THE JOURNAL OF FINANCE • VOL. LIX, NO. 5 • OCTOBER 2004

Characteristics, Contracts, and Actions: Evidence from Venture Capitalist Analyses

STEVEN N. KAPLAN and PER STRÖMBERG*

ABSTRACT

We study the investment analyses of 67 portfolio investments by 11 venture capital (VC) firms. VCs describe the strengths and risks of the investments as well as expected postinvestment actions. We classify the risks into three categories and relate them to the allocation of cash flow rights, contingencies, control rights, and liquidation rights between VCs and entrepreneurs. The risk results suggest that agency and hold-up problems are important to contract design and monitoring, but that risk sharing is not. Greater VC control is associated with increased management intervention, while greater VC equity incentives are associated with increased value-added support.

MOST FINANCIAL CONTRACTING THEORIES ADDRESS how conflicts between a principal/investor and an agent/entrepreneur affect ex ante information collection, contract design, and ex post monitoring. In this paper, we empirically test the predictions of financial contracting theories using investments by venture capitalists (VCs) in early stage entrepreneurs—real world entities that arguably closely approximate the principals and agents of theory.[1]

VCs face four generic (agency) problems in the investment process. First, the VC is concerned that the entrepreneur will not work hard to maximize value after the investment is made. In such a case, when the entrepreneur's effort is unobservable to the VC, the traditional moral hazard approach, pioneered by Holmström (1979), predicts that the VC will make the entrepreneur's compensation dependent on performance. The more severe the information problem, the more the contracts should be tied to performance.

*University of Chicago Graduate School of Business and National Bureau of Economic Research.
A previous version of this paper was titled "How Do Venture Capitalists Choose and Monitor Investments?" We appreciate comments from Ulf Axelson, Douglas Baird, Francesca Cornelli, Mathias Dewatripont, Douglas Diamond, Paul Gompers, Felda Hardymon, Josh Lerner, Frederic Martel, Bob McDonald (the editor), Kjell Nyborg, David Scharfstein, Jean Tirole, Lucy White, Luigi Zingales, an anonymous referee, and seminar participants at Amsterdam, Chicago, Columbia, ECARE, the 2001 European Finance Association meetings, Harvard Business School, HEC, INSEAD, London Business School, McGill, Michigan, New York University, North Carolina, Notre Dame, Ohio State, Purdue, Rochester, Stockholm School of Economics, Toulouse, Washington University, and Yale. This research has been supported by the Kauffman Foundation, the Lynde and Harry Bradley Foundation, and the Olin Foundation through grants to the Center for the Study of the Economy and the State, and by the Center for Research in Security Prices. Alejandro Hajdenberg provided outstanding research assistance. We are grateful to the venture capital partnerships for providing data. Any errors are our own.

[1] Hart (2001) concurs that this is a reasonable assumption.

Second, the VC may also be concerned that the entrepreneur knows more about his or her quality/ability than the VC. The model in Lazear (1986) shows that the VC can design contracts with greater pay-for-performance that good entrepreneurs will be more willing to accept.[2] Ross (1977) and Diamond (1991) show that investor liquidation rights—the ability to liquidate and the payoff in the event of liquidation—can also be used to screen for good entrepreneurs.

Third, the VC also understands that after the investment, there will be circumstances when the VC disagrees with the entrepreneur and the VC will want the right to make decisions. Control theories (such as Aghion and Bolton (1992), Dewatripont and Tirole (1994), and Dessein (2002)) show that a solution to this problem is to give control to the VC in some states and to the entrepreneur in others.

Fourth and finally, the VC is concerned that the entrepreneur can "hold-up" the VC by threatening to leave the venture when the entrepreneur's human capital is particularly valuable to the company. This is the hold-up problem analyzed in Hart and Moore (1994). The VC can reduce the entrepreneur's incentive to leave by vesting the entrepreneur's shares.

The theories predict that characteristics of VC contracts will be related to the extent of agency problems. As such problems increase, founder compensation will be more performance sensitive, VCs will have stronger control and liquidation rights, and vesting will be more pronounced.

Most previous research, including our own, estimates the extent of agency problems using indirect measures, e.g., firm age, firm size, industry R&D intensity, and industry market-to-book ratio.[3] These measures have two limitations. First, they may not measure the risks the VCs actually care about. Second, they mix different risks together when such risks may have different implications for agency problems and therefore for the VC contracts and actions.

In this paper, we construct direct measures of risks and uncertainties that VCs and entrepreneurs face, and then classify those risks depending on how they relate to specific agency problems. We obtain these measures by reading and assessing the investment memoranda for investments in 67 companies by 11 VC partnerships. We then consider whether the agency problems affect the VC contracts and actions in the ways predicted by the theories.

Most agency problems are directly related to asymmetric information, i.e., uncertainties about which the entrepreneur is better informed than the VC. For example, agency problems will be more severe when the entrepreneur's ability is unknown because of inexperience, when the operations of the venture are hard to observe and monitor, and when the entrepreneur has more discretion in actions and in the use of funds. We denote such types of uncertainties as internal risks. When internal risks are larger, moral hazard problems, adverse selection risks, and the likelihood of future conflicts of interest will also be larger. As a result, the theories predict that performance-sensitive and contingent compensation should be more pronounced, the VC should get control in

[2] Hagerty and Siegel (1988) point out that the solution to the screening problem is observationally similar to that for the moral hazard problem.

[3] Smith and Watts (1992), Gompers (1995), Gompers and Lerner (1999) and Kaplan and Strömberg (2003), e.g., all use such indirect measures.

more states of the world, and the VC should have greater ability to liquidate the venture upon poor performance.

VCs and founders also face risks that are equally uncertain for both parties. Examples are the extent of future demand for an undeveloped product, the response of competitors upon the product's introduction, and the receptivity of financial markets when investors try to sell the company or bring it public. We denote such uncertainties as external risks.

Unlike the clear predictions for internal risks, financial contracting theories have ambiguous predictions with respect to external risks. According to traditional moral hazard theories like Holmström (1979), when risks—such as external risks—are not under the entrepreneur's control, pay-for-performance compensation and other contingent payoffs are less desirable because a risk-averse entrepreneur has to be compensated for taking on such risks.

Alternatively, in a world of incomplete contracting, external uncertainties may increase the likelihood of unforeseen contingencies and the concomitant VC-entrepreneur conflicts. Theories such as Aghion and Bolton (1992) imply that the VC will get control in more states of the world. It also is plausible that external uncertainty makes direct monitoring more difficult. For this reason, Prendergast (2002) predicts that pay-for-performance compensation should increase with external uncertainty, and Dessein (2002) implies that VC control should increase.

Finally, some uncertainties are neither solely internal (because they are equally uncertain for the VC and the entrepreneur), nor solely external (because they are at least partly under the entrepreneur's control). The VC may be happy with the quality and work of the management team, and all parties may agree that there will be a great market for the product once developed, but it may be very difficult to make the technology or the strategy work. We denote such uncertainties, which are related to the venture's complexity and the importance of the entrepreneur's human capital, as difficulty of execution risks. The hold-up problem of Hart and Moore (1994) is likely to be greater in such cases because the entrepreneur can credibly threaten to leave. As a result, we would expect to see greater use of vesting provisions in such ventures.[4]

In our empirical analysis, we first describe the strengths and risks of the investments as well as expected postinvestment monitoring. We then form empirical measures of the three different types of risks and relate those measures to the contracts.

Consistent with the agency explanation, internal uncertainty is significantly related to many of the incentive and control mechanisms in the contracts. Higher internal risk is associated with more VC control, more contingent

[4] Another possibility is that for such complex ventures, it is difficult to find proper benchmarks or signals on which to base contingent compensation. Execution risks are likely to be present in ventures where the tasks that the entrepreneur has to perform are very complex and multidimensional. Basing compensation on a signal correlated with a particular aspect of the task may lead the entrepreneur to put too much effort on this aspect, as opposed to other areas. Multitasking theories such as Holmström and Milgrom (1991) and Baker (1992) predict that contingent compensation based on performance benchmarks will be used less in these cases.

compensation for the entrepreneur, and more contingent financing in a given round. The exceptions are that the overall fraction of founder cash flow rights and some VC liquidation rights are not related to internal risk.

Similar to internal risks, external risk is associated with more VC control and more contingent compensation. External risk is also associated with increases in the strength of VC liquidation rights, and tighter staging, in the sense of a shorter period between financing rounds. These findings are highly inconsistent with optimal risk-sharing between risk-averse entrepreneurs and risk-neutral investors. In contrast, the results are supportive of the arguments in Prendergast (2002) and Dessein (2002).

Risk related to difficulty of execution shows a (weakly) negative relation with many contractual terms such as contingent compensation and VC liquidation rights. These results suggest that for highly complex environments, where the founder's human capital is particularly important, standard incentive mechanisms are less effective. Furthermore, consistent with hold-up theories, execution risk is positively related to founder vesting provisions.

Next, we test two additional theoretical predictions by relating the financial contracts to VC actions. First, control theories like Aghion and Bolton (1992) imply that intervening actions are more likely when the VC has greater control rights. Second, the "double sided moral hazard" theories like Casamatta (2003) emphasize that VCs also provide value-added support activities. Since both the VC and the entrepreneur benefit from value-added services, these activities are less likely to be resisted by the entrepreneur. Rather, the problem is to provide the VC incentives to undertake supporting actions. These theories suggest that supporting actions will be more likely as the VC's equity stake in the company increases.[5]

We use the investment analyses to measure actions that the VCs took before investing and expected to undertake afterward. We then classify these actions into intervening and supporting ones. In at least half of the investments, the VC expected to play a role in recruiting management or some other intervening action that the entrepreneur is likely to view as a conflict. Consistent with the control theories, VCs are more likely to intervene as VC control increases. Second, in more than one-third of the investments, the VC expects to provide value-added services such as strategic advice or customer introductions. As predicted, we find that VC's value-added services increase with the VC's equity stake, but are not related to VC control.

Overall, we believe this paper makes three contributions. First, the paper is novel in using investors' direct assessments of risks rather than the indirect proxies used in most previous research. The internal risk results suggest that agency problems are very important to contract design. The external risk results suggest that risk-sharing concerns are unimportant relative to other concerns such as monitoring. Second, we show that VCs expect to take actions with their investments and those actions are related to the contracts. Expected

[5] We are able to measure these effects separately because control rights in VC contracts are separate and distinct from cash flow rights. See Kaplan and Strömberg (2003).

VC intervention is related to VC board control, while VC support or advice is related to VC equity ownership. Finally, the paper adds to existing work by describing the characteristics and risks that VCs consider in actual deals. Our results are consistent with those in MacMillan, Siegel and Subbanarasimha (1985) and MacMillan, Zemann, and Subbanarasimha (1987) who rely largely on survey evidence.

The paper proceeds as follows. Section I describes our sample. Section II describes the VC analyses. Section III presents the relation between the contracts and the VC analyses. Section IV considers the relation between VC actions and the contracts. Section V summarizes our results and discusses their implications.

I. Sample

A. Description

We analyze VC investments in 67 companies by 11 VC firms. This is a subsample of the 119 companies from 14 VC firms analyzed in Kaplan and Strömberg (2003), who obtained their sample by asking the VCs to provide detailed information on their investments. For each company and for each financing round for the company, the VC was asked to provide the (1) term sheet; (2) stock and security purchase agreements; (3) the company's business plan; and (4) the VC's internal analysis of the investment.

Most VC firms have a process in which the partner responsible for a potential investment writes up an analysis or memorandum for that investment. The entire partnership group uses the analysis to help decide whether to make the investment. If the VC invests in the company, the memorandum then serves as a guide for postinvestment actions.

VCs at 11 of the 14 VC firms provided an investment analysis for at least one company investment. The analyses vary in detail. Some are brief, 2-page, write-ups while others are in-depth descriptions exceeding 20 pages. A consequence of this is that our results may understate the extent of analyses that the VCs perform.

Table I presents sample summary information. We study the first investment made by the VC in these companies. Panel A indicates that of the 67 investments, 25 are prerevenue—the firms either did not have revenues or were not yet operating. We refer to these as early stage rounds. The remaining investments are rounds in which the firms had revenues and were already operating. For 44 companies, the investment is the first investment any VC ever made in the company; in the remaining 23, another VC had invested before our VC acquired a stake.

Panel B shows that the sample investments were relatively recent when collected. All but 11 of the 67 companies were initially funded by the VCs between 1996 and 1999.

Panel C indicates that the companies represent a wide range of industries. The largest group is in information technology and software (24 companies),

Table I

Summary Information

Summary information for investments in 67 portfolio companies by 11 venture capital partnerships. Investments were made between 1987 and 1999. Prerevenue stage rounds are financing rounds for companies that had no revenues before the financing. First VC investments refer to observations where we have the investment memorandum for the first time any venture capital fund invested in the company. Repeat entrepreneur refers to observations where, before founding this particular portfolio company, the founder had successfully gone public with a previous venture or sold such a venture to a public company. Total financing committed is the total amount of equity financing committed to by the venture capitalists at the time of the financing round. VC firm location includes California (CA), Midwestern United States (MW), Northeastern United States (NE), and diverse locations (DIV). Data on capital managed and funds raised by VC firms come from Venture Economics.

A.	*N*
Number of portfolio companies	67
Prerevenue	25
First VC investments	44
Repeat entrepreneur	14
Memo written by lead investor	57
Located in California	25
Located in North-East United States	13
Located in Midwest	11

B. By year initial round financed:	Pre-1995	1996	1997	1998	1999
# companies	11	14	12	29	1

C. By industry	Biotech	Internet	IT/Softw, Other	Telecom	Healthcare	Retail	Other Inds.
# companies	7	14	10	10	10	10	6

D. By VC firm	1	2	3	4	5	6	7	8	9	10	11
# portfolio companies in current draft	7	3	3	15	4	4	2	10	2	10	7
Location	CA	MW	NE	MW	CA	MW	CA	DIV	MW	DIV	DIV
Rank in terms of capital managed 2002, <= top	50	100	25	150	150	50	550	25	250	25	100

E. VC firm characteristics:	Mean	Median
By financing round ($N = 67$):		
VC firm age at time of financing round, years	13.3	12.0
Number of funds raised by firm since foundation	5.9	5.0
Amount raised by partnership since foundation ($ millions)	448.9	289.7
By VC firm ($N = 11$):		
VC firm age, November 2002	16.7	15.0
Number of funds raised by November 2002	11.2	8.5
Capital under management, November 2002 ($ millions)	1747.2	846.7

F. Financing Amounts	Mean	Median
Total financing committed ($ millions)	9.7	6.0
Total financing provided ($ millions)	5.5	4.8

G. Outcomes as of 10/31/02	Private	Public	Sold	Liquidated
# of companies	23	15	16	13

with 14 internet-related and 10 noninternet related. The sample also includes biotech, telecom, healthcare, and retail ventures.

Panel D shows that the portfolio companies were funded by 11 U.S.-based VC firms with no more than 15 companies from any one VC. Three VCs are based in California, 4 in the Midwest, 1 in the Northeast, and 3 have multiple offices. Five VCs are among the top 50 VC firms in the United States in capital under management; all but 2 are among the top 150.

Panel E shows that at the time of financing, the VC for the median investment in our sample was 12 years old and had raised five funds amounting to $290 million.

Panel F reports the financing amounts. The VCs committed a median of $6.0 million with a median of $4.8 million disbursed at closing and the rest contingent on milestones.

Finally, panel G indicates that by October 31, 2002, 15 of the 67 companies were public, 16 had been sold, and 13 had been liquidated. The remaining 23 companies were still private.

B. Sample Selection Issues

In this section, we discuss potential selection issues. The sample is not random in that we obtained the data from VC firms with whom we have a relationship.

One possible bias is that the three VCs from our previous paper that did not provide investment memoranda are different from the others. While possible, the terms and the outcomes of the investments made by those VCs appear similar to those for the investments made by the other 11 VCs.

It is also possible that the VCs provided us with memos on their better investments. Several factors suggest that this is not the case. Many of the investments the VCs provided us were their most recent. In addition, 6 of the 11 VCs provided all of their investments in the relevant period. The terms for the six VCs are similar to those for the entire sample. Finally, investments with memos are insignificantly less likely to have gone public than those without memos.

Another possible bias is that memoranda are written only for more controversial investments. The results in the previous paragraph argue against this. Furthermore, four of the six VCs who gave us all their investments gave us memoranda for all of them.

There do not appear to be industry or geographic biases as the industries and locations of the sample companies are in line with those of all VC investments over the same period.

Finally, because we contacted successful VCs, it is possible that our VCs are of above-average ability. We do not think this bias is of much concern for our analyses because we are interested in understanding how VCs choose and structure their investments rather than how well they perform. If anything, a bias towards more successful VCs would be helpful because we are more likely to have identified the methods used by sophisticated, value-maximizing principals.

Overall, we acknowledge that the sample is selected, and it is difficult to know the extent of any bias. We have discussed the more likely biases and have not found any obvious red flags.

II. Description of VC Investment Analyses

In this section, we present our classification scheme for investment strengths and risks, describe those strengths and risks, and describe the actions the VCs take and expect to take.

A. *Classification Scheme*

Previous work on VC company characteristics distinguishes among factors that relate to the opportunity (the company's market, product/service, technology, strategy, and competition), the management team, the deal terms, and the financing environment.[6] We include these factors, but group them into three categories motivated by the theories described in the introduction.

The first category includes internal factors—management quality, performance to date, downside risk, influence of other investors, VC investment fit and monitoring costs, and valuation. These factors are related to management actions and/or the quality of the management team. We believe these factors are more likely to be subject to asymmetric information and moral hazard with respect to the management team.

The second category includes those factors we view as external to the firm. We classify market size, customer adoption, competition, and exit condition risks as such factors. Because these are external to the firm and largely beyond the control of the management team, we believe that the VC and the founder should be more or less equally informed about these factors.

The third category measures factors related to difficulty of execution or implementation—product/technology and business strategy/model. These factors are designed to capture the complexity of the task and the reliance on the entrepreneur's human capital.

We recognize that there are alternative interpretations of our categories. We postpone a discussion of these alternatives until later when we present our results.

Table II summarizes the classifications, investment theses, and risks.

B. *Investment Strengths / Theses*

Panel A confirms that internal factors are important. The VCs cite management quality as a reason for investing in almost 60% of the investments. The

[6] MacMillan et al. (1987, 1987, 1988); Sapienza (1992); and Sapienza et al. (1996) rely largely on survey evidence to obtain these results.

Table II

Investment Theses and Risks in Venture Capitalist Analyses

Explicitly mentioned (1) reasons for investing and (2) risks of investment, according to venture capitalist analyses for investments in 67 portfolio companies by 11 venture capital partnerships. Investments were made between 1987 and 1999.

	Reason to Invest/Strength			Risk of Investment/Weakness		
	N	%	Examples	*N*	%	Examples
A. Internal Factors: Management, Previous Performance, Funds at Risk, Other Investors						
Quality of management	40	59.7	• Management team has extensive internet and website management experience. • Management team is believed to be good in science, and at raising and conserving money. • Experienced managers out of successful venture backed company. • Highly sought-after entrepreneur/founder, who co-founded company that went public. • Experienced, proven and high-profile CEO. • Founder has high marks from existing investors. • Known CEO for a long time. • Team has acquired significant level of penetration and relationships in a fairly short time. • CEO/founder is capable of attracting necessary employees. Has developed excellent product while consuming modest amounts of capital. • CEO is very frugal and will not spend unwisely. • Founder very committed: quit job at competitor and mortgaged his house. • Team is well-balanced, young and aggressive.	41	61.2	• CEO is a "rather difficult person." Active involvement of chairman will be crucial. • CEO/founder has a strong desire for acquisitions. VCs have to devote substantial time evaluate. • Management has not shown in the past that it can effectively forecast financial progress. • Company is in many seemingly disparate businesses; a reflection of management's lack of focus? • Will management be able to integrate acquisitions? • The CEO's choice of past companies questionable. • Management is young and relatively inexperienced. • Management team is incomplete. • Company is highly reliant on one individual (the CEO). • Company needs CEO, CFO, COO, and control (operating, reporting, and billing) systems. • Need seasoned industry executive. • Incomplete management team. A milestone for further funding is hiring VP of sales and marketing. • Must strengthen management and ensure involvement of VC as chairman. Will have to hire CEO.

(continued)

Table II—*Continued*

	Reason to Invest/Strength			Risk of Investment/Weakness		
	N	%	Examples	*N*	%	Examples
Performance to date	18	26.9	• Demonstrated profitability of business model. • Company has a manageable cash burn rate and is expected to be cash-flow break-even in 12 months. • Significant sales growth and momentum. • Has developed product, well-positioned to achieve revenue target.	5	7.5	• Company is making losses and performing below plan. • Bad debt problem, which significantly changed the profitability of the company, because of past business procedures.
Funds at risk/ downside	13	19.4	• Participating preferred protects VC if mediocre performance. • Equipment can be funded with debt. • Investors have ability to control growth. • Minimize downside by only providing limited funds until milestones met. • VC commitment will be invested over time. • Cash-efficient early stage thanks to future company acquisitions with stock. • Can take company to leading industry position with a minimum of capital.	9	13.4	• Uncertainty about what proper milestones should be. • Large amount of capital for a start-up enterprise. Will require strong management oversight. • Aggressive bank loan assumptions. Might require either slower expansion or more equity capital. • Company has little in the way of underlying asset value and thus offers limited downside protection. • Company expects to need additional financing next year. No assets of value except for employees. • Need sufficient checks and balances regarding drawdown of funds.
Influence of other investors	4	6.0	• Investing partners include investors who previously invested early in some extremely successful companies. • Co-investor also involved as active chairman and interim CEO.	4	6.0	• Lead VC will not have unilateral control, but have to reach agreement with three other VCs. • Previous investor (who is selling all shares to VCs) is anxious to get out at a deep discount. • Other VC previously decided not to finance deal.
VC portfolio fit and monitoring cost	12	17.9	• Adds additional breadth to VC portfolio within this market segment. • VC is strong in this geographic region. • Good strategic fit with VC. • VC has board seat on company in complementary business; marketing partnership possible.	10	14.9	• Complicated legal and financial due diligence needed. • May require too much time from VC. • Geographical risk—US corporate and overseas R&D. • VCs have to devote substantial time to evaluate acquisitions.

			• New market segment for VC, which should stimulate some additional opportunities. • Potential for (non-California) VC to lead a Silicon Valley deal.			• Heavy involvement of investor as interim CEO, (replacing founder) is critical to success. • Have to ensure active involvement of one of VC investors as chairman.
Valuation	14	20.9	• Low valuation: IRR of 46% in conservative case. • Exit multiples are shooting up.	13	19.4	• Are the valuation and financial projections realistic? • High valuation because of competition between VCs.
B. External Factors: Market Size, Competition, Customers, Financial Markets, and Exit Conditions						
Market size and growth	46	68.7%	• Large market amenable to rapid growth. • Very large market in which incumbents earn high profit margins. • Company could dramatically impact the evolution of the computer industry.	21	31.3%	• Regulatory uncertainty. • Country risk. • Currency risk. • New, largely unproven, marketplace. • General downturn in industry.
Competition and barriers to entry	22	32.8%	• Strong proprietary and patent position. • Company is targeting a significant market segment that is underserved by incumbents. • Early mover advantages from being pioneer of concept and largest player. • Highly fragmented industry, which makes it ripe for consolidation. • No competitors. • There is more than enough room for several competitors.	27	40.3%	• Customers might become competitors once they learn company's business model. • Patent protection alone might not provide enough barriers to entry. • Many new entrants—price competition could drive down margins. • Competitive and tight labor market, competing with larger established firms for employees. • New technology might be long-term threat. • Low barriers to entry. Low switching costs. • Product can be copied by large entrenched firms.
Likelihood of customer adoption	20	29.9%	• Conceptual acceptance by professional community. • Beta arrangements with large customers. • Solid base of customers. • Customers are positive regarding the product and the management team.	15	22.4%	• Uncertain whether can convince customers to bet on an unproven technology. • Customers may not want to pay enough of a premium for product. • Target customers have not historically been speedy adopters. • Financial viability of customers and existing contracts questionable. • Challenge is to broaden the product beyond the initial customer segment.

(continued)

Table II—*Continued*

	Reason to Invest/Strength			Risk of Investment/Weakness		
	N	%	Examples	*N*	%	Examples
Financial market and exit conditions	11	16.4%	• If successful, possibility for early exit or acquisition. • Expect to have access to both public debt and equity on attractive terms. • Quick flip potential for the investment. • Many strategic buyers available. • Recent public market enthusiasm for e-commerce companies might enable public equity financing to mitigate future financing risks. • Given the size of the market opportunity and company's strategy, capital markets will be receptive given that company achieves business plan. Also, a consolidation trend should emerge in industry as more companies enter market.	5	7.5%	• What will the leverage be and what happens to leverage if the IPO is delayed? • Would maybe be better to sell company. • Financial market and political fluctuations. • How will public markets treat the company?
C. Difficulty of Execution: Product and Technology, Strategy						
Product and/or technology	27	40.3	• Late stages of product development (first product launch planned in 15–18 months). • Superior technology with large market potential. • Revolutionary new technology. • Has developed excellent product. • Has built a robust, scalable system that can meet the current market demands. • Best product on the market. • Well tested technology/product. • Early-stage company with post-beta product with competent/experienced technology team.	21	31.3	• Outcome of clinical tests and development: Must prove that technology is superior to other marketed alternatives, in terms of efficiency and side effects. • Early stage research project: Project is elegant, ambitious and, consequently, difficult. • Ability to make technology work at target cost point. • No guarantee product will work in a full production environment. • Identification and development of a more compelling product. • Product scalability is to be fully tested.

Business strategy/ model	36	53.7	• Company significantly reduces costs while maintaining quality. • Compelling business strategy. Presence or likelihood of validating corporate alliances. • Outsourcing means less for company to manage. • Attractive and demonstrated profitability of business model. • Excellent new concept. • Favorable acquisition opportunities, which will be driver of growth. • Distinctive strategy. • High value-added, high margin strategy for very little capital upfront. • "Lean and mean" operation with few employees and good customer focus. • Pure play/focused.	34	50.7	• Real sales effort needs to be mounted, which is very reliant on management team's experience to manage profitably. Transferability of business model to other markets? • Are there enough candidates available for acquisition? • Will company be able to ensure quality while pursuing a growth-through-acquisition strategy? • How scalable is the business? Is there any operating leverage in the business model? • Lack of focus. • Vulnerable strategy. • Execution of business model has yet to be proven. • Will company be able to attract employees? • VC due diligence showed that margins and expense percentages of existing stores have to be brought into line with prototype model. • Key partnerships not nailed down. • Geographical risk—U.S. corporate and foreign R&D.

VCs cite good performance to date in almost 27% and a favorable valuation or a low amount of capital at risk in roughly 20%.

Panel B shows that external factors are also important. VCs cite large and growing markets as attractive in almost 69% of the investments; a favorable competitive position and a high likelihood of customer adoption, in roughly 30%; and favorable exit conditions, in 16%.

Panel C shows that factors related to execution are important as well. In at least 40% of investments, VCs were attracted by the product/technology or by the strategy/business model.

C. Investment Risks

While the VCs found the investments attractive on a number of dimensions, Table II also indicates that the VCs viewed the investments as having substantial risks.

Panel A shows that the primary internal risk was management, cited as risky in 61% of the analyses. For example, one CEO was "difficult," while several teams were incomplete. This 61% roughly equals the 60% of analyses for which management was a reason to make the investment. The apparent contradiction can be reconciled by observing that a VC might think highly of the founder, but be uncertain whether the founder can build the rest of the team.

Panel A also indicates that the other internal factors of valuation, VC monitoring cost, downside risk, performance to date, and other investor influence are concerns in, respectively, 19, 15, 13, 7.5, and 6% of the investments. Two observations are worth making about these risks. First, the risks of VC monitoring costs show that in several instances, the VC worried that the investment might require too much time. This indicates that while VCs regularly play a monitoring and advisory role, they do not intend to become excessively involved in the company. Second, because valuation is endogenous to the contracts, we will not include it as a risk in the regressions.

Panel B reports external factors that the VCs viewed as risks. In 40, 31, and 22%, of the investments, respectively, the VCs perceived competitive, market size, and customer adoption risks. Exit conditions were viewed as a risk in fewer than 8% of the investments.

Panel C reports that execution difficulties are also important risks. In just over 50% of the investments, the VC viewed the strategy or business model as risky. In 31%, the VC viewed the product and or technology as risky.

In general, the strengths and risks we identify are similar to those emphasized in the VC strategy and management literature, as well as in anecdotal accounts.

D. Relation of Strengths, Risks, and Firm Characteristics

Table III explores the relation of strengths and risks to each other and then to exogenous investment characteristics—pre- or postrevenue, first or subsequent

Table III

Relations between VC Strengths, Risks, and Firm Characteristics

Explicitly mentioned strengths and risks in investing according to venture capitalist analyses and their relation to exogenous firm characteristics for 67 portfolio companies by 11 venture capital partnerships. Investments were made between 1987 and 1999. Internal risk is the average of the dummy variables for the presence of management quality, previous performance, funds-at-risk/downside, influence of other investors, and costly monitoring risks (strengths). External risks (strengths) is the average of the dummy variables for the presence of market, competition, customer adoption, and financial market/exit risks (strengths). Execution risks (strengths) is the average of the dummy variables for product/technology and business model/strategy risks (strengths). Sum of risks (strengths) is the sum of all 11 risk (strength) dummy variables. Strengths minus risks is the difference between sum of risks and sum of strengths. Prerevenue stage rounds are financing rounds for companies that had no revenues at the time of the financing. First VC investments refer to the rounds involving the first time any venture capital fund invested in the company. Industry R&D/Sales is the aggregate R&D expense to sales for public firms in the venture's three-digit SIC industry, according to COMPUSTAT. CA (Non-CA) investment indicates that the portfolio company was (not) located in California at the time of financing. Lead investor indicated that the memo was written by the VC firm providing the largest amount of financing among the VCs investing in the round. Data on funds raised by VC firms are taken from venture economics. In Panel B, asterisks indicate significant differences using either a Mann–Whitney or a Kruskal–Wallis (for VC dummies) test, while in Panel A asterisks indicate significant correlation coefficients at 1%***, 5%**, and 10%* levels.

A. Correlations between Strengths and Risks (Bivariate Pearson Correlation Coefficients)

	Internal Strengths	Internal Risks	External Strengths	External Risks	Execution Strengths	Execution Risks	Strengths Minus Risks	No. of Pages in Memo
Internal strengths	1.000	0.051	0.022	−0.095	0.005	−0.038	0.527***	0.132
Internal risks	0.051	1.000	0.315***	0.291**	−0.125	−0.012	−0.47***	0.558***
External strengths	0.022	0.315***	1.000	0.334***	−0.002	−0.006	0.256**	0.442***
External risks	−0.095	0.291**	0.334***	1.000	0.089	0.089	−0.45***	0.215*
Execution strengths	0.005	−0.125	−0.002	0.089	1.000	0.264**	0.254**	−0.025
Execution risks	−0.038	−0.012	−0.006	0.089	0.264**	1.000	−0.284**	0.024
Strengths minus risks	0.527***	−0.47***	0.256**	−0.45***	0.254**	−0.284**	1.000	−0.085
No. of pages in memo	0.132	0.558***	0.442***	0.215*	−0.025	0.024	−0.085	1.000

(continued)

Table III—*Continued*

B. Relation of Risk Factors and Strengths to Deal Characteristics

	All Obs. ($N = 67$)	Pre- ($N = 21$)/ Post- ($N = 46$) Revenue	1st ($N = 44$)/ Subsequent ($N = 23$) Round	Ind. R&D/ Sales < 9% ($N = 32$)/ >=9% ($N = 34$)	Before ($N = 37$)/ After (N =30) Jan. 1, 1998	CA ($N = 25$)/ Non-CA ($N = 42$) Investment	Lead ($N = 57$)/ Non-Lead ($N = 10$) Investor	VC Raised >6 ($N = 33$)/ <=6 Funds ($N = 34$)	VC Dummies $\chi^2(10) =$
Internal strengths	26.0	26.7/25.6	24.6/28.7	23.1/28.2	24.1/28.6	27.2/25.2	25.3/30.0	25.4/26.5	8.6
Internal risks	20.9	22.9/20.0	23.2/16.5	29.4/12.4***	19.0/23.6	12.8/25.7**	22.1/14.0	21.2/20.6	32.4***
External strengths	36.9	38.1/36.4	39.2/32.6	39.8/34.6	37.8/35.7	28.0/42.3**	38.2/30.0	39.6/35.3	20.5**
External risks	25.0	21.4/26.6	27.8/19.6	31.2/19.8**	25.6/24.1	17.0/29.8***	26.3/17.5	24.2/25.7	27.1***
Execution strengths	47.0	33.3/53.2**	44.3/52.2	37.5/55.9**	46.2/48.2	52.0/44.0	49.1/35.0	47.0/47.1	7.7
Execution risks	41.0	31.0/45.6*	40.9/41.3	35.9/45.6	41.0/41.1	40.0/41.7	42.1/35.0	43.9/38.2	13.6
Sum of strengths	3.72	3.52/3.80	3.68/3.78	3.50/3.92	3.64/3.82	3.52/3.83	3.77/3.40	3.76/3.68	16.1*
Sum of risks	2.87	2.62/2.98	3.09/2.43	3.44/2.32***	2.79/2.96	2.12/3.31***	3.00/2.10	2.91/2.82	37.8***
Strengths minus risks	0.85	0.90/0.83	0.59/1.35*	0.06/1.59***	0.85/0.86	1.40/0.52	0.77/1.30	0.85/0.85	25.2***
No. of pages in memo	6.23	7.14/5.82	6.91/4.96	7.66/4.92	6.69/5.61	4.80/7.10**	6.84/2.80**	5.79/6.68	43.7***

round, industry research and development, pre- or post-1998, California or non-California investment, lead or nonlead investor, and VC firm experience.

We measure strengths and risks as the average of the dummy variables for each type of strength and risk. Internal risk (strength) is the average of the dummy variables for the presence of management quality, previous performance, funds-at-risk/downside, influence of other investors, and costly monitoring risk (strength). External risk (strength) is the average of the dummy variables for the presence of market, competition, customer adoption, and financial market/exit risk (strength). Execution risk (strength) is the average of the dummy variables for product/technology and business model/strategy risk (strength). These definitions normalize the measures to lie between zero and one. While these variables may not capture all available information, they reduce the extent to which we subjectively interpret the investment analyses.

Panel A shows that internal risks are correlated with external strengths and risks. External strengths and risks are correlated with each other, as are execution strengths and risks. While the length of the investment memo captures some relevant information, it is significantly related to only half the risks and strengths.

Panel B relates strengths and risks to other investment characteristics. Most of the significant differences are found across different industries and geographies. These effects are hard to disentangle from particular VCs because VCs tend to concentrate in particular industries and in particular geographies.[7] In subsequent regressions, we control for these effects using the investment characteristic variables and VC dummies. Panel B also shows that memos are longer for non-California investments and those in which the VC is the lead investor (57 investments.)

Finally, it is worth pointing out that measures of stage of development—pre- or postrevenue and first VC round—are not particularly correlated with our risk measures, suggesting that the risk measures pick up risks that are not driven by stage.

E. VC Actions

Many papers have studied the role of VCs in assisting and monitoring their portfolio companies. Gorman and Sahlman (1989), MacMillan, Kulow, and Khoylian (1988), Sapienza (1992), and Sapienza, Manigart, and Vermeir (1996) survey VCs and find that VCs spend substantial time and effort monitoring and supporting their investments. Using data provided by start-ups, Hellman and Puri (2000 and 2002) find that firms financed by VCs bring products to market more quickly and are more likely to professionalize their human resource functions. Lerner (1995) and Baker and Gompers (2001) find that VCs play an important role on the board of directors.

[7] For example, all our retail deals come from one VC who specializes in retail deals, and the same is true for our healthcare ventures.

Table IV
Venture Capitalist Actions

Venture capitalist (VC) actions before investment and anticipated at the time of investment for investments in 67 portfolio companies by 11 venture capital partnerships. Investments were made between 1987 and 1999.

	Number (%) of Companies
Management	
VC active in recruiting or changing management team before investing	11 (16%)
VC expects to be active in recruiting or changing management team after investing	29 (43%)
Any of the above	34 (51%)
Strategy/Business Model	
VC explicitly active in shaping strategy/business model before investing	6 (9%)
VC explicitly expects to be active in shaping strategy/business model after investing	20 (30%)
Any of the above	23 (34%)
Examples:	
Design employee compensation	
Arrange vendor financing agreements	
Install information and internal accounting systems	
Help company exit noncore businesses	
Implement currency hedging program	
Hire market research firm to help with new store locations	
Assist with development of marketing plan	
Assist with mergers and acquisitions	
Develop business plan, budget, financial forecasts	
Monitor R&D and product management efforts	
Refine pricing model and work on major account strategy	
Assist technical service team	
Leverage VC strategic relationships	

The results in previous work are all either survey-based or indirect. We use the VC analyses to complement and corroborate that previous work by reporting the actions that the VC took before investing and the actions the VC expected to undertake after investing.

Table IV confirms that VCs help shape and recruit the management team. In 16% of the investments, the VC plays such a role before investing; in 43%, the VC expects to play such a role afterward. VCs also help shape the strategy and the business model before investing (in 9% of the investments) and expect to be active in these areas afterward (in 30%). These actions include design of employee compensation, development of business plans and budgets, implementation of information and accounting systems, and assistance with acquisitions.[8]

[8] Although not reported in a table, the extent of VC actions is highly correlated with the VCs and with industry.

Our results likely understate the actions VCs take because we observe only those actions the VCs (a) reported as important and (b) had done or planned at the time of investment. Even so, the results support and complement those in Hellman and Puri (2002). In addition to actions traditionally associated with monitoring (replacing management after poor performance), our results confirm that VCs assist founders in running and professionalizing the business.

III. The Relationship between VC Risk Factors and Contractual Terms

In this section, we compare the direct VC risk assessments to the financial contracts. The regressions utilize our summary measures of internal, external, and execution risk as independent variables. In the regression analysis, we focus on the (investment) risk measures defined above rather than the (investment) strength measures because the predictions from the theories as well as previous empirical work focus on risks.

One concern with only using the risk measures is that they might measure negatives rather than uncertainty. Accordingly, the regressions attempt to control for the overall attractiveness of an investment by including the average of the strengths less the risks in all the regressions.[9]

A. The Effect of Risk on the Provision of Founder Cash Flow Incentives

Table V investigates the relation of the risk measures to measures of founder cash flow incentives. The regressions use three different dependent variables to measure founder cash flow incentives—the fraction of cash flow rights held by the founder, the sensitivity of those rights to explicit benchmarks, and the sensitivity to time vesting.

The fraction of cash flow rights held by the founder equals the fully diluted percentage of equity the founder would own in a best case scenario in which all performance benchmarks are met and full-time vesting occurs.

While the fraction of cash flow rights provides one measure of pay-for-performance, it is imperfect in that it also measures the division of value. Because the founder is typically cash constrained, the VC is likely to require greater cash flow rights than would be optimal from an incentive perspective.[10] VCs can increase the pay-for-performance sensitivity in two alternative ways—using vesting based on explicit performance benchmarks and using time vesting.

The sensitivity of cash flow rights to explicit benchmarks measures the percentage of a founder's fully diluted equity stake that vests subject to explicit

[9] The company's premoney value also provides a possible measure of attractiveness. We do not include premoney value in the reported regressions because it is likely to be endogenous with respect to the risks. In unreported regressions, we obtain qualitatively similar results when we do include premoney value.

[10] Inderst and Müeller (2003) make this point in a model of venture capital.

Table V

Relation between Founder Pay Performance Incentives and VC Risk Analyses: Multivariate Analysis

Relationship between venture capitalist (VC) risk analyses and contractual terms for investments in 67 portfolio companies by 11 venture capital partnerships. Investments were made between 1987 and 1999. The dependent variables are measures of founder pay performance incentives: Founder equity % is the percentage of equity owned by the founders if performance benchmarks are met and all founder and employee equity vest, fully diluted. The % of founder equity s.t. benchmarks (vesting) is the difference in founders' residual cash flow rights (i.e. equity) if they meet performance (time vesting) benchmarks, as a percentage of the founder equity %. The independent variables are measures as follows: Degree of external risk is the average of the dummy variables for the presence of market risk, competition risk, customer adoption risk, and financial market/exit risk. Degree of internal risk is the average of the dummy variables for the presence of management quality risk, questionable performance risk, funds-at-risk/downside, negative influence of other investors risk, and costly monitoring risk. Degree of execution risk is the average of the dummy variables for product/ technology risk and business model/strategy risk. Sum of risks (strengths) is the sum of all 11 risk (strength) dummy variables. Strengths minus risks is the sum of all 11 risk dummy variables minus the sum of all 11 strength dummy variables. First VC financing round takes the value of one if no VCs had invested in the company previous to this round, and zero otherwise. Prerevenue venture takes the value of one if the venture is not generating any revenues at the time of financing, and zero otherwise. Repeat entrepreneur takes the value of one if the founder's previous venture was taken public or sold to public company. Industry R&D/Sales is the aggregate R&D expense to sales for public firms in the venture's three-digit SIC industry, according to COMPUSTAT. California deal is a dummy variable indicating that the portfolio company was located in California at the time of financing. White (1980) robust standard errors are in parentheses. Asterisks indicate significant differences at 1%***, 5%**, and 10%* levels.

	Dependent Variable					
	Founder Equity % (OLS)	Founder Equity % (OLS)	% of Founder Equity s.t. Benchmarks (OLS)	% of Founder Equity s.t. Benchmarks (OLS)	% of Founder Equity s.t. Vesting (OLS)	% of Founder Equity s.t. Vesting (OLS)
Degree of internal risk	−14.51 (10.44)	−13.48 (9.50)	34.8 (13.7)**	32.34 (14.58)**	2.0 (25.3)	21.08 (26.50)
Degree of external risk	−10.78 (7.54)	−10.89 (8.21)	14.2 (5.8)**	11.63 (5.82)**	17.8 (17.4)	25.16 (21.03)
Degree of execution risk	0.03 (7.14)	−0.70 (7.84)	−2.4 (5.0)	1.35 (4.76)	24.5 (14.6)*	31.11 (15.32)**
Strengths minus risks	21.52 (16.16)	17.29 (17.19)	23.3 (10.5)**	23.70 (13.10)*	7.7 (30.5)	16.93 (29.23)
First VC fin. round	16.63 (4.89)***	15.08 (5.80)**	1.7 (2.5)	4.72 (2.58)*	−4.4 (8.9)	−1.07 (9.67)
Repeat entrepreneur	−3.52 (6.22)	−3.40 (6.40)	−5.2 (3.3)	−2.97 (2.69)	−3.2 (11.6)	2.06 (12.22)
Pre-revenue venture	4.77 (4.80)	0.64 (6.52)	11.3 (4.4)**	9.21 (5.49)*	25.4 (11.6)**	11.55 (15.22)
Industry R&D/Sales, %		−1.61 (1.22)		−0.92 (0.53)*		3.73 (2.13)*
California deal		−0.63 (3.99)		−3.92 (2.49)		3.13 (10.47)
1998–99 dummy		−5.09 (4.44)		−1.00 (5.85)		−9.25 (11.28)
Biotech		17.89 (11.49)		5.67 (8.37)		25.53 (21.66)
Internet		5.25 (6.80)		4.13 (6.81)		17.35 (14.54)
Other IT/Software		7.34 (6.41)		1.89 (4.42)		16.37 (18.18)
Telecom		−4.09 (8.68)		11.50 (9.45)		69.80 (21.70)***
F-test Industry [*p*-value]		0.79 [0.54]		0.54 [0.71]		2.98 [0.03]**
VC dummies	Yes	Yes	Yes	Yes	Yes	Yes
F-test VC dum. [*p*-value]	4.05 [0.00]***	3.11 [0.016]**	1.29 [0.28]	1.58 [0.18]	1.67 [0.16]	2.14 [0.08]*
Adjusted R^2	0.39	0.38	0.40	0.45	0.14	0.17
Sample size	67	67	67	67	67	67

performance benchmarks. For example, if a founder owns 30% of a company's equity and can earn an additional 10% if the founder meets the performance benchmark, then this measure will equal 25% (10% divided by a total of 40%). We view this measure as a clearer indicator of pay-for-performance sensitivity.[11]

The sensitivity of cash flow rights to time vesting measures the percentage of a founder's fully diluted equity stake that vests subject to the founder remaining employed at the company for a stated period of time. This sensitivity is calculated in the same way as the sensitivity to explicit benchmarks. Time vesting makes it more costly for the entrepreneur to leave the firm, and therefore should be used when the entrepreneur's human capital is particularly important.

There are two shortcomings to our analyses. First, we lack data on cash salaries and bonuses. We do not view this as a major problem. Just as cash compensation is relatively less important than equity-based compensation for top executives of large public companies, it should be even less important for executives of start-ups.[12] Second, cash flow incentives are more complex than we can measure. There is a complicated interaction between the entrepreneur's incentives in the current round and incentives in future rounds. This is because the entrepreneur's performance will affect valuations in future rounds and therefore subsequent cash flow rights. We attempt to control for this by including dummy variables for whether the venture has revenues and for whether the round is the first VC financing.

The primary independent variables in the regressions are our three measures of investment risk and our control for investment attractiveness. The regressions also include a number of controls: industry R&D to sales; whether any of the founders have founded a venture that was taken public or sold to a public company; whether the company is in California; and whether the financing takes place after 1997, industry, and VC.[13] These controls are included to increase the likelihood that we isolate the effects of the risk variables. In unreported regressions, we also control for the annual level of commitments to VC partnerships, whether the VC was the lead investor, the number of pages in the investment analysis, and industry market-to-book. None of those variables is consistently significant, and our primary results are qualitatively and statistically identical.

The first two regressions in Table V show that internal and external risks are negatively related to founder equity percentage, but not significantly so. At the same time, the net attractiveness of the investment (strengths minus risks) is positively, but not significantly related to the founder equity percentage. When the risk measures are excluded (in unreported regressions), net attractiveness is positive and highly significant (at the 1% level), suggesting that there is some

[11] Our results are qualitatively similar when we use the raw percentage subject to performance benchmark vesting.

[12] On the other hand, because founders of VC backed start-ups are likely to have less outside wealth than CEOs of large corporations, this measure of incentives may be "cleaner" than those in previous CEO-compensation studies.

[13] Because we only have a few observations for some of the VCs, we include a VC dummy only for the five VCs who have more than four investments in the sample.

collinearity and that founder equity percentage is more a measure of value than a measure of pay-for-performance incentives.[14]

The next two regressions in Table V consider the use of explicit performance benchmarks in equity compensation. Explicit performance benchmarks can be based on financial performance (sales or profits), nonfinancial performance (obtaining a patent or a customer), and actions (hiring a CEO). Kaplan and Strömberg (2003) describe these in greater detail.

The use of performance benchmarks increases strongly in internal risk. The coefficient on internal risk is the largest of the coefficients on the different risk variables. This is supportive of the agency predictions. We find a smaller, but significantly positive relation between external risk and benchmark compensation. This is contrary to the standard risk-sharing theoretical prediction, but consistent with the monitoring-related theories.[15] Finally, the use of performance benchmarks also increases with the net attractiveness of the investment. Net attractiveness is included in this regression as a control, so the implication of this result is theoretically less clear. The risk results are unaffected by removing the net attractiveness variable.

The last two regressions of Table V analyze founder time vesting. Time vesting increases significantly with execution risk, but is not significantly related to internal and external risks. The positive relation between execution risk and vesting is consistent with the mitigation of hold-up problems along the lines of Hart and Moore (1994).[16]

B. The Effect of Risk on the Allocation of Control

We now relate the three risk variables to the allocation of board control between the VC and the founder. We use two specifications of board control. First, we run a probit specification in which the dependent variable is a dummy for whether the VCs control more than half of the board seats at the time of financing. Second, we run an ordered probit specification in which the dependent variable has three levels of VC control. The variable: (i) equals zero if the founder always controls a majority; (ii) equals one if outside board members are always pivotal or the VC controls the board only if the firms fail to meet some milestone or covenant; and (iii) equals two if the VC always controls a majority. (We obtain similar results with four levels of VC control.)

Table VI displays the results using the two specifications. Internal and external risk measures are associated with more VC board control and are highly significant. The coefficients are of roughly equal magnitudes. The internal risk

[14] In unreported regressions, net attractiveness is significantly positively related to premoney value—the implied value of the company's prefinancing equity.

[15] The positive relationship between incentives and idiosyncratic risk has also been found by Allen and Lueck (1992), Core and Guay (1999), and Lafontaine (1992). Aggarwal and Samwick (1998) is one of the few studies that find the predicted negative relationship. Bhattacharyya and Lafontaine (1995) also discuss possible explanations for these conflicting results.

[16] An alternative interpretation is that time vesting is used as an alternative to explicit benchmarks when multitasking problems inherent in more complicated circumstances make benchmark compensation inefficient.

Table VI

Relation between Allocations of Board Control Rights and VC Risk Analyses: Multivariate Analysis

Relationship between venture capitalist (VC) risk analyses and contractual terms for investments in 67 portfolio companies by 11 venture capital partnerships. Investments were made between 1987 and 1999. In the first four regressions the dependent variable takes the value of one if the VC always controls more than half the board seats, and zero otherwise. In the last two regressions the dependent variable takes the value of zero if the founder always control a majority of the board seats, one if outside board members are always pivotal or if the VC controls the board only if the firms fails to meet some milestone or covenant, and two if the VC always controls more than half the board. Degree of external risk is the average of the dummy variables for the presence of market risk, competition risk, customer adoption risk, and financial market/exit risk. Degree of internal risk is the average of the dummy variables for the presence of management quality risk, questionable performance risk, funds-at-risk/downside, negative influence of other investors risk, and costly monitoring risk. Degree of execution risk is the average of the dummy variables for product/technology risk and business model/strategy risk. Sum of risks (strengths) is the sum of all 11 risk (strength) dummy variables. Strengths minus risks is the sum of all 11 risk dummy variables minus the sum of all 11 strength dummy variables. First VC financing round takes the value of one if no VCs had invested in the company previous to this round, and zero otherwise. Prerevenue venture takes the value of one if the venture is not generating any revenues at the time of financing, and zero otherwise. Repeat entrepreneur takes the value of one if the founder's previous venture was taken public or sold to a public company. Industry R&D/Sales is the aggregate R&D expense to sales for public firms in the venture's three-digit SIC industry, according to COMPUSTAT. California deal is a dummy variable indicating that the portfolio company was located in California at the time of financing. Standard errors are in parentheses (for the simple probit regressions, White robust standard errors are shown). Asterisks indicate significant differences at 1%***, 5%**, and 10%* levels. In specification 3, 10 observations had to be dropped because of collinearity: one of the VC funds, specializing in the retail industry, did not initially have a majority of board seats for any of their investments in our sample.

	Dependent Variable					
	VC has Majority of Board Seats (probit)	VC has Majority of Board Seats (probit)	VC has Majority of Board Seats (probit)	VC has Majority of Board Seats (probit)	Degree of VC Board Control (ord. probit)	Degree of VC Board Control (ord. probit)
Constant	−2.34 (0.76)***	−3.4 (1.1)***		−3.19 (1.59)**		
Degree of internal risk	3.12 (1.02)***	2.26 (0.97)**	3.85 (1.39)***	3.22 (1.20)***	1.94 (0.97)**	1.68 (0.98)*
Degree of external risk	2.46 (0.96)***	2.08 (0.95)**	3.02 (1.06)***	3.33 (1.43)**	2.06 (0.78)***	2.37 (0.84)***
Degree of execution risk	−0.29 (0.70)	−0.14 (0.70)	−0.93 (1.05)	−1.50 (0.90)*	−0.18 (0.63)	−0.13 (0.65)
Strengths minus risks	1.99 (1.60)	1.69 (1.55)	−0.76 (2.03)	0.89 (1.98)	0.59 (1.31)	1.37 (1.41)
First VC fin. round	−1.47 (0.45)***	−0.94 (0.54)*	−2.20 (0.57)***	−2.43 (0.78)***	−1.89 (0.50)***	−2.13 (0.57)***
Repeat entrepreneur	0.91 (0.58)	0.78 (0.57)	1.07 (0.70)	0.91 (0.55)*	0.63 (0.53)	0.48 (0.56)
Prerevenue venture	1.19 (0.51)**	1.06 (0.52)**	1.13 (0.54)**	2.45 (0.82)***	1.13 (0.47)	2.40 (0.65)***
% VC equity		2.38 (1.29)***				
Industry R&D/Sales, %				0.05 (0.11)		0.02 (0.06)
California deal				−1.44 (0.58)**		−0.70 (0.46)
1998–99 dummy				1.13 (0.61)*		1.43 (0.54)***
Biotech				−1.15 (1.56)		−1.17 (0.99)
Internet				1.29 (0.96)		0.10 (0.65)
Other IT/Software				0.79 (1.13)		0.20 (0.65)
Telecom				−0.08 (0.97)		−0.39 (0.66)
χ^2-test Industry [p-value]				6.14 [0.189]		2.93 [0.570]
VC dummies	No	No	Yes	No	Yes	No
χ^2-test VC dum. [p-value]			1.34 [0.854]		4.72 [0.451]	
Pseudo R^2	0.33	0.36	0.39	0.49	0.31	0.37
Ordered probit cut-offs:						
0 to 1					−1.59 (1.24)	−0.33 (1.14)
1 to 2					1.40 (1.19)	2.98 (1.19)
Sample size	66	66	56	66	66	66

result is supportive of the agency models focusing on control such as Aghion–Bolton (1992). The external risk result again is supportive of the monitoring-related theories, such as Dessein (2001), rather than the risk-sharing theories.

Execution risk has a negative sign and is statistically significant in one specification. One explanation is that it would be inefficient for the VC to exercise control (e.g., by replacing management) because so much of the firm value is tied up in the founder's human capital.

We obtain qualitatively similar results (that we do not report) when we use voting control rather than board control. We believe that for most corporate decisions, board control is the more important measure (see Lerner (1995)).

C. The Effect of Risk on Staging of Funds and the Allocation of Liquidation Rights

In this section, we investigate the relationship of staging and liquidation rights to the VC risk factors. First, we address staging and distinguish between two types: ex ante (within-round) and ex post (between-round) staging. In an ex ante staged deal, part of the VC's funding in the round is contingent on explicit financial or nonfinancial performance milestones, giving the VC the ability to liquidate if the milestones are not met. We measure ex ante staging as the fraction of the funds in a round contingent on milestones. In an ex post staged deal, the venture will require more funding in a subsequent (and newly negotiated) round. The number of months until the next financing round measures the VC's ability to liquidate if performance is unsatisfactory. The ability to liquidate declines as the months until the next round increases.

The regressions in Table VII present our staging results. Ex ante staging using explicit milestones is related to internal risk. This is consistent with ex ante staging being a way for good firms to signal their type (or for VCs to screen out bad firms), similar to the way short-term debt is used in the models of Ross (1977) and Diamond (1991).

Ex post staging increases in internal risk, but not significantly so. Ex post staging however increases significantly in external risk—the months until the next VC round decreases with external risk—suggesting that agency problems may not be the key driver of ex post staging.

Table VIII investigates the relation of risks to debt-like contract features: (i) redemption rights; (ii) the VCs claim in redemption or liquidation; and (iii) antidilution provisions.

The dependent variable in the first two regressions is whether the VC has redemption rights. Redemption rights give the VC the right to demand that the firm repay the VC's claim at a stated liquidation value at a stated time after the investment. Redemption rights are increasing in external risk and in the net attractiveness of the investment, but are not related to internal risk. Again, this does not seem consistent with an agency explanation.

The dependent variable in the next two regressions in Table VIII measures whether the VC's liquidation claim exceeds the VC's cumulative investment. This is therefore a measure of the strength of the liquidation claim. This

Table VII

Relation between Milestone Financings, Staging, and VC Risk Analyses: Multivariate Analysis

Relationship between venture capitalist (VC) risk analyses and contractual terms for investments in 67 portfolio companies by 11 venture capital partnerships. Investments were made between 1987 and 1999. The % of VC funding in round contingent denotes the fraction of the VCs' funding commitment that is released upon meeting future milestones. Degree of external risk is the average of the dummy variables for the presence of market risk, competition risk, customer adoption risk, and financial market/exit risk. Degree of internal risk is the average of the dummy variables for the presence of management quality risk, questionable performance risk, funds-at-risk/downside, negative influence of other investors risk, and costly monitoring risk. Degree of execution risk is the average of the dummy variables for product/technology risk and business model/strategy risk. Sum of risks (strengths) is the sum of all 11 risk (strength) dummy variables. Strengths minus risks is the sum of all 11 risk dummy variables minus the sum of all 11 strength dummy variables. First VC financing round takes the value of one if no VCs had invested in the company previous to this round, and zero otherwise. Pre-revenue venture takes the value of one if the venture is not generating any revenues at the time of financing, and zero otherwise. Repeat entrepreneur takes the value of one if the founder's previous venture was taken public or sold to public company. California deal is a dummy variable indicating that the portfolio company was located in California at the time of financing. Industry LTD/Assets is the median ratio of long-term debt to assets; Industry R&D/Sales is the aggregate R&D expense to sales; and Industry Mkt-to-Book is the median of (book value of assets − book value of equity + market value of equity)/(book value of assets); all values are calculated for public firms in the venture's three-digit SIC industry, according to COMPUSTAT. White (1980) robust standard errors are in parentheses. Asterisks indicate significant differences at 1%***, 5%**, and 10%* levels.

	Dependent Variable					
	% of VC Funding in Round Contingent (OLS)	% of VC Funding in Round Contingent (OLS)	% of VC Funding in Round Contingent (OLS)	Number of Months until Next VC Round (OLS)	Number of Months until Next VC Round (OLS)	Number of Months until Next VC Round (OLS)
Constant	5.90 (12.37)			13.54 (2.67)***		
Degree of internal risk	59.50 (15.75)***	44.53 (17.51)**	40.00 (15.48)**	−5.18 (3.20)	−6.09 (3.90)	−6.18 (4.10)
Degree of external risk	13.80 (9.17)	10.25 (9.66)	2.36 (8.82)	−7.71 (2.90)***	−8.88 (3.11)***	−9.17 (3.73)**
Degree of execution risk	−14.35 (10.98)	−10.09 (11.00)	−3.97 (10.60)	1.66 (2.48)	1.28 (3.35)	0.73 (3.54)
Strengths minus risks	8.50 (23.01)	−11.26 (21.46)	−16.44 (21.14)	−9.36 (6.64)	−5.63 (7.91)	−5.18 (7.62)
First VC fin. round	−2.05 (7.86)	−1.82 (6.16)	4.53 (6.72)	1.67 (1.86)	2.03 (1.93)	1.94 (1.93)
Repeat entrepreneur	−5.50 (8.22)	−7.07 (6.83)	−2.12 (6.45)	2.12 (1.75)	2.57 (1.69)	2.55 (1.89)
Prerevenue venture	5.89 (7.16)	−8.15 (7.42)	−13.49 (8.91)	−0.70 (1.87)	0.41 (1.99)	1.52 (2.44)
Industry R&D/Sales, %			−1.33 (1.54)*			0.40 (0.33)
California deal			−10.74 (5.43)			−0.23 (1.96)
1998–99 dummy			−5.77 (6.96)			0.45 (1.93)
Biotech			8.36 (15.76)			−6.33 (4.79)
Internet			11.52 (12.59)			−1.25 (3.70)
Other IT/Software			1.04 (12.68)			0.74 (4.13)
Telecom			22.32 (17.92)			−2.48 (4.72)
F-test Industry [*p*-value]			0.66 [0.624]			0.73 [0.577]
VC dummies	No	Yes	Yes	No	Yes	Yes
F-test VC dum. [*p*-value]		6.18 [0.000]***	5.02 [0.001]***		1.17 [0.336]	1.34 [0.248]
Adj. R^2	0.25	0.48	0.53	0.10	0.09	0.02
Sample size	67	67	67	62	62	62

Table VIII
Relation between Allocations of Liquidation Rights, Anti-dilution, and VC Risk Analyses: Multivariate Analysis

Relationship between venture capitalist (VC) risk analyses and contractual terms for investments in 67 portfolio companies by 11 venture capital partnerships. Investments were made between 1987 and 1999. VC liquidation claim > cumulative investment is a dummy variable for whether the VCs liquidation claim is larger than the accumulated VC investment, through cumulative dividends, participating preferred, or other liquidation preference provisions. Degree of external risk is the average of the dummy variables for the presence of market risk, competition risk, customer adoption risk, and financial market/exit risk. Degree of internal risk is the average of the dummy variables for the presence of management quality risk, questionable performance risk, funds-at-risk/downside, negative influence of other investors risk, and costly monitoring risk. Degree of execution risk is the average of the dummy variables for product/technology risk and business model/strategy risk. Sum of risks (strengths) is the sum of all 11 risk (strength) dummy variables. Strengths minus risks is the sum of all 11 risk dummy variables minus the sum of all 11 strength dummy variables. First VC financing round takes the value of one if no VCs had invested in the company previous to this round, and zero otherwise. Prerevenue venture takes the value of one if the venture is not generating any revenues at the time of financing, and zero otherwise. Repeat entrepreneur takes the value of one if the founder's previous venture was taken public or sold to a public company. California deal is a dummy variable indicating that the portfolio company was located in California at the time of financing. Industry LTD/Assets is the median ratio of long-term debt to assets; Industry R&D/Sales is the aggregate R&D expense to sales; and Industry Mkt-to-Book is the median of (book value of assets − book value of equity + market value of equity) / (book value of assets); all values are calculated for public firms in the venture's three-digit SIC industry, according to COMPUSTAT. White (1980) robust standard errors are in parentheses. Asterisks indicate significant differences at 1%***; 5%**, and 10%* levels.

	Dependent Variable					
	VC has Redemption Rights (Probit)	VC has Redemption Rights (Probit)	VC Liq. Claim > Cumulative Investment (Probit)	VC Liq. Claim > Cumulative Investment (Probit)	VC has Full-Ratchet Antidilution (Probit)	VC has Full-Ratchet Antidilution (Probit)
Constant	0.30 (0.66)		0.96 (0.67)		−1.78 (0.68)	
Degree of internal risk	0.03 (1.04)	2.44 (1.80)	1.18 (0.91)	2.59 (1.32)**	1.52 (0.80)*	4.81 (1.67)***
Degree of external risk	2.00 (0.95)**	4.75 (2.20)**	1.68 (0.95)*	2.28 (1.02)**	0.18 (0.70)	1.24 (0.91)
Degree of execution risk	0.03 (0.74)	1.92 (1.42)	−1.13 (0.68)*	−1.56 (0.95)*	0.45 (0.63)	0.86 (0.85)
Strengths minus risks	3.04 (1.25)**	6.64 (3.19)**	2.48 (1.33)*	2.15 (1.16)*	1.99 (1.15)*	5.26 (1.99)***
First VC fin. round	0.37 (0.46)	1.09 (0.72)	−0.35 (0.44)	−0.40 (0.52)	0.61 (0.42)	0.54 (0.60)
Repeat entrepreneur	−0.68 (0.46)	−0.78 (0.51)	−0.74 (0.49)	−0.69 (0.69)	−0.58 (0.64)	0.38 (0.82)
Prerevenue venture	−0.35 (0.50)	1.37 (0.88)	−0.43 (0.48)	−1.65 (0.71)**	−0.19 (0.43)	−0.69 (0.76)
Industry R&D/Sales, %		0.03 (0.13)		−0.11 (0.14)		0.14 (0.23)
California deal		1.59 (0.83)*		−0.30 (0.45)		0.82 (0.59)
1998–99 dummy		−0.78 (0.70)		−1.09 (0.55)**		−1.83 (0.77)**
Biotech		0.26 (1.21)		3.16 (1.44)		Dropped due to collinearity
Internet		2.43 (1.19)**		1.22 (1.00)		0.89 (0.82)
Other IT/Software		Dropped due to collinearity: predicted success perfectly		0.80 (0.88)		0.17 (0.82)
Telecom		1.19 (1.59)		3.76 (1.82)		Dropped due to collinearity
χ^2-test Industry [p-value]		6.13 [0.106]		6.49 [0.165]		1.40 [0.498]
VC dummies	No	Yes	No	Yes	No	Yes
χ^2-test VC dum. [p-value]		9.78 [0.281]		7.79 [0.555]		13.11 [0.011]
Pseudo R^2	0.18	0.40	0.23	0.38	0.13	0.35
Sample size	67	57	66	66	67	48

variable increases in external risk. It also increases in internal risk in the more general regression. In addition, the size of the liquidation claim decreases significantly with execution risk.

The dependent variable in the last two regressions in Table VIII is the presence of full-ratchet antidilution protection. Antidilution provisions increase the shares the VC receives if the company subsequently raises money at a lower valuation. Similar to liquidation claims, antidilution provisions protect the VC in bad states and are relatively less attractive to low quality founders. The dependent variable equals one if the investment has the strongest antidilution protection—full ratchet. Under a full ratchet, if the firm subsequently raises money at a lower value, the entire VC investment is repriced at that lower value. The last two regressions show that antidilution protection increases in internal risk.

Overall, the results for staging and liquidation rights are mixed. Agency problems, as measured by internal risk, clearly play a role, but not uniformly. Certain liquidation rights also increase in external risk. One possible explanation, particularly for ex post staging, is that external risk increases the value of the option to abandon the project.[17] Finally, the decrease in the liquidation claim with execution risk is supportive of hold-up theories. Collateral value is likely to be lower for companies with execution risk, where more of the firm value is tied up in the founder's intangible human capital.

D. Implications

In this section, we have studied the relation of VC risk assessments to the relevant financial contracts. Internal uncertainty is significantly related to many of the incentive and control mechanisms in the financial contracts. Higher internal risk is associated with more VC control, more contingent compensation to the entrepreneur, and more contingent financing in a given round. The primary exceptions are that the overall fraction of founder cash flow rights (arguably a noisier measure of pay-for-performance sensitivity) and some VC liquidation rights are not related to internal risk. Overall, we interpret these results as very positive for the agency theories. The results for performance benchmarks, VC control rights, and ex ante staging are very strong, as are the theoretical predictions for them.

External uncertainty is also related to many contractual features. Like internal risk, higher external risk is associated with more VC control and more contingent compensation. Moreover, higher external risk is associated with increases in VC liquidation rights and tighter staging (shorter time between financing rounds). These findings are highly inconsistent with optimal risk-sharing between risk-averse entrepreneurs and risk-neutral investors. Instead, these results are more consistent with the theories of Prendergast (2002) and Dessein (2001), in which external uncertainty makes monitoring more difficult.

[17] Berger, Ofek, and Swary (1996), Cornelli and Yosha (2003) and Gompers (1995) argue that this option is valuable.

Execution risk is significantly positively related to founder time vesting provisions and negatively related to contingent compensation and VC liquidation rights. These results suggest that hold-up concerns matter in complex environments where the manager's human capital is particularly important and standard incentive mechanisms are less effective.

E. Alternative Interpretations

In interpreting our results, we believe that internal risks are more likely to be associated with asymmetric information and moral hazard problems, while external risks are more likely to be associated with general or two-sided uncertainty. We believe the results are consistent with this interpretation. Nevertheless, one can argue that our classification of risks is inappropriate or inexact. In this section, we address several of those arguments.

Perhaps, the risks we classify as external are instead internal. For example, management may have better information on customer adoption, competition, or the market than the VC. We think this argument is unpersuasive. VCs typically undertake due diligence with respect to those risks that are external to the firm—like customer adoption, competition, and the market—and should be able to obtain the same information as the founders. In fact, for some of these risks, the VCs may even be better informed.[18] It is for risks internal to the firm, that the VCs are more likely to be at a disadvantage on average.

Alternatively, it is possible that the risks we classify as internal are not related to asymmetric information and moral hazard problems. For example, management risk may also measure managerial overconfidence as ascertained by the VC, or simply differences of opinion. We are more sympathetic to this argument. Although our results on internal risk are consistent with agency explanations, we suspect that theories of differences of opinion would make similar predictions, particularly with respect to contingencies. It also seems possible that differences of opinion might generate similar predictions for external risk.

Finally, it is possible to question whether our three risk variables measure the same things. This does not seem to be an issue for execution risk, which consistently has very different coefficients from those for internal and external risk. Internal and external risk however are significantly correlated (in Table III) and almost always have similar signs in the regressions. Nevertheless, the magnitude and significance of the coefficients on internal and external risk differ sufficiently often that we think it is likely that the two risks measure separate economic factors.

IV. The Relationship between Contracting and Monitoring

In this section, we consider the relation between the contracts and VC actions. As we showed in Table IV, the VC evaluation process identifies areas where the

[18] Garmaise (2000) presents a model that makes exactly this assumption.

VC expects to add value through intervention and support activities. The design of the financial contracts may affect the VC's ability and incentives to actually carry out such activities. For example, the founder might not agree with the actions that the VC would like to implement. In such cases, the control theories predict that VCs will need formal control to carry out those actions against the will of the entrepreneur. In addition, monitoring and support activities can require substantial VC time and effort (see, e.g., Gorman and Sahlman, 1989). The VC will undertake them only if sufficiently compensated. Recent "double moral hazard" theories have shown that the VC contract must have a substantial equity component to provide incentives for support activities.[19]

Similar to Hellman and Puri (2002), we distinguish between VC actions that are more likely to be adversarial to founders and actions that VCs and founders are likely to agree on. Actions related to strengthening and replacing management are more likely to lead to conflict, while actions related to developing the strategy and business model are less likely to lead to conflict. Because VC financings are often syndicated, with several different VC funds investing together in a given portfolio company, we also consider the possibility of free-riding behavior among VCs that decrease the incentives to provide monitoring and support.[20]

Table IX reports the results of regressions of VC intervention and support activities on contract characteristics. Panel A considers management team interventions as a function of VC board control.[21] The regressions indicate that management interventions strongly increase in VC board control. Management interventions are also more likely when the VC is the lead investor and after 1997. The last regression in Panel A regresses management intervention against VC equity ownership. Management intervention is not related to VC equity ownership, confirming that VC control and equity ownership are likely two separate factors.

The regressions in Panel B of Table IX analyze expected value-added support activities as a function of the VC's equity stake. VC value-added support increases in the VC's equity stake.[22] The last regression shows that value-added support is unrelated to board control. In other words, board control does not explain the extent of value-added support, and the VC equity stake does not explain management interventions.

To conclude, the analysis in Table IX yields two results. First, board control is associated with a greater ability and tendency for the VC to intervene in

[19] Casamatta (2003), Cestone (2002), Dessi (2001), Inderst and Müller (2003), Renucci (2000), Repullo and Suarez (1999), and Schmidt (1999) all study models of venture capital which include double-sided moral hazard.

[20] Lerner (1994) and Sorensen and Stuart (2001) study venture capital syndication empirically and find that such syndication is quite common.

[21] The board control variable is the same one used in the control regressions, but scaled to vary between 0 and 1.

[22] Syndication size is positive, while the interaction of VC equity stake and syndicate size is always negative. The effect of syndication size on incentives to provide support is therefore ambiguous.

Table IX

Relation between Contracts and VC Monitoring and Support

Relationship between venture capitalist (VC) monitoring and support actions, undertaken and anticipated, and contractual terms for investments in 67 portfolio companies by 11 venture capital partnerships. Investments were made between 1987 and 1999. Degree of board control takes the value of 0 if the founder always controls a majority of the board seats, 0.5 if (a) outside board members are always pivotal or (b) the VC controls the board only if the firms fail to meet a milestone, and 1 if the VC always has board majority. VC equity stake is measured assuming all performance benchmarks are met and all founder and employee equity vest. Syndicate size is the number of different venture capital funds that are investing in this or any previous round. First VC investments refers to the rounds involving the first time any venture capital fund invested in the company. Industry R&D/Sales is the aggregate R&D expense to sales for public firms in the venture's three-digit SIC industry, according to COMPUSTAT. California deal indicates that the portfolio company was located in California at the time of financing. Lead investor indicated that the memo was written by the VC firm providing the largest amount of financing among the VCs investing in the round. White (1980) robust standard errors are in parentheses. Asterisks indicate significant differences at 1%***, 5%**, and 10%* levels. In regressions 2 and 4, nine observations had to be dropped, since one VC dummy (for a fund specialized in healthcare investments) predicted success perfectly. In the two-stage least square specifications the contracting variables are instrumented by prerevenue, repeat entrepreneur, first VC round, degree of external risk, degree of internal risk, and degree of execution risk.

	Dependent Variable					
	VC Intervening in mgt Team (Probit)	VC Intervening in mgt Team (Probit)	VC Intervening in mgt Team (Probit)	VC Intervening in mgt Team (Probit)	VC Intervening in mgt Team (2SLS)	VC Intervening in mgt Team (Probit)
Constant	−0.53 (0.29)		−2.91 (1.29)**			−0.18 (0.44)
Degree of board control	1.77 (0.72)**	2.40 (0.90)***	2.18 (0.92)**	4.43 (1.30)***	1.57 (0.91)*	
Board ctl∗syndic. size	−0.15 (0.10)	−0.21 (0.12)*	−0.11 (0.17)	−0.12 (0.22)	−0.19 (0.16)	
VC equity stake			−0.17 (1.60)	0.91 (3.20)		0.95 (1.12)
VC equity∗syndic. size			−0.20 (0.32)	−0.78 (0.45)*		−0.12 (0.10)
Syndicate size			0.29 (0.20)	0.78 (0.38)*		
VC is lead investor			1.02 (0.60)*	2.18 (1.22)*		
Prerevenue venture			−0.45 (0.42)	−0.07 (1.03)		
Repeat entrepreneur			−0.12 (0.42)	−0.50 (0.58)		
First VC fin. round			1.14 (0.57)**	2.51 (1.40)*		
Ind. R&D/Sales, %				0.31 (0.15)**		
California deal				1.20 (0.65)*		
1998–99 dummy				1.06 (0.54)**		
Biotech		0.23 (0.84)		−1.89 (1.23)	0.14 (0.34)	
Internet		0.07 (0.63)		−1.48 (0.81)*	−0.09 (0.27)	
Other IT/Software		−0.03 (0.66)		−0.67 (0.84)	−0.02 (0.27)	
Telecom		−1.32 (0.82)		−1.79 (1.28)	0.14 (0.34)	

χ^2-test Industry [p-value]		4.67 [0.332]		4.58 [0.333]	1.47 [0.224]	
VC dummies	No	Yes	No	Yes	Yes	No
χ^2-test VC dum. [p-value]		0.90 [0.924]		5.14 [0.273]	0.26 [0.932]	
(Pseudo) R^2	0.08	0.15	0.16	0.45	0.05	0.02
Sample size	66	57	66	57	67	67

	VC Value-Added Support (Probit)	VC Value-Added Support (Probit)	VC Value-Added Support (Probit)	VC Value-Added Support (Probit)	VC Value-Added Support (2SLS)	VC Value-Added Support (Probit)
Constant	−1.03 (0.47)**		−3.67 (1.47)***			−0.72 (0.30)**
Degree of board control			−0.98 (0.96)	−1.16 (1.09)		0.76 (0.63)
Board ctl∗syndic. size			0.47 (0.21)**	0.50 (0.18)***		−0.04 (0.09)
VC equity stake	2.06 (1.17)*	2.39 (1.44)*	4.86 (1.85)***	6.23 (2.67)**	3.94 (1.71)**	
VC equity∗syndic. size	−0.17 (0.10)*	−0.17 (0.12)	−1.10 (0.45)**	−1.60 (0.57)***	−0.24 (0.12)**	
Syndicate size			0.38 (0.24)	0.71 (0.34)**		
VC is lead investor			0.97 (0.76)	0.84 (0.75)		
Prerevenue venture			−1.00 (0.47)**	−0.84 (0.94)		
Repeat entrepreneur			0.41 (0.44)	0.84 (0.46)*		
First VC fin. round			0.82 (0.63)	0.35 (0.85)		
Ind. R&D/Sales, %				−0.02 (0.09)		
California deal				−0.14 (0.50)		
1998–99 dummy				0.85 (0.48)		
Biotech		0.59 (0.91)		0.66 (0.89)	0.53 (0.52)	
Internet		0.14 (0.67)		−1.04 (0.78)	0.27 (0.39)	
Other IT/Software		0.31 (0.71)		0.47 (0.74)	0.50 (0.43)	
Telecom		−0.22 (0.78)		−0.60 (1.03)	−0.16 (0.47)	
χ^2-test Industry [p-value]		1.27 [0.866]		6.79 [0.148]	1.08 [0.377]	
VC dummies	No	Yes	No	Yes	Yes	No
χ^2-test VC dum. [p-value]		6.00 [0.306]		6.29 [0.279]	1.13 [0.356]	
(Pseudo) R^2	0.04	0.11	0.17	0.32	–	0.02
Sample size	67	67	66	66	67	66

management, consistent with control theories such as Aghion and Bolton (1992) and Hellman (1998). Second, consistent with the double-sided moral hazard theories, equity incentives are associated with an increase in the likelihood that VCs perform value-added support activities.

V. Summary and Discussion

In this paper, we study the contemporaneous investment analyses by 11 VC firms for investments in 67 companies. We relate these analyses to the contracts for those investments.

Overall, we believe this paper makes three contributions. First, it adds to existing survey-based work by describing the characteristics and risks that VCs consider in actual deals.

Second, the paper is novel in relating investors' direct assessments of risks rather than the indirect proxies used in most previous work to actual contractual terms. The internal risk results suggest that agency problems are important to contract design. The external risk results suggest that risk-sharing concerns are unimportant relative to other concerns such as monitoring. The results for execution risk suggest that VCs consider the issues described in hold-up theories.

Finally, we show that VCs expect to take actions with their investments and those actions are related to the contracts. VC management intervention is related to VC board control, while VC support or advice is related to VC equity ownership. These results highlight and expand on the differences between intervening and supporting actions analyzed in Hellman and Puri (2002).

We recognize that the risk variables (and the action variables to a lesser extent) are subject to different interpretations and may not measure precisely what we have assumed. We believe however that the direct assessments improve upon the indirect measures used in previous work. Fertile areas for future research include improving upon the direct measures for investors as well as creating similar measures for other actors, particularly entrepreneurs.

REFERENCES

Aggarwal, Rajesh, and Andrew Samwick, 1999, The other side of the tradeoff: The impact of risk on executive compensation, *Journal of Political Economy* 107, 65–105.

Aghion, Phillippe, and Patrick Bolton, 1992, An incomplete contracts approach to financial contracting, *Review of Economic Studies* 77, 338–401.

Allen, Douglas, and Dean Lueck, 1993, Transaction costs and the design of crop share contracts, *RAND Journal of Economics* 24, 78–100.

Allen, Franklin, and Andrew Winton, 1995, Corporate financial structure, incentives, and optimal contracting, in R. Jarrow, V. Maksimovic, and W. T. Ziemba, eds.: *Handbooks in Operations Research and Management Science*, Vol 9 (North-Holland, Amsterdam).

Baker, George, 1992, Incentive contracts and performance measurement, *Journal of Political Economy* 100, 598–614.

Baker, Malcolm, and Paul Gompers, 2001, The determinants of board structure at the initial public offering, Working paper, Harvard Business School.

Berger, Philip, Eli Ofek, and Itzhak Swary, 1996, The valuation of the abandonment option, *Journal of Financial Economics* 42, 257–287.

Bhattacharyya, Sugato, and Francine Lafontaine, 1995, The role of risk in franchising, *Journal of Corporate Finance* 2, 39–74.

Casamatta, Catherine, 2003, Financing and advising: Optimal financial contracts with venture capitalists, *Journal of Finance* 58, 2059–2086.

Cestone, Giacinta, 2001, Venture capital meets contract theory: Risky claims or formal control? Working paper, University of Toulouse.

Core, John, and Wayne Guay, 1999, The use of equity grants to manage optimal equity incentive levels, *Journal of Accounting and Economics* 28, 151–184.

Cornelli, Francesca, and Oded Yosha, 2003, Stage financing and the role of convertible securities, *Review of Economic Studies* 70, 1–32.

Dessein, Wouter, 2002, Information and control in alliances and ventures, Working paper, University of Chicago.

Dessi, Roberta, 2001, Start-up finance, monitoring and collusion, Working paper, IDEI, University of Toulouse.

Dewatripont, Matthias, and Jean Tirole, 1994, A theory of debt and equity: Diversity of securities and manager-shareholder congruence, *Quarterly Journal of Economics* 109, 1027–1054.

Diamond, Douglas, 1991, Debt maturity structure and liquidity risk, *Quarterly Journal of Economics* 106, 709–737.

Garmaise, Mark, 2000, Informed investors and the financing of entrepreneurial projects, Working paper, University of Chicago.

Gompers, Paul, 1995, Optimal investment, monitoring, and the staging of venture capital, *Journal of Finance* 50, 1461–1490.

Gompers, Paul, and Josh Lerner, 1999, *The Venture Capital Cycle* (MIT Press, Cambridge, MA).

Gorman, Michael, and William Sahlman, 1989, What do venture capitalists do? *Journal of Business Venturing* 4, 231–248.

Hagerty, Kathleen, and Daniel Siegel, 1988, On the observational equivalence of managerial contracts under conditions of moral hazard and self-selection, *Quarterly Journal of Economics* 103, 425–428.

Hart, Oliver, 2001, Financial contracting, *Journal of Economic Literature* 39, 1079–1100.

Hart, Oliver, and John Moore, 1994, A theory of debt based on the inalienability of human capital, *Quarterly Journal of Economics* 109, 841–879.

Hellman, Thomas, 1998, The allocation of control rights in venture capital contracts, *RAND Journal of Economics* 29, 57–76.

Hellman, Thomas, and Manju Puri, 2000, The interaction between product market and financial strategy: The role of venture capital, *Review of Financial Studies* 13, 959–984.

Hellman, Thomas, and Manju Puri, 2002, Venture capital and the professionalization of start-up firms: Empirical evidence, *Journal of Finance* 57, 169–197.

Holmström, Bengt, 1979, Moral hazard and observability, *Bell Journal of Economics* 10, 74–91.

Holmström, Bengt, and Paul Milgrom, 1991, Multitask principal agent analyses: Incentive contracts, asset ownership, and job design, *Journal of Law, Economics, and Organization* 7, 24–92.

Inderst, Roman, and Holger Müeller, 2003, The effect of capital market characteristics on the value of start-up firms, *Journal of Financial Economics*, forthcoming.

Kaplan, Steven, and Per Strömberg, 2003, Financial contracting theory meets the real world: An empirical analysis of venture capital contracts, *Review of Economic Studies* 70, 281–316.

Lafontaine, Francine, 1992, Agency theory and franchising: Some empirical results, *RAND Journal of Economics* 23, 263–283.

Lazear, Edward, 1986, Salaries and piece-rates, *Journal of Business* 59, 405–431.

Lerner, Joshua, 1994, The syndication of venture capital investments, *Financial Management* 23, 16–27.

Lerner, Joshua, 1995, Venture capitalists and the oversight of private firms, *Journal of Finance* 50, 301–318.

MacMillan, Ian, D. Kulow, and R. Khoylian, 1988, Venture capitalists' involvement in their investments: Extent and performance, *Journal of Business Venturing* 4, 27–47.

MacMillan Ian, R. Siegel and P.N. Subbanarasimha, 1985, Criteria used by venture capitalists to evaluate new venture proposals, *Journal of Business Venturing* 1, 119–128.

MacMillan, I., L. Zemann, and P.N. Subbanarasimha, 1987, Criteria distinguishing successful from unsuccessful ventures in the venture screening process, *Journal of Business Venturing* 2, 123–137.

Prendergast, Canice, 2002, The tenuous tradeoff between risk and incentives, *Journal of Political Economy* 110, 1071–1102.

Renucci, Antoine, 2000, Optimal contracts between entrepreneurs and value-enhancing financiers, Working paper, University of Toulouse.

Repullo, Rafael, and Javier Suarez, 1999, Venture capital finance: A security design approach, Working paper, CEMFI.

Ross, Stephen, 1977, The determination of financial structure: The incentive signaling approach, *Bell Journal of Economics* 8, 23–40.

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

Sapienza, Harry, 1992, When do venture capitalists add value? *Journal of Business Venturing* 7, 9–27.

Sapienza, Harry, Sophie Manigart, and W. Vermeir, 1996, Venture capitalist governance and value added in four countries, *Journal of Business Venturing* 11, 439–469.

Schmidt, Klaus, 1999, Convertible securities and venture capital finance, Working paper, Universität München.

Smith, Clifford W. Jr, and Ross L. Watts, 1992, The investment opportunity set and corporate financing, dividend, and compensation policies, *Journal of Financial Economics* 32, 263–292.

Sorensen, Olav, and Toby Stuart, 2001, Syndication networks and the spatial distribution of venture capital investments, *American Journal of Sociology* 106, 1546–1586.