, Thousand Oaks, CA.

Fried, V.H., Hisrich, R.D., 1995. The venture capitalist: a relationship investor. Calif. Manage. Rev. 37 (2), 101–114.

Fried, V.H., Bruton, G.D., Hisrich, R.D., 1998. Strategy and the board of directors in venture-backed firms. J. Bus. Venturing 13, 493–503.

Gompers, P.A., Lerner, J., 1999. The Venture Capital Cycle. MIT Press, Cambridge.

Gorman, M., Sahlman, W.A., 1989. What do venture capitalists do? J. Bus. Venturing 4, 231–248.

Gupta, A.K., Sapienza, H.J., 1992. Determinants of venture capital firms' preferences regarding the industry diversity and geographic scope of their investments. J. Bus. Venturing 7, 347–363.

Hall, B.H., 1987. The relationship between firm size and firm growth in the US manufacturing sector. J. Ind. Econ. 35, 583–606.

Hall, J., Hofer, C.W., 1993. Venture capitalists' decision criteria in new venture evaluation. J. Bus. Venturing 8, 25–43.

Hannan, M.T., Freeman, J., 1989. Organizational Ecology. Harvard Univ. Press, Cambridge.

Hellmann, T., Puri, M., 2000. The interaction between product market and financing strategy: the role of venture capital. Rev. Financ. Stud. 13, 959–984.

Kaplan, S.N., Stromberg, P., 1999. Financial contracting theory meets the real world: an empirical analysis of venture capital contracts. Working paper, University of Chicago, Chicago, IL.
Kreps, D.M., 1990. A Course in Microeconomic Theory. Princeton Univ. Press, Princeton, NJ.
Penrose, E.T., 1959. The Theory of the Growth of the Firm. Wiley, New York.
Perkins, A.B., Perkins, M.C., 1999. The Internet Bubble: Inside the Overvalued World of High-tech Stocks—and What You Need to Know to Avoid the Coming Stakeout. Harper Business, New York.
Petersen, M.A., Rajan, R.G., 1995. The effect of credit market competition on lending relationships. Q. J. Econ. 110, 407–444.
Saloner, G., Shepard, A., Podolny, J., 2000. Strategic Management. Wiley, New York.
Sapienza, H.J., Gupta, A.K., 1994. Impact of agency risks and task uncertainty on venture capitalist–CEO interaction. Acad. Manage. J. 37, 1618–1632.
Sepa, T., Maula, M., 2001. Investor certification of venture capital investments: does top–end backing lead to improved value creation? Working Paper, Helsinki University of Technology.
Shane, S., Venkatarman, S., 2000. The promise of entrepreneurship as a field of research. Acad. Manage. Rev. 25 (1), 217–226.
Singh, J., Lumsden, C., 1990. Theory and research in organizational ecology. Annu. Rev. Sociology 16, 161–195.
Spence, M.A., 1974. Market Signaling: Information Transfer in Hiring and Related Screening Processes. Harvard Univ. Press, Cambridge, MA.
Teece, D.J., Pisano, G., Shuen, A., 1997. Dynamic capabilities and strategic management. Strateg. Manage. J. 18 (7), 509–533.
Venkataraman, S., 1997. The distinctive domain of entrepreneurship research: an editor's perspective. In: Katz, J., Brockhaus, R. (Eds.), Advances in Entrepreneurship, Firm Emergence, and Growth. JAI Press, Greenwich, CT.
Wernerfelt, B., 1984. A resource-based view of the firm. Strateg. Manage. J. 5, 171–181.
Zacharakis, A.L., Meyer, G.D., 1998. A lack of insight: do venture capitalists really understand their own decision process? J. Bus. Venturing 13, 57–76.
Zacharakis, A.L., Meyer, G.D., 2000. The potential of actuarial decision models: can they improve the venture capital investment decision? J. Bus. Venturing 15, 323–346.
Zahra, S.A., Ireland, R.D., Hitt, M.A., 2000. International expansion by new venture firms: international diversity, mode of market entry, technological learning, and performance. Acad. Manage. J. 43 (5), 925–950.